

Rolling Bearings



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Rolling Bearings

CAT. No. E1102m

Introduction to Revised **NSK** Rolling Bearing Catalog (CAT.No.E1102m)

We want to thank you for your interest in this edition of our Rolling Bearing Catalog. It has been revised with our customers in mind, and we hope it fills your needs.

Recently, technology has been advancing at a remarkable pace, and with it has come a host of new products in many fields including computers, office automation, audio-visual equipment, medical equipment, and many others. Accordingly, rolling bearings, which are highly important machine elements, must be designed to satisfy increasingly stringent requirements for higher speeds, greater precision, higher reliability, and other challenging demands.

We edited this Rolling Bearing Catalog to reflect the growing number of NSK products, new developments, and technical progress. In it, you will find a wide range of bearings that will satisfy almost any requirement.

This catalog was revised to reflect the growing number of NSK products and certain revisions in JIS and ISO and to better serve our customers. The first part contains general information about rolling bearings to facilitate selection of the most appropriate type. Next supplementary technical information is provided regarding bearing life, load ratings, limiting speeds, handling and mounting, lubrication, etc. Finally, the catalog presents extensive tables containing most bearing numbers and showing dimensions and pertinent design data listed in the order of increasing bore size. Data in the table are given in both the international Unit System (SI) and Engineering Unit System (Gravitational System of Units).

We hope this catalog will allow you to select the optimum bearing for your application. However, if assistance is required, please contact NSK, and the company's engineers and computer programs can quickly supply the information you need.

NSK

NSK

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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 A10 to A12 and in Table 1.1 (Pages A14 and A15).

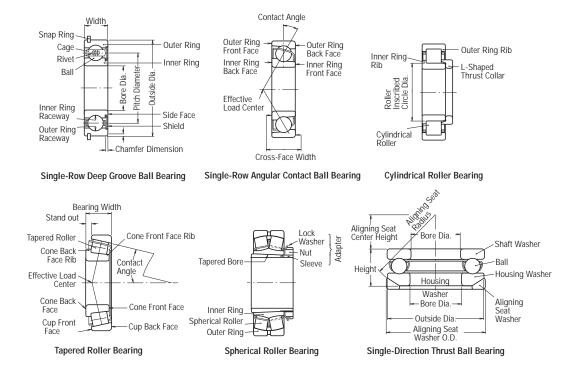
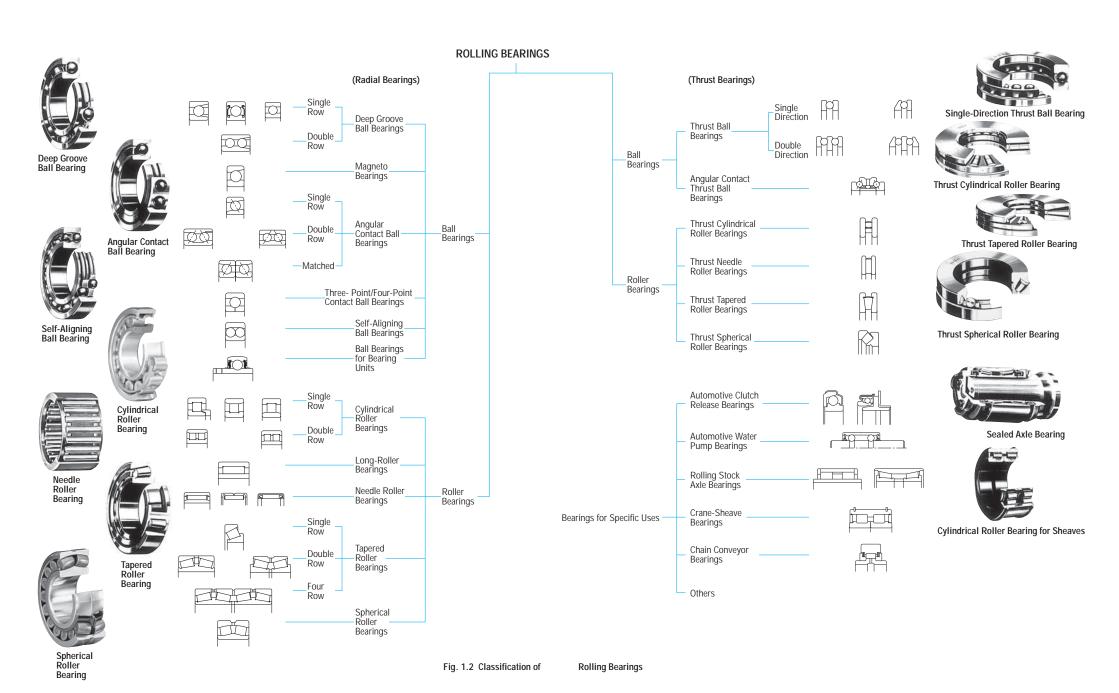


Fig. 1.1 Nomenclature for Bearing Parts







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.



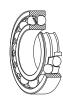
Four-Point Contact **Ball Bearings**



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.

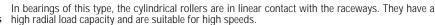
Self-Alianina Ball Bearings



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





There are different types designated NU, NJ, NUP, N, NF for single-row bearings, and NNU, NN for double-row bearings depending on the design 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.

A 11 A 10



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 the 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 selfaligning 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) Double-Direction being fixed to the shaft.

Thrust Ball Bearings

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



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





A 12 A 13



Table 1. 1 Types and Characteristics

	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
Fe	atures						料		口口		
ity	Radial Loads	\bigcirc	0	\odot	0	0	0	\bigcirc	\odot	0	\odot
Load Capacity	Axial Loads	$\bigcup_{i=1}^{n}$	0	\bigcirc	\odot	\odot	\odot	0	×	×	
Γο	Combined Loads	\bigcirc	0	0	0	0	0	0	×	×	
ı	High Speeds	0	0	0	0	0	0	0	0	0	0
ı	High Accuracy	0		0		0	0		0	0	
	_ow Noise and Torque	0							0		
ı	Rigidity					0			0	0	0
1	Angular Misalignment	0	0	0	0	0	0	0	\bigcirc	0	
(Self-Aligning Capability							☆			
ļ	Ring Separability		☆				☆		☆	☆	☆
[Fixed-End Bearing	☆			☆	☆	☆	☆			
[Free-End Bearing	*			*	*	*	*	☆	☆	
i	Tapered Bore n Inner Ring							☆		☆	
I	Remarks		Two bearings are usually mounted in opposition.	Contact angles of 15°, 25° 30°, and 40°. Iwo 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
ı	Page No.	B5 B31	B5 B28	B47	B47 B70	B47	B47 B72	B77	B85	B85 B110	B85
	Excellent	⊙ Go	ood	O Fair	0 1	Poor ×	Impossible	← Or or	ne direction nly	←→ Tw	o directions

of Rolling 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.
\odot	0	\odot	0	0	×	×	×	×	×	0	_
$\overline{\bigcirc}$	×	\bigcirc	\bigcirc	\bigcirc	\bigcirc	$\overline{\bigcirc}$	$\overline{\bigcirc}$	(i)	(i)	(i)	_
	×	0	0	0	×	×	×	×	×	0	_
\bigcirc	0	\bigcirc		\bigcirc	×	×	\bigcirc	0	0	0	A18 A37
		0			0		0				A19 A58 A81
											A19
\odot	0	0	0				0	0	0		A19 A96
\bigcirc	0		0	0	×	0	×	×	×	0	A18 Blue pages of each brg. type
				☆		☆				☆	A18
☆	☆	☆	☆		☆	☆	☆	☆	☆	☆	A19 A20
☆			☆	☆							A20 ~A21
	☆		*	*							A20 ~A27
				☆							A80 A118 A122
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	
B85	_	B115	B115 B176 B299	B183	B207	B207	B235	B207 B224	_	B207 B228	

A 14 A 15

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



2. 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 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.

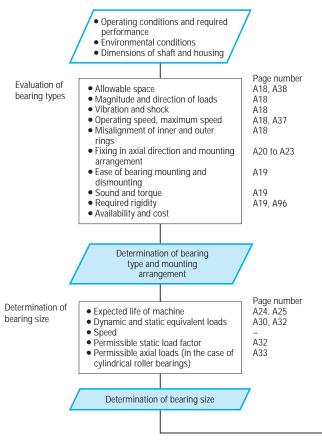
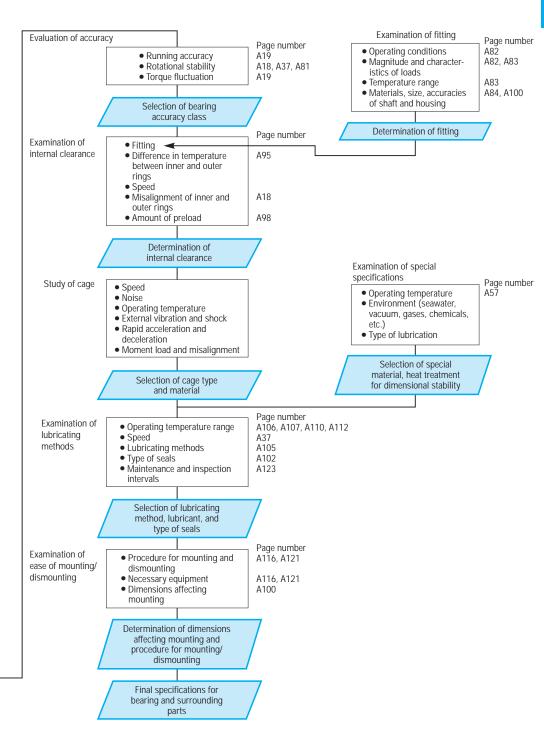


Fig. 2.1 Flow Chart for Selection of Rolling Bearings



3. SELECTION OF BEARING TYPES

3.1 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. 3.1 shows the dimension series of radial bearings and corresponding bearing types.

3.2 Load Capacity and Bearing Types

The axial load carrying capacity of a bearing is closely related to the radial load capacity (see Page A24) in a manner that depends on the bearing design as shown in Fig. 3.2. 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.

3.3 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. 3.3

3.4 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. 3.4 and 3.5).

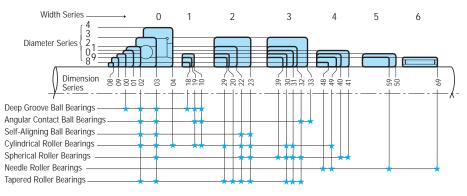


Fig. 3.1 Dimension Series of Radial Bearings

Bearing Types

Deep Groove

Ball Bearings

Ball Bearings

Needle Roller

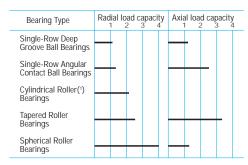
Tapered Roller

Bearings

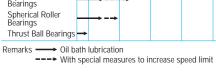
Bearings

Angular Contact

Cylindrical Roller



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



Relative permissible speed

13

10

Fig. 3.2 Relative Load Capacities of Various Bearing Types Fig. 3.3 Relative Permissible Speeds of Various Bearing Types

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

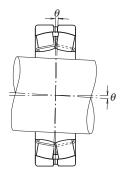


Fig. 3.4 Permissible Misalignment of Spherical Roller Bearings

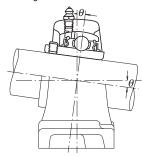


Fig. 3.5 Permissible Misalignment of Ball Bearing Units

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

3.5 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.

3.6 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.

3.7 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. 3.6.

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

3.8 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.



4. SELECTION OF BEARING ARRANGEMENT

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.

4.1 Fixed-End and Free-End Bearings

Fixed-end

Fixed-end

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 "freeend" bearings that carry only radial loads to relieve the shaft's thermal elongation and contraction.

No distinction between fixed-end and free-end

No distinction between fixed-end and free-end

No distinction between fixed-end and free-end

Free-end (separable bearing)

Free-end (non-separable bearing)

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 B

· Cylindrical Roller Bearing · Deep Groove Ball Bearing · Matched Angular Contact (NU. N types) Needle Roller Bearing (NA · Double-Row Angular type, etc.)

BEARING C(1)

Deep Groove Ball Bearing · Matched Angular Contact Ball Bearing (back-toback)

· Double-Row Angular Contact Ball Bearing

· Self-Aligning Ball Bearing · Double-Row Tapered Roller Bearing (KBE type) Spherical Roller Bearing

BEARING F

Deep Groove Ball Bearing · Self-Aligning Ball Bearing · Spherical Roller Bearing

· Tapered Roller Bearing · Magneto Bearing · Cylindrical Roller Bearing (NJ. NF types)

BEARING A

Ball Bearing

types)

Contact Ball Bearing · Self-Aligning Ball Bearing · Cylindrical Roller Bearing

with Ribs (NH, NUP

· Double-Row Tapered

· Spherical Roller Bearing

Roller Bearing

BEARING D,E(2)

Bearing

· Angular Contact Ball

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. 4.1.

4.2 Example 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 4.1.

Table 4. 1 Representative Bearing Mounting Arrangements and Application Examples

Bearing Arrangements	- Remarks	Application Examples
Fixed-end Free-end	Remarks	Application Examples
	 This is a common arrangement in which abnormal loads are not applied to bearings even if the shaft expands or contracts. If 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. ○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. For maximum rigidity of the fixed-end bearing, it is a back-to-back type. 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
	OThis 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. 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 4. 1 Representative Bearing Mounting Arrangements and Application Examples (cont'd)

Bearing Arrangements	Remarks	Application Examples
Fixed-end Free-end		,
	This is the most common arrangement.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. 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. Double row angular contact bearings may be used instead of a arrangement of two angular contact ball bearings. 	Worm gear reducers
When there is no distinction between fixed-end and free-end	Remarks	Application Examples
Back-to-back mounting Face-to-face mounting	 This arrangement is widely used since it can withstand heavy loads and shock loads. The back-to-back arrangement is especially good when the distance between bearings is short and moment loads are applied. 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. To use this arrangement with a preload, affection 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
Back-to-back mounting	 This is used at high speeds when radial loads are not so heavy and axial loads are relatively heavy. It provides good rigidity of the shaft by preloading. For moment loads, back-to-back mounting is better than face-to-face mounting. 	Grinding wheel shafts

When there is no distinction between	Remarks	Application Examples
fixed-end and free-end NJ + NJ mounting	 This can withstand heavy loads and shock loads. It can be used if interference is necessary for both the inner and outer rings. Care must be taken so the axial clearance doesn't become too small during running. NF type + NF type mounting is also possible. 	Final reduction gears of construction machines
	OSometimes 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.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. The upper bearing is on the free end. 	Vertical openers (spinning and weaving machines)

Continued on next page



5. SELECTION OF BEARING SIZE

5.1 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.

5.1.1 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. 5.1). 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. 5.2, 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 12, Lubrication, Page A107) 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.

5.2 Basic Load Rating and Fatigue Life5.2.1 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 ($10^6~{\rm rev}$). 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 $C_{\rm r}$ for radial bearings and $C_{\rm a}$ for thrust bearings in the dimension tables.

5.2.2 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



Fig. 5.1 Example of Flaking

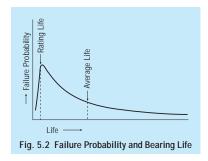


Table 5. 1 Fatigue Life Factor f_h for Various Bearing Applications

	0 11				
Operating Deriods			Fatigue Life Factor $f_{ m f}$	ı	
Operating Periods	~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 · Hand power tools	· Agricultural equipment			
Used only occasionally but reliability is impor- tant		Motors for home heaters and air conditioners Construction equipment	· Conveyors · Elevator cable sheaves		
Used intermittently for relatively long periods	· Rolling mill roll necks	Small motors Deck cranes General cargo cranes Pinion stands Passenger cars	Factory motors Machine tools Transmissions Vibrating screens Crushers	Crane sheaves Compressors Specialized transmissions	
Used intermittently for more than eight hours daily		·Escalators	Centrifugal separators Air conditioning equipment Blowers Woodworking machines Large motors Axle boxes on railway rolling stock	Mine hoists Press flywheels Railway traction motors Locomotive axle boxes	Paper making machines
Used continuously and high reliability is impor- tant					Waterworks pumps Electric power stations Mine draining pumps

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 5.1 gives an empirical fatigue life factor derived from customary operating experience for various machines. Also refer to Table 5.2.

5.2.3 Selection of Bearing Size Based on Basic Load Rating

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

For ball bearings
$$L = \left(\frac{C}{P}\right)^3$$
.....(5.1)
For roller bearings $L = \left(\frac{C}{P}\right)^{\frac{10}{3}}$(5.2)

where L: Basic rating life (10⁶ rev)

P: Bearing load (equivalent load) (N), {kgf}(Refer to Page A30)

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 mileage.

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 5.2 are obtained:

Table 5. 2 Basic Rating Life, Fatigue Life Factor and Speed Factor

	. aoto: ana opo	ou : uoto.
Life Parameters	Ball Bearings	Roller Bearings
Basic Rating Life	$L_{\rm h} = \frac{10^6}{60 n} \left(\frac{C}{P}\right)^3 = 500 f_{\rm h}^3$	$L_{\rm h} = \frac{10^6}{60n} \left(\frac{C}{P}\right)^{\frac{10}{3}} = 500 f_{\rm h}^{\frac{10}{3}}$
Fatigue Life Factor	$f_{\rm h} = f_{\rm h} \frac{C}{P}$	$f_{\rm h} = f_{ m n} \frac{C}{P}$
Speed Factor	$f_{n} = \left(\frac{10^{6}}{500 \times 60 n}\right)^{\frac{1}{3}}$ $= (0.03 n)^{-\frac{1}{3}}$	$f_{n} = \left(\frac{10^{6}}{500 \times 60 n}\right)^{\frac{3}{10}}$ $= (0.03 n)^{-\frac{3}{10}}$

n, f_nFig. 5.3 (See Page A26), Appendix Table 12 (See Page C24)

 $L_{\rm h},~f_{\rm h}$...Fig. 5.4 (See Page A26), Appendix Table 13 (See Page C25)



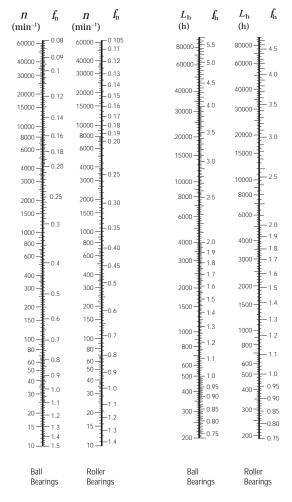


Fig. 5.3 Bearing Speed and Speed Factor

Fig. 5.4 Fatigue Life Factor and Fatigue Life

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.

$$C = \frac{f_{\rm h} \cdot P}{f_{\rm h}} \dots (5.3)$$

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

5.2.4 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:

$$C_t = f_t \cdot C \quad \dots \quad (5.4)$$

where C_t : Basic load rating after temperature correction (N), {kgf}

> $f_{\rm t}$: Temperature factor (See Table 5.3.)

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 5.3 Temperature Factor $f_{\rm t}$

		-			
Bearing Temperature °C	125	150	175	200	250
Temperature Factor $ extbf{\emph{f}}_{ ext{t}}$	1.00	1.00	0.95	0.90	0.75

5.2.5 Correction of Basic Rating Life

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

For ball bearings
$$L_{10} = \left(\frac{C}{P}\right)^3$$
(5.5)

For roller bearings
$$L_{10} = \left(\frac{C}{P}\right)^{\frac{10}{3}}$$
(5.6)

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:

$$L_{\text{na}} = \partial_1 \, \partial_2 \, \partial_3 \, L_{10} \, \dots (5.7)$$

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

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

a₁: Life adjustment factor for reliability

a2: Life adjustment factor for special bearing properties

a₃: Life adjustment factor for operating conditions

The life adjustment factor for reliability, a_1 , is listed in Table 5.4 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 (5.7), it is sufficient to assume that is greater than one.

Table 5.4 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_b value derived from past results for lubrication, temperature, mounting conditions, etc. in similar machines.

The basic rating life equations (5.1), (5.2), (5.5), and (5.6) 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 $P_{\rm r}$ exceeds $C_{\rm or}$ (Basic static load rating) or 0.5 $C_{\rm r}$, whichever is smaller, for radial bearings or P_a exceeds 0.5 C_a for thrust bearings, please consult NSK to establish the applicability of the rating fatigue life equations.



5.3 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.

5.3.1 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:

$$F_{\rm r} = f_{\rm w} \cdot F_{\rm rc} F_{\rm a} = f_{\rm w} \cdot F_{\rm ac}$$

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

 $\begin{array}{c} F_{rc},\,F_{ac}: \text{Theoretically calculated load (N),} \\ \{kgf\} \end{array}$

 f_{w} : Load factor

The values given in Table 5.5 are usually used for the load factor $f_{\rm w}$.

5.3.2 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.

$$M = 9 550 000H/n...(N \cdot mm)$$

= 974 000 $H/n....(kgf \cdot mm)$ }.....(5.9)

$$P_{\rm k} = M / r$$
(5.10)

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

 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 $K_{\rm b}$ in the case of a belt transmission, the effective transmitting power is multiplied by the belt factor $f_{\rm b}$, which represents the belt tension. The values of the belt factor $f_{\rm b}$ for different types of belts are shown in Table 5.6.

$$K_{\rm b} = f_{\rm b} \cdot P_{\rm k}$$
(5.11)

In the case of a chain transmission, the values corresponding to $f_{\rm b}$ should be 1.25 to 1.5.

Table 5. 5 Values of Load Factor f_{vv}

Operating Conditions	Typical Applications	$f_{\rm w}$
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 5. 6 Belt Factor $f_{\rm b}$

Type of Belt	$f_{ m b}$
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

5.3.3 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:

$$M = 9 550 000H / n (N \cdot mm)$$

= 974 000H / n {kgf·mm} }(5.12)
 $P_k = M / r$ (5.13)
 $S_k = P_k \tan \theta$ (5.14)
 $K_c = \sqrt{P_k^2 + S_k^2} = P_k \sec \theta$ (5.15)

where M: Torque applied to gear $(\mathbf{N} \cdot \mathbf{mm})_{i}\{\mathbf{kgf} \cdot \mathbf{mm}\}$

 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)

 θ : 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 $f_{\rm g}$ by multiplying the theoretically calculated load by this factor.

The values of $f_{\rm g}$ should generally be those in Table 5.7. When vibration from other sources accompanies gear operation, the actual load is obtained by multiplying the load factor by this gear factor.

Table 5. 7 Values of Gear Factor f_{σ}

Gear Finish Accuracy	$f_{ m g}$
Precision ground gears	1 ~1.1
Ordinary machined gears	1.1~1.3

5.3.4 Load Distribution on Bearings

In the simple examples shown in Figs. 5.5 and 5.6. The radial loads on bearings I and II can be calculated using the following equations:

$$F_{\rm CI} = \frac{b}{C} K$$
....(5.16)

$$F_{\text{CII}} = \frac{a}{C}K \dots (5.17)$$

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.

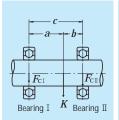


Fig. 5.5 Radial Load Distribution (1)

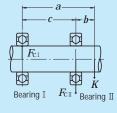


Fig. 5.6 Radial Load Distribution (2)

5.3.5 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. 5.7)

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 $F_{\rm m}$ may be calculated using the following equation:

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

 $\mathbf{p} = 3$ for ball bearings

p = 10/3 for roller bearings

NSK

The average speed $n_{\rm m}$ may be calculated as follows:

$$n_{\rm m} = \frac{n_1 t_1 + n_2 t_2 + \dots + n_n t_n}{t_1 + t_2 + \dots + t_n} \dots (5.19)$$

(2) When the load fluctuates almost linearly (Fig. 5.8), the average load may be calculated as follows:

$$F_{\rm m} = \frac{1}{3} (F_{\rm min} + 2F_{\rm max}) \dots (5.20)$$

 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. 5.9), an approximate value for the average load $F_{\rm m}$ may be calculated from the following

In the case of Fig. 5.9 (a)

$$F_{\rm m} \stackrel{..}{=} 0.65 \; F_{\rm max}$$
(5.21)

In the case of Fig. 5.9 (b)

(4) When both a rotating load and a stationary load are applied (Fig. 5.10).

 $F_{\mathbb{R}}$: 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
$$F_R \ge F_S$$

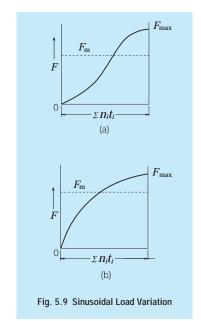
 $F_m = F_R + 0.3F_S + 0.2 \frac{{F_S}^2}{F_R}$(5.23)

b) Where
$$F_{\rm R} < F_{\rm S}$$

$$F_{\rm m} = F_{\rm S} + 0.3 F_{\rm R} + 0.2 \frac{F_{\rm R}^2}{F_{\rm c}}......(5.24)$$

5.4 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.



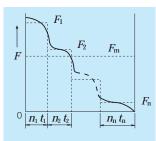


Fig. 5.7 Incremental Load Variation

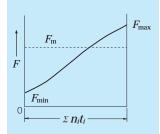
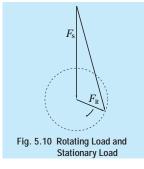


Fig. 5.8 Simple Load Fluctuation



5.4.1 Calculation of Equivalent Loads

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

$$P = XF_r + YF_a$$
(5.25)

P: Equivalent Load (N), {kgf}

 $F_{\rm r}$: 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 $\alpha = 0^{\circ}$ 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:

$$P = F_{\rm a} + 1.2 F_{\rm r} \eqno(5.26)$$
 where
$$\frac{F_{\rm r}}{F_{\rm o}} \le 0.55$$

5.4.2 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. 5.11. 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:

$$F_{ai} = \frac{0.6}{V} F_{r}$$
(5.27)

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_{r1} and F_{rII} are applied on bearings I and II (Fig. 5.12) respectively, and an external axial load $F_{\rm ae}$ is applied as shown. If the axial load factors are $Y_{\rm I}$, $Y_{\rm II}$ and the radial load factor is X, then the equivalent loads $P_{\scriptscriptstyle \rm T}$, $P_{\scriptscriptstyle \rm T}$ may be calculated as

where
$$F_{ae} + \frac{0.6}{Y_{II}} F_{r_{II}} \ge \frac{0.6}{Y_{I}} F_{r_{I}}$$

$$P_{I} = XF_{r_{I}} + Y_{I} \left(F_{ae} + \frac{0.6}{Y_{II}} F_{r_{II}} \right)$$

$$P_{II} = F_{r_{II}}$$

$$(5.28)$$

where
$$F_{
m ae} + rac{0.6}{Y_{
m II}}\,F_{
m r\,II} < rac{0.6}{Y_{
m I}}\,F_{
m r\,I}$$

$$P_{\rm I} = F_{\rm r\,I}$$

 $P_{\rm II} = X F_{\rm r\,II} + Y_{\rm II} \left(\frac{0.6}{Y_{\rm I}} F_{\rm r\,I} - F_{\rm ae} \right)$ (5.29)

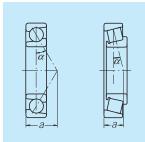


Fig. 5.11 Effective Load Centers

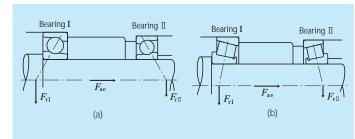


Fig. 5.12 Loads in Opposed Duplex Arrangement



5.5 Static Load Ratings and Static Equivalent Loads

5.5.1 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 nonelastic 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.

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 $C_{\rm o}$ is written $C_{\rm or}$ for radial bearings and $C_{\rm oa}$ for thrust bearings in the bearing tables.

In addition, following the modification of the criteria for basic static load rating by ISO, the new $C_{\rm o}$ 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 $f_{\rm s}$ have also changed, so please pay attention to this.

5.5.2 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 avail 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.

$$P_{\rm o} = X_{\rm o} F_{\rm r} + Y_{\rm o} F_{\rm a}$$
 (5.30)
 $P_{\rm o} = F_{\rm r}$ (5.31)

where P_0 : Static equivalent load (N), {kgf}

 $F_{\rm r}$: Radial load (N), {kgf} $F_{\rm a}$: Axial load (N), {kgf}

 X_0 : Static radial load factor

 Y_0 : Static axial load factor

(b)Static equivalent load on thrust bearings

$$P_0 = X_0 F_r + F_a$$
 $\alpha \neq 90^{\circ}$ (5.32)

where P_0 : Static equivalent load (N), {kgf}

 α : Contact angle

When $F_{\rm a}{<}X_{\rm o}F_{\rm r}$, this equation becomes less accurate. The values of $X_{\rm o}$ and $Y_{\rm o}$ for Equations (5.30) and (5.32) are listed in the bearing tables.

The static equivalent load for thrust roller bearings with

$$\alpha = 90^{\circ}$$
 is $P_0 = F_3$

5.5.3 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 (5.33). The generally recommended values of f_s are listed in Table 5.8. 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_o were increased, please keep this in mind when selecting bearings.

$$f_{\rm S} = \frac{C_0}{P_0}$$
....(5.33)

where C_0 : Basic static load rating (N), {kgf}

 P_{o} : Static equivalent load (N), {kgf}

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

Table 5. 8 Values of Permissible Static Load Factor f_s

Operating Conditions		imit of $\emph{\textbf{f}}_{s}$ Roller Bearings
Low-noise applications	2	3
Bearings subjected to vibration and shock loads	1.5	2
Standard operating conditions	1	1.5

5.6 Maximum Permissible Axial Loads for Cylindrical Roller Bearings

Cylindrical roller bearings having inner and outer rings with ribs, loose ribs or thrust collars are capable of sustaining radial loads and limited axial loads simultaneously. The maximum permissible axial load is limited by an abnormal temperature rise or heat seizure due to sliding friction between the end faces of rollers and the rib face, or the rib strength.

The maximum permissible axial load (the load considered the heat generation between the end face of rollers and the rib face) for bearings of diameter series 3 that are continuously loaded and lubricated with grease or oil is shown in Fig. 5.13.

Grease lubrication (Empirical equation)

$$C_{\Lambda} = 9.8f \left\{ \frac{900 (k \cdot d)^{2}}{n+1500} - 0.023 \times (k \cdot d)^{2.5} \right\} ...(N)$$

$$= f \left\{ \frac{900 (k \cdot d)^{2}}{n+1500} - 0.023 \times (k \cdot d)^{2.5} \right\} \{ kgf \}$$

Oil lubrication (Empirical equation)

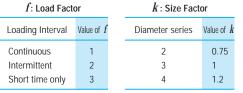
$$C_{A} = 9.8f \left\{ \frac{490 (k d)^{2}}{n+1000} - 0.000135 \times (k d)^{3.4} \right\}...(N)$$

$$= f \left\{ \frac{490 (k d)^{2}}{n+1000} - 0.000135 \times (k d)^{3.4} \right\}....\{kgf\}$$

where C_{Δ} : Permissible axial load (N), {kgf}

d: Bearing bore diameter (mm)

n : Speed (min⁻¹)



In the equations (5.34) and (5.35), the examination for the rib strength is excluded. Concerning the rib strength, please consult with NSK.

In addition, for cylindrical roller bearings to have a stable axial-load carrying capacity, the following precautions are required for the bearings and their 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.
- · Sufficient lubricant must exist between the roller end faces and ribs.
- · Superior extreme-pressure grease must be used.
- · Sufficient running-in should be done.
- ·The mounting accuracy must be good
- The radial clearance should not be more than necessary.

In cases where the bearing speed is extremely slow, the speed exceeds the limiting speed by more than 50%, or the bore diameter is more than 200mm, careful study is necessary for each case regarding lubrication, cooling, etc. In such a case, please consult with NSK.

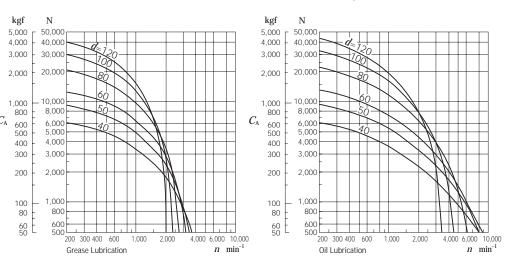


Fig. 5.13 Permissible Axial Load for Cylindrical Roller Bearings

For Diameter Series 3 bearings (k=1.0) operating under a continuous load and lubricated with grease or oil.



5.7 Examples of Bearing Calculations

(Example1)

Obtain the fatigue life factor $f_{\rm h}$ of single-row deep groove ball bearing 6208 when it is used under a radial load $F_{\rm r}$ =2 500 N, (255kgf) and speed n =900 min⁻¹.

The basic load rating $C_{\rm r}$ of **6208** is 29 100N, (2 970kgf) (Bearing Table, Page B10). Since only a radial load is applied, the equivalent load P may be obtained as follows:

$$P = F_{\rm r} = 2500$$
N, {255kgf}

Since the speed is $n = 900 \text{ min}^{-1}$, the speed factor f_n can be obtained from the equation in Table 5.2 (Page A25) or Fig. 5.3(Page A26).

$$f_{\rm n} = 0.333$$

The fatigue life factor $f_{\!\scriptscriptstyle h}$, under these conditions, can be calculated as follows:

$$f_{\rm h} = f_{\rm h} \frac{C_{\rm r}}{P} = 0.333 \times \frac{29\ 100}{2\ 500} = 3.88$$

This value is suitable for industrial applications, air conditioners being regularly used, etc., and according to the equation in Table 5.2 or Fig. 5.4 (Page A26), 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 $F_r = 3000N$, (306kgf)

Speed n = 1 900 min⁻¹

Basic rating life $L_{\rm h} \ge 10~000{\rm h}$

The fatigue life factor f_h of ball bearings with a rating fatigue life longer than 10 000 hours is $f_h \ge 2.72$. Because $f_n = 0.26$. $P = F_r = 3 000$ N. (306kgf)

$$f_{\rm h} = f_{\rm h} \frac{C_{\rm r}}{P} = 0.26 \times \frac{C_{\rm r}}{3000} \ge 2.72$$

therefore,
$$C_r \ge 2.72 \times \frac{3.000}{0.26} = 31.380 \text{N}$$
, (3.200kgf)

Among the data listed in the bearing table on Page B12, **6210** should be selected as one that satisfies the above conditions.

(Example3

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_0F_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 B10)

$$f_{\rm o}F_{\rm a}/C_{\rm or} = 14.0 \times 1\,000/17\,900 = 0.782$$

 $e \doteq 0.26$

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

$$P = XF_r + YF_a$$

$$= 0.56 \times 2500 + 1.67 \times 1000$$

$$= 3070N$$
, {313kgf}

$$\frac{C_{\rm r}}{P} = \frac{29\ 100}{3\ 070} = 9.48$$

$$f_{\rm h} = f_{\rm h} \frac{C_{\rm r}}{P} = 0.333 \times \frac{29 \ 100}{3 \ 070} = 3.16$$

This value of $f_{\rm h}$ 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 $F_r = 45\,000$ N. (4.950kgf)

Axial load $F_a = 8000 \text{N}_{1} \text{ (816kgf)}$

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

Basic rating life $L_h \ge 30~000h$

The value of the fatigue life factor f_h which makes $L_h \ge 30~000h$ is bigger than 3.45 from Fig. 5.4 (Page A26).

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
$$F_a / F_r > e$$

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

 $F_a / F_r = 8000/45000 = 0.18$

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,
$$P = XF_r + YF_a = F_r + Y_3F_a$$

= 45 000 + 2.2 × 8 000
= 62 600N, {6 380kgf}

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

$$f_{\rm h} = f_{\rm n} \frac{C_{\rm r}}{P} = 0.444 \times \frac{C_{\rm r}}{62\,600} \ge 3.45$$

consequently, $C_r \ge 490\,000N$, $_{50\,000kgf}$ Among spherical roller bearings of series 231 satisfying this value of C_r , the smallest is **23126CE4** $(C_r = 505\,000N$, $_{51\,500keff})$

Once the bearing is determined, substitude the value of Y_2 in the equation and obtain the value of P_2 .

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

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

$$L_{h} = 500 \left(f_{h} \frac{C_{r}}{P} \right)^{\frac{10}{3}}$$

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

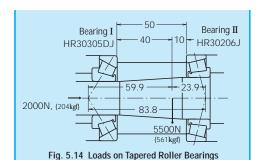
$$= 500 \times 3.49^{\frac{10}{3}} \stackrel{3}{=} 32\ 000\ h$$

(Example 5)

Assume that tapered roller bearings HR30305DJ and HR30206J are used in a back-to-back arrangement as shown in Fig. 5.14, 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 0.00N,(204kgf) are applied to HR30305DJ as shown in Fig. 5.14. The speed is 600 min⁻¹.



To distribute the radial load $F_{\rm r}$ 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 $F_{\rm r}$ and effective load centers. The result will be as shown in Fig. 5.14. Consequently, the radial load applied on bearings I (HR30305DJ) and II (HR30206J) can be obtained from the following equations:

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

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

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

Bearings	Basic dynamic load rating $C_{ m r}$ (N) {kgf}		Axial load factor Y_1	Constant e
Bearing I (HR30305DJ)	38 000	{3 900}	$Y_{\rm I} = 0.73$	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 5.4.2, Page A31).



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

= 3 474N, (354kgf)

$$\frac{0.6}{Y_{\rm I}} F_{\rm rI} = \frac{0.6}{0.73} \times 1569 = 1290 \text{N}, \{132 \text{kgf}\}$$

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

$$F_{\rm r\,I}=1$$
 569N, {160kgf}

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

since
$$F_{\mathrm{a}\,\mathrm{I}}$$
 / $F_{\mathrm{r}\,\mathrm{I}}$ = 2.2 $>$ e = 0.83

the dynamic equivalent load $P_{\perp} = XF_{r\perp} + Y_{\perp}F_{a\perp}$

$$= 0.4 \times 1569 + 0.73 \times 3474$$

= 3164N, {323kgf}

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

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

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

For bearing II

since $F_{r_{\parallel}} = 3.931 \text{N}$, (401kgf), $F_{a_{\parallel}} = 0$

the dynamic equivalent load

$$P_{\Pi} = F_{r \Pi} = 3 931 \text{N}, \{401 \text{kgf}\}$$

the fatigue life factor

$$f_{\rm h} = f_{\rm h} \frac{C_{\rm r}}{P_{\rm TI}} = \frac{0.42 \times 43\,000}{3\,931} = 4.59$$

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

Remarks 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 $F_r = 245\ 000N$, {25 000kgf}

 $F_a = 49\,000$ N, (5 000kgf) Axial load

Speed Size limitation $n = 500 \text{min}^{-1}$

Shaft diameter: 300mm

Bore of housing: Less than 500mm

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 B196)

d	D	В	Bearing No.	Basic dyl load ra $C_{ m r}$ (N)		Constant $oldsymbol{e}$	Factor Y_3
300	420	90	23960 CAE4	1 230 000	125 000	0.19	3.5
	460	118	23060 CAE4	1 920 000	196 000	0.24	2.8
	460	160	24060 CAE4	2 310 000	235 000	0.32	2.1
	500	160	23160 CAE4	2 670 000	273 000	0.31	2.2
	500	200	24160 CAE4	3 100 000	315 000	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 $f_{\rm h}$ in Table 5.1 and examples of applications (refer to Page A25), a value of $f_{\rm h}$, between 3 and 5 seems appropriate.

$$f_{\rm h} = f_{\rm n} \frac{C_{\rm r}}{P} = \frac{0.444 \ C_{\rm r}}{F_{\rm r} + Y_3 F_{\rm a}} = 3 \text{ to } 5$$

Assuming that $Y_3 = 2.1$, then the necessary basic load rating $C_{\rm r}$ can be obtained

$$C_{\rm r} = \frac{(F_{\rm r} + Y_3 F_{\rm a}) \times (3 \text{ to } 5)}{0.444}$$

$$=\frac{(245\ 000+2.1\times49\ 000)\times(3\ to\ 5)}{0.444}$$

= 2350000 to 3900000 N.{240 000 to 400 000 kgf}

The bearings which satisfy this range are 23160CAE4 and 24160CAE4.

6. LIMITING SPEED

The speed of rolling bearings is subject to certain limits. 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 failing from seizure or generation of excessive heat. 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 speeds for bearings lubricated by grease and oil are listed in the bearing tables. The limiting speeds in the tables are applicable to bearings of standard design and subjected to normal loads, i. e.

 $C/P \ge 12$ and $F_a/F_r \le 0.2$ approximately. The limiting speeds for oil lubrication listed in the bearing tables are 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, it is necessary to select an oil or grease which has good high speed characteristics.

(Refer to)

Table 12.2 Grease Properties (Pages A110 and 111)

Table 12.5 Example of Selection of Lubricant for Bearing Operating Conditions (Page A113)

Table 15.8 Brands and Properties of Lubricating Grease (Pages A138 to A141)

6.1 Correction of Limiting Speed

When the bearing load P exceeds 8 % of the basic load rating C_i or when the axial load F_a exceeds 20 % of the radial load F_r , the limiting speed must be corrected by multiplying the limiting speed found in the bearing tables by the correction factor shown in Figs. 6.1 and

When the required speed exceeds the limiting speed 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, forcedcirculation oil lubrication, jet lubrication, oil mist lubrication, or oil-air lubrication must be used.

If all these conditions are considered. The maximum permissible speed may be corrected by multiplying the limiting speed found in the bearing tables by the correction factor shown in Table 6.1. It is recommended that NSK be consulted regarding high speed applications.

6.2 Limiting Speed 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.



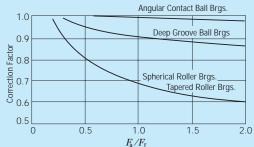


Fig. 6.2 Limiting Speed Correction Factor for Combined Radial and Axial Loads

Table 6.1 Limiting Speed Correction Factor for **High-Speed Applications**

•	
Bearing Types	Correction Factor
Cylindrical Roller Brgs.(single row)	2
Needle Roller Brgs.(except broad width)	2
Tapered Roller Brgs.	2
Spherical Roller Brgs.	1.5
Deep Grooove Ball Brgs.	2.5
Angular Contact Ball Brgs.(except matched bearings)	1.5



7. BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS

7.1 Boundary Dimensions and Dimensions of Snap Ring Grooves

7.1.1 Boundary Dimensions

The boundary dimensions of rolling bearings, which are shown in Figs.7.1 through 7.5, 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 7.1 to 7.3 (Pages A40 to A49).

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 (7.1 to 7.3), representative bearing types and series symbols are shown (refer to Table 7.5, Bearing Series Symbols, Page A55).

The relative cross-sectional dimensions of radial bearings (except tapered roller bearings) and thrust bearings for the various series classifications are shown in Figs. 7.6 and 7.7 respectively.

7.1.2 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 7.4 (Pages A50 to A53).

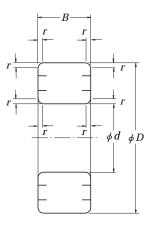


Fig. 7.1 Boundary Dimensions of Radial Ball and Roller Bearings

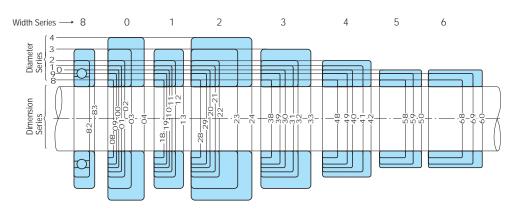


Fig. 7.6 Comparison of Cross Sections of Radial Bearings (except Tapered Roller Bearings) for various Dimensional Series

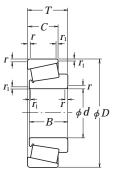


Fig. 7.2 Tapered Roller Bearings

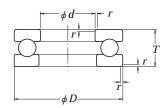


Fig. 7.3 Single-Direction Thrust Ball Bearings

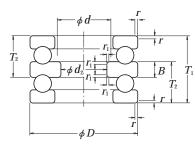


Fig. 7.4 Double-Direction Thrust Ball Bearings

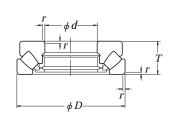


Fig. 7.5 Spherical Thrust Roller Bearings

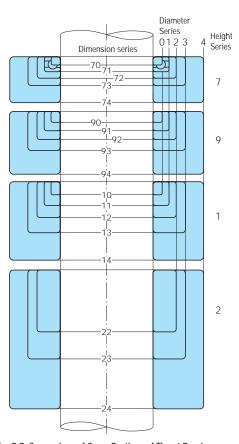


Fig. 7.7 Comparison of Cross Sections of Thrust Bearings (except Diameter Series 5) for Various Dimension Series

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- - 130 9 13 16 19 25 140 10 16 19 23 30 16 19 23 30 10 16 19 23 30 10 16 19 23 30 10 16 19 23 30 10 16 10 16 10 16 10 16 10 16 10 16 10 16 10 16 10 16 10 10	106 11 18 22 26 35 46 175 11 18 22 26 35 46 190 13 20 24 30 40 54	- - - - 200 13 20 24 30 40 54 - - - - 216 14 22 27 34 45 60 - - - - - - 225 14 22 27 34 45 60	240 16 24 30 37 50 67 - 250 16 24 30 37 50 67 67 67 67 67 67 67 67 67 67 67 67 67	1	100 100	440 25 38 48 60 76 100 136 500 31 46 60 75 100 138	- - - - 520 31 46 60 75 100 138 - - - - - 540 31 46 60 75 100 138 - - - - - - 580 37 56 72 90 118 160	600 37 56 72 90 118 160 650 37 56 72 90 118 160 650 37 56 72 90 118 160	- -	820 48 69 88 112 150 200 870 50 74 95 118 160 218 920 54 78 100 128 170 230	- - - 980 57 82 106 136 180 243 - - - 1030 57 82 106 136 180 243 - - - - 1090 60 85 112 140 190 258	1150 63 90 118 150 200 272 355 1	- - - - 1360 78 106 140 180 243 325 438 - - - 1420 78 106 140 180 243 325 438 -	1700 88 122 165 206 289 375 500 545 50	-	
		200 13 20 24 30 40 54 60 225 14 22 27 34 45 60	250 16 24 30 37 50 67 - 270 16 24 30 37 50 67	10 10 10 10 10 10 10 10		440 25 38 48 60 76 100 138 500 31 46 60 75 100 138	520 31 46 60 75 100 138 580 37 56 72 90 118 160	600 37 56 72 90 118 160 650 37 56 72 90 118 160 650 37 56 72 90 118 160	- -	820 48 69 88 112 150 200 870 50 74 95 118 160 218 920 54 78 100 128 170 230	1030 57 82 106 136 180 243 1030 57 82 106 136 180 243 1090 60 85 112 140 190 258	1220 77 100 128 165 218 300 400	1340 78 106 140 180 243 325 438 - 1500 80 112 145 186 250 335 450	1460 88 122 165 206 280 375 500 1780 95 132 175 224 300 400 545 1820 - 140 185 243 315	1950	- 2430 - 175 230 300 400
106 — — — 130 9 13 16 19 25 120 — — — — — 140 16 19 13 16 19 23 30 120 — — — — — 150 16 19 23 30	166 11 18 22 26 35 46 175 11 18 22 26 35 46 179 13 20 24 30 40 54	146 — — — 200 13 20 24 30 40 54 170 — — — 216 14 22 27 34 45 60 180 — — — 225 14 22 27 34 45 60	190 — — — 240 16 24 30 37 50 67 200 — — — — 250 16 24 30 37 50 67 220 — — — — 27 270 16 24 30 37 50 67 220 — — — — 270 16 24 30 37 50 67	240 — — — 300 19 28 36 45 60 80 280 — — — — 320 19 28 36 45 60 80 280 — — — — — 350 22 33 42 52 69 95	320 400 25 38 48 60 80 109 340 420 25 38 48 60 80 109 109 109 109 109 109 109 109 109 10	360 — — — 440 25 38 48 60 80 109 109 380 — — — — 480 31 46 60 75 100 136 400 — — — — 500 31 46 60 75 100 138	420 — — — 520 31 46 60 75 100 136 440 — — — — 540 31 46 60 75 100 136 460 — — — — 580 37 56 72 90 118 100	500 — — — 600 37 56 72 90 118 160 530 — — — 620 37 56 72 90 118 160 530 — — — 650 37 56 72 90 118 160	550 — — — — 680 37 56 72 90 118 16 600 — — — 730 42 60 78 98 128 175 630 — — — 773 42 60 78 98 128 175 20 — — — 778 48 69 88 172 150 200	670 — — — 830 48 69 88 112 150 200 710 — — — 870 50 74 96 118 160 218 750 — — — 920 54 78 100 128 170 230	800 — — — — 980 57 82 106 136 180 243 850 — — — — 1030 57 82 106 136 180 243 900 — — — — 1090 60 85 112 140 190 288	1220 77 100 128 165 218 300 400	1120 —	1460 88 122 165 206 280 375 500 1780 95 132 175 224 300 400 545 1820 - 140 185 243 315	- - - 2060 155 200 265 345 - -	2430 - 175 230 300 400

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. Remarks

2
Roller Bearings)
Tapered
(except
Bearings
of Radial
Dimensions o
Boundary
Table 7.1

UIV	IDA	I A	וט	IVIL	_14-	SIU	INO	AIN	יטו טו		YIING	INOIN	IDEK	3 FUR	(DEA	KIING	3			
					4	Dimension Series	04~24	r (min.)	111	111	111	0.6	0.6	22 I	5.1 1.5.	1.5	2.1	2.1	6 € 4	444
					Series 4				111		111	1 2 5	16 19 24	33	36	449	53	64 74 74	77 80 86	98
94	104	N 4			Diameter Series 4	Dimension Series	04	В	111	111	111	161	13 12	119	21	 25 27	33	35 37 42	45 48 52	54 58 58
					ā		D		111	1.1.1	1.1.1	30	37 42 52	62 72 —	80 80	100	120 130 140	150 160 180	190 200 210	225 240 250
						ision	03~33	in.)	111	0.2	0.3	0.3	1.00	-==	===	<u> </u>	2 2 2	2.1	2.1	ოოო
						Dimension Series	83	r (min.)	111	111	111	111	0.03	9.0	9.0	0.6		11111	1.5	22
633	323	N 33			3		33		111	_	9 0 5	512	19 19	22.2 22.2 25	25.4 30.2 30.2	32 34.9 36.5	39.7 44.4 49.2	54 58.7 63.5	68.3 68.3 73	73 77.8 82.6
623	43	N 23		223	Series 3	eries	23		111	111	=	13 3	11	19	22 24	33 33	44 63	48 51	6883	64 67 73
					Diameter Series	Dimension Series	13	В	111	111	111	111	111	111	111	111	111	111	111	- 12
63	13	N 3		213	Ω	Dime	03		111	115	7 6 2	9 6 0	121	4 5 9	19 19	828	3278	8833	33,44	445
							83		111	111	111	111	000	225	13 13	4 4 4 6	17	22 24 25	27 28 30	3633
							О		1.1.1	5	19 23	26 28 30	35 37 42	47 52 56	62 68 72	75 80 90	120	130 140 150	160 170 180	190 200 215
						nsion ies	02~42	in.)	1.1.1	0.15	0.3	003	9:0 9:0 0:4	0.6		-55	1111	21.5	1.5 2	2.1
						Dimension Series	82	r (min.)	111	1.0	0.15 0.15 0.2	0.3	0.3	0.3	0.3	9.0	9.0			1212
							42		111	111	111	111	118	22 72	27 30 32	33 37 40	40 45	2222	929	822
632	52	N 32		232	ies 2		32		111	1	7 8 01	13 13	14.3 15.9 15.9	17.5 20.6 20.6	20.6 23 23.8	25 27 30.2	30.2 30.2 33.3	36.5 38.1 39.7	41.3 44.4 49.2	52.4 55.6 60.3
622	42	N 22		222	Diameter Series 2	Dimension Series	22	В	111	111	111	111	4 4 4	9 8 8	8198	2323	2233	3338	3833	944
					Diam	imensic	12	ш	111	111	111	111	111	111	111	111	111	111	111	111
62	12	N 2					02		111	4	O O O	L 8 8	110	244	16 15	17 18	20 21	23 24	25 26 28	34
							82		1.1.1	2.5	3.5	6 5 5	L L 8	800	555	121	554	2000	18 19 21	25.42
							D		1.1.1	ا ا 5	19 13	22 24 26	30 32 35	40 47 50	52 58 62	65 72 80	900	110 120 125	130 140 150	160 170 180
						Dimension Series	11~41	r (min.)	111	111	111	111	111	111	111	111	111	111	111	222
						Dime	10	r (n	111	111	111	111	111	111	111	111	111	111	111	115
				241	_		41		111	111	111	15	8 8 8	848	25 27 28	888	8889	644	2522	929
		NN 31		231	Series 1	series	31		111	111		11 12 12	4 4 4 4	18 61	28 19	8223	888	888	37 37 41	45 52 52
					Diameter	Dimension S	21	В	111	111	[∞]	600	12 12	13	16	19 21 22	22 22 24	24 27 27	30 30	33
					۵	Dime	11		111	111	111	111	111	111	111	111	111	111	111	1 08
							10		1.1.1	111	111	111	1 1 1	111	111	111	1.1.1	1.1.1	1.1.1	
Α.	W	- S	ler	oller			Д			111	111	111	111	111	111	111	1.1.1	111	1.1.1	150 160 165
ingle-Ro: 3all Brgs	Double-Row Ball Brgs.	ylindrica oller Brog	edle Rol Brgs.	Spherical Roller Brgs.			p		0.6 1.5	2.5	4100	7 8 9	125	17 20 22	25 28 30	32 40	45 50 55	65 70	75 80 85	90 100
S	۳	ا م ي	Ne	Sph	١	əqwr	л өл	og		3 2	4 2 9	V 8 6	000	03	05 28 06)32 07 08	193	13 12	15 16 17	18 20

440	വവവ	ф 22 22	999	6 7.5 7.5	7.5 9.5 9.5	9.5 9.5	12 12	15 15	15 2 1	1 12	111	111	111	1.1
108	128 132 138	142 145 150	155 160 180	190 206 224	236 250 265	280 300 315	325 335 345	365 375 400	412 438 450	475	111	111	111	1.1
60 65 72	78 82 85	98 92 95	98 102 115	122 132 140	150 155 165	180 190 200	206 212 218	230 236 250	258 272 280	290	111	111	111	1.1
260 280 310	340 360 380	400 420 440	460 480 540	580 620 670	710 750 800	850 900 950	980 1030 1060	1120 1150 1220	1280 1360 1420	1500	1.1.1	111	1.1.1	1.1
നനന	444	444	വവവ	9 9 2	7.5 7.5 7.5	7.5 7.5 7.5	9.5 9.5 9.5	9.5 12 12	15	15 21 25	119	19	111	1.1
3 3.1	е 4	111	111	111	111	111	111	111	111	111	111	111	111	1.1
87.3 92.1 106	112 118 128	138	155 165 180	195 206 224	236 258 272	300 308 308	315 345 365	375 388 412	438 462 488	515 530 560	0630 650 650	670	111	1.1
1.88	93 102 108	120	132 138 145	155 165 175	185 200 212	224 230 243	250 265 280	290 300 325	335 355 375	400 412 438	462 488 500	515 545 —	111	1.1
53 62	66 70 75	79 88 88	92 97 106	114 123 132	140 155 165	170 175 185	190 200 212	218 230 243	258 272 280	300 308 325	355 375 388	400	111	1.1
858	58 65	922	888	95 102 108	109	125 128 136	136 145 155	921	190 200 206	218 224 236	258 272 280	300	111	1.1
37 44	48 50 —	111	111	111	111	111	111	111	111	111	111	111	111	1.1
225 240 260	280 320 320	340 360 380	400 420 460	500 540 580	620 670 710	750 780 820	850 900 950	980 1030 1090	1150 1220 1280	1360 1420 1500	1600 1700 1780	1850 1950 —	1.1.1	1.1
2:1	നനന	844	444	400	6 Cl Cl	999	7.5	7.5 7.5 9.5	9.5 9.5	122	555	5일	111	1.1
1.5	111	111	111	111	111	111	111	111	111	111	111	111	111	1.1
888	100 109 118	844	858	200 218 218	243 258 280	290 300 315	335 345 365	388 412 450	475 488 515	545 560 615	615 650 670	710	111	1.1
65.1 69.8 76	96 88 96	104 110 112	120 128 144	160 174 176	192 208 224	232 240 256	272 280 296	310 336 355	365 388 412	438 450 475	488 515 515	530	111	1.1
2222	64 73	888	92 801	130	140 150 165	170 175 185	195 200 212	224 243 258	272 280 300	315 325 345	355 375 388	412	111	1.1
42	46 50 54	62 62 62	65 70 78	90	98 105 118	122 132 140	150 155 165	170 185 200	206 212 230	243 250 265	272 280 300	315	111	1.1
38 40	45 45	52 52	58 92	72 80 80	85 92 92	95 95 103	109	125 136 145	150 155 165	175 180 195	200 206 218	230 243	111	1.1
27	111	111	111	111	111	111	111	111	111	111	111	111	111	1.1
190 200 215	230 250 270	290 310 320	340 360 400	440 480 500	540 580 620	650 680 720	760 790 830	870 920 980	1030 1090 1150	1220 1280 1360	1420 1500 1580	1660	1.1.1	1.1
222	2 2.1 2.1	2.1	ω ω 4	440	വവവ	O O O	6 7.5	7.5 7.5 7.5	7.5 7.5 7.5	7.5 9.5 9.5	9.5 12 12	127	555	51 0 0
11111	1.5	2 2 2.1	ოოო	444	വവവ	O O O	999	6 7.5 7.5	7.5	7.5 9.5 9.5	9.5 12 12	122	111	1.1
668	8860	109	178 140 128	928	200 218 243	243 243 250	280 300	308 325 335	355 375 400	412 438 475	475 500 515	545 580 600	630 670 710	750
62 55	88 64	888	104	128 144 146	160 176 198	192 194 200	224 226 240	248 264 272	280 300 315	336 345 365	375 400 412	438 462 475	475 500 530	280
448	48 50 60	999	78 88 88	36 90 108	118 128 140	140 145	165 165 175	855	206 218 230	243 250 272	272 290 300	315 335 345	365 388 400	425
8833	38 40 46	25.57	99 69	74 82 82	855	106	122	136	160 170 175	195	212 224 230	243 258 265	280 290 308	325
	25 27 31													
	210 225 250													
	130 140 150													
21 22 24	26 28 30	32 34 36	38 40 44	48 52 56	64 68 68	72 76 80	88 92	96 /500 /530	/260 /600 /630	/670 /710 /750	0820	/1000/1060	/1120 /1180 /1250	/1320

Remarks

Table 7. 2 Boundary Dimensions of

Tapi Ro Bri	ller					329						32	0 X				330					3:	31		
					Diam	eter Se	ries 9							Diam	eter Se	eries 0					Di	iametei	Serie	s 1	
nber				Din	nensio	n Serie:	s 29		Cha Dime	mfer nsion		Dime	nsion S	Series	Dime	nsion S	Series	Cha Dime	mfer nsion		Dime	nsion S	Series	Cha Dime	mfer nsion
Bore Number	d			Ι			II		Cone				20			30	ı	Cone	Cup			31	I	Cone	Cup
Bor		D	В	С	T	В	С	Т	r (1	min.)	D	В	С	Т	В	С	Т	r (r	min.)	D	В	С	Т	r (1	min.)
00 01 02	10 12 15	_ _ _	=	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	28 32	 11 12	_ _ _	 11 12	13 14	_ _ _	13 14	0.3 0.3	0.3 0.3	_ _ _	=	_	_ _ _	_ _ _	_ _ _
03 04 /22	17 20 22	— 37 40	11 —	_ _ _	11.6 —	12 12	- 9 9	— 12 12	 0.3 0.3	0.3 0.3	35 42 44	13 15 15	12 11.5	13 15 15	15 17 —	_ _ _	15 17 —	0.3 0.6 0.6	0.3 0.6 0.6	_ _ _	=	_ _ _	_ _ _	_ _ _	_
05 /28 06	25 28 30	42 45 47	11 — 11	_ _ _	11.6 — 11.6	12 12 12	9 9 9	12 12 12	0.3 0.3 0.3	0.3 0.3 0.3	47 52 55	15 16 17	11.5 12 13	15 16 17	17 — 20	14 — 16	17 — 20	0.6 1 1	0.6 1 1	_ _ _	=	_ _ _	_ _ _	_ _ _	_ -
/32 07 08	32 35 40	52 55 62	 13 14	_ _ _	 14 15	15 14 15	10 11.5 12	14 14 15	0.6 0.6 0.6	0.6 0.6 0.6	58 62 68	17 18 19	13 14 14.5	17 18 19	 21 22	 17 18	21 22	1 1 1	1 1 1	_ _ 75	_ _ 26	_ _ _ 20.5	_ _ _ 26	_ _ 1.5	_ _ 1.5
09 10 11	45 50 55	68 72 80	14 14 16	_ _ _	15 15 17	15 15 17	12 12 14	15 15 17	0.6 0.6 1	0.6 0.6 1	75 80 90	20 20 23	15.5 15.5 17.5	20 20 23	24 24 27	19 19 21	24 24 27	1 1 1.5	1 1 1.5	80 85 95	26 26 30	20.5 20 23	26 26 30	1.5 1.5 1.5	1.5 1.5 1.5
12 13 14	60 65 70	85 90 100	16 16 19	_ _ _	17 17 20	17 17 20	14 14 16	17 17 20	1 1 1	1 1 1	95 100 110	23 23 25	17.5 17.5 19	23 23 25	27 27 31	21 21 25.5	27 27 31	1.5 1.5 1.5	1.5 1.5 1.5	100 110 120	30 34 37	23 26.5 29	30 34 37	1.5 1.5 2	1.5 1.5 1.5
15 16 17	75 80 85	105 110 120	19 19 22	_ _ _	20 20 23	20 20 23	16 16 18	20 20 23	1 1 1.5	1 1 1.5	115 125 130	25 29 29	19 22 22	25 29 29	31 36 36	25.5 29.5 29.5	31 36 36	1.5 1.5 1.5	1.5 1.5 1.5	125 130 140	37 37 41	29 29 32	37 37 41	2 2 2.5	1.5 1.5 2
18 19 20	90 95 100	125 130 140	22 22 24	_ _ _	23 23 25	23 23 25	18 18 20	23 23 25	1.5 1.5 1.5	1.5 1.5 1.5	140 145 150	32 32 32	24 24 24	32 32 32	39 39 39	32.5 32.5 32.5	39 39 39	2 2 2	1.5 1.5 1.5	150 160 165	45 49 52	35 38 40	45 49 52	2.5 2.5 2.5	2 2 2
21 22 24	105 110 120	145 150 165	24 24 27	_ _ _	25 25 29	25 25 29	20 20 23	25 25 29	1.5 1.5 1.5	1.5 1.5 1.5	160 170 180	35 38 38	26 29 29	35 38 38	43 47 48	34 37 38	43 47 48	2.5 2.5 2.5	2 2 2	175 180 200	56 56 62	44 43 48	56 56 62	2.5 2.5 2.5	2 2 2
26 28 30	130 140 150	180 190 210	30 30 36	_ _ _	32 32 38	32 32 38	25 25 30	32 32 38	2 2 2.5	1.5 1.5 2	200 210 225	45 45 48	34 34 36	45 45 48	55 56 59	43 44 46	55 56 59	2.5 2.5 3	2 2 2.5	_ _ _	=	=	_ _ _	_ _ _	_
32 34 36	160 170 180	220 230 250	36 36 42	_ _ _	38 38 45	38 38 45	30 30 34	38 38 45	2.5 2.5 2.5	2 2 2	240 260 280	51 57 64	38 43 48	51 57 64	_ _ _	_ _ _	_ _ _	3 3 3	2.5 2.5 2.5	_ _ _	=	_ _ _	_ _ _	_ _ _	_
38 40 44	190 200 220	260 280 300	42 48 48	_ _ _	45 51 51	45 51 51	34 39 39	45 51 51	2.5 3 3	2 2.5 2.5	290 310 340	64 70 76	48 53 57	64 70 76	_ _ _	_ _ _	_ _ _	3 3 4	2.5 2.5 3	_ _ _	=	_ _ _	_ _ _		_ _ _
48 52 56	240 260 280	320 360 380	48 — —	_ _ _	51 —	51 63.5 63.5	39 48 48	51 63.5 63.5	3 3 3	2.5 2.5 2.5	360 400 420	76 87 87	57 65 65	76 87 87	_ _ _	_ _ _	=	4 5 5	3 4 4	_ _ _	Ξ	_ _ _	_ _ _	_ _ _	=
60 64	300 320	420 440	_	_	_	76 76	57 57	76 76	4	3	460 480	100	74 74	100	_	_	_	5	4	_	_	_	_	_	_

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 the ISO.

2. Dimension Series not classified conform to dimensions (D, B, C, T) 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.

Tapered Roller Bearings

																								Units:	mm	
	31	02			322				332				303	3 or 30)3D			313				323			Tape Ro Bre	ller
				Di	amete	r Series	s 2										Diam	eter Se	eries 3							
	Di	imensi	ion	Di	imensi	on	Di	imensi	on	Cha	mfer nsion		Di	mensi	on Ser	ies	Di	mensi	on	Di	imensi	on	Cha	mfer		per
	S	ieries (12	S	eries 2	2	S	eries 3	2	Cone				C	3		S	eries 1	3	S	eries 2	23	Cone		d	Bore Number
D												D													-	ore
	В	С	T	В	С	T	В	С	Т	<i>r</i> (1	min.)	D	В	С	C (1)	Т	В	С	Т	В	С	T	r (1	min.)		<u> </u>
30 32 35	9 10 11	9 10	9.7 10.75 11.75	14 14 14	_ _ _	14.7 14.75 14.75	_ _ _		1 1 1	0.6 0.6 0.6	0.6 0.6 0.6	35 37 42	11 12 13	_ _ 11	 	11.9 12.9 14.25		_ _ _	_	17 17 17	_ _ 14	17.9 17.9 18.25	0.6 1 1	0.6 1 1	10 12 15	00 01 02
40 47 50	12 14 14	11 12 12	13.25 15.25 15.25	16 18 18	14 15 15	17.25 19.25 19.25	_ _ _	_ _ _	_ _ _	1 1 1	1 1 1	47 52 56	14 15 16	12 13 14	_ _ _	15.25 16.25 17.25	_ _ _	_ _ _	_	19 21 21	16 18 18	20.25 22.25 22.25	1 1.5 1.5	1 1.5 1.5	17 20 22	03 04 /22
52 58 62	15 16 16	13 14 14	16.25 17.25 17.25	18 19 20	15 16 17	19.25 20.25 21.25	22 24 25	18 19 19.5	22 24 25	1 1 1	1 1 1	62 68 72	17 18 19	15 15 16	13 14 14	18.25 19.75 20.75	=	 - -	_ _ _	24 24 27	20 20 23	25.25 25.75 28.75		1.5 1.5 1.5	25 28 30	05 /28 06
65 72 80	17 17 18	15 15 16	18.25 18.25 19.75	21 23 23	18 19 19	22.25 24.25 24.75	26 28 32	20.5 22 25	26 28 32	1 1.5 1.5	1 1.5 1.5	75 80 90	20 21 23	17 18 20	15 15 17	21.75 22.75 25.25	=	_ 	_	28 31 33	24 25 27	29.75 32.75 35.25	1.5 2 2	1.5 1.5 1.5	32 35 40	/32 07 08
85 90 100	19 20 21	16 17 18	20.75 21.75 22.75	23 23 25	19 19 21	24.75 24.75 26.75	32 32 35	25 24.5 27	32 32 35	1.5 1.5 2	1.5 1.5 1.5	100 110 120	25 27 29	22 23 25	18 19 21	27.25 29.25 31.5	_ _ _	_ _ _	_	36 40 43	30 33 35	38.25 42.25 45.5	2 2.5 2.5	1.5 2 2	45 50 55	09 10 11
110 120 125	22 23 24	19 20 21	23.75 24.75 26.25	28 31 31	24 27 27	29.75 32.75 33.25	38 41 41	29 32 32	38 41 41	2 2 2	1.5 1.5 1.5	130 140 150	31 33 35	26 28 30	22 23 25	33.5 36 38	_ _ _	_ _ _	_	46 48 51	37 39 42	48.5 51 54	3 3 3	2.5 2.5 2.5	60 65 70	12 13 14
130 140 150	25 26 28	22 22 24	27.25 28.25 30.5	31 33 36	27 28 30	33.25 35.25 38.5	41 46 49	31 35 37	41 46 49	2 2.5 2.5	1.5 2 2	160 170 180	37 39 41	31 33 34	26 27 28	40 42.5 44.5	_	_ _ _		55 58 60	45 48 49	58 61.5 63.5	3 3 4	2.5 2.5 3	75 80 85	15 16 17
160 170 180	30 32 34	26 27 29	32.5 34.5 37	40 43 46	34 37 39	42.5 45.5 49	55 58 63	42 44 48	55 58 63	2.5 3 3	2 2.5 2.5	190 200 215	43 45 47	36 38 39	30 32 —	46.5 49.5 51.5	_ 51	_ _ 35	_ _ 56.5	64 67 73	53 55 60	67.5 71.5 77.5	4 4 4	3 3 3	90 95 100	18 19 20
190 200 215	36 38 40	30 32 34	39 41 43.5	50 53 58	43 46 50	53 56 61.5	68 — —	52 —	68 —	3 3 3	2.5 2.5 2.5	225 240 260	49 50 55	41 42 46	_	53.5 54.5 59.5	53 57 62	36 38 42	58 63 68	77 80 86	63 65 69	81.5 84.5 90.5	4 4 4	3 3 3	105 110 120	21 22 24
230 250 270	40 42 45	34 36 38	43.75 45.75 49	64 68 73	54 58 60	67.75 71.75 77	_ _ _	_ _ _	_ _ _	4 4 4	3 3 3	280 300 320	58 62 65	49 53 55	_ _ _	63.75 67.75 72	66 70 75	44 47 50	72 77 82	93 102 108	78 85 90	98.75 107.75 114	5 5 5	4 4 4	130 140 150	26 28 30
290 310 320	48 52 52	40 43 43	52 57 57	80 86 86	67 71 71	84 91 91	_ _ _	_ _ _	_ _ _	4 5 5	3 4 4	340 360 380	68 72 75	58 62 64	_ _ _	75 80 83	79 84 88	_ _ _	87 92 97	114 120 126	95 100 106	121 127 134	5 5 5	4 4 4	160 170 180	32 34 36
340 360 400	55 58 65	46 48 54	60 64 72	92 98 108	75 82 90	97 104 114	_ _ _	_ _ _	_ _ _	5 5 5	4 4 4	400 420 460	78 80 88	65 67 73	_ _ _	86 89 97	92 97 106	_ _ _	101 107 117	132 138 145	109 115 122	140 146 154	6 6 6	5 5 5	190 200 220	38 40 44
440 480 500	72 80 80	60 67 67	79 89 89	120 130 130	100 106 106	127 137 137	_ _ _	_ _ _	_ _ _	5 6 6	4 5 5	500 540 580	95 102 108	80 85 90	_ _ _	105 113 119	114 123 132	_ _ _	125 135 145	155 165 175	132 136 145	165 176 187	6 6 6	5 6 6	240 260 280	48 52 56
540 580 —	85 92 —	71 75 —	96 104 —	140 150 —	115 125 —	149 159 —	_ _ _	_ _ _	- - -	6 6 —	5 5 —	_ _ _ _	_ _ _	=	_ _ _	_ _ _ _	_ _ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _ _	_ _ _	300 320 340 360	60 64 68 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 7. 3 Boundary Dimensions of

Thrust B	Ball Brgs.									511					512		522			
Spherica Roller	al Thrust Brgs.													292						
			Diam	neter Se	ries 0			Diam	neter Se	ries 1					Dian	neter Sei	ries 2			
per			Dime	ension S	Series			Dime	ension S	Series				[Dimensi	on Serie	S			
Bore Number	d	ъ.	70	90	10		D	71	91	11		D	72	92	12	22	2	2		
Bori		D		Т		$m{r}$ (min.)	D		Т		$m{r}$ (min.)	D			Т		Central	Washer	I (min.)	r_1 (min.)
				1					1						1		d_2	В		
4 6 8	4 6 8	12 16 18	4 5 5	_ _ _	6 7 7	0.3 0.3 0.3	=	_ _ _	_ _ _	_ _ _	=	16 20 22	6 6 6	_ _ _	8 9 9	_ _ _	_	_ _ _	0.3 0.3 0.3	_ _ _
00 01 02	10 12 15	20 22 26	5 5 5	_ _ _	7 7 7	0.3 0.3 0.3	24 26 28	6 6 6	_ _ _	9 9 9	0.3 0.3 0.3	26 28 32	7 7 8	_ _ _	11 11 12	_ 22	_ 10	_ _ 5	0.6 0.6 0.6	 0.3
03 04 05	17 20 25	28 32 37	5 6 6	_ _ _	7 8 8	0.3 0.3 0.3	30 35 42	6 7 8	_ _ _	9 10 11	0.3 0.3 0.6	35 40 47	8 9 10		12 14 15	26 28	15 20	- 6 7	0.6 0.6 0.6	 0.3 0.3
06 07 08	30 35 40	42 47 52	6 6 6	_ _ _	8 8 9	0.3 0.3 0.3	47 52 60	8 8 9	_ _ _	11 12 13	0.6 0.6 0.6	52 62 68	10 12 13		16 18 19	29 34 36	25 30 30	7 8 9	0.6 1 1	0.3 0.3 0.6
09 10 11	45 50 55	60 65 70	7 7 7	_ _ _	10 10 10	0.3 0.3 0.3	65 70 78	9 9 10	_ _ _	14 14 16	0.6 0.6 0.6	73 78 90	13 13 16	_ 21	20 22 25	37 39 45	35 40 45	9 9 10	1 1 1	0.6 0.6 0.6
12 13 14	60 65 70	75 80 85	7 7 7	_ _ _	10 10 10	0.3 0.3 0.3	85 90 95	11 11 11	_ _ _	17 18 18	1 1 1	95 100 105	16 16 16	21 21 21	26 27 27	46 47 47	50 55 55	10 10 10	1 1 1	0.6 0.6 1
15 16 17	75 80 85	90 95 100	7 7 7	_ _ _	10 10 10	0.3 0.3 0.3	100 105 110	11 11 11	_ _ _	19 19 19	1 1 1	110 115 125	16 16 18	21 21 24	27 28 31	47 48 55	60 65 70	10 10 12	1 1 1	1 1 1
18 20 22	90 100 110	105 120 130	7 9 9	_ _ _	10 14 14	0.3 0.6 0.6	120 135 145	14 16 16		22 25 25	1 1 1	135 150 160	20 23 23	27 30 30	35 38 38	62 67 67	75 85 95	14 15 15	1.1 1.1 1.1	1 1 1
24 26 28	120 130 140	140 150 160	9 9 9	_ _ _	14 14 14	0.6 0.6 0.6	155 170 180	16 18 18	21 24 24	25 30 31	1 1 1	170 190 200	23 27 27	30 36 36	39 45 46	68 80 81	100 110 120	15 18 18	1.1 1.5 1.5	1.1 1.1 1.1
30 32 34	150 160 170	170 180 190	9 9 9	_ _ _	14 14 14	0.6 0.6 0.6	190 200 215	18 18 20	24 24 27	31 31 34	1 1 1.1	215 225 240	29 29 32	39 39 42	50 51 55	89 90 97	130 140 150	20 20 21	1.5 1.5 1.5	1.1 1.1 1.1
36 38 40	180 190 200	200 215 225	9 11 11	_ _ _	14 17 17	0.6 1 1	225 240 250	20 23 23	27 30 30	34 37 37	1.1 1.1 1.1	250 270 280	32 36 36	42 48 48	56 62 62	98 109 109	150 160 170	21 24 24	1.5 2 2	2 2 2
44 48 52	220 240 260	250 270 290	14 14 14	_ _ _	22 22 22	1 1 1	270 300 320	23 27 27	30 36 36	37 45 45	1.1 1.5 1.5	300 340 360	36 45 45	48 60 60	63 78 79	110 —	190 —	24 —	2 2.1 2.1	2
56 60 64	280 300 320	310 340 360	14 18 18	 24 24	22 30 30	1 1 1	350 380 400	32 36 36	42 48 48	53 62 63	1.5 2 2	380 420 440	45 54 54	60 73 73	80 95 95	_ _ _	_ _ _	_ _ _	2.1 3 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 bearing tables for Thrust Bearings).

Thrust Bearings (Flat Seats) — 1 —

																					Un	its: mm	
				513		523							514		524							Thrus Bro	
			293									294										Spherica Roller	l Thrust Brgs.
				Diam	eter Se	ries 3							Diam	eter Se	ries 4				Diam	neter Se	ries 5		
			D)imensi	on Serie	es						D	imensi	on Serie	es					Dimensior Series			Je C
		73	93	13	23	2	3				74	94	14	24	2	4				95			Bore Number
	D			1		Central	Washer	$m{r}$ (min.)	$m{r}_1$ (min.)	D		1			Central	Washer	$m{r}$ (min.)	$m{r}_1$ (min.)	D		I (min.)	d	Bore
				T		d_2	В						Γ		d_2	В				Т			
-						u _L									u _L								
	20 24	7 8	_	11 12	_	_	_	0.6 0.6	_	_	_	_	_	_	_	_	_	_	_	=	_	4 6	6
	26	8	_	12	_	_	_	0.6	_	_	_	_	_	_	_	_	_	_	_	_	_	8	8
	30 32	9	_	14 14	_	_	_	0.6 0.6	_	_	_	_	_	_	_	_	_	_	_	_	_	10 12	00 01
	37	10	_	15	_	_	_	0.6	_	_	_	_	_	_	_	_	_	_	_	-	_	15	02
	40 47	10 12	_	16 18	_	-	_	0.6 1	_	=	=	_	_	=	_	=	_	_	52 60	21 24	1	17 20	03 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 68	14 15	_	21 24	38 44	25 30	9 10	1	0.3 0.3	70 80	18 20	24 27	28 32	52 59	20 25	12 14	1 1.1	0.6	85 100	34 39	1.1 1.1	30 35	06 07
	78	17	22	26	49	30	12	i	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
	95 105	20 23	27 30	31 35	58 64	40 45	14 15	1.1 1.1	0.6 0.6	110 120	27 29	36 39	43 48	78 87	40 45	18 20	1.5 1.5	0.6	135 150	51 58	2 2.1	50 55	10 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
	115 125	23 25	30 34	36 40	65 72	55 55	15 16	1.1 1.1	0.6 1	140 150	34 36	45 48	56 60	101 107	50 55	23 24	2 2	1	170 180	63 67	2.1 3	65 70	13 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
	140 150	27 29	36 39	44 49	79 87	65 70	18 19	1.5 1.5	1 1	170 180	41 42	54 58	68 72	120 128	65 65	27 29	2.1 2.1	1 1.1	200 215	73 78	3 4	80 85	16 17
	155	29	39	50	88	75	19	1.5	1	190	45	60	77	135	70	30	2.1	11	225	82	4	90	18
	170 190	32 36	42 48	55 63	97 110	85 95	21 24	1.5	1 1	210 230	50 54	67 73	85 95	150 166	80 90	33 37	3	1.1	250 270	90 95	4 5	100 110	20 22
	210 225 240	41 42 45	54 58 60	70 75 80	123 130 140	100 110 120	27 30 31	2.1 2.1 2.1	1.1 1.1 1.1	250 270 280	58 63 63	78 85 85	102 110 112	177 192 196	95 100 110	40 42 44	4 4 4	1.5 2 2	300 320 340	109 115 122	5 5 5	120 130 140	24 26 28
	250 270	45 50	60 67	80 87	140 153	130 140	31 33	2.1	1.1	300 320	67 73	90 95	120 130	209 226	120 130	46 50	5	2 2	360 380	125 132	6	150 160	30 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
	300 320	54 58	73 78	95 105	165 183	150 160	37 40	3	2	360 380	82 85	109 115	140 150	245 —	140	52 —	5	3	420 440	145 150	6	180 190	36 38
	340	63	85	110	192	170	42	4	2	400	90	122	155	_	-	_	5	_	460	155	7.5	200	40
	360 380	63 63	85 85	112 112	_	=	_	4 4	_	420 440	90 90	122 122	160 160	=	_	=	6	_	500 540	170 180	7.5 7.5	220 240	44 48
	420	73	95	130	-	-	-	5	-	480	100	132	175	-	-	_	6	_	580	190	9.5	260	52
	440 480	73 82	95 109	130 140	_	_	_	5 5	_	520 540	109 109	145 145	190 190	_	_	_	6	_	620 670	206 224	9.5 9.5	280 300	56 60
	500	82	109	140	_	_	_	5	_	580	118	155	205	_	_	_	7.5	_	710	236	9.5	320	64

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Table 7. 3 Boundary Dimensions of

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

- Remarks
 Dimension Series 22, 23, and 24 are double direction bearings.
 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).

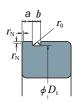
Thrust Bearings (Flat Seats) — 2 —

		ŭ	Ť		•															Un	its: mm	1
			513		523							514		524							Thrus Br	st Ball gs.
		293									294										Spheric	al Thrust Brgs.
			Diam	eter Se	ries 3							Diam	eter Se	ries 4				Diam	neter Se	ries 5		
		D	imensi	on Serie	es						0	imensi	on Serie	es					Dimension Series			Jer.
	73	93	13	23	2	3				74	94	14	24	2	4				95		d	Bore Number
D					Central	Washer	I (min.)	$m{r}_1$ (min.)	D					Central	Washer	I (min.)	$m{r}_1$ (min.)	D		$m{r}$ (min.)	_	Bore
			T		d_2	В						T		d_2	В				Т			
540	90	122	160	_	_	_	5	_	620	125	170	220	_	_	_	7.5	_	750	243	12	340	68
560 600	90 100	122	160 175	_	=	=	5	_	640 670	125 132	170 175	220 224	_	_	_	7.5 7.5	_	780 820	250 265	12	360 380	72 76
620	100	132	175				١,		710	140	185	243				7.5		850	272	12	400	80
650 680	100 103 109	140 145	180 190	_		=	6 6	_	730 780	140 140 155	185 185 206	243 243 265	=	_	=	7.5 7.5 9.5	=	900 950	290 308	15 15	420 440	84 88
							-										_					
710 730	112 112	150 150	195 195	_	_	_	6	_	800 850	155 165	206 224	265 290	_	_	_	9.5 9.5	_	980 1000	315 315	15 15	460 480	92 96
750	112	150	195	_	_	_	6	-	870	165	224	290	_	_	_	9.5	_	1060	335	15	500	/500
800 850	122 132	160 175	212 224	_	_	_	7.5 7.5	_	920 980	175 190	236 250	308 335	_	_	_	9.5 12	_	1090 1150	335 355	15 15	530 560	/530 /560
900	136	180	236	_	_	_	7.5	-	1030	195	258	335	_	_	_	12	_	1220	375	15	600	/600
950 1000	145 150	190 200	250 258	_	_	_	9.5 9.5	_	1090 1150	206 218	280 290	365 375	_	_	_	12 15	_	1280 1320	388 388	15 15	630 670	/630 /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 1250	170 180	230 243	300 315	_	_	=	9.5 12	_	1360 1440	250 —	335 354	438	_	_	_	15 15	_	_	=	_	800 850	/800 /850
1320	190	250	335	_	_	_	12	_	1520	_	372	_	_	_	_	15	_	_	_	_	900	/900
1400 1460	200	272 276	355	_	_	_	12 12	_	1600 1670	_	390 402	_	_	_	_	15 15	_	_	=	_	950 1000	/950 /1000
1540	_	288	_	_	_	_	15	_	1770	_	426	_	_	_	_	15	_	_	_	_	1060	/1060
1630 1710	_	306 318	_	_	_	_	15 15	_	1860 1950	_	444 462	_	_	_	_	15 19	_	_	=	_	1120 1180	/1120 /1180
1800		330					19		2050		480					19					1250	/1250
1900 1900 2000	_	348 360	_	_		=	19 19 19	_	2160 2280	Ξ	505 530	_		_	=	19 19 19	=	=	Ξ	_	1320 1400	/1320 /1400
									2200		330					'						
2140 2270	_	384 402	_	_	_	_	19 19	_	_	=	_	_	_	_	_	_	_	_	=	_	1500 1600	/1500 /1600
_	_	_	_	_	-	_	-	_	_	-	_	_	_	_	_	_	_	_	_	_	1700	/1700
_	_	_	_	_	=	_	_	_	_	=	_	_	_	_	_	_	_	_	_	_	1800 1900	/1800 /1900
_	_	_	_	_	_	-	-	_	_	-	_	_	_	_	_	_	_	_	-	-	2000	/2000
Ξ	=	_	_	_	_	=	_	_	_	=	_	_	_	_	_	_	_	=	=	_	2120 2240	/2120 /2240
_	_	_	_	_	_	_	_	_	_	=	_	_	_	_	_	_	_	Ξ	Ξ	=	2360 2500	/2360 /2500

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Table 7. 4 Dimensions of Snap Ring Grooves and Locating Snap Rings — (1) Bearings of Dimension Series 18 and 19

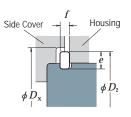


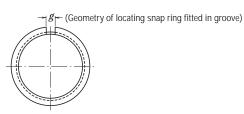
App	licable Bear	ings				Snap F	Ring Groove	!			
	d			ng Groove neter	Š	Snap Ring Gr	oove Positi	on	Snap Rin	g Groove dth	Radius of Bottom
		D				Bearing Dime	ension Serie	es			Corners
Dimensi	on Series		I	O_1		18	1	19	<u> </u>	b	I_0
18	19		max.	min.	max.	min.	max.	min.	max.	min.	max.
_	10 12 15	22 24 28	20.8 22.8 26.7	20.5 22.5 26.4	_		1.05 1.05 1.3	0.9 0.9 1.15	1.05 1.05 1.2	0.8 0.8 0.95	0.2 0.2 0.25
20 22	17 — —	30 32 34	28.7 30.7 32.7	28.4 30.4 32.4	1.3 1.3	 1.15 1.15	1.3 — —	1.15 — —	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
25 — 28	20 22 —	37 39 40	35.7 37.7 38.7	35.4 37.4 38.4	1.3 — 1.3	1.15 — 1.15	1.7 1.7 —	1.55 1.55 —	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
30 32 —	25 — 28	42 44 45	40.7 42.7 43.7	40.4 42.4 43.4	1.3 1.3 —	1.15 1.15 —	1.7 — 1.7	1.55 — 1.55	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
35 40 —	30 32 35	47 52 55	45.7 50.7 53.7	45.4 50.4 53.4	1.3 1.3 —	1.15 1.15 —	1.7 1.7 1.7	1.55 1.55 1.55	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
45 — 50	40 —	58 62 65	56.7 60.7 63.7	56.4 60.3 63.3	1.3 — 1.3	1.15 — 1.15	1.7 —	1.55 —	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
55 60	45 50 —	68 72 78	66.7 70.7 76.2	66.3 70.3 75.8	1.7 1.7	— 1.55 1.55	1.7 1.7 —	1.55 1.55 —	1.2 1.2 1.6	0.95 0.95 1.3	0.25 0.25 0.4
65 70	55 60 65	80 85 90	77.9 82.9 87.9	77.5 82.5 87.5	1.7 1.7	 1.55 1.55	2.1 2.1 2.1	1.9 1.9 1.9	1.6 1.6 1.6	1.3 1.3 1.3	0.4 0.4 0.4
75 80 —	70 75	95 100 105	92.9 97.9 102.6	92.5 97.5 102.1	1.7 1.7 —	1.55 1.55 —	2.5 2.5	2.3 2.3	1.6 1.6 1.6	1.3 1.3 1.3	0.4 0.4 0.4
85 90 95	80 — 85	110 115 120	107.6 112.6 117.6	107.1 112.1 117.1	2.1 2.1 2.1	1.9 1.9 1.9	2.5 — 3.3	2.3 — 3.1	1.6 1.6 1.6	1.3 1.3 1.3	0.4 0.4 0.4
100 105 110	90 95 100	125 130 140	122.6 127.6 137.6	122.1 127.1 137.1	2.1 2.1 2.5	1.9 1.9 2.3	3.3 3.3 3.3	3.1 3.1 3.1	1.6 1.6 2.2	1.3 1.3 1.9	0.4 0.4 0.6
120 130	105 110 120	145 150 165	142.6 147.6 161.8	142.1 147.1 161.3	2.5 3.3	2.3 3.1	3.3 3.3 3.7	3.1 3.1 3.5	2.2 2.2 2.2	1.9 1.9 1.9	0.6 0.6 0.6
140 — 150 160	130 140 —	175 180 190 200	171.8 176.8 186.8 196.8	171.3 176.3 186.3 196.3	3.3 — 3.3 3.3	3.1 3.1 3.1	3.7 3.7 —	3.5 3.5 —	2.2 2.2 2.2 2.2	1.9 1.9 1.9 1.9	0.6 0.6 0.6 0.6

Remarks The minimum permissible chamfer dimensions $r_{\rm N}$ on the snap-ring-groove side of the outer rings are as follows: Dimension series 18: For outside diameters of 78mm and less, use 0.3mm chamfer. For all others exceeding 78mm, use 0.5mm chamfer. Dimension series 19: For outside diameters of 24mm and less, use 0.2mm chamfer.

For 47mm and less, use 0.3mm 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).



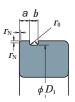


Units: mm

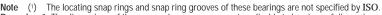
		Locati	ng Snap Rir	ng			Side Cover
Locating Snap Ring Number		Sectional eight $oldsymbol{e}$	Thic	kness	fitted	ry of snap ring I in groove eference) Snap Ring Outside Diameter D_2	Stepped Bore Diameter (Reference)
	max.	min.	max.	min.	approx.	max.	min.
NR 1022	2.0	1.85	0.7	0.6	2	24.8	25.5
NR 1024	2.0	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 7. 4 Dimensions of Snap Ring Grooves and Locating Snap Rings — (2) Bearing of Diameter Series 0, 2, 3, and 4



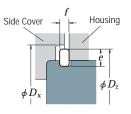
	Appli	cable Bea	rings					Snap Ri	ng Groove				
	(d				ng Groove meter		nap Ring Gr Bearing Dia	a			ig Groove dth	Radius of Bottom
	Diamete	er Series		D		D_1		0	2, 3		1 .	b	Corners r_0
0	2	3	4	-	max.	min.	max.	min.	max.	min.	max.	min.	max.
10 12	_	_	_	26 28	24.5 26.5	24.25 26.25	1.35 1.35	1.19 1.19	_	_	1.17 1.17	0.87 0.87	0.2 0.2
— 15 17	10 12 15	9 — 10	8 9 —	30 32 35	28.17 30.15 33.17	27.91 29.9 32.92	2.06 2.06	1.9 1.9	2.06 2.06 2.06	1.9 1.9 1.9	1.65 1.65 1.65	1.35 1.35 1.35	0.4 0.4 0.4
 20	17 —	12 — 15	10 — 12	37 40 42	34.77 38.1 39.75	34.52 37.85 39.5	 2.06	— — 1.9	2.06 2.06 2.06	1.9 1.9 1.9	1.65 1.65 1.65	1.35 1.35 1.35	0.4 0.4 0.4
22 25 —		17 —	_ _ _	44 47 50	41.75 44.6 47.6	41.5 44.35 47.35	2.06 2.06 —	1.9 1.9 —	2.46 2.46	2.31 2.31	1.65 1.65 1.65	1.35 1.35 1.35	0.4 0.4 0.4
28 30 —	25 —	20 — 22	15 —	52 55 56	49.73 52.6 53.6	49.48 52.35 53.35	2.06 2.08 —	1.9 1.88 —	2.46 — 2.46	2.31 — 2.31	1.65 1.65 1.65	1.35 1.35 1.35	0.4 0.4 0.4
32 35 —	28 30 32	 25 	17 —	58 62 65	55.6 59.61 62.6	55.35 59.11 62.1	2.08 2.08 —	1.88 1.88 —	2.46 3.28 3.28	2.31 3.07 3.07	1.65 2.2 2.2	1.35 1.9 1.9	0.4 0.6 0.6
40 — 45	35 —	28 30 32	20 —	68 72 75	64.82 68.81 71.83	64.31 68.3 71.32	2.49 — 2.49	2.29 — 2.29	3.28 3.28 3.28	3.07 3.07 3.07	2.2 2.2 2.2	1.9 1.9 1.9	0.6 0.6 0.6
50 — 55	40 45 50	35 — 40	25 — 30	80 85 90	76.81 81.81 86.79	76.3 81.31 86.28	2.49 — 2.87	2.29 — 2.67	3.28 3.28 3.28	3.07 3.07 3.07	2.2 2.2 3	1.9 1.9 2.7	0.6 0.6 0.6
60 65 70	55 60	45 50	35 40	95 100 110	91.82 96.8 106.81	91.31 96.29 106.3	2.87 2.87 2.87	2.67 2.67 2.67	3.28 3.28	3.07 3.07	3 3 3	2.7 2.7 2.7	0.6 0.6 0.6
75 — 80	65 70	55 —	45 —	115 120 125	111.81 115.21 120.22	111.3 114.71 119.71	2.87 — 2.87	2.67 — 2.67	4.06 4.06	3.86 3.86	3 3.4 3.4	2.7 3.1 3.1	0.6 0.6 0.6
85 90 95	75 80 —	60 65 —	50 55 —	130 140 145	125.22 135.23 140.23	124.71 134.72 139.73	2.87 3.71 3.71	2.67 3.45 3.45	4.06 4.9 —	3.86 4.65 —	3.4 3.4 3.4	3.1 3.1 3.1	0.6 0.6 0.6
100 105 110	85 90 95	70 75 80	60 65 —	150 160 170	145.24 155.22 163.65	144.73 154.71 163.14	3.71 3.71 3.71	3.45 3.45 3.45	4.9 4.9 5.69	4.65 4.65 5.44	3.4 3.4 3.8	3.1 3.1 3.5	0.6 0.6 0.6
120 — 130	100 105 110	85 90 95	70 75 80	180 190 200	173.66 183.64 193.65	173.15 183.13 193.14	3.71 — 5.69	3.45 — 5.44	5.69 5.69 5.69	5.44 5.44 5.44	3.8 3.8 3.8	3.5 3.5 3.5	0.6 0.6 0.6

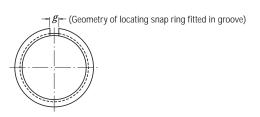


Note (1) The locating snap rings and snap ring grooves of these bearings are not specified by ISO.

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 0.5mm. However, for bearings of diameter series 0 having outside diameters 35mm and below, it is 0.3mm.





Units: mm

		Locat	ing Snap I	Ring			Side Cover
Locating Snap Ring Number		Sectional eight	Thic	kness	fitte	ry of snap ring d in groove eference) Snap Ring	Stepped Bore Diameter (Reference)
King Number		e		f	Width	Outside Diameter D_2	$D_{\rm X}$
	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		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 3 3	41.3	42
NR 40	3.25	3.1	1.12	1.02		44.6	45.5
NR 42	3.25	3.1	1.12	1.02		46.3	47
NR 44 NR 47 NR 50	3.25 4.04 4.04	3.1 3.89 3.89	1.12 1.12 1.12 1.12	1.02 1.02 1.02 1.02	3 4 4	48.3 52.7 55.7	49 53.5 56.5
NR 52	4.04	3.89	1.12	1.02	4 4 4	57.9	58.5
NR 55	4.04	3.89	1.12	1.02		60.7	61.5
NR 56	4.04	3.89	1.12	1.02		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

A 52 A 53 (Example 4) NU 3 18 M CM

(Example 5) NN 3 0 17 K CC1 P4

Radial Clearance for

Machined Brass Cage

Bearing Bore 90mm

Diameter Series 3

NU Type Cylindrical

Accuracy of ISO Class 4

Radial Clearance in Non-

Roller Bearing

Electric-Motor Bearings CM



7.2 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

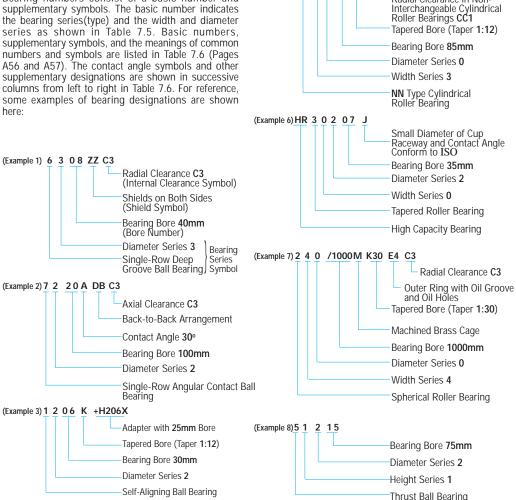


Table 7. 5 Bearing Series Symbols

			lable	7.5 Bear	ing Series Symbols				
			Dimensio	n Symbols				Dimension	n Symbols
Bearing Type	Bearing Series Symbols	Type Symbols	Width Symbols	Diameter Symbols	Bearing Type	Bearing Series Symbols	Type Symbols	Width Symbols or Height Symbols	Diameter Symbols
	68	6	(1)	8	Double-Row	NNU49	NNU	4	9
Single-Row	69	6	(1)	9	Cylindrical	NN30	NN	3	0
Deep Groove	60	6	(1)	0	Roller Bearings				
Ball Bearings	62	6	(0)	2		NA48	NA	4	8
	63	6	(0)	3	Needle Roller	NA49	NA	4	9
	79	7	(1)	9	Bearings	NA59	NA	5	9
Single-Row	70	7	(1)	0	J	NA69	NA	6	9
Angular Contact	72	7	(0)	2					
Ball Bearings	73	7	(0)	3		329	3	2	9
	40	4	(0)			320	3	2	0
Colf Alianina	12 13	1 1	(0)	2		330	3	3	0
Self-Aligning Ball Bearings	22	(1)	(0)	2		331	3	3	1
Dali Dealligs	23	(1)	2	3	Tapered Roller	302	3	0	2
					Bearings	322	3	2	2
	NU10	NU	1 (0)	0		332	3	3	2
	NU2	NU	(0)	2					
	NU22	NU	2	2		303	3	0	3
	NU3	NU	(0)	3		323	3	2	3
	NU23	NU	2	3		220	2	3	0
	NU4	NU	(0)	4		230 231	2	3	1
	NJ2	NJ	(0)	2	Spherical	222	2	2	2
	NJ22	NJ	2	2	Roller	222	2		
	NJ3	NJ	(0)	3	Bearings	232	2	3	2
	NJ23	NJ	2	3	Ŭ	213 (1)	2	0	3
Single-Row	NJ4	NJ	(0)	4		223	2	2	3
Cylindrical	NUP2	NUP	(0)	2					
Roller Bearings	NUP22	NUP	2	2		511	5	1	1
bearings	NUP3	NUP	(0)	3		512	5	1	2
	NUP23	NUP	2	3	Thrust Ball	513	5	1	3
	NUP4	NUP	(0)	4	Bearings with	514	5	1	4
	N10	N	1	0	Flat Seats	522	5	2	2
	N2	N	(0)	2		523	5	2	3
	N3	N	(0)	3		524	5	2	4
	N4	N	(0)	4					
	NF2	NF	(0)	2	Spherical	292	2	9	2
	NF3	NF	(0)	3	Thrust Roller	293	2	9	3
	NF4	NF	(0)	4	Bearings	294	2	9	4
Note (1) Res					13 hut customarily it is i	numbered 010			

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.

A 54 A 55



Table 7. 6 Formulation of

		Bas	ic Numbers	S									
	ing Series nbols (¹)	Bor	e Number		ntact Angle Symbol	Interr	nal Design Symbol	Ma	terial Symbol	Cag	e Symbol	Sea	nal Features Is, Shields Symbol
Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
68 69 60	Single- Row Deep Groove Ball Bearings	1 2 3	Bearing 1mm 2 3	C	ngular ontact Ball earings Standard Contact Angle	A	Internal Design Differs from Standard One Smaller Diameter	g	Case-Hardened Steel Used in Rings, Rolling Elements	М	Machined Brass Cage	Z ZS	Shield on One Side Only
70 72 73 :	Single-Row Angular Contact Ball Bearings Self-	9 00	9 10	A5	of 30° Standard Contact Angle of 25°		of Outer Ring Raceway, Contact Angle, and Outer Ring Width of Tapered Roller Bearings Conform to ISO 355	h	Stainless Steel Used in Rings, Rolling Elements	W	Pressed Steel Cage	ZZ ZZS	Shields on Both Sides
13 22 :	Aligning Ball Bearings	01 02 03	12 15 17	В	Standard Contact Angle of 40°					Т	Synthetic Resin Cage	DU	Contact Rubber Seal on One Side Only
NJ 2 N 3 NN 30	Roller Bearings	/22 /28 /32	22 28 32	С	Standard Contact Angle of 15°	C (F	or High Capacity) Bearings			V	Without	DDU	Contact Rubber Seals on
•	Needle Roller Bearings Tapered Roller	04(3) 05 06	20 25 30		Tapered Roller Bearings / Contact Angle Less than 17°	CA CD EA	Spherical Roller Bearings			V	Cage	V	Non- Contact Rubber Seal on One Side Only
323 : 230 222 223	Spherical Roller Bearings	88 92 96	440 460 480	C	Contact Angle about 20°	E E	Cylindrical Roller Bearings Spherical Thrust					VV	Non- Contact Rubber Seals on Both Sides
511 512 513	Thrust Ball Bearing with Flat Seats	/500 /530 /560	500 530 560 :		about 28°	-	Roller Bearings						
292 293 294	Thrust Spherical Roller Bearings	/2 360 /2 500											
HR(*) High Capacity Tapered Roller Bearings, and others													
	Symbols	and Nu	ımbers Conf	orm to	JIS(5)	NSK Symbol						NS	K Symbol
					Marked on Bea	rings					t Marked Bearings		
										UII	Dodrings		

- Notes
 (1) Bearing Series Symbols conform to Table 7.5.
 (2) For basic numbers of tapered roller bearings in ISO's new series, refer to Page B111.
 (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.

Bearing Numbers

Αι	ıxiliary Syn	nbols												
Symbo	bol ol for Design		ngement ymbol			Clearance Symbol load Symbol		rance Class Symbol	Sp	Special ecification		er or Sleeve Symbol	Grea	se Symbol
	f Rings	,								Symbol				
Symbol	Meaning	Symbol	Meaning	Symbol	Mea	aning (radial clearance)	Symbol	Meaning	Symbo	Meaning	Symbol	Meaning	Symbol	Meaning
K	Tapered Bore of Inner Ring (Taper 1:12)	DB	Back-to-Back Arrangement	C1 C2	l Brgs.	Clearance Less than C2 Clearance Less than CN	Omitted P6	ISO Normal	tre	earings eated for mensional abilization	+ K	Bearings with Outer Ring Spacers	AS2 ENS	SHELL ALVANIA GREASE S2 ENS GREASE
K30	Tapered Bore of	DF	Face-to- Face Arrangement	Omitted C3 C4	For All Radial	CN Clearance Clearance Greater than CN Clearance Greater		ISO Class 6X	X26	Working Temperature Lower than	+L	Bearings with Inner Ring Spacers		NS HI-LUBE
	Inner Ring (Taper 1:30)	DT	Tandem Arrangement	C5	-	than C3 Clearance Greater than C4	. P5	ISO Class 5	X28	150 °C Working Temperature	+KL	Bearings with Both Inner and Outer Ring	PS2	MULTEMP PS No. 2
E	Notch or Lubricating Groove in			CC1 CC2 CC	Clearance Less than CC2 Clearance Less than CC2 Normal Clearance		P4	ISO Class 4	X29	Lower than 200 °C Working Temperature	Н	Spacers Adapter Designation		
	Ring				-Intercical Rc	Clearance Greater	P2	ISO Class 2		Lower than 250 °C		Designation		
E4	Lubricating Groove in Outside			CCA	For Non- Cylindri	than CC Clearance Greater		MA(7) pered ler bearing		Spherical	НЈ	Withdrawal Sleeve Designation		
	Surface and Holes in Outer Ring			MC1 MC2	all I Brgs.	Clearance Less than MC2 Clearance Less than MC3		Class 4		Roller Bearings Dimensional Stabilizing		Collar Designation		
N	Snap Ring Groove in Outer Ring			MC3 MC4	For Extra-Sma Miniature Ball	Normal Clearance Clearance Greater	PN2	Class 2		Treatment Working Temperature Lower than 200°C				
NR	Snap Ring Groove with Snap Ring in Outer			MC5 MC6	Fc and M	Clearance Greater than MC4 Clearance Greater than MC5	PN3	Class 3						
	Ring			СМ	Clea Ball Mot	rance in Deep Groove Bearings for Electric ors	PN00							
				CT CM	Clea Roll Mot	rance in Cylindrical er Bearings for Electric ors								
				EL (F	Ball Be									
				L M H	Ligi Me	Extra light Preload Light Preload Medium Preload Heavy Preload								
S	tially the ame as JIS(5)		nme as IIS(5)	NSK S		Partially the)/ Same as JIS(*) N			NSK Syr	nbol, Pa	rtially the same	as JIS(5)
	-1 (5)					ple, Marked on Bearing	js					Not Marked	on Bear	rings

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



8. BEARING TOLERANCES

8.1 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 8.1.

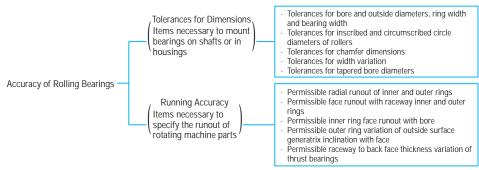


Table 8. 1 Bearing Types and Tolerance Classes

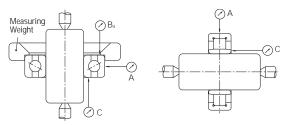
	Bearing	Types		Applica	able Tolerance (Classes		Applicable Tables	Reference Pages
- 1	Deep Groove B	all Bearings	Normal	Class 6	Class 5	Class 4	Class 2		
	Angular Contac	t Ball Bearings	Normal	Class 6	Class 5	Class 4	Class 2		
:	Self-Aligning Ba	all Bearings	Normal	Class 6 equivalent	Class 5 equivalent	_	_	Table	A60
	Cylindrical Roller Bearings		Normal	Class 6	Class 5	Class 4	Class 2	8.2	to A63
	Needle Roller Bearings (solid type)		Normal	Class 6	Class 5	Class 4	_		
:	Spherical Roller Bearings		Normal	Class 6	Class 5	_	_		
	Tapered Metri Desig		Normal Class 6X	_	Class 5	Class 4	_	Table 8.3	A64 to A67
	Roller Bearings	Inch Design	ANSI/ABMA CLASS 4	ANSI/ABMA CLASS 2	ANSI/ABMA CLASS 3	ANSI/ABMA CLASS 0	ANSI/ABMA CLASS 00	Table 8.4	A68 and A69
	Magneto Bearir	ngs	Normal	Class 6	Class 5	_	_	Table 8.5	A70 and A71
	Thrust Ball Bea	rings	Normal	Class 6	Class 5	Class 4	_	Table 8.4	A72 to A74
	Thrust Spherica	al Roller Bearings	Normal	_	_	_	_	Table 8.7	A75
S	JIS	(1)	Class 0	Class 6	Class 5	Class 4	Class 2	_	_
ndard	DIN	J(2)	P0	P6	P5	P4	P2	_	_
ent sta eferenc	DIN(DIN(ANSI/ ABMA(3)	Ball Bearings	ABEC 1	ABEC 3	ABEC 5 (CLASS 5P)	ABEC 7 (CLASS 7P)	ABEC 9 (CLASS 9P)	Table 8.2	A60 to A63
quival (Re		Roller Bearings	RBEC 1	RBEC 3	RBEC 5	_	_	Table 8.8	(A76 and A77)
ш		Tapered Roller Bearings	CLASS 4	CLASS 2	CLASS 3	CLASS 0	CLASS 00	[Table]	(A68 and A69)

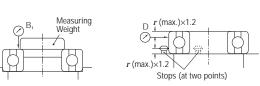
Notes (1) JIS: Japanese Industrial Standards (2) DIN: Deutsch Industrie Norm

(3) ANSI/ABMA: The American Bearing Manufacturers Association

Remarks The permissible limit of chamfer dimensions shall conform to Table 8.9 (Page A78), and the tolerances and permissible tapered bore diameters shall conform to Table 8.10 (Page A80).

(Reference) Rough definitions of the items listed for Running Accuracy and their measuring methods are shown in Fig. 8.1, 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 _{fa}	Rotating	Stationary	А
K_{ea}	Stationary	Rotating	А
S_{ia}	Rotating	Stationary	B ₁
S_{ea}	Stationary	Rotating	B ₂
S_d	Rotating	Stationary	С
S_D	_	Rotating	D
S_i , $S_{ m e}$	Only the shaft or central was rotated.	or housing her is to be	E

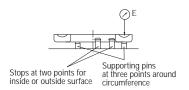


Fig. 8.1 Measuring Methods for Running Accuracy (summarized)

Symbols for Boundary Dimensions and Running Accuracy

Brg bore dia., nominal

Deviation of a single bore dia. Δ_{ds}

Single plane mean bore dia. deviation

Bore dia. Variation in a single radial plane

 $V_{d\mathrm{mp}}$ Mean bore dia. Variation

В Inner ring width, nominal

Deviation of a single inner ring width Δ_{Bs}

Inner ring width variation V_{Bs}

Radial runout of assembles brg inner ring K_{ia}

inner ring reference face (backface, where applicable) runout with bore

Assembled brg inner ring face (back face) runout with raceway

 S_h S_e Raceway to backface thickness variation of thrust brg

Brg width, nominal T

Deviation of the actual brg width

Brg outside dia., nominal

 Δ_{Ds} Deviation of a single outside dia.

Single plane mean outside dia. Deviation

Outside dia. Variation in a single radial V_{Dp}

Mean outside dia. Variation

COuter ring width, nominal

Deviation of a single outer ring width $\Delta c_{\rm s}$

Outer ring width variation

 K_{ea} Radial runout of assembled brg outer ring

Variation of brg outside surface generatrix inclination with outer ring reference face (backface)

Assembled brg outer ring face (backface) runout with raceway





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Table 8. 2 Tolerances for Radial Bearings Table 8. 2. 1 Tolerances for Inner Rings and

Nominal	Bore Diameter					Δ,	_{dmp} (2)						Δ	ds (2)	
	<i>d</i>										_		ass 4		_
1	(mm)	N	ormal	Cl	ass 6	C	lass 5	CI	lass 4		class 2		eries	С	lass 2
												0, 1,	2, 3, 4		
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low
0.6(1) 2.5	2.5 10	0	- 8 - 8	0	- 7 - 7	0	- 5 - 5	0	- 4 - 4	0	-2.5 -2.5	0	- 4 - 4	0	-2.5 -2.5
10	18	0	- 8	0	- 7 - 7	0	- 5 - 5	0	- 4	0	-2.5 -2.5	0	- 4	0	-2.5 -2.5
18	30	0	- 10	0	- 8	0	- 6	0	- 5	0	-2.5	0	- 5	0	-2.5
30 50	50 80	0	- 12 - 15	0	-10 -12	0	- 8 - 9	0	- 6 - 7	0	-2.5 -4	0	- 6 - 7	0	-2.5 -4
80	120	0	- 20	0	-15	0	-10	0	- 8	0	-5	0	- 8	0	-5
120 150	150 180	0	- 25 - 25	0	-18 -18	0	-13 -13	0	-10 -10	0	-7 -7	0	-10 -10	0	-7 -7
180	250	0	- 30	0	-22	0	-15	0	-12	0	-8	0	-12	0	-8
250 315	315 400	0	- 35 - 40	0	-25 -30	0	-18 -23	-	_	_	_	-	_	_	-
400	500	0	- 45	0	-35	-	-23	_	_	_	_	-	_	_	_
500	630	0	- 50	0	-40	-	-	-	-	-	-	-	-	-	-
630 800	800 1 000	0	- 75 -100	_	_	_	_	_	_	_	_	_	_	_	_
1 000	1 250	0	-125	_	_	_	_	_	_	_	_	_	_	_	_
1 250	1 600	0	-160	-	-	-	-	-	-	-	-	-	-	-	-
1 600	2 000	0	-200	-	_	-	_	-	_	-	-	-	_	-	

				Δ_{E}	$_{ m s_s}$ (or $arDelta$	Cs)(3)							V	Bs (or V	_{Cs})	
		Single	Bearing				Со	mbined	d Bearing:	s (4)		Inner Ri Outer Ri	ing (or ing) (³)		Inner Rin	ıg
	ormal class 6		ass 5 ass 4	Cl	ass 2		ormal ass 6		ass 5 ass 4	Cl	ass 2	Normal	Class 6	Class 5	Class 4	Clas
high	low	high	low	high	low	high	low	high	low	high	low	max.	max.	max.	max.	ma
0 0 0	- 40 - 120 - 120	0 0 0	- 40 - 40 - 80	0 0 0	- 40 - 40 - 80	_ 0 0	-250 -250	0 0 0	-250 -250 -250	0 0 0	-250 -250 -250	12 15 20	12 15 20	5 5 5	2.5 2.5 2.5	1.! 1.! 1.!
0 0 0	- 120 - 120 - 150	0 0 0	-120 -120 -150	0 0 0	-120 -120 -150	0 0 0	-250 -250 -380	0 0 0	-250 -250 -250	0 0 0	-250 -250 -250	20 20 25	20 20 25	5 5 6	2.5 3 4	1. 1. 1.
0 0 0 0	- 200 - 250 - 250 - 300	0 0 0 0	-200 -250 -250 -300	0 0 0	-200 -250 -250 -300	0 0 0	-380 -500 -500 -500	0 0 0 0	-380 -380 -380 -500	0 0 0 0	-380 -380 -380 -500	25 30 30 30	25 30 30 30	7 8 8 10	4 5 5 6	2. 2. 4 5
0 0 0	- 350 - 400 - 450	0 0 -	-350 -400 -	- - -	- - -	0 0 -	-500 -630 -	0 0 -	-500 -630 -	- - -	- - -	35 40 50	35 40 45	13 15 -	- - -	- - -
0 0 0	- 500 - 750 -1 000	_ _ _	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	60 70 80	50 - -	- - -	- - -	- - -
0 0	-1 250 -1 600 -2 000	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	100 120 140	- - -	_ _ _	_ _ _	- -

Notes (1) 0.6mm is included in the group.

- Applicable to bearings with cylindrical bores.
 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 8.2.2.
 Applicable to individual rings manufactured for combined bearings.
 Applicable to ball bearings such as deep groove ball bearings, angular contact ball bearings, etc.

(excluding Tapered Roller Bearings) Widths of Outer Rings

					V_{dp} (2)								V_{dr}	_{mp} (2)	
	Norma	l		Class 6	3	Cla	ss 5	Cla	ss 4	Class 2					
Dia	meter Se	eries	Dia	meter S	eries		neter ries	Diar Se	neter ries	Diameter Series	Normal	Class 6	Class 5	Class 4	Class 2
9	0, 1	2, 3, 4	9	0, 1	2, 3, 4	9			0,1,2,3,4	0,1,2,3,4		Ü		•	~
	max.			max.		m	ах.	max. max. max. max. max. max. max.		max.					
10 10 10	8 8 8	6 6 6	9 9 9	7 7 7	5 5 5	5 5 5	4 4 4	4 4 4	3 3 3	2.5 2.5 2.5	6 6 6	5 5 5	3 3 3	2 2 2	1.5 1.5 1.5
13 15 19	10 12 19	8 9 11	10 13 15	8 10 15	6 8 9	6 8 9	5 6 7	5 6 7	4 5 5	2.5 2.5 4	8 9 11	6 8 9	3 4 5	2.5 3 3.5	1.5 1.5 2
25 31 31 38	25 31 31 38	15 19 19 23	19 23 23 28	19 23 23 28	11 14 14 17	10 13 13 15	8 10 10 12	8 10 10 12	6 8 8 9	5 7 7 8	15 19 19 23	11 14 14 17	5 7 7 8	4 5 5 6	2.5 3.5 3.5 4
44 50 56	44 50 56	26 30 34	31 38 44	31 38 44	19 23 26	18 23 -	14 18 -	- - -	- - -	- - -	26 30 34	19 23 26	9 12 -	- - -	- - -
63	63	38	50	50	30	-	-	-	-	-	38	30	_	-	-
_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
_	_	-	-	_	-	-	_	-	-	_	-	_	_	_	_
-	-	-	_	_	_	_	-	-	-	_	-	_	_	_	_

Units : µm

		K ia				S_d			S _{fa} (5)		Nominal Bore I	Diameter
Norma	Class 6	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	d (mm)	
max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	over	incl.
10	5	4	2.5	1.5	7	3	1.5	7	3	1.5	0.6(¹)	2.5
10	6	4	2.5	1.5	7	3	1.5	7	3	1.5	2.5	10
10	7	4	2.5	1.5	7	3	1.5	7	3	1.5	10	18
13	8	4	3	2.5	8	4	1.5	8	4	2.5	18	30
15	10	5	4	2.5	8	4	1.5	8	4	2.5	30	50
20	10	5	4	2.5	8	5	1.5	8	5	2.5	50	80
25 30 30 40	13 18 18 20	6 8 8 10	5 6 6 8	2.5 2.5 5	9 10 10 11	5 6 6 7	2.5 2.5 4 5	9 10 10 13	5 7 7 8	2.5 2.5 5	80 120 150 180	120 150 180 250
50	25	13	-	-	13	-	-	15	-	-	250	315
60	30	15	-	-	15	-	-	20	-	-	315	400
65	35	-	-	-	–	-	-	–	-	-	400	500
70	40	-	-	-	-	-	-	_	-	-	500	630
80	-	-	-	-	-	-	-	_	-	-	630	800
90	-	-	-	-	-	-	-	_	-	-	800	1 000
100	-	-	-	-	-	-	-	_	_	-	1 000	1 250
120	-	-	-	-	-	-	-	_	_	-	1 250	1 600
140	-	-	-	-	-	-	-	_	_	-	1 600	2 000

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 8. 2 Tolerances for Radial Bearings

Table 8. 2. 2 Tolerances

Nominal O	utside					Δ	<i>D</i> mp						۷	Ds	
Diamet D (mm)	er	N	ormal	Cl	ass 6	Cl	ass 5	Cl	ass 4	С	lass 2	Dia S	ass 4 imeter eries 2, 3, 4	- Cl	lass 2
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low
2.5(¹) 6 18	6 18 30	0 0 0	- 8 - 8 - 9	0 0 0	- 7 - 7 - 8	0 0 0	- 5 - 5 - 6	0 0 0	- 4 - 4 - 5	0 0 0	- 2.5 - 2.5 - 4	0 0 0	- 4 - 4 - 5	0 0 0	- 2.5 - 2.5 - 4
30 50 80	50 80 120	0 0 0	- 11 - 13 - 15	0 0 0	- 9 -11 -13	0 0 0	- 7 - 9 -10	0 0 0	- 6 - 7 - 8	0 0 0	- 4 - 4 - 5	0 0 0	- 6 - 7 - 8	0 0 0	- 4 - 4 - 5
120 150 180	150 180 250	0 0 0	- 18 - 25 - 30	0 0 0	-15 -18 -20	0 0 0	-11 -13 -15	0 0 0	- 9 -10 -11	0 0 0	- 5 - 7 - 8	0 0 0	- 9 -10 -11	0 0 0	- 5 - 7 - 8
250 315 400	315 400 500	0 0 0	- 35 - 40 - 45	0 0 0	-25 -28 -33	0 0 0	-18 -20 -23	0 0 -	-13 -15 -	0 0 -	- 8 -10 -	0 0 -	-13 -15 -	0 0 -	- 8 -10 -
500 630 800	630 800 1 000	0 0 0	- 50 - 75 -100	0 0 0	-38 -45 -60	0 0 -	-28 -35 -	- - -	- - -	- - -	_ _ _	- - -	- - -	- - -	- - -
1 000 1 250 1 600 2 000	1 250 1 600 2 000 2 500	0 0 0 0	-125 -160 -200 -250	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - -	- - - -	- - - -	- - - -	- - - -	- - - -

Notes (1) 2.5mm 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 8.2.1.

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.

(excluding Tapered Roller Bearings) for Outer Rings

		{Dmp} (2)	V								2)	V{Dp} (
					Class 2	ss 4	Cla	ss 5	Cla		ss 6	Cla			nal	Norr	
Class	Class	Class	Class	Normal	Open Type	Туре	Open	Туре	Open	Shielded Sealed	е	pen Typ	0	Shielded Sealed	:	pen Type	C
2	4	5	6	INOFMAI	Diameter Series	neter ries	Dian Ser	neter ies	Dian Ser		r Serie	Diamete	[Series	Diameter	
					0,1,2,3,4	0,1,2,3,4	9	0,1,2,3,4	9	0,1,2,3,4	2, 3, 4	0, 1	9	2, 3, 4	2, 3, 4	0, 1	9
max.	max.	max.	max.	max.	max.	ax.	ma	ax.	ma		ax.	m			Κ.	ma	
1.5 1.5 2	2 2 2.5	3 3 3	5 5 6	6 6 7	2.5 2.5 4	3 3 4	4 4 5	4 4 5	5 5 6	9 9 10	5 5 6	7 7 8	9 9 10	10 10 12	6 6 7	8 8 9	10 10 12
2 2 2.5	3 3.5 4	4 5 5	7 8 10	8 10 11	4 4 5	5 5 6	6 7 8	5 7 8	7 9 10	13 16 20	7 8 10	9 11 16	11 14 16	16 20 26	8 10 11	11 13 19	14 16 19
2.5 3.5 4	5 5 6	6 7 8	11 14 15	14 19 23	5 7 8	7 8 8	9 10 11	8 10 11	11 13 15	25 30 -	11 14 15	19 23 25	19 23 25	30 38 -	14 19 23	23 31 38	23 31 38
4 5 –	7 8 -	9 10 12	19 21 25	26 30 34	8 10 -	10 11 -	13 15 -	14 15 17	18 20 23	- - -	19 21 25	31 35 41	31 35 41	- - -	26 30 34	44 50 56	44 50 56
- - -	- - -	14 18 -	29 34 45	38 55 75	- - -	- - -	- - -	21 26 -	28 35 -	- - -	29 34 45	48 56 75	48 56 75	- - -	38 55 75	63 94 125	63 94 125
_ _	_	-	<u>-</u>	- -	_ _	_	_	-	_	-	_	-	-	-	-	_ _	_
<u> </u>	_	-	_	_	_	_	_	_	_	_	_	_	_	-	_	_	_

Units :	μm
---------	----

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

A 62 A 63



Table 8. 3 Tolerances for Metric Design Tapered Roller Bearings

Table 8. 3. 1 Tolerances for Inner Ring Bore Diameter and Running Accuracy

	Nomina Diam				Δ	<i>d</i> mp				1 _{ds}		V	<i>d</i> p			V_{α}	<i>l</i> mp	
	(m)			ormal ss 6X		ass 6 ass 5	Cl	ass 4	Cla	ass 4	Normal Class 6X	Class 6	Class 5	Class 4	Normal Class 6X	Class 6	Class 5	Class 4
Ī	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	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 8. 3. 2 Tolerances for Outer Ring Outside Diameter and Running Accuracy

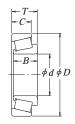
	l Outside neter			Δ	<i>D</i> mp				1 _{Ds}		V	<i>D</i> p			V_I	Omp	
_	D im)		ormal ass 6X		ass 6 ass 5	Cl	ass 4	Cl	ass 4	Normal Class 6X	Class 6	Class 5	Class 4	Normal Class 6X	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	high	low	high	low	max.	max.	max.	max.	max.	max.	max.	max.
18	30	0	- 9	0	- 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	-	-	-	-	-	-	-	-	_	-	_	

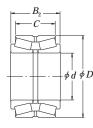
Remarks 1. The outside diameter "no-go side" tolerances (low) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.
 2. Some of these tolerances conform to the NSK Standard.

					Units : μ	ım
	K	ía		S	d	S ia
Normal	Class	Class	Class	Class	Class	Class
Class 6X	6	5	4	5	4	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	-	-

ı	Inits	٠	11	m	

		K	ea		S	D	S ea
	Normal	Class	Class	Class	Class	Class	Class
	Class 6X	6	5	4	5	4	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	-	-





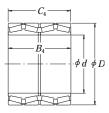


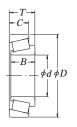


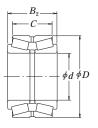
Table 8. 3 Tolerances for Metric Design Table 8. 3. 3 Tolerances for Width, Overall Bearing Width,

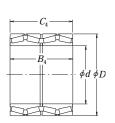
N	omina Diam	al Bore neter			Δ	1 _{Bs}					4	1 _{Cs}					Δ_T	's		
	(m)			ormal ass 6	Cla	ss 6X		ass 5 ass 4		ormal ass 6	Cla	ass 6X		lass 5 lass 4		rmal iss 6	Class	6X		iss 5 iss 4
	over	incl.	high	low	high	low	high	low	high	low	high	low	high	n low	high	low	high	low	high	low
	10 18 30	18 30 50	0 0 0	-120 -120 -120	0 0 0	-50 -50 -50	0 0 0	-200 -200 -240	0 0 0	-120 -120 -120	0 0 0	-100 -100 -100	0 0 0	-200 -200 -240	+200 +200 +200	0 0 0	+100 +100 +100	0 0 0	+200 +200 +200	-200 -200 -200
	50 80 120	80 120 180	0 0 0	-150 -200 -250	0 0 0	-50 -50 -50	0 0 0	-300 -400 -500	0 0 0	-150 -200 -250	0 0 0	-100 -100 -100	0 0 0	-300 -400 -500	+200 +200 +350	0 -200 -250	+100 +100 +150	0 0 0	+200 +200 +350	-200 -200 -250
	180 250 315	250 315 400	0 0 0	-300 -350 -400	0 0 0	-50 -50 -50	0 0 0	-600 -700 -800	0 0 0	-300 -350 -400	0 0 0	-100 -100 -100	0 0 0	-600 -700 -800	+350 +350 +400	-250 -250 -400	+150 +200 +200	0 0 0	+350 +350 +400	-250 -250 -400
	400 500 630	500 630 800	0 0 0	-450 -500 -750	- - -	- - -	0 0 0	-800 -800 -800	0 0 0	-450 -500 -750	- - -	- - -	0 0 0	-800 -800 -800	+400 +500 +600	-400 -500 -600	- - -	- - -	+400 +500 +600	-400 -500 -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.







Tapered Roller Bearings and Combined Bearing Width

 $\text{Units}: \mu m$

	R		with Roller	S	Outer Ri	٠,	ve Width D	eviation		Combined Bea		Deviation , $\Delta_{C4\mathrm{s}}$		nal Bore meter
	Nor	mal	Class	s 6X	Nor	mal	Class	s 6X	All classes row be			of four-row ings		d nm)
	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

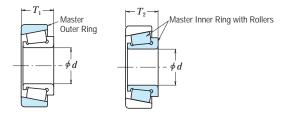




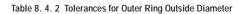
Table 8. 4 Tolerances for Inch Design Tapered Roller Bearings

(Refer to page A58 Table 8. 1 for the tolerance class "CLASS ** " that is the tolerance classes of ANSI/ABMA.)

Table 8. 4. 1 Tolerances for Inner Ring Bore Diameter

Units : $\mu \, m$

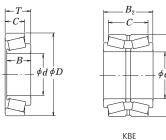
	Nominal Bo	1				Δ	ds		
over		incl.		CLAS	S 4, 2	CLAS	S 3, 0	CLAS	SS 00
(mm)	(mm) 1/25.4 (mm) 1/25.4				low	high	low	high	low
- 76.200 266.700	3.0000 10.5000	76.200 266.700 304.800	3.0000 10.5000 12.0000	+ 13 + 25 + 25	0 0 0	+13 +13 +13	0 0 0	+8 +8 -	0 0 -
304.800 609.600 914.400 1 219.200	12.0000 24.0000 36.0000 48.0000	609.600 914.400 1 219.200	24.0000 36.0000 48.0000	+ 51 + 76 +102 +127	0 0 0	+25 +38 +51 +76	0 0 0	- - - -	- - -

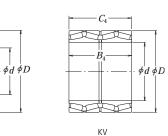


		side Diameter D				Δ	Ds		
over		incl.		CLAS	S 4, 2	CLASS 3, 0		CLASS 00	
(mm)	1/25.4	(mm)	1/25.4	high	low	high	low	high	low
266.700 304.800	10.5000 12.0000	266.700 304.800 609.600	10.5000 12.0000 24.0000	+ 25 + 25 + 51	0 0 0	+13 +13 +25	0 0 0	+8 +8 -	0 0 -
609.600 914.400 1 219.200	24.0000 36.0000 48.0000	914.400 1 219.200 -	36.0000 48.0000 –	+ 76 +102 +127	0 0 0	+38 +51 +76	0 0 0	- - -	- - -

Table 8. 4. 3 Tolerances for

	Nominal Bo	re Diameter d						Δ	Ts				
OV	over incl.			CL	ASS 4	CLA	SS 2		CLA			CLASS 0, 00	
								D≦508.0	000 (mm)	D > 508	.000 (mm)		
(mm)	1/25.4	(mm)	1/25.4	high	high low		low	high	low	high	low	high	low
_ 101.600	4.0000	101.600 304.800	4.0000 12.0000	+203 +356	0 -254	+203 +203	0	+203 +203	-203 -203	+203 +203	-203 -203	+203 +203	-203 -203
304.800 609.600	12.0000 24.0000	609.600	24.0000	+381 +381	-381 -381	+381	-381 -	+203 +381	-203 -381	+381 +381	-381 -381	- -	_ _





and Radial Runout of Inner and Outer Rings

 $\text{Units}: \mu m$

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

Overall Width and Combined Width

Un	IIS	÷	μ	n

			Dou		irings (KBE T B2s	ype)				Four-Row Bearing (KV Type) Δ_{B4s} , Δ_{C4s}		
CLA	CLASS 4 CLASS 2 CLASS 3 CLASS 0,00 (mm) D>508 000 (mm) CLASS 0,00											
	D≦508.000 (mm) D>508.000 (mm)										•	
high	low	high	low	high	low	high	low	high	low	high	low	
+406 +711	0 -508	+406 +406	0 -203	+406 +406	-406 -406	+406 +406	-406 -406	+406 +406	-406 -406	+1 524 +1 524	-1 524 -1 524	
+762 +762	-762 -762	+762 -	-762 -	+406 +762	-406 -762	+762 +762	-762 -762	- -	- -	+1 524 +1 524	-1 524 -1 524	

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Table 8. 5 Tolerances
Table 8. 5. 1 Tolerances for Inner Rings

Nomina Diam	neter		9 9						$V_{d\mathrm{p}}$			$V_{d\mathrm{mp}}$			Δ $_{Bs}$ (or Δ $_{Cs}$) (1)			
(m				ass 6	Cla	ass 5	Normal	Class 6	Class 5	Normal	Class 6	Class 5		rmal ss 6	Cla	ass 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

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 8. 5. 2 Tolerances

Diam	Nominal Outside Δ_{Dmp} Diameter D (mm) Normal Class 6 Class 5 Normal Class 6 Class 5 I														$V_{D\mathrm{p}}$	
		Norr	nal	Clas	s 6	Clas	ss 5	Nor	mal	Clas	s 6	Clas	Class 5		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.

for Magneto Bearings and Width of Outer Rings

							Un	its:μ m
${V}_{B\! m s}$ (or	V _{Cs}) (1)	Δ	Ts		K ia		S_d	S _{ia}
Normal Class 6	Class 5	Normal Class 5	Class 6	Normal	Class 6	Class 5	Class 5	Class 5
max.	max.	high	high low		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

for Outer Rings

	9-					Units : μ	ιm
	$V_{D{ m mp}}$			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 8. 6 Tolerances for Thrust Ball Bearings

Table 8. 6. 1 Tolerances for Shaft Washer Bore Diameter and Running Accuracy

Units: μm

Nominal Bore Diameter $oldsymbol{d}$ or $oldsymbol{d}_2$			Δ_{dmp} O	r ⊿ _{d2mp}		·	V_{d2p}		$S_{\it i}$ or	S _e (¹)	
(mm)		Nor Clas Clas		Cla	ss 4	Normal Class 6 Class 5	Class 4	Normal	Class 6	Class 5	Class 4
over ir	ncl.	high	low	high	low	max.	max.	max.	max.	max.	max.
-	18	0	- 8	0	- 7	6	5	10	5	3 3 3	2
18	30	0	- 10	0	- 8	8	6	10	5		2
30	50	0	- 12	0	-10	9	8	10	6		2
	80	0	- 15	0	-12	11	9	10	7	4	3
	120	0	- 20	0	-15	15	11	15	8	4	3
	180	0	- 25	0	-18	19	14	15	9	5	4
250	250	0	- 30	0	-22	23	17	20	10	5	4
	315	0	- 35	0	-25	26	19	25	13	7	5
	400	0	- 40	0	-30	30	23	30	15	7	5
500	500	0	- 45	0	-35	34	26	30	18	9	6
	630	0	- 50	0	-40	38	30	35	21	11	7
	800	0	- 75	0	-50	-	-	40	25	13	8
	000	0	-100	-	-	-	<u>-</u>	45	30	15	-
	250	0	-125	-	-	-	-	50	35	18	-

Note (1) For double-direction bearings, the thickness variation doesn't 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.



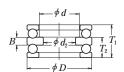
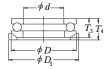


Table 8. 6. 2 Tolerances for Outside Diameter of Housing Washers and Aligning Seat Washers

 $\text{Units}: \mu \, m$

Nominal Outside Diame Bearing or Aligning Seat Washer			Flat Se		<i>D</i> mp	Alignii Wash	ng Seat er Type	V	<i>D</i> p	Outside Dev	eat Washer Diameter iation D3s
D or D_3 (mm)		Cla	rmal ss 6 ss 5	Cla	ss 4	No	rmal ss 6	Normal Class 6 Class 5	Class 4	No	rmal ss 6
over i	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
250	250	0	- 30	0	-20	0	- 45	23	15	0	- 90
	315	0	- 35	0	-25	0	- 53	26	19	0	-105
	400	0	- 40	0	-28	0	- 60	30	21	0	-120
500	500	0	- 45	0	-33	0	- 68	34	25	0	-135
	630	0	- 50	0	-38	0	- 75	38	29	0	-180
	800	0	- 75	0	-45	0	-113	55	34	0	-225
1 000 1	000	0	-100	-	-	-	-	75	-	-	-
	250	0	-125	-	-	-	-	-	-	-	-
	600	0	-160	-	-	-	-	-	-	-	-



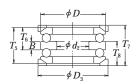




Table 8. 6. 3 Tolerances for Thrust Ball Bearing Height and Central Washer Height

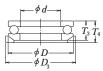
Units: um

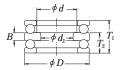
														011110 1 pc 111		
Nomina	al Bore		Flat Se	at Type		Aliç	gning Seat	Washer	Туре	Witl	n Aligning	Seat Wa	sher		Deviation	
	ameter $\Delta_{T_{S}}$ or $\Delta_{T_{2S}}$		or Δ $_{T2s}$	Δ	Tis	Δ_{T3s}	or Δ $_{T6s}$	Δ	T5s	Δ_{T4s} C	or $ extstyle \Delta extstyle T_{88}$	Δ	T7s		al Washer 1 _{Bs}	
d (mi			, Class 6 , Class 4		,		rmal ass 6		rmal ss 6	Noi Clas	rmal ss 6	Nor Clas	rmal ss 6		l, Class 6 , Class 4	
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low	
- 30 50	30 50 80	0 0 0	- 75 -100 -125	+ 50 + 75 +100	-150 -200 -250	0 0 0	- 75 -100 -125	+ 50 + 75 +100	-150 -200 -250	+ 50 + 50 + 75	- 75 -100 -125	+150 +175 +250	-150 -200 -250	0 0 0	- 50 - 75 -100	
80 120 180	120 180 250	0 0 0	-150 -175 -200	+125 +150 +175	-300 -350 -400	0 0 0	-150 -175 -200	+125 +150 +175	-300 -350 -400	+ 75 +100 +100	-150 -175 -200	+275 +350 +375	-300 -350 -400	0 0 0	-125 -150 -175	
250 315	315 400	0 0	-225 -300	+200 +250	-450 -600	0 0	-225 -300	+200 +250	-450 -600	+125 +150	-225 -275	+450 +550	-450 -550	0 0	-200 -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 Δ_{T_s} in the table is the deviation in the respective heights T in figures below.







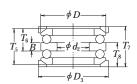


Table 8. 7 Tolerances for Thrust Spherical Roller Bearings

Table 8. 7. 1 Tolerances for Bore Diameters of Shaft Rings and Height (Class Normal)

Units: μm

Nomina						Reference	
Diam <i>C</i> (mi	ĺ	Δ,	<i>l</i> mp	<i>V</i> _{<i>d</i>p}	S_d	Δ	Ts
over	incl.	high	low	max.	max.	high	low
50 80 120	80 120 180	0 0 0	-15 -20 -25	11 15 19	25 25 30	+150 +200 +250	-150 -200 -250
180 250 315	250 315 400	0 0 0	-30 -35 -40	23 26 30	30 35 40	+300 +350 +400	-300 -350 -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 8. 7. 2 Tolerances for Housing Ring Diameter (Class Normal)

Jnits : μm

		UI	ιιι3 . μ ΙΙΙ
1	side Diameter D m)	Δ	<i>D</i> mp
over	incl.	high	low
120 180 250	180 250 315	0 0 0	- 25 - 30 - 35
315 400 500	400 500 630	0 0 0	- 40 - 45 - 50
630 800	800 1 000	0	- 75 -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 \boldsymbol{r} (max.) from the ring face.

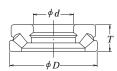




Table 8. 8 Tolerances of

CLASS 5P, CLASS 7P, and CLASS 9P

(1) Tolerances for Inner Rings

	Nominal Bore Diameter d (mm)			Δ,	/mp			Δ	ds		V	dp	V_a	/mp	4	1 _{Bs}
			CLASS 5P CLASS 7P		CLASS 9P		CLAS CLAS		CLAS	SS 9P	CLASS 5P CLASS 7P	CLASS 9P	CLASS 5P CLASS 7P	CLASS 9P	CLA CLA	le Brgs ASS 5P ASS 7P ASS 9P
Ī	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 (!) 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

Nominal		Δ	Omp		Δ $_{Ds}$							$V_{D\mathbf{p}}$		$V_{D{ m mp}}$		
Outside Diameter D	CLA	CLASS 5P CLASS 7P					SS 5P SS 7P		CLA	SS 9P	CLASS 5P CLASS 7P		CLASS 9P		SS 5P SS 7P	CLASS 9P
(mm)				CLASS 9P		Open Shielded Sealed		Ol	pen	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 (i) Applicable to flange width variation for flanged bearings.
(2) Applicable to flange back face.

Instrument Ball Bearings (Inch design)

(ANSI/ABMA Equivalent)

and Width of Outer Rings

Units : $\mu\,m$

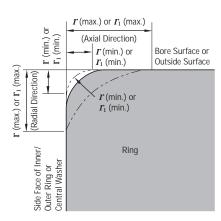
	(or Δ_{C_S})			V_{Bs}			K ia			S ia		S_d		
1	CL/	ASS 5P ASS 7P ASS 9P	CLASS 5P	CLASS 7P	CLASS 9P									
h	igh	low	max.											
	0	-400	5.1	2.5	1.3	3.8	2.5	1.3	7.6	2.5	1.3	7.6	2.5	1.3
	0	-400	5.1	2.5	1.3	3.8	2.5	1.3	7.6	2.5	1.3	7.6	2.5	1.3
	0	-400	5.1	2.5	1.3	3.8	3.8	2.5	7.6	3.8	1.3	7.6	3.8	1.3

Outer Rings

Units : $\mu\,m$

V Cs (1)			S_D			K _{ea}				S_{ea}		Deviation of Flange Outside		Deviation of Flange Width		Flange Backface Runout
CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS		meter D 1s		C 1s	with Raceway (2) Sea1
5P	7P	9P	5P	7P	9P	5P	7P	9P	5P	7P	9P	CLASS 5P CLASS 7P			CLASS 5P CLAS CLASS 7P CLAS	
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





- 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.

Table 8. 9 Chamfer Dimension Limits (for Metric Design Bearings)

Table 8. 9. 1 Chamfer Dimension Limits for Radial Bearings (excluding Tapered Roller Bearings) Units : mm

Permissible			Permissibl	o Chamfor	Reference
Chamfer Dimension for Inner/ Outer Rings r (min.) or	Nomina Dian		Dimens Inner/Ou r (max.) o	sion for ter Rings r $m{r}_1$ (max.)	Corner Radius of Shaft or Housing r a
$m{r}_1$ (min.)	over	incl.	Radial Direction	Axial Direction	max.
0.05	-	-	0.1	0.2	0.05
0.08 0.1	-	-	0.16 0.2	0.3 0.4	0.08 0.1
		_			
0.15 0.2	-	-	0.3 0.5	0.6 0.8	0.15 0.2
0.3	- 40	40 -	0.6 0.8	1 1	0.3
0.6	- 40	40 -	1 1.3	2 2	0.6
1	- 50	50 -	1.5 1.9	3 3	1
1.1	- 120	120 -	2 2.5	3.5 4	1
1.5	- 120	120 -	2.3 3	4 5	1.5
2	- 80 220	80 220 –	3 3.5 3.8	4.5 5 6	2
2.1	- 280	280 –	4 4.5	6.5 7	2
2.5	- 100 280	100 280 –	3.8 4.5 5	6 6 7	2
3	- 280	280 -	5 5.5	8 8	2.5
4 5	- -	- -	6.5 8	9 10	3 4
6 7.5 9.5	- - -	- - -	10 12.5 15	13 17 19	5 6 8
12 15 19	- - -	- - -	18 21 25	24 30 38	10 12 15

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

Table 8. 9. 2 Chamfer Dimension Limits for **Tapered Roller Bearings**

Units : mm

Permissible	Nominal Outside		Dormiccih	le Chamfer	Reference
Chamfer Dimension for Inner/ Outer Rings	Nominal Diame		Dimensior Outer	n for Inner/ Rings nax.)	Corner Radius of Shaft or Housing r_a
$m{r}$ (min.)	over	incl.	Radial Direction	Axial Direction	max.
0.15	-	-	0.3	0.6	0.15
0.3	- 40	40 -	0.7 0.9	1.4 1.6	0.3
0.6	- 40	40 -	1.1 1.3	1.7 2	0.6
1	- 50	50 -	1.6 1.9	2.5 3	1
1.5	- 120 250	120 250 –	2.3 2.8 3.5	3 3.5 4	1.5
2	- 120 250	120 250 –	2.8 3.5 4	4 4.5 5	2
2.5	- 120 250	120 250 –	3.5 4 4.5	5 5.5 6	2
3	- 120 250 400	120 250 400 –	4 4.5 5 5.5	5.5 6.5 7 7.5	2.5
4	- 120 250 400	120 250 400 –	5 5.5 6 6.5	7 7.5 8 8.5	3
5	- 180	180 –	6.5 7.5	8 9	4
6	- 180	180	7.5 9	10 11	5
Note	(1) Inne	r Rings a	re classified	i by <i>d</i> and (Juter Rings

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

Table 8. 9. 3 Chamfer Dimension Limits for Thrust Bearings

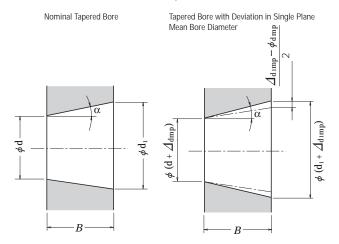
Units: mm

Dannaianible Observice	Permissible Chamfer	Reference			
Permissible Chamfer Dimension for Shaft (or Central)/Housing Washers *\mathcal{\varPsi}(\text{min.})\text{ or } \mathcal{\varPsi}_1 \text{ (min.})	Dimension for Shaft (or Central)/Housing Washers r (max.) or r 1 (max.)	Corner Radius of Shaft or Housing $oldsymbol{r_a}$			
2 () 5: 21 ()	Radial or 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			

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Table 8.10 Tolerances for Tapered Bores (Class Normal)



d: Nominal Bore Diameter

 d_1 : Theoretical Diameter of Larger End of Tapered Bore

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

 Δ_{dmp} : Single Plane Mean Bore Diameter Deviation in Theoretical Diameter of Smaller End of Bore Δ_{dmp} : Single Plane Mean Bore Diameter Deviation in Theoretical Diameter of Larger End of Bore

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

 \vec{B} : Nominal Inner Ring width

 α : Half of Taper Angle of Tapered Bore

Taper 1:12

Units : $\mu\,m$

Nominal Boo	1	Δα	l mp	△ _{d1mp} -	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	1 250 1 600	+165 +195	0	+105 +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

70

(re Diameter d m)	Δ,	<i>l</i> mp	Δ_{dimp} -	V _{dp} (1) (2)	
over	incl.	high	low	high	low	max.
80 120 180	120 180 250	+20 +25 +30	0 0 0	+35 +40 +46	0 0 0	22 40 46
250 315 400	315 400 500	+35 +40 +45	0 0 0	+52 +57 +63	0 0 0	52 57 63

+70

Notes (1) Applicable to all radial planes of tapered bores.

+50

630

(2) Not applicable to diameter series 7 and 8.

Remarks For a value exceeding 630 mm, please contact NSK.

8.2 Selection of Accuracy Classes

500

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 8.11, examples of applications and appropriate tolerance classes are listed for various bearing requirements and operating conditions.

Table 8. 11 Typical Tolerance Classes for Specific Applications (Reference)

Bearing Requirement, Operating Conditions	Examples of Applications	Tolerance Classes
	VTR Drum Spindles	P5
	Magnetic Disk Spindles for Computers	P5, P4, P2
	Machine-Tool Main Spindles	P5, P4, P2
High running accuracy	Rotary Printing Presses	P5
is required	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
	Dental Drills	CLASS 7P, CLASS 5P
	Gyroscopes	CLASS 7P, P4
Extra high speed is	High Frequency Spindles	CLASS 7P, P4
required	Superchargers	P5, P4
	Centrifugal Separators	P5, P4
	Main Shafts of Jet Engines	Higher than P4
Low torque and low	Gyroscope Gimbals	CLASS 7P, P4
torque variation are	Servomechanisms	CLASS 7P, CLASS 5P
required	Potentiometric Controllers	CLASS 7P

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9. FITS AND INTERNAL CLEARANCES

9.1 Fits

9.1.1 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.

9.1.2 Selection of Fit

(1) Load Conditions and Fit

The proper fit may be selected from Table 9.1 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:

$$\Delta d_{\rm F} = 0.08 \sqrt{\frac{d}{B} F_{\rm r}} \times 10^{-3} \dots (N)$$

$$\Delta d_{\rm F} = 0.25 \sqrt{\frac{d}{B} F_{\rm r}} \times 10^{-3} \dots {\rm \{kgf\}}$$
... (9.1)

where $\Delta d_{\rm F}$: Interference decrease of inner ring (mm)

d: Bearing bore diameter (mm)

B: Nominal inner ring width (mm)

 $F_{\rm r}$: Radial load applied on bearing

(N), {kgf}

Table 9.1 Loading Conditions and Fits

Load Application	Bearing (Operation	Load	Fitt	ing
Load Application	Inner Ring	Outer Ring	Conditions	Inner Ring	Outer Ring
TO T	Rotating	Stationary	Rotating Inner Ring Load		
Load Rotating O O O O O O O O O O O O O	Stationary	Rotating	Stationary Outer Ring Load	Tight Fit	Loose Fit
Load Stationary	Stationary	Rotating	Rotating Outer Ring Load	Loose Fit	Tight Fit
[Coad Rotating Coad Rotating	Rotating	Stationary	- Stationary Inner Ring Load		
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 Δd should be larger than the interference given by Equation (9.1). However, in the case of heavy loads where the radial load exceeds 20% of the basic static load rating $C_{\rm or}$, under the operating condition, interference often becomes shortage. Therefore, interference should be estimated using Equation (9.2):

where Δd : Effective interference (mm)

 $F_{\rm r}$: Radial load applied on bearing (N), {kgf}

B: Nominal inner ring width (mm)

(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 ΔT (°C), then the temperature difference between the fitted surfaces of the shaft and inner ring is estimated to be about (0.1~0.15) ΔT in case that the shaft is cooled. The decrease in the interference of the inner ring due to this temperature difference $\Delta d_{\rm T}$ may be calculated using Equation (9.3):

$$\Delta d_{\rm T} = (0.10 \text{ to } 0.15) \times \Delta T \cdot \alpha \cdot d$$

= 0.0015 \Delta T \cdot d \times 10^{-3}(9.3)

where Δd_T : Decrease in interference of inner ring due to temperature difference (mm)

△ T: Temperature difference between bearing interior and surrounding parts (°C)

 α : Coefficient of linear expansion of bearing steel=12.5×10⁻⁶ (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 ground shafts
$$\Delta d = \frac{d}{d+2} \Delta d_a \dots (9.4)$$

For machined shafts
$$\Delta d = \frac{d}{d+3} \Delta d_a$$
(9.5)

where Δd : Effective interference (mm)

 Δd_a : Apparent interference (mm)

d: Bearing nominal bore diameter (mm)

According to Equations (9.4) and (9.5), 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 Section 15.2, Fitting(1) (Pages A130 and A131).

9.1.3 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 9.2 to 9.7. 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 11.1 (Page A100).



Table 9.2 Fits of Radial Bearings with Shafts

			S	haft Diameter (mm	n)		
Load	Conditions	Examples	Ball Brgs	Ball Brgs Cylindrical Roller Brgs, Tapered Roller Brgs Brgs		Tolerance of Shaft	Remarks
			Radial Bearings	with Cylindrical Bo	res		
Rotating Outer	Easy axial displacement of inner ring on shaft desirable.	Wheels on Stationary Axles	ionary				Use g5 and h5 where accuracy is required. In case of large
Ring Load	Easy axial displacement of inner ring on shaft unnecessary	Tension Pulleys Rope Sheaves		All Shart Diameters	'	h6	bearings, f6 can be used to allow easy axial movement.
	Light Loads	Electrical Home	<18	_		js5	
	or Variable	Appliances Pumps, Blowers, Transport	18 to 100	<40	_	js6(j6)	
	Loads $(<0.06C_r(^1))$	Vehicles, Precision Machinery,	100 to 200	40 to 140	_	k6	
	(< 0.00C _r ())	Machine Tools	_	140 to 200	_	m6	
	Normal Loads (0.06 to 0.13 $C_{\rm r}(^{\rm l})$)		<18	_	_	js5 or js6 (j5 or j6)	
		General Bearing Applications, Medium and Large Motors(³), Turbines, Pumps, Engine Main Bearings, Gears, Woodworking Machines	18 to 100	<40	<40	k5 or k6	k6 and m6 can be
Rotating Inner			100 to 140	40 to 100	40 to 65	m5 or m6	used for single-row tapered roller
Ring Load or Direction of			140 to 200	100 to 140	65 to 100	m6	bearings and single-
Load			200 to 280	140 to 200	100 to 140	n6	row angular contact ball bearings
Indeterminate			_	200 to 400	140 to 280	p6	instead of k5 and
			_	_	280 to 500	r6	m5.
			_	_	over 500	r7	
		Railway Axleboxes,	_	50 to 140	50 to 100	n6	Mara than CNI
	Heavy Loads or Shock Loads	Industrial Vehicles, Traction Motors,	_	140 to 200	100 to 140	p6	More than CN bearing internal
	$(>0.13C_{\rm r}(^1))$	Construction Equipment,	_	over 200	140 to 200	r6	clearance is necessary.
		Crushers	_	_	200 to 500	r7	necessary.
Axial	Loads Only			All Shaft Diameters		js6 (j6)	_
		Rad	ial Bearings with	Tapered Bores and	Sleeves		
All Tyrn	es 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
ліі Турі	55 or Evaling	Transmission Shafts, Woodworking Spindles		All Shart Diameters	1	h10/IT7(2)	cylindricity should be within the tolerances of IT5 and IT7 respectively.

 Notes (1) C_r represents the basic load rating of the bearing.
 (2) Refer to Appendix Table 11 on page C22 for the values of standard tolerance grades IT.
 (3) Refer to Tables 9.13.1 and 9.13.2 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 9.3 Fits of Thrust Bearings with Shafts

Load	Conditions	Examples	Shaft Diameter (mm)	Tolerance of Shaft	Remarks
Central A	ixial Load Only	Main Shafts of Lathes	All Shaft Diameters	h6 or js6 (j6)	
Combined	Stationary Inner Ring Load	Cone Crushers	All Shaft Diameters	js6 (j6)	
Radial and Axial Loads	Rotating Inner Ring	Paper Pulp	<200	k6	_
(Spherical Thrust Roller	Load or Direction of Load	Refiners, Plastic	200 to 400	m6	
Bearings)	Indeterminate	Extruders	over 400	n6	

Table 9.4 Fits of Radial Bearings with Housings

	Load Co	nditions	Examples	Tolerances for Housing Bores	Axial Displacement of Outer Ring	Remarks	
		Heavy Loads on Bearing in Thin-Walled Housing or Heavy Shock Loads	Automotive Wheel Hubs (Roller Bearings) Crane Travelling Wheels	P7			
	Rotating Outer Ring	Normal or Heavy Loads	Normal or Heavy Automotive Wheel Hubs		- Impossiblo		
Solid Housings	Load	Light or Variable Loads	Conveyor Rollers Rope Sheaves Tension Pulleys	M7	Impossible	_	
		Heavy Shock Loads	Traction Motors				
	Direction of Load	Normal or Heavy Loads	Pumps Crankshaft Main Bearings	heel Hubs pig Wheels heel Hubs P7 Impossible P7 Impossible P7 Impossible P8 Impossible P8 Impossible P8 Impossible P8 Impossible P9 Impossible Impossible P9 Impossible P9 Impossible Impossibl	If axial displacement of the outer ring is not required.		
	macterninate	Normal or Light Loads	Medium and Large Motors(1)	Main K7 Generally the oute required the oute required the outer sequired the outer sequired the outer right of the outer required the outer right of the outer right	Axial displacement of outer ring is necessary.		
Solid or Split		Loads of All kinds	General Bearing Applications, Railway Axleboxes	Н7			
Housings		Normal or Light Loads	Plummer Blocks	Н8		_	
	Rotating Inner Ring Load	High Temperature Rise of Inner Ring Through Shaft	Paper Dryers	G7			
	Luau	Accurate Running Desirable under	Grinding Spindle Rear Ball Bearings High Speed Centrifugal Compessor Free Bearings	Mheels P7 all Hubs N7 as Impossible K7 Generally Impossible K7 Generally Impossible La Signature	_		
Solid Housing	Direction of Load Indeterminate	Normal or Light Loads	Grinding Spindle Front Ball Bearings High Speed Centrifugal Compressor Fixed Bearings	K6		For heavy loads, interference fit tighter than K is used. When high accuracy is	
	Rotating	Accurate Running and High Rigidity Desirable under Variable Loads	Cylindrical Roller Bearings for Machine Tool Main Spindle	M6 or N6	Impossible	required, very strict tolerances should be used for fitting.	
	Inner Ring Load	Minimum noise is required.	Electrical Home Appliances	Н6		_	
Note	(1) Refer to	Tables 9 13 1 and 9 1	3.2 for the recomme	nded fits of housing	hores of deep o	rroove hall bearings and	

Note (1) Refer to Tables 9.13.1 and 9.13.2 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 9.5 Fits of Thrust Bearings with Housings

	Load Conditions	Bearing Types	Tolerances for Housing Bores	Remarks
		Thrust Ball	Clearance over 0.25mm	For General Applications
		Bearings	H8	When precision is required
	Axial Loads Only	Spherical Thrust Roller Bearings Steep Angle Tapered Roller Bearings	Outer ring has radial clearance.	When radial loads are sustained by other bearings.
Combined Radial	Stationary Outer Ring Loads	Spherical Thrust	H7 or JS7 (J7)	_
and Axial	Rotating Outer Ring Loads or	Roller Bearings	K7	Normal Loads
Loads	Direction of Load Indeterminate		M7	Relatively Heavy Radial Loads

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Table 9.6 Fits of Inch Design Tapered Roller Bearings with Shafts

(1) Bearings of Precision Classes 4 and 2

Unite : um

(.,	(1) boarings of 1 toolston oldsses 1 and 2											
Ono	rating Conditions		Nominal Bore	e Diameters $oldsymbol{d}$		Tolera	Bore Diameter Tolerances Δ_{ds}		iameter ances	- Remarks		
Ope	atting conditions	OV	ver .	inc	:l.					IXEITIBI K3		
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low			
		-	_	76.200	3.0000	+13	0	+ 38	+ 25			
_	Normal Loads	76.200	3.0000	304.800	12.0000	+25	0	+ 64	+ 38	For bearings with $d \le 152.4 \text{ mm}$,		
S	NOTHIAI LUAUS	304.800	12.0000	609.600	24.0000	+51	0	+127	+ 76	clearance is usually larger than CN.		
Rotating Inner Ring Loads		609.600	24.0000	914.400	36.0000	+76	0	+190	+114			
atin g Lc	Home Loods	_	_	76.200	3.0000	+13	0	+ 64	+ 38	In general, bearings with a clear-		
Sot	Heavy Loads Shock Loads High Speeds	76.200	3.0000	304.800	12.0000	+25	0	*		ance larger than CN are used.		
		304.800	12.0000	609.600	24.0000	+51	0	*		* means that the average		
		609.600	24.0000	914.400	36.0000	+76	0	+381	+305	interference is about 0.0005 d.		
		_	_	76.200	3.0000	+13	0	+ 13	0	The inner ring cannot be displaced axially.		
<u>_</u>		76.200	3.0000	304.800	12.0000	+25	0	+ 25	0	When heavy or shock loads exist, the		
Sute		304.800	12.0000	609.600	24.0000	+51	0	+ 51	0	figures in the above (Rotating inner ring		
Rotating Outer Ring Loads	Normal Loads	609.600	24.0000	914.400	36.0000	+76	0	+ 76	0	loads, heavy or shock loads) apply.		
atir g L	without Shocks	_	_	76.200	3.0000	+13	0	0	- 13			
Rot		76.200	3.0000	304.800	12.0000	+25	0	0	- 25	The inner ring can be displaced		
		304.800	12.0000	609.600	24.0000	+51	0	0	- 51	axially.		
		609.600	24.0000	914.400	36.0000	+76	0	0	- 76			

(2) Bearings of Precision Classes 3 and 0 (1)

Units : $\mu \, m$

One	rating Conditions		Nominal Bore		Bore Di Tolera	ances	Snatt Diameter		- Remarks	
Ope	rating Conditions	OV	er	inc	il.					Remarks
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low	
	Danaisia a	_	_	76.200	3.0000	+13	0	+ 30	+18	
_	Precision Machine-Tool	76.200	3.0000	304.800	12.0000	+13	0	+ 30	+18	
inel.	Main Spindles	304.800	12.0000	609.600	24.0000	+25	0	+ 64	+38	_
n g		609.600	24.0000	914.400	36.0000	+38	0	+102	+64	
Rotating Inner Ring Loads		_	-	76.200	3.0000	+13	0	_	_	
Sing Sing	Heavy Loads Shock Loads	76.200	3.0000	304.800	12.0000	+13	0	_	_	A minimum interference of about
4	High Speeds	304.800	12.0000	609.600	24.0000	+25	0	_	_	0.00025 d is used.
	J '	609.600	24.0000	914.400	36.0000	+38	0	_	_	
nter	Descioles	_	-	76.200	3.0000	+13	0	+ 30	+18	
g Or	Precision Machine-Tool	76.200	3.0000	304.800	12.0000	+13	0	+ 30	+18	
atin	Main Spindles	304.800	12.0000	609.600	24.0000	+25	0	+ 64	+38	_
Rotating Outer Ring Loads	waiii Spiriules	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 9.7 Fits of Inch Design Tapered Roller Bearings with Housings

(1) Bearings of Precision Classes 4 and 2

Units : μm

										onits . µm	
Ono	rating Conditions	No	ominal Outsid	de Diameters <i>I</i>	D	Outside Diameter Tolerances Δ_{Ds}		Housing Bore Diameter Tolerances		- Remarks	
Ope	alling Conditions	OVE	er	ind	cl.					Remarks	
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low		
		_	_	76.200	3.0000	+25	0	+ 76	+ 51		
	Used either	76.200	3.0000	127.000	5.0000	+25	0	+ 76	+ 51	The outer ring can be easily	
	on free-end or	127.000	5.0000	304.800	12.0000	+25	0	+ 76	+ 51	The outer ring can be easily displaced axially.	
SS	fixed-end	304.800	12.0000	609.600	24.0000	+51	0	+152	+102	displaced axially.	
-0a		609.600	24.0000	914.400	36.0000	+76	0	+229	+152		
Rotating Inner Ring Loads		_	-	76.200	3.0000	+25	0	+ 25	0		
돌	The outer ring position can be adjusted axially.	76.200	3.0000	127.000	5.0000	+25	0	+ 25	0	The outer ring can be displaced	
ner		127.000	5.0000	304.800	12.0000	+25	0	+ 51	0	axially.	
J L		304.800	12.0000	609.600	24.0000	+51	0	+ 76	+ 25	axiany.	
ţiu		609.600	24.0000	914.400	36.0000	+76	0	+127	+ 51		
ota	The autorian	_	-	76.200	3.0000	+25	0	- 13	- 38		
~	The outer ring position cannot	76.200	3.0000	127.000	5.0000	+25	0	- 25	- 51	Generally, the outer ring is fixed	
	be adjusted	127.000	5.0000	304.800	12.0000	+25	0	- 25	- 51	axially.	
	axially.	304.800	12.0000	609.600	24.0000	+51	0	- 25	- 76	axiany.	
		609.600	24.0000	914.400	36.0000	+76	0	- 25	-102		
Rotating Outer Ring Loads	Normal Loads	_	-	76.200	3.0000	+25	0	- 13	- 38		
3g	The outer ring	76.200	3.0000	127.000	5.0000	+25	0	- 25	- 51		
200	position cannot	127.000	5.0000	304.800	12.0000	+25	0	- 25	- 51	The outer ring is fixed axially.	
200	be adjusted (304.800	12.0000	609.600	24.0000	+51	0	- 25	- 76		
ᅐ	axially.	609.600	24.0000	914.400	36.0000	+76	0	- 25	-102		

(2) Bearings of Precision Classes 3 and 0 (1)

Units : μm

One	rating Conditions	No	ominal Outsid)	Outside Diameter Tolerances Δ _{Ds}		Housing Bore Diameter Tolerances		- Remarks	
Ope	rating conditions	OVE	er	incl.						IVEITIGI N.3
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low	
		_	-	152.400	6.0000	+13	0	+38	+25	
	Used on free-	152.400	6.0000	304.800	12.0000	+13	0	+38	+25	The outer ring can be easily
	end	304.800	12.0000	609.600	24.0000	+25	0	+64	+38	displaced axially.
		609.600	24.0000	914.400	36.0000	+38	0	+89	+51	
Rotating Inner Ring Loads		_	-	152.400	6.0000	+13	0	+25	+13	
J.	Used on fixed-	152.400	6.0000	304.800	12.0000	+13	0	+25	+13	The outer ring can be displaced
ÿi	end	304.800	12.0000	609.600	24.0000	+25	0	+51	+25	axially.
er F		609.600	24.0000	914.400	36.0000	+38	0	+76	+38	
드	The outer ring	_	-	152.400	6.0000	+13	0	+13	0	
р	position can be	152.400	6.0000	304.800	12.0000	+13	0	+25	0	Generally, the outer ring is fixed
tati	adjusted axially.	304.800	12.0000	609.600	24.0000	+25	0	+25	0	axially.
&	. ,	609.600	24.0000	914.400	36.0000	+38	0	+38	0	
	The outer ring	_	-	152.400	6.0000	+13	0	0	-13	
	position cannot	152.400	6.0000	304.800	12.0000	+13	0	0	-25	The outer ring is fixed axially.
	be adjusted	304.800	12.0000	609.600	24.0000	+25	0	0	-25	The cater ring is tinea amany.
	axially.	609.600	24.0000	914.400	36.0000	+38	0	0	-38	
ıter	Normal Loads	_	-	76.200	3.0000	+13	0	-13	-25	
35 Sp	The outer ring	76.200	3.0000	152.400	6.0000	+13	0	-13	-25	
Log	position cannot	152.400	6.0000	304.800	12.0000	+13	0	-13	-38	The outer ring is fixed axially.
Rotating Outer Ring Loads	be adjusted	304.800	12.0000	609.600	24.0000	+25	0	-13	-38	
200	axially.	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.

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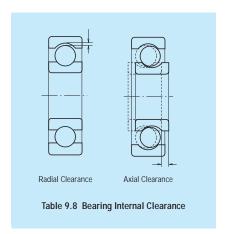


9.2 Bearing Internal Clearances

9.2.1 Internal Clearances and Their Standards

The internal clearance in rolling bearings in operation greatly influences bearing performance including fatique 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 clearances between the inner/outer rings and rolling elements. The radial and axial clearances are defined as the total amount that one ring can be displaced relative to the other in the radial and axial directions respectively (Fig. 9.1).



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

Usually the clearance before mounting is the one specified as the theoretical internal clearance.

In Table 9.8, reference table and page numbers are listed by bearing types.

Table 9.8 Index for Radial Internal Clearances by Bearing Types

Ве	earing Types	Table Number	Page Number
Deep Groove Ba	III Bearings	9.9	A89
Extra Small and	Miniature Ball Bearings	9.10	A89
Magneto Bearin	gs	9.11	A89
Self-Aligning Ba	III Bearings	9.12	A90
Deep Groove Ball Bearings		9.13.1	A90
Cylindrical Roller Bearings	For Motors	9.13.2	A90
Cylindrical Roller Bearings	With Cylindrical Bores With Cylindrical Bores (Matched) With Tapered Bores (Matched)	9.14	A91
Spherical Roller Bearings	With Cylindrical Bores With Tapered Bores	9.15	A92
Double-Row an Roller Bearings	d Combined Tapered	9.15	A93
Combined Angu Bearings (1)	ılar Contact Ball	9.17	A94
Four-Point Cont	act Ball Bearings (¹)	9.18	A94

Note (1) Values given are axial clearances.

Table 9.9 Radial Internal Clearances in **Deep Groove Ball Bearings**

Clearance

Units: um

Diamet						Oicui	unicc				
d (mn		C	2	С	N	С	3	С	:4	C	:5
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
10 only 10 18	18 24	0 0 0	7 9 10	2 3 5	13 18 20	8 11 13	23 25 28	14 18 20	29 33 36	20 25 28	37 45 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 obt	ain th	e mea	surec	l value	es. use	e the o	leara	nce co	rrecti	

Nominal Bore

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 E Dia. d (n		Meas Lo			lial Cle ount	arance	Correc	tion
over	incl.	(N)	au {kgf}	C2	CN	C3	C4	C5
10 (incl) 18 50	18 50 280	24.5 49 147		3 to 4 4 to 5 6 to 8	4 5 8	4 6 9	4 6 9	4 6 9

Remarks For values exceeding 280 mm, please contact NSK.

Table 9.10 Radial Internal Clearances in Extra Small and Miniature Ball Bearings

Units: um

Clear- ance Symbol		C1	M	C2	M	СЗ	M	C4	M	C5	M	C6
	min.	max.										
Clear- ance	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	МС3	MC4	MC5	MC6
Clearance Correction Value	1	1	1	1	2	2

The measuring loads are as follows:

For miniature ball bearings* 2.5N {0.25kgf} For extra small ball bearings*

4.4N {0.45kgf} *For their classification, refer to Table 1 on Page B 31.

Table 9.11 Radial Internal Clearances in Magneto Bearings

Units: um

Nomina Diam $oldsymbol{d}$ (n	neter	Bearing Series	Clea	rance
over	incl.		min.	max.
2.5	30	EN	10	50
2.5	30	E	30	60

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Table 9.12 Radial Internal Clearances in Self-Aligning Ball Bearings

Units : $\mu \, m$

Nomina			Cl	earanc	e in Be	arings	with C	ylindri	cal Bo	es			(learan	ice in E	earing	s with	Tapere	d Bore	S	
Dia. d ((mm)	C	22	C	N	(C3	C	:4	C	5	(C2	C	N	C	23	C	4		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 10	6 10 14	1 2 2	8 9 10	5 6 6	15 17 19	10 12 13	20 25 26	15 19 21	25 33 35	21 27 30	33 42 48	=	=	=	=	=	=	=	=	=	=
14 18 24	18 24 30	3 4 5	12 14 16	8 10 11	21 23 24	15 17 19	28 30 35	23 25 29	37 39 46	32 34 40	50 52 58		17 20	13 15	 26 28	20 23	33 39	28 33	42 50	37 44	55 62
30 40 50	40 50 65	6 6 7	18 19 21	13 14 16	29 31 36	23 25 30	40 44 50	34 37 45	53 57 69	46 50 62	66 71 88	12 14 18	24 27 32	19 22 27	35 39 47	29 33 41	46 52 61	40 45 56	59 65 80	52 58 73	72 79 99
65 80 100	80 100 120	8 9 10	24 27 31	18 22 25	40 48 56	35 42 50	60 70 83	54 64 75	83 96 114	76 89 105	108 124 145	23 29 35	39 47 56	35 42 50	57 68 81	50 62 75	75 90 108	69 84 100	98 116 139	91 109 130	123 144 170
120 140	140 160	10 15	38 44	30 35	68 80	60 70	100 120	90 110	135 161	125 150	175 210	40 45	68 74	60 65	98 110	90 100	130 150	120 140	165 191	155 180	205 240

Table 9.13 Radial Internal Clearances in **Bearings for Electric Motors**

Table 9.13. 1 Deep Groove Ball Bearings for Electric Motors

9-		
Units	:	μm

				Units	s:μm
Nominal B		Clea	rance	Ren	narks
Dia. $m{d}$ (m	m)	C	M	Recomn	nended fit
over	incl.	min.	max.	Shaft	Housing Bore
10 (incl)	18	4	11	js5 (j5)	
18	30	5	12		
30	50	9	17		H6, H7(1)
50	80	12	22	k5	or JS6, JS7
80	100	18	30		(J6, J7)(²)
100	120	18	30	m5	
120	160	24	38	1110	

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 9.9.

Table 9.13.2 Cylindrical Roller Bearings for Electric Motors

Units: um

							110 . pc 111
Nomina	al Bore		Clear	ance		F	Remarks
Dia. d	(mm)	Interchan	geable CT	Non-Interch	angeable CM	Recor	mmended Fit
over	incl.	min.	max.	min.	max.	Shaft	Housing Bore
24	40	15	35	15	30	k5	
40	50	20	40	20	35		
50	65	25	45	25	40		
65	80	30	50	30	45		
80	100	35	60	35	55	m5	JS6, JS7 (J6, J7)(1)
100	120	35	65	35	60		or
120	140	40	70	40	65		K6, K7(2)
140	160	50	85	50	80		
160	180	60	95	60	90		
180	200	65	105	65	100	n6	

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 9.14 Radial Internal Clearances in Cylindrical Roller Bearings and Solid-Type Needle Roller Bearings

 $\text{Units}: \mu m$

	lom ore						ances Cylind									Cleara				angeal I Bores	ole Bea	rings		
	d (m	nm)	C	2	С	N	C	3	C	4	C	5	C	C1	С	C2	CC	(1)	C	C3	C	C4	C	C5
0	ver	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.								
	10 24	10 24 30	0 0 0	25 25 25	20 20 20	45 45 45	35 35 35	60 60 60	50 50 50	75 75 75	— 65 70	90 95	 5 5	 15 15	10 10	 20 25	20 25	30 35	35 40	— 45 50	45 50	 55 60	65 70	75 80
	30 40 50	40 50 65	5 5 10	30 35 40	25 30 40	50 60 70	45 50 60	70 80 90	60 70 80	85 100 110	80 95 110	105 125 140	5 5 5	15 18 20	12 15 15	25 30 35	25 30 35	40 45 50	45 50 55	55 65 75	55 65 75	70 80 90	80 95 110	95 110 130
		80 100 120	10 15 15	45 50 55	40 50 50	75 85 90	65 75 85	100 110 125	90 105 125	125 140 165	130 155 180	165 190 220	10 10 10	25 30 30	20 25 25	40 45 50	40 45 50	60 70 80	70 80 95	90 105 120	90 105 120	110 125 145	130 155 180	150 180 205
1	40	140 160 180	15 20 25	60 70 75	60 70 75	105 120 125	100 115 120	145 165 170	145 165 170	190 215 220	200 225 250	245 275 300	10 10 10	35 35 40	30 35 35	60 65 75	60 65 75	90 100 110	105 115 125	135 150 165	135 150 165	160 180 200	200 225 250	230 260 285
2	00	200 225 250	35 45 45	90 105 110	90 105 110	145 165 175	140 160 170	195 220 235	195 220 235	250 280 300	275 305 330	330 365 395	15 15 15	45 50 50	40 45 50	80 90 100	80 90 100	120 135 150	140 155 170	180 200 215	180 200 215	220 240 265	275 305 330	315 350 380
2	80	280 315 355	55 55 65	125 130 145	125 130 145	195 205 225	190 200 225	260 275 305	260 275 305	330 350 385	370 410 455	440 485 535	20 20 20	55 60 65	55 60 65	110 120 135	110 120 135	165 180 200	185 205 225	240 265 295	240 265 295	295 325 360	370 410 455	420 470 520
4	00	400 450 500	100 110 110	190 210 220	190 210 220	280 310 330	280 310 330	370 410 440	370 410 440	460 510 550	510 565 625	600 665 735	25 25 25	75 85 95	75 85 95	150 170 190	150 170 190	225 255 285	255 285 315	330 370 410	330 370 410	405 455 505	510 565 625	585 650 720

Note (1) CC denotes normal clearance for non-Interchangeable cylindrical roller bearings and solid-type needle roller bearings.

Units : μm

	lominal ore Dia.					Clearar	nces in N	on-Inter	changea	ble Bear	ings witl	n Tapere	d Bores				
	d (mm)	CC	9 (1)	C	C 0	C	C1	C	C2	CC	(2)	C	C3	C	C4	C	C5
ove	r incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
1 2 3	4 30	5 5 5	10 10 12	 8 8	— 15 15	10 10 12	20 25 25	20 25 25	30 35 40	35 40 45	45 50 55	45 50 55	55 60 70	55 60 70	65 70 80	75 80 95	85 95 110
5 6	0 65	5 5 10	15 15 20	10 10 15	20 20 30	15 15 20	30 35 40	30 35 40	45 50 60	50 55 70	65 75 90	65 75 90	80 90 110	80 90 110	95 110 130	110 130 150	125 150 170
10 12	120	10 10 15	25 25 30	20 20 25	35 35 40	25 25 30	45 50 60	45 50 60	70 80 90	80 95 105	105 120 135	105 120 135	125 145 160	125 145 160	150 170 190	180 205 230	205 230 260
14 16 18	180	15 15 20	35 35 40	30 30 30	50 50 50	35 35 40	65 75 80	65 75 80	100 110 120	115 125 140	150 165 180	150 165 180	180 200 220	180 200 220	215 240 260	260 285 315	295 320 355
20 22 25	5 250	20 25 25	45 50 55	35 40 40	60 65 70	45 50 55	90 100 110	90 100 110	135 150 165	155 170 185	200 215 240	200 215 240	240 265 295	240 265 295	285 315 350	350 380 420	395 430 475
28 31 35	355	30 30 35	60 65 75	=	_	60 65 75	120 135 150	120 135 150	180 200 225	205 225 255	265 295 330	265 295 330	325 360 405	325 360 405	385 430 480	470 520 585	530 585 660
40 45		40 45	85 95		=	85 95	170 190	170 190	255 285	285 315	370 410	370 410	455 505	455 505	540 600	650 720	735 815

(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 9.15 Radial Internal Clearances in Spherical Roller Bearings

Units : μm

	ninal Dia.		(Cleara	nce in	Beari	ings wit	th Cylin	drical B	ores				Cle	arance	in Beari	ngs wit	h Taper	ed Bore	!S	
	nm)	C	2	C	N	(C3	C	24	(C5	C	22	(CN	C	23	C	24	C	5
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
450 500 560	500 560 630	140 150 170	260 280 310	260 280 310	410 440 480	410 440 480	550 600 650	550 600 650	720 780 850		900 1 000 1 100	260 290 320	370 410 460	370 410 460	490 540 600	490 540 600	630 680 760	630 680 760	790 870 980	870	1 000 1 100 1 230
630 710 800	710 800 900	190 210 230	350 390 430	350 390 430	530 580 650	530 580 650	700 770 860	700 770 860	920 1 010 1 120	1 010	1 190 1 300 1 440	350 390 440	510 570 640	510 570 640	670 750 840	670 750 840	850 960 1 070	850 960 1 070	1 090 1 220 1 370	1 090 1 220 1 370	1 360 1 500 1 690
900 1 000 1 120 1 250	1 000 1 120 1 250 1 400	260 290 320 350	480 530 580 640	480 530 580 640	710 780 860 950	710 780 860 950	930 1 020 1 120 1 240		1 220 1 330 1 460 1 620	1 220 — — —	1 570 — — —	490 530 570 620	710 770 830 910	830	930 1 030 1 120 1 230	1 030	1 190 1 300 1 420 1 560	1 190 1 300 1 420 1 560	1 520 1 670 1 830 2 000	1 520 — — —	

Table 9.16 Radial Internal Clearances in Double-Row and Combined Tapered Roller Bearings

 $\text{Units}: \mu m$

	ndrical						CI	earance					
Bore Tape	ered Bore	C	C1	C	22	C	N	C	C3	C	24	C	5
Nominal Bo Dia. d (mr		-	_	C	1	C	22	C	N	C	23	С	4
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
18 24	18 24 30	0 0 0	10 10 10	10 10 10	20 20 20	20 20 20	30 30 30	35 35 40	45 45 50	50 50 50	60 60 60	65 65 70	75 75 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 1 250	1 120 1 250 1 400	130 150 170	190 210 240	200 220 250	260 280 320	400 450 500	460 510 570	600 670 750	700 770 870		=	_ _ _	_ _ _

 $\begin{array}{ll} \textbf{Remarks} & \textbf{Axial internal clearance} \quad \varDelta_{\textbf{a}} = \varDelta_{\textbf{r}} \cot \alpha \stackrel{:}{=} \frac{1.5}{e} \ \varDelta_{\textbf{r}} \\ & \text{where} \ \varDelta_{\textbf{r}} : \textbf{Radial internal clearance} \\ & \alpha : \textbf{Contact angle} \\ & e : \textbf{Constant (Listed in bearing tables)} \\ \end{array}$

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Table 9.17 Axial Internal Clearances in Combined Angular Contact Ball Bearings (Measured Clearance)

Units : μm

Nomi	inal Bore		Axial Intern				Axial Interna	al Clearance					
Diameter. d (mm)			Contact Angle 30°				Contact Angle 40°						
		C	N	(C3	C	C4	C	N	C	C3	(C4
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
10 18	10 18 24	9 10 19	29 30 39	29 30 39	49 50 59	49 50 59	69 70 79	6 7 13	26 27 33	26 27 33	46 47 53	46 47 53	66 67 73
24 30 40	30 40 50	20 26 29	40 46 49	40 46 49	60 66 69	60 66 69	80 86 89	14 19 21	34 39 41	34 39 41	54 59 61	54 59 61	74 79 81
50 65 80	65 80 100	35 38 49	60 63 74	60 63 74	85 88 99	85 88 99	110 115 125	25 27 35	50 52 60	50 52 60	75 77 85	75 77 85	100 100 110
100 120 140	120 140 160	72 85 90	97 115 120	97 115 120	120 145 150	120 145 150	145 175 180	52 63 66	77 93 96	77 93 96	100 125 125	100 125 125	125 155 155
160 180	180 200	95 110	125 140	125 140	155 170	155 170	185 200	68 80	98 110	98 110	130 140	130 140	160 170

Remarks This table is applicable to bearings in Tolerance Classes Normal and 6. For internal axial clearances in bearings in tolerance classes better than 5 and contact angles of 15° and 25°, it is advisable to consult NSK.

Table 9.18 Axial Internal Clearance in Four-Point **Contact Ball Bearings** (Measured Clearances)

Unite : um

							UI	IIIS : μ1	111
Nomin	Nominal Bore			Axia	l Intern	al Clear	ance		
Dia. d	(mm)	C2		CN		C3		C4	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
10	18	15	55	45	85	75	125	115	165
18	40	26	66	56	106	96	146	136	186
40	60	36	86	76	126	116	166	156	206
60	80	46	96	86	136	126	176	166	226
80	100	56	106	96	156	136	196	186	246
100	140	66	126	116	176	156	216	206	266
140	180	76	156	136	196	176	246	226	296
180	220	96	176	156	226	206	276	256	326
220	260	115	196	175	245	225	305	285	365
260	300	135	215	195	275	255	335	315	395
300	350	155	235	215	305	275	365	345	425
350	400	175	265	245	335	315	405	385	475
400	500	205	305	285	385	355	455	435	525

9.2.2 Selection of Bearing Internal Clearances

Among the bearing internal clearances 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 $(P = 0.1C_r)$, 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 9.13.1 and

Internal clearance varies with the fit and temperature differences in operation. The changes in radial clearance in a roller bearing are shown in Fig. 9.2.

(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 15.2, Fits (1), Pages A130 to A133). The internal clearance after subtracting this decrease from the theoretical internal clearance Δ_0 is called the residual clearance, $\Delta_{\rm f}$

(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:

$$\delta_t = \alpha \Delta_t D_e$$
 (9.6)

where δ_t : Decrease in radial clearance due to temperature difference between inner and outer rings (mm)

- α : Coefficient of linear expansion of bearing steel $= 12.5 \times 10^{-6} (1/^{\circ}C)$
- Δ_t : Temperature difference between inner and outer rings (°C)
- $D_{\rm e}$: Outer ring raceway diameter (mm)

For ball bearings

$$D_{\rm e} = \frac{1}{5} (4D + d) \dots (9.7)$$

For roller bearings
$$D_{\rm e} = \frac{1}{4} (3D + d) \dots (9.8)$$

The clearance after substracting this δ_t from the residual clearance. Δ_f is called the effective clearance. Δ . 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 clearances used in some specific applications are given in Table 9.19. Under special operating conditions, it is advisable to consult NSK.

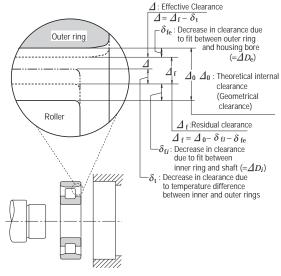


Fig. 9.2 Changes in Radial Internal Clearance of Bearings

Table 9. 19 Examples of Clearances 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	Dryers in paper making machines	C3, C4
through hollow shafts or roller shafts are heated.	Table rollers for rolling mills	C3
When impact loads and	Traction motors for railways	C4
When impact loads and vibration are severe or	severe or Vibrating screens	
when both the inner and outer rings are tight-	Fluid couplings	C4
fitted.	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



10. PRELOAD

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.

10.1 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
- (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

10.2 Preloading Methods

10.2.1 Position Preload

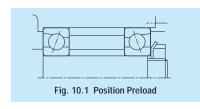
A position preload is achieved by fixing two axially opposed bearings in such a way that a preload is imposed on them. Their position, once fixed, remain unchanged while in operation.

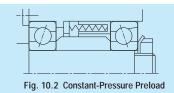
In practice, the following three methods are generally used to obtain a position preload.

- (1) By installing a duplex bearing set with previously adjusted stand-out dimensions (see Page A7, 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.
- (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.

10.2.2 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. 10.2)





10.3 Preload and Rigidity

10.3.1 Position Preload and Rigidity

When the inner rings of the duplex bearings shown in Fig.10.3 are fixed axially, bearings A and B are displaced δ_{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. 10.4.

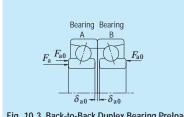


Fig. 10.3 Back-to-Back Duplex Bearing Preload

10.3.2 Constant-Pressure Preload and Rigidity

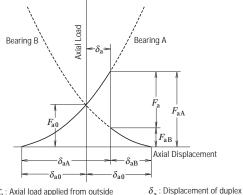
A preload diagram for duplex bearings under a constant-pressure preload is shown in Fig. 10.5. The deflection curve of the spring is nearly parallel to the horizontal axis because the rigidity of springs is lower than that of the bearing. As a result, the rigidity under a constant-pressure preload is approximately equal to that for a single bearing with a preload F_{a0} applied to it. Fig. 10.6 presents a comparison of the rigidity of a bearing with a position preload and one with a constant-pressure preload.

10.4 Selection of Preloading Method and Amount of Preload

10.4.1 Comparison of Preloading Methods

A comparison of the rigidity using both preloading methods is shown in Fig. 10.6. 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.



 $F_{\rm a}$: Axial load applied from outside F_{aA} : Axial load imposed on Bearing A F_{aB} : Axial load imposed on Bearing B

bearing set : Displacement of Bearing A

Displacement of Bearing B



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.

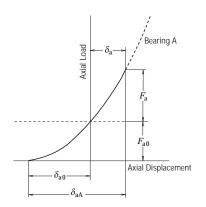


Fig. 10.5 Axial Displacement with Constant-Pressure Preload

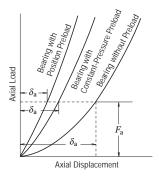


Fig. 10.6 Comparison of Rigidities and Preloading Methods



10.4.2 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.

(1) Preloading of Duplex Angular Contact Ball Bearings

Average preloads for duplex angular contact ball bearings (contact angle of 15°) with precision better than P5 class, which are used on the main shafts of machine tools, are listed in Table 10.2.

The recommended fitting between the shaft and inner ring and between the housing and outer ring are listed in Table 10.1. In the case of fits with housings, the lower limit of the fitting range should be selected for fixed-end bearings and the upper limit for free-end bearings.

As a general rule, an extra light or light preload should be selected for grinding spindles and the main shafts of machining centers, while a medium preload should be adopted for the main shafts of lathes requiring rigidity

When speeds result in a value of $D_{\rm pw} \times n$ ($d_{\rm m} n$ value) higher than 500000, the preload should be very carefully studied and selected. In such a case, please consult with NSK beforehand.

Table 10 2 1 Duplex Bearings of Series 79

	Table TO	. 2. 1 Duplex Bear	ings or Series 79	Units : N
		Prel	oads	
Bearing No.	Extra light	Light	Medium	Heavy
	Preload EL	Preload L	Preload M	Preload H
7900 C	7	15	29	59
7901 C	8.6	15	39	78
7902 C	12	25	49	100
7903 C	12	25	59	120
7904 C	19	39	78	150
7905 C	19	39	100	200
7906 C	24	49	100	200
7907 C	34	69	150	290
7908 C	39	78	200	390
7909 C	50	100	200	390
7910 C	50	100	250	490
7911 C	60	120	290	590
7912 C	60	120	290	590
7913 C	75	150	340	690
7914 C	100	200	490	980
7915 C	100	200	490	980
7916 C	100	200	490	980
7917 C	145	290	640	1 270
7918 C	145	290	740	1 470
7919 C	145	290	780	1 570
7920 C	195	390	880	1 770

Table 10. 1 Recommended Fitting for High Accuracy Duplex Angular Contact Ball Bearings with Preload

				UII	ιιs . <i>μ</i> III
Nominal Bore Dia. d (mm)		Target Shaft Interference	D	Outside ia. nm)	Target Housing
over	incl.		over	incl.	Clearance
18 30 50 80 120	18 30 50 80 120 150	0 to 2 0 to 2.5 0 to 2.5 0 to 3 0 to 4	18 30 50 80 120	18 30 50 80 120 150	2 to 6 2 to 6 3 to 8 3 to 9 4 to 12
150 180	180 250	 	150 180	180 250	4 to 12 4 to 12 5 to 15

Bearing

No.

7000 C

7001 C

7002 C

7003 C

7004 C

7005 C

7006 C

7007 C

7008 C

7009 C

7010 C

7011 C

7012 C

7013 C

7014 C

7015 C

7016 C

7017 C

7018 C

7019 C

7020 C

Table 10. 2 Preloads for Duplex

Light

Preload L

25

25

29

29

49

59

78

120

120

150

150

200

200

250

290

290 390

390

490 540

540

Extra light

Preload EL

12

12

14

14

24

29

39

60

75

75

100

100

125

145

195

195

245

270

Units · um

Table 10. 2. 2 Duplex Bearings of Series 70

		 -
Preload	S	

Dealeada						
	Preloads					
	Medium Preload M	Heavy Preload H				
	49 59 69	100 120 150				
	69 120 150	150 250 290				
	200 250 290	390 490 590				
	340 390 490	690 780 980				
	540 540 740	1 080 1 080 1 470				
	780 930 980	1 570 1 860 1 960				
	1 180 1 180 1 270	2 350 2 350 2 550				

(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 $F_{\rm a\ min}$ necessary to prevent such sliding is obtained from the following equation:

$$F_{\rm a\,min} = \frac{C_{0\,\rm a}}{1000} \qquad (10.3)$$

Angular Contact Ball Bearings

(2) Preload of Thrust Ball Bearings

such sliding

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(10.1) and (10.2) below should be

adopted as the minimum axial load in order to prevent

 $F_{\rm a\,min} = \frac{C_{0\,\rm a}}{100} \left(\frac{n}{N_{\rm max}}\right)^2 \dots (10.1)$

 $F_{\rm a\,min} = \frac{C_{0\,\rm a}}{1000}$ (10.2)

 C_{0a} : Basic static load rating (N), {kgf} N_{max} : Limiting speed (oil lubrication) (min⁻¹)

where $F_{\rm a\,min}$: Minimum axial load (N), {kgf} n : Speed (min $^{-1}$)

 $\label{eq:Table 10.2.3 Duplex Bearings of Series 72}$ Units : N

				J	Units : N
			Prel	oads	
	earing	Extra light	Light	Medium	Heavy
	No.	Preload EL	Preload L	Preload M	Preload H
72	200 C	14	29	69	150
	201 C	19	39	100	200
	202 C	19	39	100	200
72	203 C	24	49	150	290
	204 C	34	69	200	390
	205 C	39	78	200	390
72	206 C	60	120	290	590
	207 C	75	150	390	780
	208 C	100	200	490	980
72	209 C	125	250	540	1 080
	210 C	125	250	590	1 180
	211 C	145	290	780	1 570
72	212 C	195	390	930	1 860
	213 C	220	440	1 080	2 160
	214 C	245	490	1 180	2 350
72	215 C	270	540	1 230	2 450
	216 C	295	590	1 370	2 750
	217 C	345	690	1 670	3 330
72	218 C	390	780	1 860	3 730
	219 C	440	880	2 060	4 120
	220 C	490	980	2 350	4 710



11. DESIGN OF SHAFTS AND HOUSINGS

11.1 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 11. 1 Accuracy and Roughness of Shaft and Housing

Item	Class of Bearings	Shaft	Housing Bore	
Tolerance for	Normal, Class 6	$\frac{\text{IT3}}{2}$ to $\frac{\text{IT4}}{2}$	$\frac{\text{IT4}}{2}$ to $\frac{\text{IT5}}{2}$	
Out-of-roundness	Class 5, Class 4	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$	
Tolerance for	Normal, Class 6	$\frac{\text{IT3}}{2}$ to $\frac{\text{IT4}}{2}$	$\frac{\text{IT4}}{2}$ to $\frac{\text{IT5}}{2}$	
Cylindricality	Class 5, Class 4	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$	
Tolerance for	Normal, Class 6	IT3	IT3 to IT4	
Shoulder Runout	Class 5, Class 4	IT3	IT3	
Roughness of Fitting Surfaces R _a	Small Bearings Large Bearings	0.8 1.6	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 C22). In cases that the outer ring is mounted in the housing bore with interference or that a thin crosssection 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.

11.2 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 11.1) 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 .

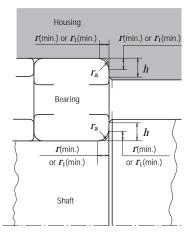


Fig. 11.1 Chamfer Dimensions, Fillet Radius of Shaft and Housing, and Shoulder Height

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 11.2

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 \vec{h} and \vec{r}_a in Table 11.2 should be adopted in those cases where the fillet radius of the shaft or housing is as shown in Fig. 11.2 (a), while the values in Table 11.3 are generally used with an undercut fillet radius produced when grinding the shaft as shown in Fig. 11.2 (b).

Table 11. 2 Recommended Minimum Shoulder Heights for Use with Metric Series Radial Bearings

			UIIIIS . IIIIII			
Nominal		Shaft or Housir	ng			
Chamfer Dimensions		Minimun Shoulder Heights h (min.)				
$m{arGamma}(min.)$ or $m{arGamma}_1$ (min.)	Radius $r_{ m a}$ (max.)	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.



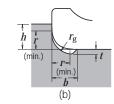


Fig. 11. 2 Chamfer Dimensions, Fillet Radius, and Shoulder Height

Table 11. 3 Shaft Undercut

Units: mm

Chamfer Dimensions of Inner and	Undercut Dimensions					
Outer Rings $m{r}$ (min.) or $m{r}_1$ (min.)	t	$r_{ m g}$	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			

A 100



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 $D_{\rm a}$ 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. 11.3).

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. 11.4).

These diameters d_a and D_a are listed in the bearing tables.

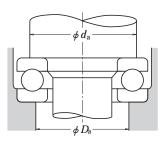


Fig. 11.3 Face Supporting Diameters for Thrust Ball Bearings

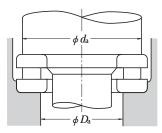


Fig. 11.4 Face Supporting Diameters for Thrust Roller Bearings

11.3 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.

11.3.1 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. 11.5 (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. 11.5 (c)). The entry of dust is impeded by packing grease with a consistency of about 200 into the

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 11.4.

The recommended groove width is approximately 3 to 5mm, with a depth of about 4 to 5mm. In the case of sealing methods using grooves only, there should be three or more grooves.

(2) Flinger (Slinger) Type Seals

(a) Axial Labyrinth

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. 11.6 (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 11.6 (c), (d).

Table 11. 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

(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. 11.7 (a) is widely used because of its ease of assembly, but those shown in Fig. 11.7 (b), (c) have better seal effectiveness.

Table 11. 5 Labyrinth Seal Gaps

Units: mm

Nominal Shaft Diameter	Labyrinth Gaps					
Norminal Strait Diameter	Radial Gap	Axiall Gap				
Under 50	0.25 to 0.4	1 to 2				
50-200	0.5 to 1.5	2 to 5				

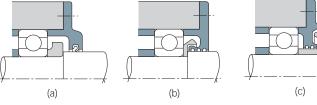
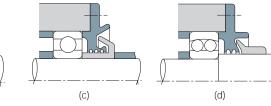
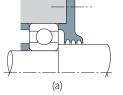
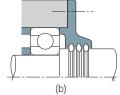
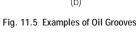


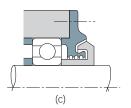
Fig. 11.6 Examples of Flinger Configurations

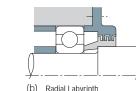












(b) Radial Labyrinth

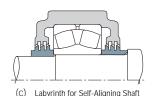


Fig. 11.7 Examples of Labyrinth Designs

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11.3.2 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. 11.8 and 11.9)

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. 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 11.6.

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 HRC40 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 11.7.

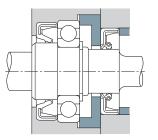


Fig. 11.8 Example of Application of Oil Seal (1)

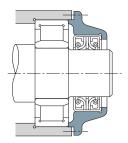


Fig. 11.9 Example of Application of Oil Seal (2)

Table 11. 6 Permissible Circumferential Surface Speeds and Temperature Range for Oil Seals

Sea	al Materials	Permissible Circumferential Speeds(m/sec)	Operating Temperature Range(°C)(¹)		
	Nitrile Rubber	Under 16	-25 to +100		
Synthetic	Acrylic Rubber	Under 25	-15 to +130		
Rubber	Silicone Rubber	Under 32	-70 to +200		
	Fluorine- containes Rubber	Under 32	-30 to +200		
Tetrafluori	de 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 11. 7 Shaft Circumferential Surface Speeds and Finish of Contact Surfaces

Surface Finish R _a (μm)				
0.8				
0.4				
0.2				

(2) Felt Seals

Felt seals are one of the simplest and most common seals being 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.

12. LUBRICATION

12.1 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.

12.2 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 12.1.

Table 12. 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 transter is possible using forced oil circulation.		
Fluidity	Poor	Good		
Full Lubricant Replacement	Sometimes difficult	Easy		
Removal of Foreign Matter	Removal of particles from grese 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.		

12.2.1 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.

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(2) Replacement of Grease

Grease, once packed, usually need not 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. 12.1). If a grease valve is not used, the space on

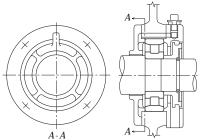


Fig. 12.1 Combination of Partitioned Grease Reservoir and Grease Valve

Radial Ball Bearings 20 000 10 0 Interval, t 8 000 6 000-5 000-4 000-3 000 2 000-1 000-800-600-Speed n

(1) Radial Ball Bearings, Cylindrical Roller Bearings

(3) Load factor

≤0.06 0.1 0.13 0.16 0.65 0.45 Load factor 1.5

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.

(3) Replenishing Interval

Even if high-quality grease is used, there is deterioration of its properties with time; therefore, periodic replenishment is required. Figs 12.2 (1) and (2) show the replenishment time intervals for various bearing types running at different speeds. Figs. 12.2 (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 soapsynthetic oil grease may extend about two times of replenishing time interval shown in Fig.12.2 (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.)

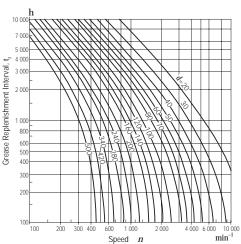
It is advisable to consult NSK.

Load

The replenishing time interval depends on the magnitude of the bearing load.

Please refer to Fig. 12.2 (3).

If P/C exceeds 0.16, it is advisable to consult NSK.



(2) Tapered Roller Bearings, Spherical Roller Bearings

min-1

(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 (12.1) or (12.2) or Fig. 12.3: (General purpose grease (1))

$$log t = 6.54 - 2.6 \frac{n}{N_{\text{max}}} - \left(0.025 - 0.012 \frac{n}{N_{\text{max}}}\right)T$$
.....(12.1)

(Wide-range grease (2))

$$log \ t = 6.12 - 1.4 \frac{n}{N_{\text{max}}} - \left(0.018 - 0.006 \frac{n}{N_{\text{max}}}\right)T$$
.....(12.2)

where *t*: Average grease life, (h)

n: Speed (min⁻¹)

 $N_{\rm max}$: Limiting speed with grease lubrication (values for ZZ and VV types listed in the

bearing tables)

T: Operating temperature °C

Equations (12.1) and (12.2) and Fig. 12.3 apply under the following conditions:

(a) Speed, n

$$0.25 \leq \frac{n}{N_{\text{max}}} \leq 1$$

when
$$\frac{n}{N_{\rm max}}$$
 < 0.25, assume $\frac{n}{N_{\rm max}}$ = 0.25

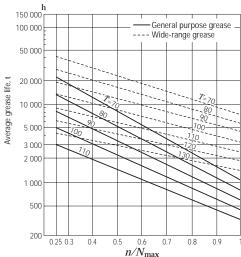


Fig. 12.3 Grease Life of Sealed Ball Bearings

(b) Operating Temperature, T For general purpose grease (1)

70 °C ≤ T ≤ 110 °C

For wide-range grease (2)

70 °C ≤ T ≤ 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.

12.2.2 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. 12.4)

(2) Drip-Feed Lubrication

Drip feed lubrication is widely used for small ball bearings operated at relatively high speeds. As shown in Fig. 12.5, oil is stored in a visible oiler. The oil drip rate is controlled with the screw in the top

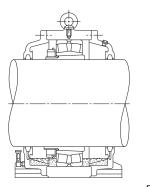


Fig. 12.4 Oil Bath Lubrication



Lubrication



(3) Splash Lubrication

With this lubricating method, oil is splashed onto the bearings by gears or a simple rotating disc installed near bearings without submerging the bearings in oil. It is commonly used in automobile transmissions and final drive gears. Fig. 12.6 shows this lubricating method used on a reduction gear.

(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. 12.7 (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.

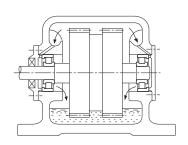


Fig. 12.6 Splash Lubrication

(5) Jet Lubrication

Jet lubrication is often used for ultra high speed bearings, such as the bearings in jet engines with a $d_{\mathbf{m}}n$ valve ($d_{\mathbf{m}}$: 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. 12.8 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.

(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. 12.9).

For oil mist lubrication of large bearings, it is advisable to consult NSK.

(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. 12.10).

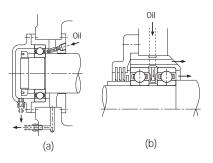


Fig. 12.8 Jet Lubrication

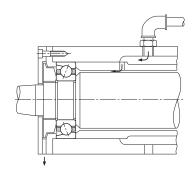


Fig. 12.9 Oil Mist Lubrication

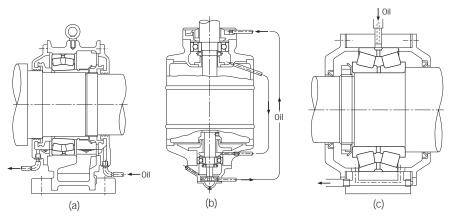


Fig. 12.7 Circulating Lubrication

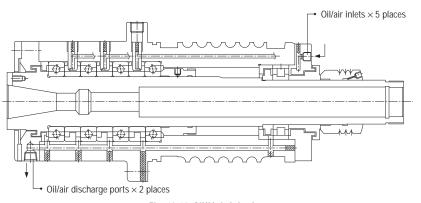


Fig. 12.10 Oil/Air Lubrication

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12.3 Lubricants

12.3.1 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 12.2. 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 12.2

				Table 12.2					
	Name (Popular name)	Lithium Grease							
	Thickener	Li Soap							
ı	Base Oil Properties	Mineral Oil	Silicone Oil						
D P	oropping Point,°C	170 to 195	170 to 195	200 to 210					
	Vorking emperatures, °C	-20 to +110	-50 to +130	-50 to +160					
	Vorking Speed, %(1)	70	100	60					
	Mechanical Stability	Good	Good	Good					
	ressure Resistance	Fair	Fair	Poor					
٧	Vater Resistance	Good	Good	Good					
R	Rust Prevention	Good	Good	Poor					
F	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 12.3 shows the relation between consistency and working conditions.

Grease Properties

Sodium Grease (Fiber Grease)	Calcium Grease (Cup Grease)	Mixed Base Grease	Complex Base Grease (Complex Grease)		oap Base Grease -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, Fluor 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	and high temp lubricant. Syn is recommend temperature.	se grease is middle berature purpose thetic oil base grease ded for low or high Some silicone and ed grease have poor n and noise.	

Remarks The grease properties shown here can vary between brands.

Table 12.3 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 -When fretting is likely to occur	For centralized oiling When fretting is likely to occur For low temperatures	-For general use -For sealed ball bearings	·For general use ·For sealed ball bearings ·For high temperatures	·For high temperatures ·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 1/10mm. The larger the value, the softer the grease.

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(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.

12.3.2 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 12.4 gives generally recommended viscosities for bearings under normal operating conditions.

For use when selecting the proper lubricating oil, Fig. 12.11 shows the relationship between oil temperature and viscosity, and examples of selection are shown in Table 12.5.

Table 12. 4 Bearing Types and Proper Viscosity of Lubricating Oils

Bearing Type	Proper Viscosity at Operating Temperature
Ball Bearings and Cylindrical Roller Bearings	Higher than 13mm²/s
Tapered Roller Bearings and Spherical Roller Bearings	Higher than 20mm ² /s
Spherical Thrust Roller Bearings	Higher than 32mm²/s

Remarks 1mm²/s=1cSt (centistokes)

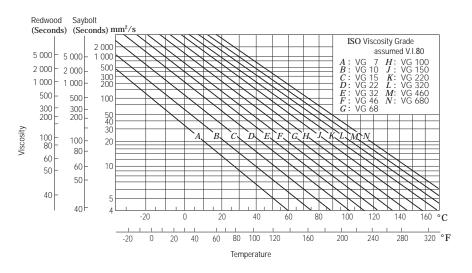


Fig. 12.11 Temperature-Viscosity Chart

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 12. 5 Examples of Selection Lubricating Oils

Operating Temperature	Speed	Light or normal Load	Heavy or Shock Load
−30 to 0 °C	Less than limiting speed	ISO VG 15, 22, 32 (refrigerating machine oil)	_
	Less than 50% of limiting speed	ISO VG 32, 46, 68 (bearing oil, turbine oil)	ISO VG 46, 68, 100 (bearing oil, turbine oil)
0 to 50 °C	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 °C	Less than 50% of limiting speed 50 to 100% of limiting speed	ISO VG 100, 150, 220 (bearings oil) ISO VG 46, 68, 100 (bearing oil, turbine oil)	ISO VG 150, 220, 320 (bearing oil) ISO VG 68, 100, 150 (bearing oil, turbine oil)
	More than limiting speed	ISO VG 32, 46, 68 (bearing oil, turbine oil)	
	Less than 50% of limiting speed	ISO VG 320, 460 (bearing oil)	ISO VG 460, 680 (bearing oil, gear oil)
80 to 110 °C	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.

- 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 $^{\circ}$ C or higher than 110 $^{\circ}$ C , it is advisable to consult NSK.

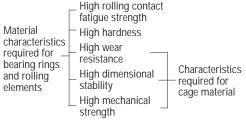
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13. BEARING MATERIALS

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.

13.1 Materials for Bearing Rings and Rolling Elements

Primarily, high carbon chromium bearing steel (Table 13.1) is used for the bearing rings and rolling elements. Most NSK bearings are made of SUJ2 among the JIS steel types listed in Table 13.1, 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 England.

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 13.2.

Table 13. 1 Chemical Composition of High-Carbon Chromium Bearing Steel (Major Elements)

Standard	Cumbala	Chemical Composition (%)									
Standard	Symbols	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 13. 2 Chemical Composition of Carburizing Bearing Steels (Major Elements)

Standard	Cumbala		Chemical Composition (%)							
Staridard	Symbols	С	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 13. 3 Chemical Composition of High Speed Steel for Bearings Used at High Temperatures

Standard	Cumbala					Ch	emical Com	position (%)				
	Syllibols	С	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 13.3 and 13.4.

13.2 Cage Materials

The low carbon steels shown in Table 13.5 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 13.6) or carbon steel (Table 13.5) is used. Sometimes synthetic resin is also used.

Table 13. 4 Chemical Composition of Stainless Steel for Rolling Bearing (Major Elements)

Standard	Cumbala		Chemical Composition (%)										
Staridard	Symbols	С	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 13. 5 Chemical Composition of Steel sheet and Carbon Steel for Cages (Major Elements)

Classification	Standard	Cumbala	Chemical Composition (%)							
Classification	Standard	Symbols		Si	Mn	P	S			
Steel sheet and	JIS G 3141	SPCC	Less than 0.12	_	Less than 0.50	Less than 0.04	Less than 0.045			
strip for pressed	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			
cages	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			

Remarks BAS is Japanese Bearing Association Standard.

Table 13. 6 Chemical Composition of High Strength Brass for Machined Cages

Standard	Symbols	Chemical Composition (%)												
		Cu	Zn	Mn	Fe	Al	Sn	Ni	Impurities					
		Cu	ZII	MIII Fe		AI	SII	INI	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	_				

Remarks Improved HBsC 1 is also used.

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14. BEARING HANDLING

14.1 Precautions for Proper Handling of Bearings

Since rolling bearings are high precision machine parts, they must be handled accordingly. Even if high quality bearings are used, their expected performance cannot be achieved if they are not handled properly. The main precautions to be observed are as follows:

(1) Keep Bearings and Surrounding Area Clean

Dust and dirt, even if invisible to the naked eye, have harmful effects on bearings. It is necessary to prevent the entry of dust and dirt by keeping the bearings and their environment as clean as possible.

(2) Careful Handling

Heavy shocks during handling may cause bearings to be scratched or otherwise damaged possibly resulting in their failure. Excessively strong impacts may cause brinelling, breaking, or cracking.

(3) Use Proper Tools

Always use the proper equipment when handling bearings and avoid general purpose tools.

(4) Prevent Corrosion

Since perspiration on the hands and various other contaminants may cause corrosion, keep the hands clean when handling bearings. Wear gloves if possible. Pay attention to rust of bearing caused by corrosive gasses.

14.2 Mounting

The method of mounting rolling bearings strongly affects their accuracy, life, and performance, so their mounting deserves careful attention. Their characteristics should first be thoroughly studied, and then they should be mounted in the proper manner. It is recommended that the handling procedures for bearings be fully investigated by the design engineers and that standards be established with respect to the following items:

- (1) Cleaning the bearings and related parts.
- (2) Checking the dimensions and finish of related parts.
- (3) Mounting
- (4) Inspection after mounting.
- (5) Supply of Jubricants.

Bearings should not be unpacked until immediately before mounting. When using ordinary grease lubrication, the grease should be packed in the bearings without first cleaning them. Even in the case of ordinary oil lubrication, cleaning the bearings is not required. However, bearings for instruments or for high speed operation must first be cleaned with clean filtered oil in order to remove the anti-corrosion agent.

After the bearings are cleaned with filtered oil, they should be protected to prevent corrosion.

Prelubricated bearings must be used without cleaning. Bearing mounting methods depend on the bearing type and type of fit. As bearings are usually used on rotating shafts, the inner rings require a tight fit.

Bearings with cylindrical bores are usually mounted by pressing them on the shafts (press fit) or heating them to expand their diameter (shrink fit). Bearings with tapered bores can be mounted directly on tapered shafts or cylindrical shafts using tapered sleeves.

Bearings are usually mounted in housings with a loose fit. However, in cases where the outer ring has an interference fit, a press may be used. Bearings can be interference-fitted by cooling them before mounting using dry ice. In this case, a rust preventive treatment must be applied to the bearing because moisture in the air condenses on its surface.

14.2.1 Mounting of Bearings with Cylindrical Bores

(1) Press Fits

Fitting with a press is widely used for small bearings. A mounting tool is placed on the inner ring as shown in Fig. 14.1 and the bearing is slowly pressed on the shaft with a press until the side of the inner ring rests against the shoulder of the shaft. The mounting tool must not be placed on the outer ring for press mounting, since the bearing may be damaged. Before mounting, applying oil to the fitted shaft surface is recommended for smooth insertion. The mounting method using a hammer should only be used for small ball bearings with minimally tight fits and when a press is not available. In the case of tight interference fits or for medium and large bearings, this method should not be used. Any time a hammer is used, a mounting tool must be placed on the inner ring.

When both the inner and outer rings of non-separable bearings, such as deep groove ball bearings, require tight-fit, a mounting tool is placed on both rings as shown in Fig. 14.2, and both rings are fitted at the same time using a screw or hydraulic press. Since the outer ring of self-aligning ball bearings may deflect a mounting tool such as that shown in Fig. 14.2 should always be used for mounting them.

In the case of separable bearings, such as cylindrical roller bearings and tapered roller bearings, the inner and outer rings may be mounted separately. Assembly of the inner and outer rings, which were previously mounted separately, should be done carefully to align the inner and outer rings correctly. Careless or forced assembly may cause scratches on the rolling contact surfaces.

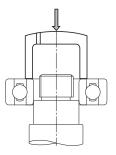


Fig. 14.1 Press Fitting Inner Ring

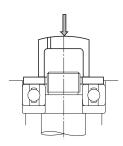
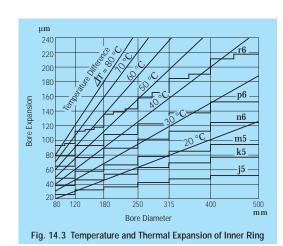


Fig. 14.2 Simultaneous Press Fitting of Inner and Outer Rings



(2) Shrink Fits

Since press fitting large bearings requires a large force, a shrink fit is widely used. The bearings are first heated in oil to expand them before mounting.

This method prevents an excessive force from being imposed on the bearings and allows mounting them in a short time.

The expansion of the inner ring for various temperature differences and bearing sizes is shown in Fig. 14.3. The precautions to follow when making shrink fits are as follows:

- (a) Do not heat bearings to more than 120°C.
- (b) Put the bearings on a wire net or suspend them in an oil tank in order to prevent them from touching the tank's bottom directly.
- (c) Heat the bearings to a temperature 20 to 30°C higher than the lowest temperature required for mounting without interference since the inner ring will cool a little during mounting.
- (d) After mounting, the bearings will shrink in the axial direction as well as the radial direction while cooling. Therefore, press the bearing firmly against the shaft shoulder using locating methods to avoid a clearance between the bearing and shoulder.

NSK Bearing Induction Heaters

Besides heating in oil, NSK Bearing Heaters, which use electromagnetic induction to heat bearings, are widely used. (Refer to Page C7.)

In NSK Bearing Heaters, electricity (AC) in a coil produces a magnetic field that induces a current inside the bearing that generates heat. Consequently, without using flames or oil uniform heating in a short time is possible, making bearing shrink fitting efficient and

In the case of relatively frequent mounting and dismounting such as cylindrical roller bearings for roll necks of rolling mills and for railway journal boxes, induction heating should be used for mounting and dismounting inner rings.

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14.2.2 Mounting of Bearings with Tapered Bores

Bearings with tapered bores are mounted on tapered shafts directly or on cylindrical shafts with adapters or withdrawal sleeves (Figs. 14.4 and 14.5). Large spherical roller bearings are often mounted using hydraulic pressure. Fig. 14.6 shows a bearing mounting utilizing a sleeve and hydraulic nut. Fig. 14.7 shows another mounting method. Holes are drilled in the sleeve which are used to feed oil under pressure to the bearing seat. As the bearing expands radially, the sleeve is inserted axially with adjusting bolts.

Spherical roller bearings should be mounted while checking their radial-clearance reduction and referring to the push-in amounts listed in Table 14.1. The radial clearance must be measured using clearance gauges.

In this measurement, as shown in Fig. 14.8, the clearance for both rows of rollers must be measured simultaneously, and these two values should be kept roughly the same by adjusting the relative position of the outer and inner rings.

When a large bearing is mounted on a shaft, the outer ring may be deformed into an oval shape by its own weight. If the clearance is measured at the lowest part of the deformed bearing, the measured value may be bigger than the true value. If an incorrect radial internal clearance is obtained in this manner and the values in Table 14.1 are used, then the interference fit may

become too tight and the true residual clearance may become too small. In this case, as shown in Fig. 14.9. one half of the total clearance at points \boldsymbol{a} and \boldsymbol{b} (which are on a horizontal line passing through the bearing center) and \boldsymbol{c} (which is at the lowest position of the bearing) may be used as the residual clearance. When a self-aligning ball bearing is mounted on a shaft with an adapter, be sure that the residual clearance does not become too small. Sufficient clearance for easy alignment of the outer ring must be allowed.

14.3 Operation Inspection

After the mounting has been completed, a running test should be conducted to determine if the bearing has been mounted correctly. Small machines may be manually operated to assure that they rotate smoothly. Items to be checked include sticking due to foreign matter or visible flaws, uneven torque caused by improper mounting or an improper mounting surface, and excessive torque caused by an inadequate clearance, mounting error, or seal friction. If there are no abnormalities, powered operation may be started.



Fig. 14.4 Mounting with Adapter

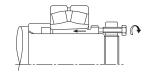


Fig. 14.5 Mounting with Withdrawal Sleeve

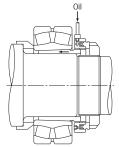


Fig. 14.6 Mounting with Hydraulic Nut

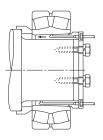


Fig. 14.7 Mounting with Special Sleeve and Hydraulic Pressure

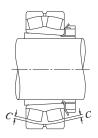


Fig. 14.8 Clearance Measurement of Spherical Roller Bearing



Units: mm

	2.1.1.2.1										
	Bearing Diam	eter		n in Radial rance	Push	-in amour	nt in axial di	rection	Minimum Permissible Residual Clearance		
	C	1			Taper	1:12	Taper	1:30			
	over	incl.	min.	max.	min.	max.	min.	max.	CN	C3	
	30	40	0.025	0.030	0.40	0.45	-	-	0.010	0.025	
	40	50	0.030	0.035	0.45	0.55	-	-	0.015	0.030	
	50	65	0.030	0.035	0.45	0.55	-	-	0.025	0.035	
	65	80	0.040	0.045	0.60	0.70	-	-	0.030	0.040	
	80	100	0.045	0.055	0.70	0.85	1.75	2.15	0.035	0.050	
	100	120	0.050	0.060	0.75	0.90	1.9	2.25	0.045	0.065	
	120	140	0.060	0.070	0.90	1.1	2.25	2.75	0.055	0.080	
	140	160	0.065	0.080	1.0	1.3	2.5	3.25	0.060	0.100	
	160	180	0.070	0.090	1.1	1.4	2.75	3.5	0.070	0.110	
	180	200	0.080	0.100	1.3	1.6	3.25	4.0	0.070	0.110	
	200	225	0.090	0.110	1.4	1.7	3.5	4.25	0.080	0.130	
	225	250	0.100	0.120	1.6	1.9	4.0	4.75	0.090	0.140	
	250	280	0.110	0.140	1.7	2.2	4.25	5.5	0.100	0.150	
	280	315	0.120	0.150	1.9	2.4	4.75	6.0	0.110	0.160	
	315	355	0.140	0.170	2.2	2.7	5.5	6.75	0.120	0.180	
	355	400	0.150	0.190	2.4	3.0	6.0	7.5	0.130	0.200	
	400	450	0.170	0.210	2.7	3.3	6.75	8.25	0.140	0.220	
	450	500	0.190	0.240	3.0	3.7	7.5	9.25	0.160	0.240	
	500	560	0.210	0.270	3.4	4.3	8.5	11.0	0.170	0.270	
	560	630	0.230	0.300	3.7	4.8	9.25	12.0	0.200	0.310	
	630	710	0.260	0.330	4.2	5.3	10.5	13.0	0.220	0.330	
	710	800	0.280	0.370	4.5	5.9	11.5	15.0	0.240	0.390	
	800	900	0.310	0.410	5.0	6.6	12.5	16.5	0.280	0.430	
	900	1 000	0.340	0.460	5.5	7.4	14.0	18.5	0.310	0.470	
	1 000	1 120	0.370	0.500	5.9	8.0	15.0	20.0	0.360	0.530	
ľ	Rema	rks The	values for	reduction i	n radial ir	nternal cle	arance are	for bearing	as with CN	I clearance	

Remarks The values for reduction in radial internal clearance are for bearings with CN clearance. For bearing with C3 Clearance, the maximum values listed should be used for the reduction in radial internal clearance.

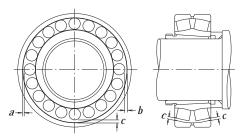


Fig. 14.9 Measuring Clearance in Large Spherical Roller Bearing

Large machines, which cannot be turned by hand, can be started after examination with no load, and the power immediately cutoff and the machine allowed to coast to a stop. Confirm that there is no abnormality such as vibration, noise, contact of rotating parts, etc. Powered operation should be started slowly without load and the operation should be observed carefully until it is determined that no abnormalities exist, then gradually increase the speed, load, etc. to their normal levels. Items to be checked during the test operation include the existence of abnormal noise, excessive rise of bearing temperature, leakage and contamination of lubricants, etc. If any abnormality is found during the test operation, it must be stopped immediately and the machine should be inspected. If necessary, the bearing should be dismounted for examination.



Although the bearing temperature can generally be estimated by the temperature of the outside surface of the housing, it is more desirable to directly measure the temperature of the outer ring using oil holes for access.

The bearing temperature should rise gradually to the steady state level within one to two hours after the operation starts. If the bearing or its mounting is improper, the bearing temperature may increase rapidly and become abnormally high. The cause of this abnormal temperature may be an excessive amount of lubricant, insufficient bearing clearance, incorrect mounting, or excessive friction of the seals.

In the case of high speed operation, an incorrect selection of bearing type or lubricating method may also cause an abnormal temperature rise.

The sound of a bearing may be checked with a noise locater or other instruments. Abnormal conditions are indicated by a loud metallic sound, or other irregular noise, and the possible cause may include incorrect lubrication, poor alignment of the shaft and housing, or the entry of foreign matter into the bearing. The possible causes and measures for irregularities are listed in Table 14.2.

Table 14. 2 Causes of and Measures for Operating Irregularities

Ir	regularities	Possible Causes	Measures					
		Abnormal Load	Improve the fit, internal clearance, preload, position of housing shoulder, etc.					
	Loud Metallic Sound (1)	Incorrect mounting	Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting method.					
	.,	Insufficient or improper Lubricant	Replenish the lubricant or select another lubricant.					
		Contact of rotating parts	Modify the labyrinth seal, etc.					
Noise	Laud Danilar	Flaws,corrosion,or scratches on raceways	Replace or clean the bearing, improve the seals, and use clean lubricant.					
	Loud Regular Sound	Brinelling	Replace the bearing and use care when handling bearings.					
		Flaking on raceway	Replace the bearing.					
		Excessive clearance	Improve the fit, clearance and preload.					
	Irregular Sound	Penetration of foreign particles	Replace or clean the bearing, improve the seals, and use clean lubricant.					
		Flaws or flaking on balls	Replace the bearing.					
		Excessive amount of lubricant	Reduce amount of lubricant, select stiffer grease.					
		Insufficient or improper lubricant	Replenish lubricant or select a better one.					
Abnorr	nal Temperature Rise	Abnormal load	Improve the fit, internal clearance, preload, position of housing shoulder.					
	Rise	Incorrect mounting	Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting, or mounting method.					
		Creep on fitted surface, excessive seal friction	Correct the seals, replace the bearing, correct the fitting or mounting.					
		Brinelling	Replace the bearing and use care when handling bearings.					
	Vibration	Flaking	Replace the bearing.					
	xial runout)	Incorrect mounting	Correct the squareness between the shaft and housing shoulder or side of spacer.					
		Penetration of foreign particles	Replace or clean the bearing, improve the seals.					
Dis	eakage or coloration of Lubricant	Too much lubricant, Penetration by foreign matter or abrasion chips	Reduce the amount of lubricant, select a stiffer grease. Replace the bearing or lubricant. Clean the housing and adjacent parts.					

Note (1) Intermittent squeal or high-pitch noise may be heard in medium- to large-sized cylindrical roller bearings or ball bearings that are operating under grease lubrication in low-temperature environments. Under such low-temperature conditions, bearing temperature will not rise resulting in fatigue nor is grease performance affected. Although intermittent squeal or high-pitch noise may occur under these conditions, the bearing is fully functional and can continue to be used. In the event that greater noise reduction or quieter running properties are needed, please contact your nearest NSK branch office.

14.4 Dismounting

A bearing may be removed for periodic inspection or for other reasons. If the removed bearing is to be used again or it is removed only for inspection, it should be dismounted as carefully as when it was mounted. If the bearing has a tight fit, its removal may be difficult. The means for removal should be considered in the original design of the adjacent parts of the machine. When dismounting, the procedure and sequence of removal should first be studied using the machine drawing and considering the type of mounting fit in order to perform the operation properly.

14.4.1 Dismounting of Outer Rings

In order to remove an outer ring that is tightly fitted, first place bolts in the push-out holes in the housing at several locations on its circumference as shown in Fig. 14.10, and remove the outer ring by uniformly tightening the bolts. These bolt holes should always be fitted with blank plugs when not being used for dismounting. In the case of separable bearings, such as tapered roller bearings, some notches should be made at several positions in the housing shoulder, as shown in Fig. 14.11, so the outer ring may be pressed out using a dismounting tool or by tapping it.

14.4.2 Dismounting of Bearings with Cylindrical Bores

If the mounting design allows space to press out the inner ring, this is an easy and fast method. In this case, the withdrawal force should be imposed only on the inner ring (Fig. 14.12). Withdrawal tools like those shown in Figs. 14.13 and 14.14 are often used.

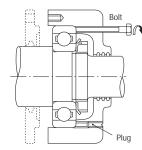


Fig. 14.10 Removal of Outer Ring with Dismounting Bolts

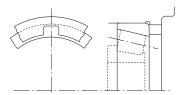


Fig. 14.11 Removal Notches

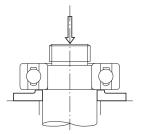


Fig. 14.12 Removal of Inner Ring Using a Press

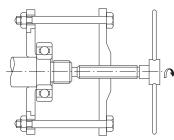


Fig. 14.13 Removal of Inner Ring Using Withdrawal Tool (1)

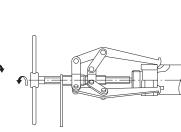


Fig. 14.14 Removal of Inner Ring Using Withdrawal Tool (2)



In both cases, the claws of the tools must substantially engage the face of the inner ring; therefore, it is advisable to consider the size of the shaft shoulder or to cut grooves in the shoulder to accommodate the withdrawal tools (Fig. 14.14).

The oil injection method is usually used for the withdrawal of large bearings. The withdrawal is achieved easily by mean of oil pressure applied through holes in the shaft. In the case of extra wide bearings, the oil injection method is used together with a withdrawal tool.

Induction heating is used to remove the inner rings of NU and NJ types of cylindrical roller bearings. The inner rings are expanded by brief local heating, and then withdrawn (Fig. 14.15). Induction heating is also used to mount several bearings of these types on a shaft.

14.4.3 Dismounting of Bearings with Tapered Bores

When dismounting relatively small bearings with adapters, the inner ring is held by a stop fastened to the shaft and the nut is loosened several turns. This is followed by hammering on the sleeve using a suitable tool as shown in Fig. 14.18. Fig. 14.16 shows one procedure for dismounting a withdrawal sleeve by tightening the removal nut. If this procedure is difficult, it may be possible to drill and tap bolt holes in the nut and withdraw the sleeve by tightening the bolts as shown in Fig. 14.17.

Large bearings may be withdrawn easily using oil pressure. Fig. 14.19 illustrates the removal of a bearing by forcing oil under pressure through a hole and groove in a tapered shaft to expand the inner ring. The bearing may suddenly move axially when the interference is relieved during this procedure so a stop nut is recommended for protection. Fig. 14.20 shows a withdrawal using a hydraulic nut.

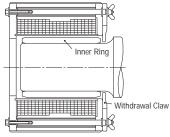


Fig. 14.15 Removal of Inner Ring Using Induction Heater



Fig. 14.16 Removal of Withdrawal Sleeve Using Withdrawal Nut (1)

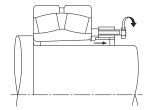


Fig. 14.17 Removal of Withdrawal Sleeve Using Withdrawal Nut (2)

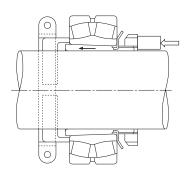


Fig. 14.18 Removal of Adapter with Stop and Axial Pressure

Fig. 14.19 Removal Using Oil Injection Hydraulic Pump

14.5 Inspection of Bearings

14.5.1 Bearing Cleaning

When bearings are inspected, the appearance of the bearings should first be recorded and the amount and condition of the residual lubricant should be checked. After the lubricant has been sampled for examination, the bearings should be cleaned. In general, light oil or kerosene may be used as a cleaning solution.

Dismounted bearings should first be given a preliminary cleaning followed by a finishing rinse. Each bath should be provided with a metal net to support the bearings in the oil without touching the sides or bottom of the tank. If the bearings are rotated with foreign matter in them during preliminary cleaning, the raceways may be damaged. The lubricant and other deposits should be removed in the oil bath during the initial rough cleaning with a brush or other means. After the bearing is relatively clean, it is given the finishing rinse. The finishing rinse should be done carefully with the bearing being rotated while immersed in the rinsing oil. It is necessary to always keep the rinsing oil clean.

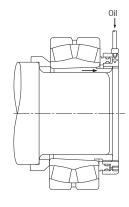


Fig. 14.20 Removal Using Hydraulic Nut

14.5.2 Inspection and Evaluation of Bearings

After being thoroughly cleaned, bearings should be examined for the condition of their raceways and external surfaces, the amount of cage wear, the increase in internal clearance, and degradation of tolerances. These should be carefully checked, in addition to examination for possible damage or other abnormalities, in order to determine the possibility for its reuse.

In the case of small non-separable ball bearings, hold the bearing horizontally in one hand, and then rotate the outer ring to confirm that it turns smoothly.

Separable bearings such as tapered roller bearings may be checked by individually examining their rolling elements and the outer ring raceway.

Large bearings cannot be rotated manually; however, the rolling elements, raceway surfaces, cages, and contact surface of the ribs should be carefully examined visually. The more important a bearing is, the more carefully it should be inspected.

The determination to reuse a bearing should be made only after considering the degree of bearing wear, the function of the machine, the importance of the bearings in the machine, operating conditions, and the time until the next inspection. However, if any of the following defects exist, reuse is impossible and replacement is necessary.

- (a) When there are cracks in the inner or outer rings, rolling elements, or cage.
- (b) When there is flaking of the raceway or rolling elements.
- (c) When there is significant smearing of the raceway surfaces, ribs, or rolling elements.
- (d) When the cage is significantly worn or rivets are loose.
- (e) When there is rust or scoring on the raceway surfaces or rolling elements.
- (f) When there are any significant impact or brinell traces on the raceway surfaces or rolling elements.(g) When there is significant evidence of creep on the
- bore or the periphery of the outer ring.
- (h) When discoloration by heat is evident.
- When significant damage to the seals or shields of grease sealed bearings has occurred.

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14.6 Maintenance and Inspection

14.6.1 Detecting and Correcting Irregularities

In order to maintain the original performance of a bearing for as long as possible, proper maintenance and inspection should be performed. If proper procedures are used, many bearing problems can be avoided and the reliability, productivity, and operating costs of the equipment containing the bearings are all improved. It is suggested that periodic maintenance be done following the procedure specified. This periodic maintenance encompasses the supervision of operating conditions, the supply or replacement of lubricants, and regular periodic inspection. Items that should be regularly checked during operation include bearing noise, vibration, temperature, and lubrication. If an irregularity is found during operation, the cause should be determined and the proper corrective actions should be taken after referring to Table 14.2. If necessary, the bearing should be dismounted and examined in detail. As for the procedure for

NSK BEARING MONITOR (Bearing Abnormality Detector)

Inspection of Bearings.

It is important during operation to detect signs of irregularities early before damage becomes severe. The NSK Bearing Monitor (see Page C5) is an instrument that checks the condition of bearings and gives a warning of any abnormality, or it stops a machine automatically in order to prevent serious trouble. In addition, it helps to improve maintenance and reduce its cost.

dismounting and inspection, refer to Section 14.5,

14.6.2 Bearing Failures and Measures

In general, if rolling bearings are used correctly they will survive to their predicted fatigue life. However, they often fail prematurely due to avoidable mistakes. In contrast to fatigue life, this premature failure is caused by improper mounting, handling, or lubrication, entry of foreign matter, or abnormal heat generation. For instance, the causes of rib scoring, as one example of premature failure, may include insufficient lubrication, use of improper lubricant, faulty lubrication system, entry of foreign matter, bearing mounting error, excessive deflection of the shaft, or any combination of these. Thus, it is difficult to determine the real cause of some premature failures. If all the conditions at the time of failure and previous to the time of failure are known, including the application. the operating conditions, and environment; then by studying the nature of the failure and its probable causes, the possibility of similar future failures can be reduced. The most frequent types of bearing failure, along with their causes and corrective actions, are listed in Table 14.3.

Table 14.3 Causes and Measures for Bearing Failures

Type of Failure	Probable Causes	Measures
Flaking Flaking of one-side of the raceway of radial bearing.	Abnomal axial load.	A loose fit should be used when mounting the outer ring of free-end bearings to allow axial expansion of the shaft.
Flaking of the raceway in symmetrical patterm.	Out-of-roundness of the housing bore.	Correct the faulty housing.
Flaking pattern inclined relative to the raceway in radial ball bearings. Flaking near the edge of the raceway and rolling surfaces in roller bearings.	Improper muonting, deflection of shaft, inadequate tolerances for shaft and housing.	Use care in mounting and centering, select a bearing with a large clearance, and correct the shaft and housing shoulder.
Flaking of raceway with same spacing as rolling elements.	Large shock load during mounting, rusting while bearing is out of operation for prolonged period.	Use care in mounting and apply a rust preventive when machine operation is suspended for a long time.
Premature flaking of raceway and rolling elements.	Insufficient clearance, excessive load, improper lubrication, rust, etc.	Select proper fit, bearing clearance, and lubricant.
Premature flaking of duplex bearings.	Excessive preload.	Adjust the preload.

Type of Failure	Probable Causes	Measures
Scoring Scoring or smearing between raceway and rolling surfaces.	Inadequate initial lubrication, excessively hard grease and high acceleration when starting.	Use a softer grease and avoid rapid acceleration.
Spiral scoring or smearing of raceway surface of thrust ball bearing.	Raceway rings are not parallel and excessive speed.	Correct the mounting, apply a preload, or select another bearing type.
Scoring or smearing between the end face of the rollers and guide rib.	Inadequate lubrication, incorrect mounting and large axial load.	Select proper lubricant and modify the mounting.
Cracks Crack in outer or inner ring.	Excessive shock load, excessive interference in fitting, poor surface cylindricality, improper sleeve taper, large fillet radius, development of thermal cracks and advancement of flaking.	Examine the loading conditions, modify the fit of bearing and sleeve. The fillet radius must be smaller than the bearing chamfer.
Crack in rolling element. Broken rib.	Advancement of flaking, shock applied to the rib during mounting or dropped during handling.	Be carefull in handling and mounting.
Fractured cage.	Abnormal loading of cage due to incorrect mounting and improper lubrication.	Reduce the mounting error and review the lubricating method and lubricant.
Indentations Indentations in raceway in same pattern as rolling elements.	Shock load during mounting or excessive load when not rotating.	Use care in handling.
Indentations in raceway and rolling elements.	Foreign matter such as metallic chips or sand.	Clean the housing, improve the seals, and use a clean lubricant.
Abnormal Wear False brinelling (phenomenon similar to brinelling)	Vibration of the bearing without rotation during shipment or rocking motion of small amplitude.	Secure the shaft and housing, use oil as a lubricant and reduce vibration by applying a preload.
Fretting	Slight wear of the fitting surface.	Increase interference and apply oil.
Wearing of raceway, rolling elements, rib, and cage.	Penentration by foreign matter, incorrect lubrication, and rust.	Improve the seals, clean the housing, and use a clean lubricant.
Creep	Insufficient interference or insufficient tightening of sleeve.	Modify the fit or tighten the sleeve
Seizure Discoloration and melting of raceway, rolling elements, and ribs.	Insufficient clearance, incorrect lubrication, or improper mounting.	Review the internal clearance and bearing fit, supply an adequate amount of the proper lubricant and improve the mounting method and related parts.
Electric Burng Fluting or corrugations.	Melting due to electric arcing.	Install a ground wire to stop the flow of electricity or insulate the beaning.
Corrosion & Rust Rust and corrosion of fitting surfaces and bearing interior.	Condensation of water from the air, or fretting. Penetration by corrosive substance(especially varnish-gas, etc).	Use care in storing and avoid high temperature and high humidity, treatment for rust prevention is necessary when operation is stopped for long time. Selection of varnish and grease.

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DEFINIONS OF SYMBOLS AND THEIR UNITS

Symbols	Nomenclature	Units
a b	Contact Ellipse Major Axis Contact Ellipse Major Axis	(mm) (mm)
$C_{ m r}$	Basic Dynamic Load Rating of Radial Bearings	(N){kgf}
C_{0r}	Basic Static Load Radial of Radial Bearings	(N){kgf}
$C_{\rm a}$	Basic Dynamic Load Rating of Thrust Bearings	(N){kgf}
C_{0a}	Basic Static Load Rating of Thrust Bearings	(N){kgf}
d	Shaft Diameter, Nominal Bearing Bore Diameter	(mm)
D	Housing Bore Diameter, Nominal Bearing Outside Diameter	(mm)
D_{e}	Outer Ring Raceway Diameter	(mm)
D_i	Inner Ring Raceway Diameter	(mm)
D_0	Housing Outside Diameter	(mm)
D_{pw}	Rolling Element Pitch Diameter	(mm)
$\dot{D_{ m W}}$	Nominal Rolling Element Diameter	(mm)
e	Contact Position of Tapered Roller End Face with Rib	(mm)
E	Modulus of Longitudinal Elasticity (Bearing Steel) 208 000 MPa{21 200 kgf/mm²}	
E(k)	Complete elliptic integral of the 2nd kind for which the population parameter is $k=\sqrt{1-\left(\frac{b}{a}\right)^2}$	
f_{0}	factor which depends on the geometry of the bearing components and on the applicable stress level	
$f(\varepsilon)$	Function of ϵ	
$F_{\rm a}$	Axial Load, Preload	(N){kgf}
$F_{ m r}$	Radial Load	(N){kgf}
h	$D_{ m e}/D$	
$h_{\scriptscriptstyle 0}$	D/D_0	
k	d/D_i	
K	Constant Determined by Internal Design of Bearing	
L	Fatigue Life when Effective Clearance is 0	
$L_{\rm we}$	Effective Leng of Roller	(mm)
L_{ϵ}	Fatigue Life when Effective Clearance is $ec{ec{\Delta}}$	
$m_{\scriptscriptstyle 0}$	Distance between Centers of Curvature of Inner and Outer Rings	
	r_i + $r_{ m e}$ - $D_{ m w}$ Frictional Torque	(mm) (N·mm){kgf·mm
Λ.4		
M $M_{ m S}$	Spin Friction	(N·mm){kgf·mm]

Symbols	Nomenclature	Units
$n_{\rm a}$	Rotating Speed of Rolling Elements	(min ⁻¹)
$n_{\rm c}$	Revolving Speed of Rolling Elements (Cape Speed)	(min ⁻¹)
$n_{\rm e}$	Speed of Ouder Ring	(min ⁻¹)
n_i	Speed of Inner Ring	(min ⁻¹)
p_{m}	Surface Pressure on Fitted Surface	$(MP_a)\{kgf/mm^2\}$
P	Bearing Load	(N){kgf}
Q	Rolling Element Load	(N){kgf}
$r_{\rm e}$	Groove Radius of Outer Ring	(mm)
r_i	Groove Radius of Inner Ring	(mm)
V a	Circumferential Speed of Rolling Element about Its Center	(m/sec)
<i>V</i> _C	Circumferential Speed of Rolling Element about Beaing Center	(m/sec)
Z	Number of Rolling Elements per Row	
α	Contact Angle (when axial load is applied on Radial Ball Bearning	(°)
α_0	Initial Confact Angle (Geometri) (when inner and outer rings of Angular Contact Ball Bearings are pushed axially)	(°)
α_R	Initial Contact Angle (Geometric) (when inner and outer rings Angular Contact Ball Bearing are pushed radially)	(°)
β	1/2 of Conical Angle of Roller	(°)
δ_a	Relative Axial Displacement of Inner and Outer Rings	(mm)
⊿a	Axial Internal Clearance	(mm)
Δd	Effective Interference of Inner Ring and Shaft	(mm)
$\Delta_{\rm r}$	Radial Internal Clearance	(mm)
ΔD	Effective Interference of Outer Ring and Housing	(mm)
$\Delta D_{\rm e}$	Contraction of Outer Ring Raceway Diameter due to Fit	(mm)
ΔD_i	Expansion of Inner Ring Raceway Diameter dus to Fit	(mm)
ε	Load Factor	
μ	Coefficient of Dynamic Friction of Rolling Bearing	
μ_{e}	Coefficient of Friction between Roller End Face and Rib	
$\mu_{\rm s}$	Coefficient of Sliding Friction	
σ_{tmax}	Maximum Stress on Fitted Surfaces	$(MP_a)\{kgf/mm^2\}$

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NSK

15. 1 Axial Displacement of Bearings

(1) Contact Angle α and Axial Displacement δ_a of Deep Groove Ball Bearing and Angular Contact Ball Bearings

(Figs. 15.1 to 15.3)
$$\delta_{a} = \frac{0.00044}{\sin \alpha} \left(\frac{Q^{2}}{D_{w}}\right)^{\frac{1}{3}} \dots (N)$$

$$\delta_{a} = \frac{0.002}{\sin \alpha} \left(\frac{Q^{2}}{D_{w}}\right)^{\frac{1}{3}} \dots \{kgf\}$$

$$Q = \frac{F_{a}}{Z\sin \alpha} \qquad (N), \{kgf\}$$

(2) Axial Load F_a and Axial Displacement δ_a of Tapered Roller Bearings (Fig. 15.4)

 $\delta_{a} = \frac{0.000077 F_{a}^{0.9}}{(\sin \alpha)^{1.9} Z^{0.9} L_{we}^{0.8}} \dots (N)$ (mm)

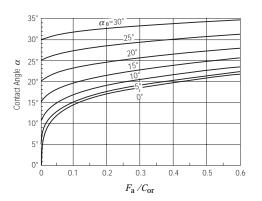


Fig. 15.1 F_a/C_{or} and Contact Angle of Deep Groove and Angular Contact Ball Bearings

Remarks:

Actual axial displacement may vary depending on the shaft/housing thickness, material, and fitting interference with the bearing. Please contact NSK about such factors of axial displacement which are not discussed in detail in this catalog.

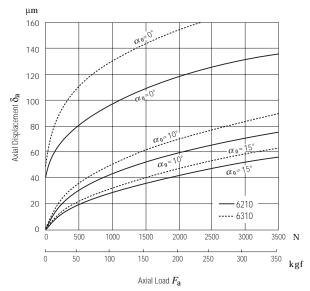


Fig. 15.2 Axial Load and Axial Displacement of Deep Groove Ball Bearings

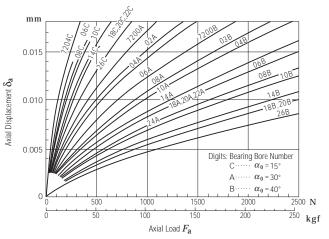


Fig. 15.3 Axial Load and Axial Displacement of Angular Contact Ball Bearings

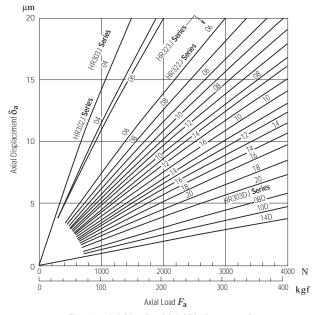


Fig. 15.4 Axial Load and Axial Displacement of Tapered Roller Bearings



15.2 Fits

(1) Surface Pressure $p_{\rm m}$, Maximum Stress $\sigma_{\rm tmax}$ on Fitted Surfaces and Expansion of Inner Ring Raceway Diameter ΔD_i or Contraction of Outer Ring Raceway Diameter ΔD_e (Table 15.1, Figs. 15.5 and 15.6)

- (2) Interferences or Clearances of Shafts and Inner Rings (Table 15.2)
- (3) Interferences or Clearances of Housing Bores and Outer Rings (Table 15.3)

Table. 15. 1 Surface Pressure, Maximum Stress on Fitted Surfaces and Expansion or Contraction

Items	Shaft & Inner Ring	Housing & Bore & Outer Ring
Surface Pressure $p_{\rm m}$ (MP _a) {kgf/mm ² }	(In case of sold shaft) $p_{\rm m} = \ \frac{E}{2} \ \frac{\varDelta d}{2} \ \ (1 - \emph{k}^2)$	In case of housing outside dia. $D_0 \neq \infty$ $p_{\rm m} = \frac{E}{2} \frac{\Delta D}{D} \frac{(1 - h^2)(1 - h_0^2)}{1 - h^2 h_0^2}$ In case $D_0 = \infty$ $p_{\rm m} = \frac{E}{2} \frac{\Delta D}{D} (1 - h^2)$
$\begin{array}{c} \text{Maximum stress} \\ \sigma_{\text{t max}} \\ \text{(MP_a)} \\ \text{\{kgf/mm^2\}} \end{array}$	Maximum circumferential stress on fitted surface of inner ring bore is $\sigma_{t \max} = p_{\text{m}} \frac{1 + k^2}{1 - k^2}$	Maximum circumferential stress on outer ring bore surface is $\sigma_{\text{t max}} = p_{\text{m}} \frac{2}{1 - h^2}$
Expansion of inner ring raceway dia. \$\Displace D_i \text{ (mm)}\$	In case of solid shaft $\Delta D_i = \Delta d \cdot k$	In case $D_0 \neq \infty$ $\Delta D_0 = \Delta D \cdot h \frac{1 - h_0^2}{1 - h^2 h_0^2}$
Contraction of outer ring raceway dia. \$\D_{\text{e}}(\text{mm})\$		In case D_0 = ∞ $ extstyle extstyle extstyle extstyle extstyle extstyle D_0 = extstyle extstyle D \cdot extstyle extstyle h$

Remarks The modulus of longitudinal elasticity and Poisson's ratio for the shaft and housing material are the same as those for inner and outer rings.

Reference 1 MPa=1 N/mm²=0.102 kgf/mm²

Table 15. 2 Interferences or Clearances

Si	70		e Plane n Bore											Interf	erences	or Cleara	ances for
Classif	ication	Dia. Deviation (Normal) $\Delta d_{\rm mp}$		fi	6	8	g5	g	<u>5</u> 6	h	15	h	6	js	5	j	5
(m	m)			Clearance		Clearance	Inter- ference	Clearance	Inter- ference	Clearance	Inter- ference	Clearance	Inter- ference	Clearance	Inter- ference	Clearance	Inter- ference
over	incl.	high	low	max.	min.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.
3 6 10	6 10 18	0 0 0	- 8 - 8 - 8	18 22 27	2 5 8	9 11 14	4 3 2	12 14 17	4 3 2	5 6 8	8 8 8	8 9 11	8 8 8	3 4	— 11 12		— 12 13
18	30	0	- 10	33	10	16	3	20	3	9	10	13	10	4.5	14.5	4	15
30	50	0	- 12	41	13	20	3	25	3	11	12	16	12	5.5	17.5	5	18
50	65	0	- 15	49	15	23	5	29	5	13	15	19	15	6.5	21.5	7	21
65	80	0	- 15	49	15	23	5	29	5	13	15	19	15	6.5	21.5	7	21
80	100	0	- 20	58	16	27	8	34	8	15	20	22	20	7.5	27.5	9	26
100	120	0	- 20	58	16	27	8	34	8	15	20	22	20	7.5	27.5	9	26
120	140	0	- 25	68	18	32	11	39	11	18	25	25	25	9	34	11	32
140	160	0	- 25	68	18	32	11	39	11	18	25	25	25	9	34	11	32
160	180	0	- 25	68	18	32	11	39	11	18	25	25	25	9	34	11	32
180	200	0	-30	79	20	35	15	44	15	20	30	29	30	10	40	13	37
200	225	0	-30	79	20	35	15	44	15	20	30	29	30	10	40	13	37
225	250	0	-30	79	20	35	15	44	15	20	30	29	30	10	40	13	37
250	280	0	- 35	88	21	40	18	49	18	23	35	32	35	11.5	46.5	16	42
280	315	0	- 35	88	21	40	18	49	18	23	35	32	35	11.5	46.5	16	42
315	355	0	- 40	98	22	43	22	54	22	25	40	36	40	12.5	52.5	18	47
355	400	0	- 40	98	22	43	22	54	22	25	40	36	40	12.5	52.5	18	47
400	450	0	- 45	108	23	47	25	60	25	27	45	40	45	13.5	58.5	20	52
450	500	0	- 45	108	23	47	25	60	25	27	45	40	45	13.5	58.5	20	52

Remarks 1. The figures for tolerance classes where stress caused by the fitting of the shaft and inner ring becomes excessive are omitted.

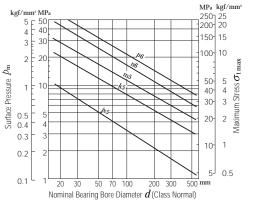


Fig. 15.5 Surface Pressure $p_{\rm m}$ and Maximum Stress $\sigma_{\rm t\,max}$ for Average Fitting Interference

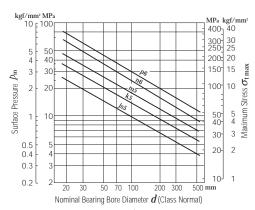


Fig. 15.6 Surface Pressure $p_{\rm m}$ and Maximum Stress $\sigma_{\rm t \ max}$ for Maximum Fitting Interference

of Shafts and Inner Rings

T	Inite	lln

Each Fit	ting Cla	SS																- Si	70
js	6	j	6	k	ι5	k	:6	n	15	n	n6	n	16	F	6	r	6	Classif	ication
Clearance	Inter- ference	Clearance	Inter- ference	Interf	erence	Interf	erence	Interf	erence	Interf	erence	Interf	erence	Interf	erence	Interfe	erence	(m	m)
max.	max.	max.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	over	incl.
— 4.5 5.5	— 12.5 13.5	_ 2 3	— 15 16		=		=		_	_	_		=		_	_ _ _	_	3 6 10	6 10 18
6.5 8 9.5	16.5 20 24.5	4 5 7	19 23 27	2 2 2	21 25 30	2 2 2	25 30 36	9 11	— 32 39	9 11	— 37 45	_ 	_	_ _ _	_		_	18 30 50	30 50 65
9.5 11 11	24.5 31 31	7 9 9	27 33 33	2 3 3	30 38 38	2 3 3	36 45 45	11 13 13	39 48 48	11 13 13	45 55 55	20 23 23	54 65 65	— 37 37	— 79 79		_	65 80 100	80 100 120
12.5 12.5 12.5	37.5 37.5 37.5	11 11 11	39 39 39	3 3 3	46 46 46	3 3 3	53 53 53	15 15 15	58 58 58	15 15 15	65 65 65	27 27 27	77 77 77	43 43 43	93 93 93	63 65 68	113 115 118	120 140 160	140 160 180
14.5 14.5 14.5	44.5 44.5 44.5	13 13 13	46 46 46	4 4 4	54 54 54	4 4 4	63 63 63	17 17 17	67 67 67	17 17 17	76 76 76	31 31 31	90 90 90	50 50 50	109 109 109	77 80 84	136 139 143	180 200 225	200 225 250
16 16 18	51 51 58	16 16 18	51 51 58	4 4 4	62 62 69	4 4 4	71 71 80	20 20 21	78 78 86	20 20 21	87 87 97	34 34 37	101 101 113	56 56 62	123 123 138	94 98 108	161 165 184	250 280 315	280 315 355
18 20 20	58 65 65	18 20 20	58 65 65	4 5 5	69 77 77	4 5 5	80 90 90	21 23 23	86 95 95	21 23 23	97 108 108	37 40 40	113 125 125	62 68 68	138 153 153	114 126 132	190 211 217	355 400 450	400 450 500

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^{2.} The tolerance range **js** is now recommended instead of **j**.

Table 15. 3 Interferences or

Si	70	Sing	e Plane n O. D.											Interf	erences	or Cleara	ances for
Classif	ication	Dev	viation ormal)	G	7	Н	16	F	I 7	H	I8	J	6	JS	66	J	7
(m	m)		Dmp	Clear	ance	Clea	rance	Clea	ırance	Clea	irance	Clearance	Inter- ference	Clearance	Inter- ference	Clearance	Inter- ference
over	incl.	high	low	max.	min.	max.	min.	max.	min.	max.	min.	max.	max.	max.	max.	max.	max.
6 10 18	10 18 30	0 0 0	- 8 - 8 - 9	28 32 37	5 6 7	17 19 22	0 0 0	23 26 30	0 0 0	30 35 42	0 0 0	13 14 17	4 5 5	12.5 13.5 15.5	4.5 5.5 6.5	16 18 21	7 8 9
30 50 80	50 80 120	0 0 0	- 11 - 13 - 15	45 53 62	9 10 12	27 32 37	0 0 0	36 43 50	0 0 0	50 59 69	0 0 0	21 26 31	6 6 6	19 22.5 26	8 9.5 11	25 31 37	11 12 13
120 150 180	150 180 250	0 0 0	- 18 - 25 - 30	72 79 91	14 14 15	43 50 59	0 0 0	58 65 76	0 0 0	81 88 102	0 0 0	36 43 52	7 7 7	30.5 37.5 44.5	12.5 12.5 14.5	44 51 60	14 14 16
250 315 400	315 400 500	0 0 0	- 35 - 40 - 45	104 115 128	17 18 20	67 76 85	0 0 0	87 97 108	0 0 0	116 129 142	0 0 0	60 69 78	7 7 7	51 58 65	16 18 20	71 79 88	16 18 20
500 630 800	630 800 1 000	0 0 0	- 50 - 75 -100	142 179 216	22 24 26	94 125 156	0 0 0	120 155 190	0 0 0	160 200 240	0 0 0	_ _ _	=	72 100 128	22 25 28	_ _ _	_ _ _

Note (*) Indicates the minimum interference

Remarks The tolerance range JS is now recommended instead of J.

15.3 Radial and Axial Internal Clearances

(1) Radial Internal Clearance $\Delta_{\rm r}$ and Axial Internal Clearance $\Delta_{\rm a}$ in Single-Row Deep Groove Ball Bearings (Fig. 15.7)

$$\Delta_{\mathbf{a}} = K \Delta_{\mathbf{r}}^{\frac{1}{2}} \tag{mm}$$

where

$$K=2 (r_{\rm e} + r_i - D_{\rm w})^{\frac{1}{2}}$$

(2) Radial Internal Clearance $\Delta_{\rm r}$ and Axial Internal Clearance $\Delta_{\rm a}$ in Double-Row Angular Contact Ball Bearings (Fig. 15.8)

$$\Delta_{\rm a} = 2\sqrt{m_0^2 - \left(m_0 \cos \alpha_{\rm R} - \frac{\Delta_{\rm r}}{2}\right)^2}$$
$$-2m_0 \sin \alpha_{\rm R} \qquad (mm)$$

Table 15. 4 Constant K

		Value	s of <i>K</i>	
Bore No.	160XX	60XX	62XX	63XX
00 01 02	— 0.80 0.80	0.80 0.93	0.93 0.93 0.93	1.14 1.06 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	1.57	1.76	2.11	2.59

Clearances of Housing Bores and Outer Rings



Each Fit	ting Cla	SS																c	ize
JS	57	K	6	К	.7	N	16	N	17	N	16	N	17	I	P6	P7		Classi	fication
Clearance	Inter- ference	Interf	erence	Interf	erence	(n	nm)												
max.	max.	max.	max.	min.	max.	over	incl.												
15	7	10	7	13	10	5	12	8	15	1	16	4	19	4	21	1	24	6	10
17	9	10	9	14	12	4	15	8	18	1*	20	3	23	7	26	3	29	10	18
19	10	11	11	15	15	5	17	9	21	2*	24	2	28	9	31	5	35	18	30
23	12	14	13	18	18	7	20	11	25	1*	28	3	33	10	37	6	42	30	50
28	15	17	15	22	21	8	24	13	30	1*	33	4	39	13	45	8	51	50	80
32	17	19	18	25	25	9	28	15	35	1*	38	5	45	15	52	9	59	80	120
38	20	22	21	30	28	10	33	18	40	2*	45	6	52	18	61	10	68	120	150
45	20	29	21	37	28	17	33	25	40	5	45	13	52	11	61	3	68	150	180
53	23	35	24	43	33	22	37	30	46	8	51	16	60	11	70	3	79	180	250
61	26	40	27	51	36	26	41	35	52	10	57	21	66	12	79	1	88	250	315
68	28	47	29	57	40	30	46	40	57	14	62	24	73	11	87	1	98	315	400
76	31	53	32	63	45	35	50	45	63	18	67	28	80	10	95	0	108	400	500
85	35	50	44	50	70	24	70	24	96	6	88	6	114	28	122	28	148	500	630
115	40	75	50	75	80	45	80	45	110	25	100	25	130	13	138	13	168	630	800
145	45	100	56	100	90	66	90	66	124	44	112	44	146	0	156	0	190	800	1 000

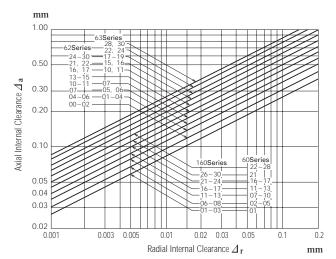


Fig. 15.7 \varDelta_r and \varDelta_a in Single-Row Deep Groove Ball Bearings

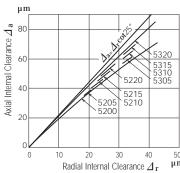


Fig. 15.8 $\varDelta_{\rm T}$ and $\varDelta_{\rm a}$ in Double-Row Angular Contact Ball Bearings (52, 53 Series)



15. 4 Preload and Staring Torque

(1) Axial Load $F_{\rm a}$ and Starting Torque M of Tapered Roller Bearings (Figs. 15.9 and 15.10)

$$M$$
 = $e \mu_{\rm e} F_{\rm a} \cos \beta$ (N·mm), {kgf·mm} where

$$\mu_{\rm e}$$
: 0.20

When bearings with the same number are used in opposition, the torque M caused by the preload becomes 2M.

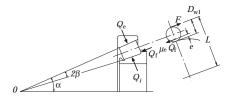


Fig. 15.9 Relation between e and β

(2) Preload $F_{\rm a}$ and Starting Torque M of Angular Contact Ball Bearings and Double-Direction Angular Contact Thrust Ball Bearings (Figs. 15.11 and 15.12)

$$M = M_{\rm s} \, Z \sin \alpha$$
 (N·mm), {kgf·mm} where $M_{\rm S}$ is spin friction

$$M_{\rm S} = \frac{3}{8} \,\mu_{\rm s} \,Q \,a \,E(k)$$
 (N·mm), {kgf·mm}

where

$$\mu_{\rm s} = 0.15$$

When bearings with the same number are used in opposition, the torque M caused by the preload becomes 2M.

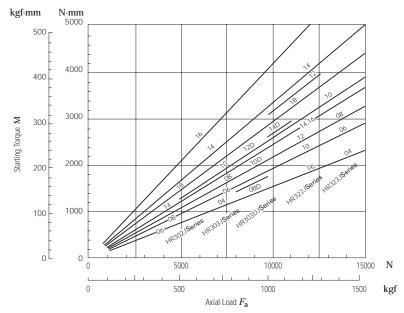


Fig. 15.10 Relation between Axial Load and Starting Torque of Tapered Roller Bearings

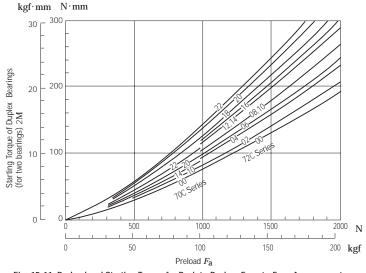


Fig. 15.11 Preload and Starting Torque for Back-to-Back or Face-to-Face Arrangements of Angular Contact Ball Bearings (α =15°)

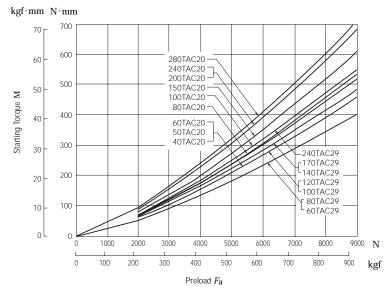


Fig. 15.12 Preload and Starting Torque of Double-Direction
Angular Contact Thrust Ball Bearings



15.5 Coefficients of Dynamic Friction and Other Bearing Data

(1) Bearing Types and Their Coefficients of Dynamic Friction μ

$$\mu = \frac{M}{P \cdot \frac{d}{2}}$$

Table 15.5 Coefficients of Dynamic Friction

Bearing Types	Approximate values of $\boldsymbol{\mu}$
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

(3) Radial Internal Clearance $\Delta_{\rm r}$ and Fatigue Life L(Fig. 15.13)

For the radial internal clearance Δ_r and the function f(ε) of the load factor, the following equations are valid:

For Deep Groove Ball Bearings

$$f(\varepsilon) = \frac{\Delta_{\rm r} \cdot D_{\rm w}^{\frac{1}{3}}}{0.00044 \left(\frac{F_{\rm r}}{Z}\right)^{\frac{2}{3}}} \tag{N}$$
$$f(\varepsilon) = \frac{\Delta_{\rm r} \cdot D_{\rm w}^{\frac{1}{3}}}{0.002 \left(\frac{F_{\rm r}}{Z}\right)^{\frac{2}{3}}} \tag{kgf}$$

$$f(\varepsilon) = \frac{\Delta_{\rm r} \cdot D_{\rm w}^{\frac{1}{3}}}{0.002 \left(\frac{F_{\rm r}}{Z}\right)^{\frac{2}{3}}} \dots \{\text{kgf}$$

For Cylindrical Roller Bearings

$$f(\varepsilon) = \frac{\Delta_{\rm r} \cdot L_{\rm we}^{0.8}}{0.000077 \left(\frac{F_{\rm r}}{Z}\right)^{0.9}}$$
 (N)

$$f(\varepsilon) = \frac{\Delta_{\rm r} \cdot L_{\rm we}^{0.8}}{0.0006 \left(\frac{F_{\rm r}}{Z}\right)^{0.9}} \dots \{\rm kgf\}$$

The relation between the load factor ε and $f(\varepsilon)$ and L_{ε}/L , when the radial internal clearance is Δ_{r} is as shown in Table 15.7.

From the above equations, first obtain $f(\varepsilon)$ and then ε and L_{ε}/L can be obtained.

(2) Circumferential Speeds of Rolling Elements about Their Centers and Bearing Center

Table 15.6 Circumferential Speeds of Rolling Elements about Their Centers and Bearing Center

Items	Rotating inner ring, fixed outer ring	Rotating outer ring, fixed inner ring
Ball rotating speed n _a (min ⁻¹)	$-\left(\frac{D_{\mathrm{pw}}}{D_{\mathrm{w}}}-\frac{\mathrm{cos}^{2}\alpha}{D_{\mathrm{pw}}/D_{\mathrm{w}}}\right)\frac{n_{i}}{2}$	$+ \left(\frac{D_{\mathrm{pw}}}{D_{\mathrm{w}}} - \frac{\cos^{2}\alpha}{D_{\mathrm{pw}}/D_{\mathrm{w}}}\right) \frac{n_{\mathrm{e}}}{2}$
Cicumferential speed around bearing ball's center υ_a (m/sec)	$-\frac{\pi \cdot D_{\mathrm{w}}}{60 \times 10^{3}} \left(\frac{D_{\mathrm{pw}}}{D_{\mathrm{w}}} - \frac{\cos^{2} \alpha}{D_{\mathrm{pw}}/D_{\mathrm{w}}}\right) \frac{n_{i}}{2}$	$+\frac{\pi \cdot D_{\mathrm{w}}}{60 \times 10^{3}} \left(\frac{D_{\mathrm{pw}}}{D_{\mathrm{w}}} - \frac{\cos^{2} \alpha}{D_{\mathrm{pw}}/D_{\mathrm{w}}}\right) \frac{n_{\mathrm{e}}}{2}$
Revolving speed around bearing center n_c (min ⁻¹)	$+ \left(1 - \frac{\cos \alpha}{D_{\rm pw}/D_{\rm w}}\right) \frac{n_i}{2}$	$+ \left(1 - \frac{\cos \alpha}{D_{\rm pw}/D_{\rm w}}\right) \frac{n_{\rm e}}{2}$
Cicumferential speed around bearing center $\upsilon_{c}\left(m/sec\right)$	$-\frac{\pi \cdot D_{\mathrm{pw}}}{60 \times 10^{3}} \left(1 - \frac{\cos \alpha}{D_{\mathrm{pw}}/D_{\mathrm{w}}}\right) \frac{n_{i}}{2}$	$+\frac{\pi \cdot D_{\mathrm{pw}}}{60 \times 10^{3}} \left(1 - \frac{\cos \alpha}{D_{\mathrm{pw}}/D_{\mathrm{w}}}\right) \frac{n_{\mathrm{e}}}{2}$

1. + sign indicates CW rotation and - sign CCW

2. The revolving speed and circumferential speed of the rolling elements are the same as those of the

Table 15. 7 ϵ and $f(\epsilon)$, L_{ϵ}/L

	Deep Groove	Ball Bearings	Cylindrical Ro	oller Bearings
ε	$f(\varepsilon)$	$\frac{L_{\mathcal{E}}}{L}$	$f(\varepsilon)$	$\frac{L_{\mathcal{E}}}{L}$
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

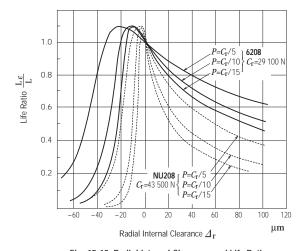


Fig. 15.13 Radial Internal Clearance and Life Ratio



15. 6 BRANDS AND PROPERTIES OF LUBRICATING GREASES

Table 15. 8 Brands of Lubricating Greases

Brands	Thickeners	Base Oils				
ADLEX	Lithium	Mineral oil				
APOLOIL AUTOLEX A	Lithium	Mineral oil				
ARAPEN RB 300	Lithium/Calcium	Mineral oil				
EA2 GREASE	Urea (3)	Poly-α-olefin oil				
EA3 GREASE	Urea (³)	Poly-α-olefin oil				
EA5 GREASE	Urea (³)	Poly-α-olefin oil				
EA7 GREASE	Urea (3)	Poly-α-olefin oil				
ENC GREASE	Urea (3)	Polyol ester oil + Mineral oil (4)				
ENS GREASE	Urea (3)	Polyol ester oil (4)				
ECE GREASE	Lithium	Poly-α-olefin oil				
ISOFLEX NBU 15	Barium Complex	Ester oil + Mineral oil (4)				
ISOFLEX SUPER LDS 18	Lithium	Ester oil (4)				
ISOFLEX TOPAS NB 52	Barium Complex	Poly-α-olefin oil				
DOW CORNING SH 33 L GREASE	Lithium	Silicone oil (5)				
DOW CORNING SH 44 M GREASE	Lithium	Silicone oil (5)				
NS HI-LUBE	Lithium	Polyol ester oil + Diester oil (4)				
NSC GREASE	Lithium	Alkyldiphenyl ether oil + Polyol ester oil (4)				
NSK CLEAN GREASE LG2	Lithium	Poly-α-olefin oil + Mineral oil				
EMALUBE 8030	Urea (³)	Mineral oil				
MA8 GREASE	Urea (³)	Alkyldiphenyl ether oil + Poly-α-olefin oil				
KRYTOX GPL-524	PTFE	Perfluoropolyether oil				
KP1 GREASE	PTFE	Perfluoropolyether oil				
COSMO WIDE GREASE WR No.3N	Sodium Terephtalamate	Polyol ester oil + Mineral oil (4)				
G-40M	Lithium	Silicone oil (5)				
SHELL GADUS S2 V220 2	Lithium	Mineral oil				
SHELL ALVANIA GREASE S1	Lithium	Mineral oil				
SHELL ALVANIA GREASE S2	Lithium	Mineral oil				
SHELL ALVANIA GREASE S3	Lithium	Mineral oil				
CASSIDA GREASE RLS 2	Aluminum Complex	Poly-α-olefin oil				
SHELL SUNLIGHT GREASE 2	Lithium	Mineral oil				
WPH GREASE	Urea (3)	Poly-α-olefin oil				
DEMNUM GREASE L-200	PTFE	Perfluoropolyether oil				
NIGACE WR-S	Urea (3)	Synthetic oil				
NIGLUBE RSH	Sodium Complex	Polyalkylene Glycol oil				

Notes (1) If grease will be used at the upper or lower limit sufficient of the temperature range or in a special environment such

- If grease will be used at the upper or lower limit sufficient of the temperature range or in a special environment such as vacuum, it is advisable to consult NSK.
 For short-term operation or when cooling is grease may be used at speeds exceeding the above limits provided the supply of grease is appropriate.
 Urea-based grease causes fluorine-based material to deteriorate.
 Ester-based grease causes acrylic rubber material to swell.
 Silicone-based grease causes silicone-based material to swell.

and Comparison of Properties

Dropping Point (°C)	Consistency	Working Temperature Range(¹)(°C)	Pressure Resistance	Usable Limit Compare to Listed Limiting Speed(2)(%)
198	300	0 to +110	Good	70
198	280	-10 to +110	Fair	60
177	294	-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	Fair	100
≧260	280	-30 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	Fair	100
192	235	-30 to +140	Fair	70
201	199	-40 to +130	Poor	100
≧260	280	0 to +130	Good	60
≧260	283	-30 to +160	Fair	70
≧260	265	0 to +200	Fair	70
≧260	280	-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
182	323	-10 to +110	Fair	70
185	275	-10 to +110	Fair	70
185	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	230	-30 to +150	Poor	70
≧260	270	-20 to +120	Fair	60

(continued on next page)

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Brands	Thickeners	Base Oils
PALMAX RBG	Lithium Complex	Mineral oil
BEACON 325	Lithium	Diester oil (4)
MULTEMP PS No.2	Lithium	Poly-α-olefin oil + Diester oil (4)
MOLYKOTE FS-3451 GREASE	PTFE	Fluorosilicone oil (5)
UME GREASE	Urea	Mineral oil
RAREMAX AF-1	Urea	Mineral oil

Ν	lotes	(
I١	OLCS	(

- (1) If grease will be used at the upper or lower limit sufficient of the temperature range or in a special environment such
- (3) Silicone-based grease causes silicone-based material to swell.

Dropping Point (°C)	Consistency	Working Temperature Range(¹)(°C)	Pressure Resistance	Usable Limit Compared to Listed Limiting Speed(2)(%)
216	300	-10 to +130	Good	70
190	274	-50 to +100	Poor	100
190	275	-50 to +110	Poor	100
≧260	285	0 to +180	Fair	70
≧260	268	-10 to +130	Fair	70
≧260	300	-10 to +130	Fair	70

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BEARING TABLES



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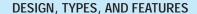
		9-
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DEEP GROOVE BALL BEARINGS

SINGLE-ROW DEEP GROOVE BALL BEARINGS

Open Type, Shielded Type, Sealed Type Bore Diameter 10 – 240mm..... B8 Open Type Bore Diameter 260 – 800mm ···· B20 MAXIMUM TYPE BALL BEARINGS Bore Diameter 25 – 110mm B26 **MAGNETO BEARINGS** Bore Diameter 4 – 20mm····· B28

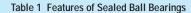
Extra Small and Miniature Ball Bearings are described on Pages B30 to B45.



SINGLE-ROW DEEP GROOVE BALL BEARINGS

Single-Row Deep Groove Ball Bearings are classified into the types shown

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.





Open Type





With Snap Ring



Shielded Type (ZZ Type)



Non-Contact **Rubber Sealed** Type (VV Type)



Contact **Rubber Sealed** Type (DDU Type)

Туре	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

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.





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



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

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RECOMMENDED FITS

SINGLE-ROW DEEP GROOVE BALL				
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	Table	9.4	(Page	A85)
MAXIMUM TYPE BALL BEARINGS	Table	9.2	(Page	A84)
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INTERNAL CLEARANCES

SINGLE-I	ROW DEEP GROOVE BA	LL	
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			, ,
IVIAXIIVIU	M TYPE BALL BEARING	S labi	e 9.9 (Page A89)
MAGNET	O BEARINGS	Tabl	e 9.11 (Page A89)

LIMITING SPEEDS

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 A37 for detailed information.

B6 B7

Shielded Type

ZZ

(N)

 $C_{\rm r}$

1 720

2 700

4 550

5 100

8 100

1 920

2 890

5 100

5 100

6 800

9 700

2 070

4 350

5 600

5 600

7 650

11 400

2 6 3 0

4 600

6 000

6 000

9 550

13 600

4 000

6 400

7 900

9 400

12 800

15 900

9 400

12 900

18 400

Basic Load Ratings

 C_{0r}

840

1 270

1 970

2 390

3 450

1 040

1 460

2 370

2 370

3 050

4 200

1 260

2 260

2 830

2 830

3 750

5 450

1 570

2 550

3 250

4 800

6 650

2 470

3 700

4 450

5 000

6 600

7 900

5 050

6 800

9 250

dimensions of sealed or shielded bearings.

Non-Contact

Sealed Type

VV

{kgf}

 $C_{0\mathrm{r}}$ f_0

86 14.8

129

201

244

350

106

149

241 13.0

241

310 12.3

425

128 15.8

230

289 13.9

289

380

555

160 15.7

260 14.7

330

330 14.4

490

675

252

375 14.7

455

510

670 13.1

805 12.4

515

695

940

(3) Ring types N and NR applicable only to open-type bearings. Please consult NSK about the snap ring groove

 $C_{\rm r}$

175

275

465

520 825

195

295

520

520

695

990

212

440

570

570

780

1 170

268

470

610

610

975

410

650

810

955

1 300

1 620

960

1 320

1 870

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A50 to A53.

(2) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.

1 390

Factor

14.0

12.4

13.2

11.2

15.3

14.5

13.0

11.1

14.3

13.9

13.2

12.3

14.4

13.2

12.4

15.5

14.5

13.8

14.0

13.5

12.4

Contact

Sealed Type

 $\mathsf{DD} \cdot \mathsf{DDU}$

Open

Z · ZZ V · VV

24 000

28 000

28 000

22 000

24 000

26 000

24 000

22 000

17 000

15 000

19 000

18 000

18 000

15 000

17 000

14 000

13 000

Limiting Speeds (min⁻¹)

DH

DDU

34 000 24 000 40 000

32 000 22 000 38 000

30 000 22 000 36 000

22 000 17 000 26 000

32 000 20 000 38 000

30 000 20 000 36 000

20 000 16 000 24 000

28 000 17 000 34 000

26 000 17 000 30 000

24 000 15 000 28 000

20 000 14 000 24 000

17 000 13 000 20 000

22 000 13 000 26 000

14 000 10 000 17 000

15 000 30 000

15 000 28 000

13 000 26 000

12 000 20 000

11 000 18 000

12 000 22 000

11 000 20 000

11 000 18 000

11 000 20 000

9 500 16 000

9 500 16 000

— 20 000

— 26 000

18 000 30 000

18 000 32 000

17 000 28 000

— 32 000

— 28 000

Grease

With Snap

Ring Groove

Ν

Oil

Open Z

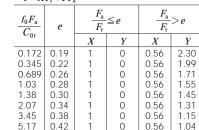
Dynamic Equivalent Load

NSK

0.56

1.00

 $P = XF_r + YF_a$



 $F_{\rm r}$

# D ₁	ϕD_a r_a ϕD_a	ϕD_X	0 0 0 1 1 1 2 3 5 6
<u></u>		Cy	

# P D 1	ϕD_a Γ_a ϕD_a	ϕD_X C_{Y-}
---------	----------------------------------	---------------------

 ϕD_2

With

Snap Ring

NR

VV DD

ZZ VV DDU

ZZ VV DDU

VV DDU

VV DDU

VV DDU

VV DDU

VV DDU

ZZ VV DDU

Bearing Numbers

Open Shielded Sealed

6800 ZZ VV DD

6000 ZZ VV DDU

6300 ZZ VV DDU

6801 ZZ VV DD

6901 ZZ VV DD

ZZ

6802 ZZ VV DD

6902 ZZ VV DD

6002 ZZ VV DDU

6202 ZZ VV DDU

6302 ZZ VV DDU

6803 ZZ VV DD

ZZ

6903 ZZ VV DDU

6303 ZZ VV DDU

6804 ZZ VV DD

6304 ZZ VV DDU

60/22 ZZ VV DDU

63/22 ZZ VV DDU

ZZ

6900 ZZ

6200

16001

6001

6201 ZZ VV DDU

6301

16002

16003

6203

6904

6004 ZZ

6204 ZZ

62/22

16004

## ## ## ## ## ## ## ## ## ## ## ## ##	ϕD_a r_a ϕD_a ϕd_a	ϕD_X $C_{Y^{-1}}$
--	--	-------------------------

ϕD_1	φD_a ϕd_a	φD _x	2.07 3.45 5.17 6.89	0.34 0.38 0.42 0.44	1 1 1 1	0 0 0 0
		$C_{Y^{-1}}$	-	•	=0.6 <i>F</i> _r +	0.5 <i>F</i> _a

With Snap	With Snap	Sna	p Ring G	roove Dim (mm)	ensions	(1)	Snap R Dimen	sions		Abutmen	t and Fille (mm		nsions		Mass (kg)
Ring Groove	Ring	a max.	$m{b}$ min.	$D_{ m 1}$ max.	r_0 max.	$\emph{r}_{ m N}$ min.	$D_{2}^{(111)}$ max.	f max.	min.	$m{d}_{\mathbf{a}}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	$r_{ m a}$ max.	D_{x} min.	$C_{\scriptscriptstyle m Y}$ max.	approx.
N(3) N(4)	— NR(3) NR(4)		 0.8 0.87	 20.8 24.5	0.2 0.2	0.2 0.3	24.8 28.7	 0.7 0.84	12 12 12	12 12.5 13	17 20 24	0.3 0.3 0.3	 25.5 29.4	 1.5 1.9	0.005 0.009 0.018
N N	NR NR	2.06 2.06	1.35 1.35	28.17 33.17	0.4 0.4	0.5 0.5	34.7 39.7	1.12 1.12	14 14	16 16.5	26 31	0.6 0.6	35.5 40.5	2.9 2.9	0.032 0.052
N(3)	 NR(3) 	 1.05 	0.8	22.8 —	0.2	0.2 —	26.8 —	0.7	14 14 14	14 14.5 —	19 22 26	0.3 0.3 0.3	 27.5 	1.5 —	0.006 0.010 0.019
N(4) N N	NR(4) NR NR	1.35 2.06 2.06	0.87 1.35 1.35	26.5 30.15 34.77	0.2 0.4 0.4	0.3 0.5 0.5	30.7 36.7 41.3	0.84 1.12 1.12	14 16 17	15.5 17 18	26 28 32	0.3 0.6 1	31.4 37.5 42	1.9 2.9 2.9	0.022 0.037 0.060
(3)	 NR(3) 	1.3 —	0.95 —	26.7 —	0.25 —	0.3	30.8 —	0.85 —	17 17 17	17 17 —	22 26 30	0.3 0.3 0.3	_ 31.5 _	1.8 —	0.007 0.015 0.027
N N N	NR NR NR	2.06 2.06 2.06	1.35 1.35 1.35	30.15 33.17 39.75	0.4 0.4 0.4	0.3 0.5 0.5	36.7 39.7 46.3	1.12 1.12 1.12	17 19 20	19 20.5 22.5	30 31 37	0.3 0.6 1	37.5 40.5 47	2.9 2.9 2.9	0.031 0.045 0.083
N(3)	NR(3)	1.3	0.95 —	28.7 —	0.25 —	0.3	32.8 —	0.85	19 19 19	19 19.5 —	24 28 33	0.3 0.3 0.3	33.5 —	1.8	0.007 0.017 0.033
N N N	NR NR NR	2.06 2.06 2.46	1.35 1.35 1.35	33.17 38.1 44.6	0.4 0.4 0.4	0.3 0.5 0.5	39.7 44.6 52.7	1.12 1.12 1.12	19 21 22	21.5 23.5 25.5	33 36 42	0.3 0.6 1	40.5 45.5 53.5	2.9 2.9 3.3	0.041 0.067 0.113
N N	NR NR —	1.3 1.7 —	0.95 0.95 —	30.7 35.7 —	0.25 0.25 —	0.3 0.3 —	34.8 39.8 —	0.85 0.85 —	22 22 22	22 24 —	30 35 40	0.3 0.3 0.3	35.5 40.5 —	1.8 2.3 —	0.017 0.037 0.048
N N N	NR NR NR	2.06 2.46 2.46	1.35 1.35 1.35	39.75 44.6 49.73	0.4 0.4 0.4	0.5 0.5 0.5	46.3 52.7 57.9	1.12 1.12 1.12	24 25 26.5	25.5 26.5 28	38 42 45.5	0.6 1 1	47 53.5 58.5	2.9 3.3 3.3	0.068 0.107 0.145
N N N	NR NR NR	2.06 2.46 2.46	1.35 1.35 1.35	41.75 47.6 53.6	0.4 0.4 0.4	0.5 0.5 0.5	48.3 55.7 61.7	1.12 1.12 1.12	26 27 28.5	26.5 29.5 30.5	40 45 49.5	0.6 1 1	49 56.5 62.5	2.9 3.3 3.3	0.074 0.119 0.179

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.

⊢-B⊸

Open Type

Boundary Dimensions

(mm)

22 6 0.3

26 8 0.3

30 35 9 0.6

21

24

28 7 0.3

28 8

32 37 10

24 5

28 7

32 8 0.3

32 35

42 13

26

30 7 0.3

35 8

35 10 0.3

40 12

47 14 1

32 7 0.3

42

42 12

47 14

52 15 1.1

44 12 0.6

56 16 1.1

11 0.6

> 5 0.3

6

9 0.3

9 0.3

8 0.3

14 50

11

min.

0.3

0.3

0.6 12

0.3

0.3

0.6

0.3 5

0.3

0.6

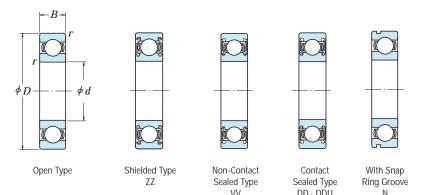
0.6

1

d DBr

10 19 5 0.3





 ϕD_2

With

Snap Ring

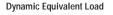
 ϕD_a

 ϕD_1

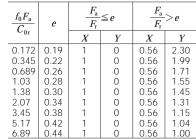
 $\phi d_a \phi D_x$

						\	/V		DD · DD	J	N			N	IR
Bou	ndary [sions		Basic Load	Ratings		Factor	Limiting	g Speeds	(min ⁻¹)		Roarin	a Nur	mbers
	(m	m)		1)	N)	{kç	gf}		Gre	ase	Oil		Dearin	y ivui	IIDEIS
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open S	hielded	Se	aled
25	37 42 47	7 9 8	0.3 0.3 0.3	4 500 7 050 8 850	3 150 4 550 5 600	455 715 905	320 460 570	16.1 15.4 15.1	18 000 16 000 15 000	10 000 10 000 —	22 000 19 000 18 000	6805 6905 16005	ZZ ZZ	VV VV	DD DDU —
	47 52 62	12 15 17	0.6 1 1.1	10 100 14 000 20 600	5 850 7 850 11 200	1 030 1 430 2 100	595 800 1 150	14.5 13.9 13.2	15 000 13 000 11 000	9 500 9 000 8 000	18 000 15 000 13 000	6005 6205 6305	ZZ ZZ ZZ	VV VV VV	DDU DDU DDU
28	52 58 68	12 16 18	0.6 1 1.1	12 500 16 600 26 700	7 400 9 500 14 000	1 270 1 700 2 730	755 970 1 430	14.5 13.9 12.4	14 000 12 000 10 000	8 500 8 000 7 500	16 000 14 000 13 000	60/28 62/28 63/28	ZZ ZZ ZZ	VV VV	DDU DDU DDU
30	42 47 55	7 9 9	0.3 0.3 0.3	4 700 7 250 11 200	3 650 5 000 7 350	480 740 1 150	370 510 750	16.4 15.8 15.2	15 000 14 000 13 000	9 000 8 500 —	18 000 17 000 15 000	6806 6906 16006	ZZ ZZ —	VV VV	DD DDU —
	55 62 72	13 16 19	1 1 1.1	13 200 19 500 26 700	8 300 11 300 15 000	1 350 1 980 2 720	845 1 150 1 530	14.7 13.8 13.3	13 000 11 000 9 500	8 000 7 500 6 700	15 000 13 000 12 000	6006 6206 6306	ZZ ZZ ZZ	VV VV	DDU DDU DDU
32	58 65 75	13 17 20	1 1 1.1	15 100 20 700 29 900	9 150 11 600 17 000	1 530 2 120 3 050	935 1 190 1 730	14.5 13.6 13.2	12 000 10 000 9 000	7 500 7 100 6 300	14 000 12 000 11 000	60/32 62/32 63/32	ZZ ZZ ZZ	VV VV VV	DDU DDU DDU
35	47 55 62	7 10 9	0.3 0.6 0.3	4 900 10 600 11 700	4 100 7 250 8 200	500 1 080 1 190	420 740 835	16.7 15.5 15.6	14 000 12 000 11 000	7 500 7 500 —	16 000 15 000 13 000	6807 6907 16007	ZZ ZZ	VV VV	DD DDU —
	62 72 80	14 17 21	1 1.1 1.5	16 000 25 700 33 500	10 300 15 300 19 200	1 630 2 620 3 400	1 050 1 560 1 960	14.8 13.8 13.2	11 000 9 500 8 500	6 700 6 300 6 000	13 000 11 000 10 000	6007 6207 6307	ZZ ZZ ZZ	VV VV VV	DDU DDU DDU
40	52 62 68	7 12 9	0.3 0.6 0.3	6 350 13 700 12 600	5 550 10 000 9 650	650 1 390 1 290	565 1 020 985	17.0 15.7 16.0	12 000 11 000 10 000	6 700 6 300 —	14 000 13 000 12 000	6808 6908 16008	ZZ ZZ	VV VV	DD DDU —
	68 80 90	15 18 23	1 1.1 1.5	16 800 29 100 40 500	11 500 17 900 24 000	1 710 2 970 4 150	1 180 1 820 2 450	15.3 14.0 13.2	10 000 8 500 7 500	6 000 5 600 5 300	12 000 10 000 9 000	6008 6208 6308	ZZ ZZ ZZ	VV VV VV	DDU DDU DDU
45	58 68 75	7 12 10	0.3 0.6 0.6	6 600 14 100 14 900	6 150 10 900 11 400	670 1 440 1 520	625 1 110 1 160	17.2 15.9 15.9	11 000 9 500 9 000	6 000 5 600 —	13 000 12 000 11 000	6809 6909 16009	ZZ ZZ —	VV VV	DD DDU —
	75 85 100	16 19 25	1 1.1 1.5	20 900 31 500 53 000	15 200 20 400 32 000	2 140 3 200 5 400	1 550 2 080 3 250	15.3 14.4 13.1	9 000 7 500 6 700	5 300 5 300 4 800	11 000 9 000 8 000	6009 6209 6309	ZZ ZZ ZZ	VV VV VV	DDU DDU DDU

- Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A50 to A53.
 - (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.



 $P = XF_r + YF_a$



NSK

Static Equivalent Load

 $\frac{F_a}{F_r}$ > 0.8, P_0 = 0.6 F_r + 0.5 F_a

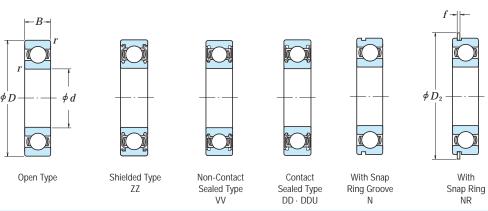
With		Sna	p Ring G	roove Dim (mm)	nensions	(1)	Snap R Dimen	sions		Abutmer	Abutment and Fillet Dimensions (mm)					
Sna _l Ring Groo	Ring	а тах.	$m{b}$ min.	$D_{ m 1}$ max.	r_0 max.	$\emph{r}_{ m N}$ min.	$D_{\scriptscriptstyle 2}^{({ m mr}}$	f max.	min.	$m{l}_{ m a}$ (2) max.	$D_{ m a}^{(2)}$	$r_{ m a}$ max.	$D_{\!\scriptscriptstyle m x}$ min.	$C_{ m Y}$ max.	арргох.	
N N	NR 3) NR(3)	1.3 1.7 —	0.95 0.95 —	35.7 40.7 —	0.25 0.25 —	0.3 0.3	39.8 44.8 —	0.85 0.85	27 27 27	27 28.5 —	35 40 45	0.3 0.3 0.3	40.5 45.5 —	1.8 2.3 —	0.021 0.042 0.059	
N	NR	2.06	1.35	44.6	0.4	0.5	52.7	1.12	29	30	43	0.6	53.5	2.9	0.079	
N	NR	2.46	1.35	49.73	0.4	0.5	57.9	1.12	30	32	47	1	58.5	3.3	0.129	
N	NR	3.28	1.9	59.61	0.6	0.5	67.7	1.7	31.5	36	55.5	1	68.5	4.6	0.235	
N	NR	2.06	1.35	49.73	0.4	0.5	57.9	1.12	32	34	48	0.6	58.5	2.9	0.096	
N	NR	2.46	1.35	55.6	0.4	0.5	63.7	1.12	33	35.5	53	1	64.5	3.3	0.175	
N	NR	3.28	1.9	64.82	0.6	0.5	74.6	1.7	34.5	38	61.5	1	76	4.6	0.287	
N N	NR NR —	1.3 1.7 —	0.95 0.95 —	40.7 45.7 —	0.25 0.25 —	0.3 0.3 —	44.8 49.8 —	0.85 0.85 —	32 32 32	32 34 —	40 45 53	0.3 0.3 0.3	45.5 50.5 —	1.8 2.3 —	0.024 0.052 0.087	
N	NR	2.08	1.35	52.6	0.4	0.5	60.7	1.12	35	36.5	50	1	61.5	2.9	0.116	
N	NR	3.28	1.9	59.61	0.6	0.5	67.7	1.7	35	38.5	57	1	68.5	4.6	0.199	
N	NR	3.28	1.9	68.81	0.6	0.5	78.6	1.7	36.5	42.5	65.5	1	80	4.6	0.345	
N	NR	2.08	1.35	55.6	0.4	0.5	63.7	1.12	37	38.5	53	1	64.5	2.9	0.122	
N	NR	3.28	1.9	62.6	0.6	0.5	70.7	1.7	37	40	60	1	71.5	4.6	0.225	
N	NR	3.28	1.9	71.83	0.6	0.5	81.6	1.7	38.5	44.5	68.5	1	83	4.6	0.389	
N N	NR NR —	1.3 1.7 —	0.95 0.95 —	45.7 53.7 —	0.25 0.25 —	0.3 0.5 —	49.8 57.8 —	0.85 0.85 —	37 39 37	37 39 —	45 51 60	0.3 0.6 0.3	50.5 58.5 —	1.8 2.3 —	0.027 0.075 0.107	
N	NR	2.08	1.9	59.61	0.6	0.5	67.7	1.7	40	41.5	57	1	68.5	3.4	0.151	
N	NR	3.28	1.9	68.81	0.6	0.5	78.6	1.7	41.5	44.5	65.5	1	80	4.6	0.284	
N	NR	3.28	1.9	76.81	0.6	0.5	86.6	1.7	43	47	72	1.5	88	4.6	0.464	
N N	NR NR —	1.3 1.7 —	0.95 0.95 —	50.7 60.7 —	0.25 0.25 —	0.3 0.5 —	54.8 64.8 —	0.85 0.85 —	42 44 42	42 46 —	50 58 66	0.3 0.6 0.3	55.5 65.5 —	1.8 2.3 —	0.031 0.112 0.13	
N	NR	2.49	1.9	64.82	0.6	0.5	74.6	1.7	45	47.5	63	1	76	3.8	0.19	
N	NR	3.28	1.9	76.81	0.6	0.5	86.6	1.7	46.5	50.5	73.5	1	88	4.6	0.366	
N	NR	3.28	2.7	86.79	0.6	0.5	96.5	2.46	48	53	82	1.5	98	5.4	0.636	
N N	NR NR —	1.3 1.7 —	0.95 0.95 —	56.7 66.7 —	0.25 0.25 —	0.3 0.3(4)	60.8 70.8 —	0.85 0.85 —	47 49 49	47.5 50 —	56 64 71	0.3 0.6 0.6	61.5 72 —	1.8 2.3 —	0.038 0.126 0.167	
N	NR	2.49	1.9	71.83	0.6	0.5	81.6	1.7	50	53.5	70	1	83	3.8	0.241	
N	NR	3.28	1.9	81.81	0.6	0.5	91.6	1.7	51.5	55.5	78.5	1	93	4.6	0.42	
N	NR	3.28	2.7	96.8	0.6	0.5	106.5	2.46	53	61.5	92	1.5	108	5.4	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.

Mass

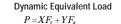
Bore Diameter 50 - 75 mm

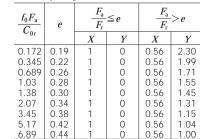


							VV		טטט יטט		N			NR	
Bou	ndary D		sions		Basic Load	Ratings		Factor	Limiting	Speeds	(min ⁻¹)	B	earing	Numbe	ers
	(m	m)		1)	1)	{kg	ſf}		Grea	se	Oil		caring	rvairib(013
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open Sh	ielded	Seale	ed :
50	65 72 80	7 12 10	0.3 0.6 0.6	6 400 14 500 15 400	6 200 11 700 12 400	655 1 480 1 570	635 1 200 1 260	17.2 16.1 16.1	9 500 9 000 8 500	5 300 5 300 —	11 000 11 000 10 000	6910			DU DU
	80 90 110	16 20 27	1 1.1 2	21 800 35 000 62 000	16 600 23 200 38 500	2 220 3 600 6 300	1 700 2 370 3 900	15.6 14.4 13.2	8 500 7 100 6 000	4 800 4 800 4 300	10 000 8 500 7 500	6210	ZZ V	V D	DU DU DU
55	72 80 90	9 13 11	0.3 1 0.6	8 800 16 000 19 400	8 500 13 300 16 300	900 1 630 1 980	865 1 350 1 660	17.0 16.2 16.2	8 500 8 000 7 500	4 800 4 500 —	10 000 9 500 9 000	6911		V D	DU DU
	90 100 120	18 21 29	1.1 1.5 2	28 300 43 500 71 500	21 200 29 300 44 500	2 880 4 450 7 300	2 170 2 980 4 550	15.3 14.3 13.1	7 500 6 300 5 600	4 500 4 300 4 000	9 000 7 500 6 700	6211	ZZ V	V D	DU DU DU
60	78 85 95	10 13 11	0.3 1 0.6	11 500 19 400 20 000	10 900 16 300 17 500	1 170 1 980 2 040	1 120 1 660 1 780	16.9 16.2 16.3	8 000 7 500 7 100	4 500 4 300 —	9 500 9 000 8 500	6912		V D	D DU -
	95 110 130	18 22 31	1.1 1.5 2.1	29 500 52 500 82 000	23 200 36 000 52 000	3 000 5 350 8 350	2 370 3 700 5 300	15.6 14.3 13.1	7 100 5 600 5 300	4 000 3 800 3 600	8 500 7 100 6 300	6212	ZZ V	V D	DU DU DU
65	85 90 100	10 13 11	0.6 1 0.6	11 900 17 400 20 500	12 100 16 100 18 700	1 220 1 770 2 090	1 230 1 640 1 910	17.0 16.6 16.5	7 500 7 100 6 700	4 000 4 000 —	8 500 8 500 8 000	6913		V D	D DU
	100 120 140	18 23 33	1.1 1.5 2.1	30 500 57 500 92 500	25 200 40 000 60 000	3 100 5 850 9 450	2 570 4 100 6 100	15.8 14.4 13.2	6 700 5 300 4 800	4 000 3 600 3 400	8 000 6 300 6 000	6213	ZZ V	V D	DU DU DU
70	90 100 110	10 16 13	0.6 1 0.6	12 100 23 700 26 800	12 700 21 200 23 600	1 230 2 420 2 730	1 300 2 160 2 410	17.2 16.3 16.3	6 700 6 300 6 000	3 800 3 600 —	8 000 7 500 7 100	6914			DU -
	110 125 150	20 24 35	1.1 1.5 2.1	38 000 62 000 104 000	31 000 44 000 68 000	3 900 6 350 10 600	3 150 4 500 6 950	15.6 14.5 13.2	6 000 5 000 4 500	3 600 3 400 3 200	7 100 6 300 5 300	6214 6314	ZZ V ZZ V	V D	DU DU DU
75	95 105 115	10 16 13	0.6 1 0.6	12 500 24 400 27 600	13 900 22 600 25 300	1 280 2 480 2 820	1 410 2 300 2 580	17.3 16.5 16.4	6 300 6 000 5 600	3 600 3 400 —	7 500 7 100 6 700	6915 7 16015 -	ZZ V	V D	DU DU
	115 130 160	20 25 37	1.1 1.5 2.1	39 500 66 000 113 000	33 500 49 500 77 000	4 050 6 750 11 600	3 400 5 050 7 850	15.8 14.7 13.2	5 600 4 800 4 300	3 400 3 200 2 800	6 700 5 600 5 000	6215	ZZ V	V D	DU DU DU

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A50 to A53.

(2) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.





1.03	0.28	1	0							
1.38	0.30	1	0							
2.07	0.34	1	0							
3.45	0.38	1	0							
5.17	0.42	1	0							
6.89	0.44	1	0							
Static Equivalent Load $\frac{F_a}{F} > 0.8, P_0 = 0.6F_r + 0.5F_r$										

 $\frac{F_a}{F_r} \leq 0.8, P_0 = F_r$

Abutment and Fillet Dimensions

1.5

2

0.6

0.6

1.5

2

118

162

101

112

123

172

141.5

136.5

6.5

7.3

2.5

3.3

6.5

7.3

103.5 1

117

139

91

100

111

122

149

108.5

With	With	(mm)					Dimen		(mm)						(kg)
Snap Ring Groove	Snap Ring	а max.	b min.	$D_{ m 1}$ max.	r_0 max.	$\emph{\textbf{r}}_{ m N}$ min.	$D_{\scriptscriptstyle 2}^{({ m mr}}$	f max.	d min.	$a^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	$m{r_{\mathrm{a}}}$ max.	$D_{\!\scriptscriptstyle m x}$ min.	$C_{ m Y}$ max.	approx.
N N	NR NR	1.3 1.7	0.95 0.95 —	63.7 70.7 —	0.25 0.25 —	0.3 0.5 —	67.8 74.8 —	0.85 0.85	52 54 54	52.5 55 —	63 68 76	0.3 0.6 0.6	68.5 76 —	1.8 2.3 —	0.050 0.135 0.175
N N N	NR NR NR	2.49 3.28 3.28	1.9 2.7 2.7	76.81 86.79 106.81	0.6 0.6 0.6	0.5 0.5 0.5	86.6 96.5 116.6	1.7 2.46 2.46	55 56.5 59	58.5 60 68	75 83.5 101	1 1 2	88 98 118	3.8 5.4 5.4	0.261 0.459 1.06
N N	NR NR	1.7 2.1 —	0.95 1.3 —	70.7 77.9 —	0.25 0.4 —	0.3 0.5 —	74.8 84.4 —	0.85 1.12 —	57 60 59	59 61.5 —	70 75 86	0.3 1 0.6	76 86 —	2.3 2.9 —	0.081 0.189 0.257
N N N	NR NR NR	2.87 3.28 4.06	2.7 2.7 3.1	86.79 96.8 115.21	0.6 0.6 0.6	0.5 0.5 0.5	96.5 106.5 129.7	2.46 2.46 2.82	61.5 63 64	64 66.5 72.5	83.5 92 111	1 1.5 2	98 108 131.5	5 5.4 6.5	0.381 0.619 1.37
N N	NR NR	1.7 2.1 —	1.3 1.3	76.2 82.9 —	0.4 0.4 —	0.3 0.5 —	82.7 89.4 —	1.12 1.12 —	62 65 64	64 66 —	76 80 91	0.3 1 0.6	84 91 —	2.5 2.9 —	0.103 0.192 0.281
N N N	NR NR NR	2.87 3.28 4.06	2.7 2.7 3.1	91.82 106.81 125.22	0.6 0.6 0.6	0.5 0.5 0.5	101.6 116.6 139.7	2.46 2.46 2.82	66.5 68 71	69 74.5 79	88.5 102 119	1 1.5 2	103 118 141.5	5 5.4 6.5	0.412 0.783 1.72
N N	NR NR —	1.7 2.1 —	1.3 1.3	82.9 87.9 —	0.4 0.4 —	0.5 0.5 —	89.4 94.4 —	1.12 1.12 —	69 70 69	69 71.5 —	81 85 96	0.6 1 0.6	91 96 —	2.5 2.9 —	0.128 0.218 0.30
N N N	NR NR NR	2.87 4.06 4.9	2.7 3.1 3.1	96.8 115.21 135.23	0.6 0.6 0.6	0.5 0.5 0.5	106.5 129.7 149.7	2.46 2.82 2.82	71.5 73 76	73 80 85.5	93.5 112 129	1 1.5 2	108 131.5 152	5 6.5 7.3	0.439 1.0 2.11
N N	NR NR —	1.7 2.5 —	1.3 1.3 —	87.9 97.9 —	0.4 0.4 —	0.5 0.5 —	94.4 104.4 —	1.12 1.12 —	74 75 74	74.5 77.5 —	86 95 106	0.6 1 0.6	96 106 —	2.5 3.3 —	0.134 0.349 0.441

Snap Ring (1)

 ϕD_a

Snap Ring Groove Dimensions (1)

 ϕD_1

NR 2.87 2.7

4.06 3.1

2.5

2.87

4.06 3.1

4.9

3.1

1.3

1.3

3.1

NR

NR 4.9

NR 1.7

NR

NR

NR

NR

106.81

120.22

145.24

92.9

102.6

111.81

125.22

155.22

0.6

0.6

0.6

0.4

0.4

0.6

0.6

0.6

0.5

0.5

0.5

0.5

0.5

0.5

0.5

0.5

116.6 2.46

134.7 2.82

159.7 2.82

99.4 1.12

110.7 1.12

121.6 2.46 139.7 2.82

169.7 2.82

 ϕd_a

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.

76.5

78

81

79

80

79

83 86

81.5

80.5

84

92

82

79.5

85.5

98.5

90

0.608

1.09

2.57

0.149

0.364

0.463

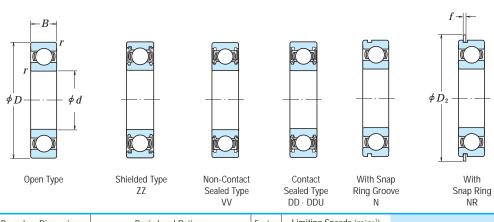
0.649

1.19

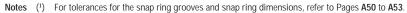
3.08

c Equivalent Load

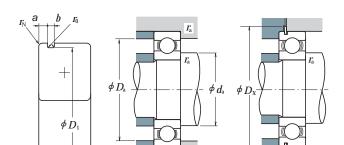
Bore Diameter 80 – 105 mm



							VV		טט י טטנ	J	N			NR
Bou	ndary E		sions		Basic Load	Ratings		Factor	Limiting	Speeds (min ⁻¹)	Be	aring N	lumbers
	(m	m)		1)	(N) {kgf}				Grea	Grease		<i>D</i> (aring i	idi i iber 3
<u>d</u>	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open Shi	elded	Sealed
80	100 110 125	10 16 14	0.6 1 0.6	12 700 25 000 32 000	14 500 24 000 29 600	1 290 2 540 3 250	1 470 2 450 3 000	17.4 16.6 16.4	6 000 5 600 5 300	3 400 3 200 —	7 100 6 700 6 300	6916 Z	Z V\ Z V\	
	125 140 170	22 26 39	1.1 2 2.1	47 500 72 500 123 000	40 000 53 000 86 500	4 850 7 400 12 500	4 050 5 400 8 850	15.6 14.6 13.3	5 300 4 500 4 000	3 200 3 000 2 800	6 300 5 300 4 800	6216 Z 6316 Z	Z V Z V Z V	/ DDU / DDU
85	110 120 130	13 18 14	1 1.1 0.6	18 700 32 000 33 000	20 000 29 600 31 500	1 910 3 250 3 350	2 040 3 000 3 200	17.1 16.4 16.5	5 600 5 300 5 000	3 200 3 000 —	6 700 6 300 6 000	6917 Z 16017 –	Z V Z V	/ DDU
	130 150 180	22 28 41	1.1 2 3	49 500 84 000 133 000	43 000 62 000 97 000	5 050 8 550 13 500	4 400 6 300 9 850	15.8 14.5 13.3	5 000 4 300 3 800	3 000 2 800 2 600	6 000 5 000 4 500	6217 Z 6317 Z	Z V Z V Z V	/ DDU / DDU
90	115 125 140	13 18 16	1 1.1 1	19 000 33 000 41 500	21 000 31 500 39 500	1 940 3 350 4 250	2 140 3 200 4 000	17.2 16.5 16.3	5 300 5 000 4 800	3 000 2 800 —	6 300 6 000 5 600	6918 Z 16018 -	Z V\ Z V\ 	
	140 160 190	24 30 43	1.5 2 3	58 000 96 000 143 000	50 000 71 500 107 000	5 950 9 800 14 500	5 050 7 300 11 000	15.6 14.5 13.3	4 800 4 000 3 600	2 800 2 600 2 400	5 600 4 800 4 300	6218 Z	Z V Z V Z V	/ DDU
95	120 130 145	13 18 16	1 1.1 1	19 300 33 500 43 000	22 000 33 500 42 000	1 970 3 450 4 350	2 240 3 400 4 250	17.2 16.6 16.4	5 000 4 800 4 500	2 800 2 800 —	6 000 5 600 5 300		Z V Z V	
	145 170 200	24 32 45	1.5 2.1 3	60 500 109 000 153 000	54 000 82 000 119 000	6 150 11 100 15 600	5 500 8 350 12 100	15.8 14.4 13.3	4 500 3 800 3 000	2 600 2 600 2 400	5 300 4 500 3 600	6219 Z	Z V Z V Z V	/ DDU
100	125 140 150	13 20 16	1 1.1 1	19 600 43 000 42 500	23 000 42 000 42 000	2 000 4 350 4 300	2 340 4 250 4 300	17.3 16.4 16.5	4 800 4 500 4 300	2 800 2 600 —	5 600 5 300 5 300	6920 Z	Z V Z V	
	150 180 215	24 34 47	1.5 2.1 3	60 000 122 000 173 000	54 000 93 000 141 000	6 150 12 500 17 700	5 550 9 500 14 400	15.9 14.4 13.2	4 300 3 600 2 800	2 600 2 400 2 200	5 300 4 300 3 400	6220 Z 6320 Z	Z V Z V Z V	/ DDU / DDU
105	130 145 160	13 20 18	1 1.1 1	19 800 42 500 52 000	23 900 42 000 50 500	2 020 4 300 5 300	2 440 4 300 5 150	17.4 16.5 16.3	4 800 4 300 4 000	2 600 — —	5 600 5 300 4 800	6921 Z 16021 –	Z V\ Z V\ 	/
	160 190 225	26 36 49	2 2.1 3	72 500 133 000 184 000	66 000 105 000 154 000	7 400 13 600 18 700	6 700 10 700 15 700	15.8 14.4 13.2	4 000 3 400 2 600	2 400 2 200 2 000	4 800 4 000 3 200	6221 Z	Z V Z V Z —	



⁽²⁾ When heavy axial loads are applied, increase d_a and decrease D_a from the above values.



Dynamic Equivalent Load	
$P = XF_r + YF_a$	

$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
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		e		$\leq e$	>e			
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	c_{0r}		X	Y	X	Y		
0.689 0.26 1 0 0.56 1.71 1.03 0.28 1 0 0.56 1.55	0.172	0.19	1	0	0.56	2.30		
1.03 0.28 1 0 0.56 1.55	0.345	0.22	1	0	0.56	1.99		
	0.689	0.26	1	0	0.56	1.71		
1.38 0.30 1 0 0.56 1.45	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	2.07	0.34	1	0	0.56	1.31		
3.45 0.38 1 0 0.56 1.15	3.45	0.38	1	0	0.56	1.15		
5.17 0.42 1 0 0.56 1.04	5.17	0.42	1	0	0.56	1.04		
6.89 0.44 1 0 0.56 1.00	6.89	0.44	1	0	0.56	1.00		

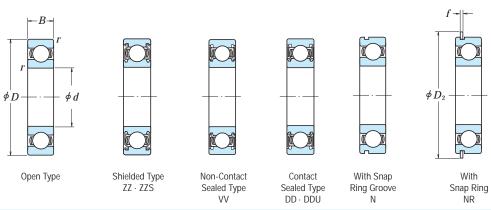
Static Equivalent Load

$\frac{F_{\rm a}}{F_{\rm r}}$ >0.8, $P_{\rm 0}$ =0.6 $F_{\rm r}$ +0.5 $F_{\rm a}$	1
$\frac{F_{\rm a}}{F_{\rm r}} \leq 0.8, P_0 = F_{\rm r}$	

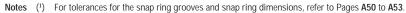
With	With	Snap Ring Groove Dimensions (1) (mm)				Snap Ring (¹) Abutment Dimensions (mm)			nt and Fillet Dimensions (mm)				Mass (kg)		
Snap Ring Groov	Ring	а max.	b min.	$D_{ m 1}$ max.	r_0 max.	$\emph{r}_{ m N}$ min.	$D_{2}^{(\mathrm{mr})}$	f max.	min.	$m{d}_{\mathbf{a}}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	$r_{ m a}$ max.	$D_{ m x}$ min.	$C_{\scriptscriptstyle m Y}$ max.	approx.
N N	NR NR	1.7 2.5 —	1.3 1.3 —	97.9 107.6 —	0.4	0.5 0.5 —	104.4 115.7	1.12 1.12 —	84 85 84	84.5 87.5 —	96 105 121	0.6 1 0.6	106 117 —	2.5 3.3	0.151 0.391 0.621
N N N	NR NR NR NR	2.87 4.9 5.69 2.1	3.1 3.1 3.5 1.3	120.22 135.23 163.65 107.6	0.6 0.6 0.6 0.4	0.5 0.5 0.5 0.5	134.7 149.7 182.9 115.7	2.82 2.82 3.1 1.12	86.5 89 91 90	91 95.5 104.5 90.5	118.5 131 159 105	1 2 2	136.5 152 185 117	5.3 7.3 8.4 2.9	0.872 1.42 3.67 0.263
N N	NR — NR	3.3 — 2.87	1.3 — 3.1	117.6 — 125.22	0.4	0.5	125.7 — 139.7	1.12 — 2.82	91.5 89 91.5	94.5 — 96	113.5 126 123.5	1 0.6	127 — 141.5	4.1 — 5.3	0.55 0.652 0.918
N N	NR NR NR	4.9 5.69	3.1 3.1 3.5	125.22 145.24 173.66	0.6 0.6 0.6	0.5 0.5 0.5	159.7 192.9	2.82 2.82 3.1	94 98	102 110.5	141 167	1 2 2.5	162 195	7.3 8.4	1.76 4.28
N N	NR NR	2.1 3.3 —	1.3 1.3 —	112.6 122.6 —	0.4 0.4 —	0.5 0.5 —	120.7 130.7 —	1.12 1.12 —	95 96.5 95	95.5 98.5 —	110 118.5 135	1 1 1	122 132 —	2.9 4.1 —	0.276 0.585 0.873
N N N	NR NR NR	3.71 4.9 5.69	3.1 3.1 3.5	135.23 155.22 183.64	0.6 0.6 0.6	0.5 0.5 0.5	149.7 169.7 202.9	2.82 2.82 3.1	98 99 103	103 107.5 117	132 151 177	1.5 2 2.5	152 172 205	6.1 7.3 8.4	1.19 2.18 4.98
N N	NR NR —	2.1 3.3 —	1.3 1.3 —	117.6 127.6 —	0.4 0.4 —	0.5 0.5 —	125.7 135.7 —	1.12 1.12 —	100 101.5 100	101.5 103.5 —	115 123.5 140	1 1 1	127 137 —	2.9 4.1 —	0.297 0.601 0.904
N N N	NR NR NR	3.71 5.69 5.69	3.1 3.5 3.5	140.23 163.65 193.65	0.6 0.6 0.6	0.5 0.5 0.5	154.7 182.9 212.9	2.82 3.1 3.1	103 106 108	108.5 114 123.5	137 159 187	1.5 2 2.5	157 185 215	6.1 8.4 8.4	1.23 2.64 5.76
N N	NR NR	2.1 3.3 —	1.3 1.9 —	122.6 137.6 —	0.4 0.6 —	0.5 0.5 —	130.7 145.7 —	1.12 1.7 —	105 106.5 105	105.5 111 —	120 133.5 145	1 1 1	132 147 —	2.9 4.7 —	0.31 0.828 0.945
N N	NR NR	3.71 5.69 —	3.1 3.5 —	145.24 173.66 —	0.6 0.6	0.5 0.5 —	159.7 192.9 —	2.82 3.1 —	108 111 113	112.5 121.5 133	142 169 202	1.5 2 2.5	162 195 —	6.1 8.4 —	1.29 3.17 7.04
N N	NR NR —	2.1 3.3 —	1.3 1.9 —	127.6 142.6 —	0.4 0.6 —	0.5 0.5 —	135.7 150.7 —	1.12 1.7 —	110 111.5 110	110.5 116 —	125 138.5 155	1 1 1	137 152 —	2.9 4.7 —	0.324 0.856 1.24
N N	NR NR —	3.71 5.69 —	3.1 3.5 —	155.22 183.64 —	0.6 0.6 —	0.5 0.5 —	169.7 202.9 —	2.82 3.1 —	114 116 118	120 127.5 138	151 179 212	2 2 2.5	172 205 —	6.1 8.4 —	1.58 3.79 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.

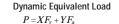
Bore Diameter 110 – 160 mm

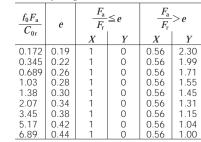


							VV		טטע י טטע		N		ı	VK .
Bou	ndary [sions		Basic Load	l Ratings		Factor	Limiting	Speeds (min ⁻¹)		Bearing Nu	mhers
	(m	m)		1)	۷)	{k	gf}		Grea	se	Oil		Dearing iva	ITIDOIS
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open	Shielded S	ealed
110	140 150 170	16 20 19	1 1.1 1	28 100 43 500 57 500	32 500 44 500 56 500	2 860 4 450 5 850	3 350 4 550 5 800	17.1 16.6 16.3	4 300 4 300 3 800	2 400 2 400 —	5 300 5 000 4 500	6822 6922 16022	ZZ VV ZZ VV	DDU DDU
	170 200 240	28 38 50	2 2.1 3	85 000 144 000 205 000	73 000 117 000 179 000	8 650 14 700 20 900	7 450 11 900 18 300	15.5 14.3 13.2	3 800 2 800 2 400	2 200 2 200 —	4 500 3 400 3 000	6022 6222 6322	ZZ VV ZZ VV ZZ —	DDU DDU
120	150 165 180	16 22 19	1 1.1 1	28 900 53 000 56 500	35 500 54 000 57 500	2 950 5 400 5 800	3 650 5 500 5 850	17.3 16.5 16.5	4 000 3 800 3 600	2 200 — —	4 800 4 500 4 300	6824 6924 16024	ZZ VV ZZ — — —	DD _ _
	180 215 260	28 40 55	2 2.1 3	88 000 155 000 207 000	80 000 131 000 185 000	9 000 15 800 21 100	8 150 13 400 18 800	15.7 14.4 13.5	3 600 2 600 2 200	2 200 2 000 1 800	4 300 3 200 2 800	6024 6224 6324	ZZ VV ZZ VV ZZS —	DDU DDU DDU
130	165 180 200	18 24 22	1.1 1.5 1.1	37 000 65 000 75 500	44 000 67 500 77 500	3 750 6 650 7 700	4 450 6 850 7 900	17.1 16.5 16.4	3 600 3 400 3 000	2 000	4 300 4 000 3 600	6826 6926 16026	ZZS VV ZZ — — —	DD — —
	200 230 280	33 40 58	2 3 4	106 000 167 000 229 000	101 000 146 000 214 000	10 800 17 000 23 400	10 300 14 900 21 800	15.8 14.5 13.6	3 000 2 400 2 200	1 900 — —	3 600 3 000 2 600	6026 6226 6326	ZZ – ZZ – ZZS –	DDU — —
140	175 190 210	18 24 22	1.1 1.5 1.1	38 500 66 500 77 500	48 000 72 000 82 500	3 900 6 800 7 900	4 850 7 300 8 400	17.3 16.6 16.5	3 400 3 200 2 800	1 900 — —	4 000 3 800 3 400	6828 6928 16028	ZZ VV ZZS VV — —	DDU — —
	210 250 300	33 42 62	2 3 4	110 000 166 000 253 000	109 000 150 000 246 000	11 200 17 000 25 800	11 100 15 300 25 100	16.0 14.9 13.6	2 800 2 200 2 000	1 800 1 700 —	3 400 2 800 2 400	6028 6228 6328	ZZ — ZZS — ZZS —	DDU DDU
150	190 210 225	20 28 24	1.1 2 1.1	47 500 85 000 84 000	58 500 90 500 91 000	4 850 8 650 8 550	5 950 9 200 9 250	17.1 16.5 16.6	3 200 2 600 2 600	1 800 1 700 —	3 800 3 200 3 000	6830 6930 16030	ZZ VV ZZS — — —	DDU DDU
	225 270 320	35 45 65	2.1 3 4	126 000 176 000 274 000	126 000 168 000 284 000	12 800 18 000 28 000	12 800 17 100 28 900	15.9 15.1 13.9	2 600 2 000 1 800	1 700 — —	3 000 2 600 2 200	6030 6230 6330	ZZ VV ZZS — ZZS —	DDU — —
160	200 220 240	20 28 25	1.1 2 1.5	48 500 87 000 99 000	61 000 96 000 108 000	4 950 8 850 10 100	6 250 9 800 11 000	17.2 16.6 16.5	2 600 2 600 2 400	1 700 1 600 —	3 200 3 000 2 800	6832 6932 16032	ZZS VV ZZS — — —	DDU DDU —
	240 290 340	38 48 68	2.1 3 4	137 000 185 000 278 000	135 000 186 000 287 000	13 900 18 900 28 300	13 800 19 000 29 200	15.9 15.4 13.9	2 400 1 900 1 700	1 600 — —	2 800 2 400 2 000	6032 6232 6332	ZZ — ZZS — ZZS —	DDU — —



⁽²⁾ When heavy axial loads are applied, increase d_a and decrease D_a from the above values.





 $\frac{F_a}{F_r} > 0.8$, $P_0 = 0.6F_r + 0.5F_a$

$F_{\rm a}$	<00	D	E
$F_{\rm r}$	·≦0.8,	P_0	$=P_{\Gamma}$

With	With	Sna	Snap Ring Groove Dimensions (I) (mm)				Dimen	sions	Snap Ring (¹) A Dimensions (mm)			et Dime	ensions		Mass (kg)
Snap Ring Groov	Ring	a max.	$m{b}$ min.	$D_{ m 1}$ max.	r_0 max.	$\emph{r}_{ m N}$ min.	$D_{\!\scriptscriptstyle 2}^{\scriptscriptstyle (m ff1f}$ max.	f max.	min.	$m{l}_{\mathbf{a}}^{(2)}$ max.	$D_{ m a}^{(2)}$	$\emph{\textbf{r}}_{a}$ max.	$D_{ m x}$ min.	$C_{ m Y}$ max.	арргох.
N N	NR NR	2.5 3.3	1.9 1.9 —	137.6 147.6	0.6 0.6	0.5 0.5	145.7 155.7 —	1.7 1.7 —	115 116.5 115	117 121 —	135 143.5 165	1 1 1	147 157 —	3.9 4.7 —	0.497 0.893 1.51
N N	NR NR	3.71 5.69	3.5 3.5 —	163.65 193.65 —	0.6 0.6	0.5 0.5 —	182.9 212.9 —	3.1 3.1 —	119 121 123	124.5 134 147	161 189 227	2 2 2.5	185 215 —	6.4 8.4	1.94 4.45 9.51
N N	NR NR	2.5 3.7 —	1.9 1.9 —	147.6 161.8 —	0.6 0.6	0.5 0.5 —	155.7 171.5 —	1.7 1.7 —	125 126.5 125	127 132 —	145 158.5 175	1 1 1	157 173 —	3.9 5.1	0.537 1.21 1.6
N _	NR —	3.71 — —	3.5	173.66 — —	0.6	0.5 —	192.9 — —	3.1 _ _	129 131 133	134.5 146 161	171 204 247	2 2 2.5	195 — —	6.4	2.08 5.29 12.5
N N	NR NR	3.3 3.7 —	1.9 1.9 —	161.8 176.8 —	0.6 0.6	0.5 0.5 —	171.5 186.5 —	1.7 1.7 —	136.5 138 136.5	138 144 —	158.5 172 193.5	1 1.5 1	173 188 —	4.7 5.1	0.758 1.57 2.4
N _	NR —	5.69 — —	3.5 — —	193.65 — —	0.6	0.5 —	212.9 — —	3.1 _ _	139 143 146	148.5 157 175	191 217 264	2 2.5 3	215 — —	8.4	3.26 5.96 15.2
N N	NR NR	3.3 3.7	1.9 1.9 —	171.8 186.8 —	0.6 0.6	0.5 0.5 —	181.5 196.5 —	1.7 1.7 —	146.5 148 146.5	148.5 153.5	168.5 182 203.5	1 1.5 1	183 198 —	4.7 5.1	0.832 1.67 2.84
_	_	_ _	_	_ _ _	_	_	_ _ _	_ _ _	149 153 156	158.5 171.5 187	201 237 284	2 2.5 3	_ _ _	_	3.48 7.68 18.5
N 	NR —	3.3	1.9 — —	186.8 — —	0.6	0.5	196.5 — —	1.7 —	156.5 159 156.5	160 166 —	183.5 201 218.5	1 2 1	198 — —	4.7 —	1.15 3.01 3.62
_	_	_ _ _	_	— · — ·	_	_	_ _ _	_	161 163 166	170 186 203	214 257 304	2 2.5 3	— ·	_ _ _	4.24 10 22.7
N 	NR —	3.3	1.9 	196.8 — —	0.6	0.5 — —	206.5 — —	1.7 —	166.5 169 168	170.5 176	193.5 211 232	1 2 1.5	208 	4.7 —	1.23 2.71 4.2
_	=	_	_	_	_	_	_ _ _		171 173 176	181.5 202 215.5	229 277 324	2 2.5 3	_	_	5.15 12.8 26.2

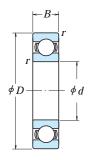
 ϕD_a

 ϕD_1

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

										VV		
Bou	ndary D		sions		Basic Load			Factor	Limiting	Speeds (min ⁻¹)	Bearing Numbers
	(m	m)		(1	N)	{k	gf}		Grea	ise	Oil	3
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open Shielded Sealed
170	215 230 260	22 28 28	1.1 2 1.5	60 000 86 000 114 000	75 000 97 000 126 000	6 100 8 750 11 700	7 650 9 850 12 900	17.1 16.7 16.5	2 600 2 400 2 200	1 600 — —	3 000 2 800 2 600	6834 ZZS VV DDU 6934 ZZS — — 16034 — — —
	260 310 360	42 52 72	2.1 4 4	161 000 212 000 325 000	161 000 224 000 355 000	16 400 21 700 33 500	16 400 22 800 36 000	15.8 15.3 13.6	2 200 1 800 1 600	_	2 600 2 200 2 000	6034 ZZS VV — 6234 ZZS — — 6334 — — —
180	225 250 280	22 33 31	1.1 2 2	60 500 119 000 145 000	78 500 128 000 157 000	6 200 12 100 14 700	8 000 13 100 16 000	17.2 16.4 16.3	2 400 2 200 2 000	_	2 800 2 600 2 400	6836 — VV — 6936 ZZS — — 16036 — — —
	280 320 380	46 52 75	2.1 4 4	180 000 227 000 355 000	185 000 241 000 405 000	18 400 23 200 36 000	18 800 24 600 41 500	15.6 15.1 13.9	2 000 1 700 1 500	_ _ _	2 400 2 000 1 800	6036 ZZS VV — 6236 ZZS — — 6336 — — —
190	240 260 290	24 33 31	1.5 2 2	73 000 113 000 149 000	93 500 127 000 168 000	7 450 11 500 15 200	9 550 13 000 17 100	17.1 16.6 16.4	2 200 2 200 2 000		2 600 2 600 2 400	6838 — VV — 6938 — — — 16038 — — —
	290 340 400	46 55 78	2.1 4 5	188 000 255 000 355 000	201 000 282 000 415 000	19 200 26 000 36 000	20 500 28 700 42 500	15.8 15.0 14.1	2 000 1 600 1 400		2 400 2 000 1 700	6038 ZZS — — 6238 ZZS — — 6338 — — —
200	250 280 310	24 38 34	1.5 2.1 2	74 000 143 000 161 000	98 000 158 000 180 000	7 550 14 600 16 400	10 000 16 100 18 300	17.2 16.4 16.4	2 200 2 000 1 900	_	2 600 2 400 2 200	6840 — — — 6940 ZZS — — 16040 — — —
	310 360 420	51 58 80	2.1 4 5	207 000 269 000 380 000	226 000 310 000 445 000	21 100 27 400 38 500	23 000 31 500 45 500	15.6 15.2 13.8	1 900 1 500 1 300		2 200 1 800 1 600	6040 ZZS — — 6240 ZZS — — 6340 — — —
220	270 300 340	24 38 37	1.5 2.1 2.1	76 500 146 000 180 000	107 000 169 000 217 000	7 800 14 900 18 400	10 900 17 300 22 100	17.4 16.6 16.5	1 900 1 800 1 600		2 400 2 200 2 000	6844 ZZS — — 6944 ZZS — — 16044 — — —
	340 400 460	56 65 88	3 4 5	235 000 310 000 410 000	271 000 375 000 520 000	24 000 31 500 42 000	27 600 38 500 53 000	15.6 15.1 14.3	1 700 1 300 1 200	_	2 000 1 600 1 500	6044 ZZS — — 6244 — — — 6344 — — —
240	300 320 360	28 38 37	2 2.1 2.1	98 500 154 000 196 000	137 000 190 000 243 000	10 000 15 700 19 900	14 000 19 400 24 700	17.3 16.8 16.5	1 700 1 700 1 500	_	2 000 2 000 1 900	6848 — — — 6948 ZZS — — 16048 — — —
	360 440 500	56 72 95	3 4 5	244 000 340 000 470 000	296 000 430 000 625 000	24 900 34 500 48 000	30 000 44 000 63 500	15.9 15.2 14.2	1 500 1 200 1 100	=	1 900 1 500 1 300	6048 — — — 6248 — — — 6348 — — —

Note (1) When heavy axial loads are applied, increase d_a and decrease D_a from the above values. **Remarks** When using bearings with rotating outer rings, contact NSK if they are sealed or shielded.



 $P = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{\rm a}}{F_{\rm r}} > e$		
Our		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	



$$\frac{F_{\rm a}}{F_{\rm r}} \leq 0.8, \ P_0 = F_{\rm r}$$

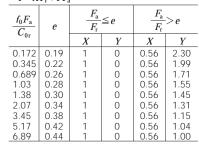
	Abutment and Fillet Dimensions (mm)										
d_{i} min.	max.	$D_{ m a}^{(1)}$ max.	$r_{ m a}$ max.	approx.							
				1.86 3.34 5.71 6.89 15.8 36.6 1.98 4.16 7.5 8.88 15.9 43.1 2.53 5.18 9.39 22.3 49.7 2.67 7.28 10 12 26.7 55.3 2.9 7.88 13.1 18.6 6.7 55.3 2.9 7.88 13.1 18.6 19.7 19.7 19.7 19.7 19.7 19.7 19.7 19.7							
253 256 260	_ _ _	347 424 480	2.5 3 4	19.9 50.5 94.4							

 ϕD_a

Bore Diameter 260 - 360 mm

Dynamic Equivalent Load



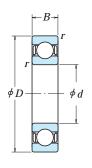


NSK



$$\frac{F_a}{F_r} > 0.8$$
, $P_0 = 0.6F_r + 0.5F_a$

$$\frac{F_{\rm a}}{F_{\rm r}} \leq 0.8, \ P_0 = F_{\rm r}$$



Open Type

Во	oundary [(m	Dimensio m)	ons	A)	Basic Load	I Ratings {kg	gf}	Factor	Limiting :		Bearing Numbers
d	$egin{array}{cccccccccccccccccccccccccccccccccccc$			$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	Open
260	320	28	2	101 000	148 000	10 300	15 100	17.4	1 600	1 900	6852
	360	46	2.1	204 000	255 000	20 800	26 000	16.5	1 500	1 800	6952
	400	44	3	237 000	310 000	24 100	31 500	16.4	1 400	1 700	16052
	400	65	4	291 000	375 000	29 700	38 500	15.8	1 400	1 700	6052
	480	80	5	400 000	540 000	41 000	55 000	15.1	1 100	1 300	6252
	540	102	6	505 000	710 000	51 500	72 500	14.6	1 000	1 200	6352
280	350	33	2	133 000	191 000	13 600	19 500	17.3	1 500	1 700	6856
	380	46	2.1	209 000	272 000	21 300	27 700	16.6	1 400	1 700	6956
	420	44	3	243 000	330 000	24 700	33 500	16.5	1 300	1 600	16056
	420	65	4	300 000	410 000	31 000	41 500	16.0	1 300	1 600	6056
	500	80	5	400 000	550 000	41 000	56 000	15.2	1 000	1 300	6256
	580	108	6	570 000	840 000	58 000	86 000	14.5	900	1 100	6356
300	380	38	2.1	166 000	233 000	17 000	23 800	17.1	1 300	1 600	6860
	420	56	3	269 000	370 000	27 400	38 000	16.4	1 300	1 500	6960
	460	50	4	285 000	405 000	29 000	41 000	16.4	1 200	1 400	16060
	460	74	4	355 000	500 000	36 500	51 000	15.8	1 200	1 400	6060
	540	85	5	465 000	670 000	47 500	68 500	15.1	950	1 200	6260
320	400	38	2.1	168 000	244 000	17 200	24 900	17.2	1 300	1 500	6864
	440	56	3	266 000	375 000	27 100	38 000	16.5	1 200	1 400	6964
	480	50	4	293 000	430 000	29 800	44 000	16.5	1 100	1 300	16064
	480	74	4	390 000	570 000	40 000	58 000	15.7	1 100	1 300	6064
	580	92	5	530 000	805 000	54 500	82 500	15.0	850	1 100	6264
340	420	38	2.1	175 000	265 000	17 800	27 100	17.3	1 200	1 400	6868
	460	56	3	273 000	400 000	27 800	40 500	16.6	1 100	1 300	6968
	520	82	5	440 000	660 000	45 000	67 500	15.6	1 000	1 200	6068
	620	92	6	530 000	820 000	54 000	83 500	15.3	800	1 000	6268
360	440	38	2.1	192 000	290 000	19 600	29 600	17.3	1 100	1 300	6872
	480	56	3	280 000	425 000	28 500	43 000	16.7	1 100	1 300	6972
	540	82	5	460 000	720 000	47 000	73 500	15.7	950	1 200	6072
	650	95	6	555 000	905 000	57 000	92 000	15.4	750	950	6272

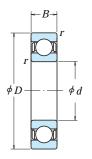
	Abutment and Fillet Dimensions (mm)										
$d_{\!\scriptscriptstyle a}^{\!\scriptscriptstyle (1)}$ min.	$D_{\!\scriptscriptstyle a}^{\scriptscriptstyle (1)}$ max.	$r_{ m a}$ max.	approx.								
269	311	2	4.84								
271	349	2	14								
273	387	2.5	21.1								
276	384	3	29.4								
280	460	4	67								
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								

 ϕD_a

Note (1) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.



Bore Diameter 380 - 600 mm



Open Type

Во	oundary [(m	Dimension)	ons	1)	Basic Load		gf}	Factor	Limiting :		Bearing Numbers
d	D	B	$r \atop { m min.}$	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	Open
380	480	46	2.1	238 000	375 000	24 200	38 000	17.1	1 000	1 200	6876
	520	65	4	325 000	510 000	33 000	52 000	16.6	950	1 200	6976
	560	82	5	455 000	725 000	46 500	74 000	15.9	900	1 100	6076
400	500	46	2.1	241 000	390 000	24 600	40 000	17.2	950	1 200	6880
	540	65	4	335 000	540 000	34 000	55 000	16.7	900	1 100	6980
	600	90	5	510 000	825 000	52 000	84 000	15.7	850	1 000	6080
420	520	46	2.1	245 000	410 000	25 000	41 500	17.3	900	1 100	6884
	560	65	4	340 000	570 000	35 000	58 500	16.8	900	1 100	6984
	620	90	5	530 000	895 000	54 000	91 000	15.8	800	1 000	6084
440	540	46	2.1	248 000	425 000	25 300	43 500	17.4	900	1 100	6888
	600	74	4	395 000	680 000	40 500	69 000	16.6	800	1 000	6988
	650	94	6	550 000	965 000	56 000	98 500	16.0	750	900	6088
460	580	56	3	310 000	550 000	31 500	56 000	17.1	800	1 000	6892
	620	74	4	405 000	720 000	41 500	73 500	16.7	800	950	6992
	680	100	6	605 000	1 080 000	62 000	110 000	15.8	710	850	6092
480	600	56	3	315 000	575 000	32 000	58 500	17.2	800	950	6896
	650	78	5	450 000	815 000	45 500	83 000	16.6	750	900	6996
	700	100	6	605 000	1 090 000	61 500	111 000	15.9	710	850	6096
500	620	56	3	320 000	600 000	33 000	61 000	17.3	750	900	68/500
	670	78	5	460 000	865 000	47 000	88 000	16.7	710	850	69/500
	720	100	6	630 000	1 170 000	64 000	120 000	16.0	670	800	60/500
530	650	56	3	325 000	625 000	33 000	63 500	17.4	710	850	68/530
	710	82	5	455 000	870 000	46 500	88 500	16.8	670	800	69/530
	780	112	6	680 000	1 300 000	69 500	133 000	16.0	600	750	60/530
560	680	56	3	330 000	650 000	33 500	66 500	17.4	670	800	68/560
	750	85	5	525 000	1 040 000	53 500	106 000	16.7	600	750	69/560
	820	115	6	735 000	1 500 000	75 000	153 000	16.2	560	670	60/560
600	730	60	3	355 000	735 000	36 000	75 000	17.5	600	710	68/600
	800	90	5	550 000	1 160 000	56 500	118 000	16.9	560	670	69/600
	870	118	6	790 000	1 640 000	80 500	168 000	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.



 $P = XF_r + YF_a$

	-1	1 · a								
$\frac{f_0 F_a}{C_{0r}}$	e	$e \frac{F_{\rm a}}{F_{\rm r}} \leq e$		$\frac{F_{\rm a}}{F_{\rm r}}$	>e					
$\mathcal{O}_{0\mathrm{r}}$		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

$$\frac{F_{\rm a}}{F_{\rm r}}$$
>0.8, P_0 =0.6 $F_{\rm r}$ +0.5 $F_{\rm a}$

$$\frac{F_{\rm a}}{F_{\rm r}} \le 0.8$$
, $P_0 = F_{\rm r}$



B 23

 ϕD_a

 $d_{\!
m a}^{(1)}$ min.

Abutment and Fillet Dimensions (mm)

 $D_{\!\scriptscriptstyle a}^{\scriptscriptstyle (1)}$ max.

793.5

 $r_{\rm a}$

2.5

2.5

2.5

2.5

2.5

2.5 (kg)

approx.

19.5

20.5 88.4

21.4

43.6 92.2

22.3 60.2

34.3 62.6

35.4 73.5

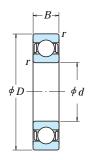
37.2

> 39.8 89.8

41.5

50.9

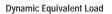
Bore Diameter 630 - 800 mm



Open Type

В	Boundary Dimensions (mm)			Basic Load Ratings (N) {kgf}			Factor	Limiting S (min		Bearing Numbers	
d	D	B	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	Open
630	780	69	4	420 000	890 000	43 000	90 500	17.3	560	670	68/630
	850	100	6	625 000	1 350 000	64 000	138 000	16.7	530	630	69/630
	920	128	7.5	750 000	1 620 000	76 500	165 000	16.4	480	600	60/630
670	820	69	4	435 000	965 000	44 500	98 000	17.4	500	630	68/670
	900	103	6	675 000	1 460 000	68 500	149 000	16.7	480	560	69/670
	980	136	7.5	765 000	1 730 000	78 000	177 000	16.6	450	530	60/670
710	870	74	4	480 000	1 100 000	49 000	113 000	17.4	480	560	68/710
	950	106	6	715 000	1 640 000	72 500	167 000	16.8	450	530	69/710
750	920	78	5	525 000	1 260 000	53 500	128 000	17.4	430	530	68/750
	1 000	112	6	785 000	1 840 000	80 000	188 000	16.7	400	500	69/750
800	980	82	5	530 000	1 310 000	54 000	133 000	17.5	400	480	68/800
	1 060	115	6	825 000	2 050 000	84 500	209 000	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.



 $P = XF_r + YF_a$

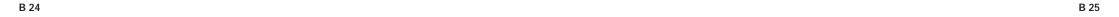
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\rm a}}{F_{ m r}}$			>e
O _{0r}		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22	1	0	0.56	1.99
0.689	0.26	1	0	0.56	1.71
1.03	0.28	1	0	0.56	1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34	1	0	0.56	1.31
3.45	0.38	1	0	0.56	1.15
5.17	0.42	1	0	0.56	1.04
6.89	0.44	1	0	0.56	1.00

Static Equivalent Load

$$\frac{F_{\rm a}}{F_{\rm r}} > 0.8, \ P_0 = 0.6F_{\rm r} + 0.5F_{\rm a}$$

$$\frac{F_{\rm a}}{F_{\rm r}} \le 0.8, \ P_0 = F_{\rm r}$$

$$\frac{F_{\rm a}}{F_{\rm r}} \leq 0.8, P_0 = F_{\rm r}$$



 ϕD_a

 $d_{\!\scriptscriptstyle a}^{\scriptscriptstyle (1)}$ min.

646 656 662

686 696 702

726 736

770 776

820 826

Abutment and Fillet Dimensions (mm)

 $D_{\!\scriptscriptstyle
m a}^{\scriptscriptstyle (1)}$

764 824 888

804 874

948

854 924

900 974

960 1 034

 $r_{\rm a}$ max.

3 5 6

4 5

4 5

Mass (kg)

approx.

71.3 163 285

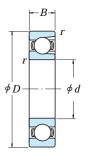
75.4 181 351

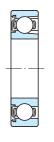
92.6 208

110 245

132 275

Bore Diameter 25 – 110 mm





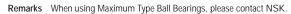


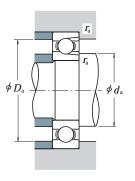
Open Type

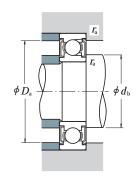
Shielded Type (One Shield) Z

Shielded Type (Two Shields) ZZ

В	Soundary D		ns	,	Basic Loa	d Ratings	gf}	Limiting		
d	D	В	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	C_{0r}	(mii Grease Open Z · ZZ	Oil Open Z	Open
25	52	15	1	14 400	10 500	1 470	1 070	12 000	15 000	BL 205
	62	17	1.1	21 500	15 500	2 200	1 580	11 000	13 000	BL 305
30	62	16	1	21 000	16 300	2 150	1 660	10 000	12 000	BL 206
	72	19	1.1	27 900	20 700	2 840	2 110	9 000	11 000	BL 306
35	72	17	1.1	27 800	22 100	2 830	2 250	9 000	11 000	BL 207
	80	21	1.5	37 000	29 100	3 800	2 970	8 000	9 500	BL 307
40	80	18	1.1	35 500	28 800	3 600	2 940	8 000	9 500	BL 208
	90	23	1.5	46 500	36 000	4 750	3 650	7 500	9 000	BL 308
45	85	19	1.1	37 000	32 000	3 800	3 250	7 500	9 000	BL 209
	100	25	1.5	55 500	44 000	5 650	4 500	6 300	8 000	BL 309
50	90	20	1.1	39 000	35 000	3 950	3 550	6 700	8 500	BL 210
	110	27	2	65 000	52 500	6 600	5 350	6 000	7 100	BL 310
55	100	21	1.5	48 000	44 000	4 900	4 500	6 300	7 500	BL 211
	120	29	2	75 000	61 500	7 650	6 250	5 600	6 700	BL 311
60	110	22	1.5	58 000	54 000	5 950	5 550	5 600	6 700	BL 212
	130	31	2.1	85 500	71 500	8 700	7 300	5 000	6 000	BL 312
65	120	23	1.5	63 500	60 000	6 450	6 150	5 300	6 300	BL 213
	140	33	2.1	103 000	89 500	10 500	9 150	4 800	5 600	BL 313
70	125	24	1.5	69 000	66 000	7 050	6 750	5 000	6 000	BL 214
	150	35	2.1	115 000	102 000	11 800	10 400	4 300	5 300	BL 314
75	130	25	1.5	72 000	72 000	7 350	7 300	4 500	5 600	BL 215
	160	37	2.1	126 000	116 000	12 800	11 800	4 000	5 000	BL 315
80	140	26	2	84 000	85 000	8 600	8 650	4 300	5 300	BL 216
	170	39	2.1	136 000	130 000	13 900	13 300	3 800	4 500	BL 316
85	150 180	28 41	2	93 000 147 000	93 000 145 000	9 500 15 000	9 450 14 800	4 000 3 600	5 000 4 300	BL 217 BL 317
90	160 190	30 43	2	107 000 158 000	107 000 161 000	10 900 16 100	10 900 16 400	3 800 3 400	4 500 4 000	BL 218 BL 318
95	170	32	2.1	121 000	123 000	12 300	12 500	3 600	4 300	BL 219
	200	45	3	169 000	178 000	17 300	18 100	2 800	3 600	BL 319
100	180	34	2.1	136 000	140 000	13 800	14 200	3 400	4 000	BL 220
105	190	36	2.1	148 000	157 000	15 000	16 000	3 200	3 800	BL 221
110	200	38	2.1	160 000	176 000	16 300	17 900	2 800	3 400	BL 222





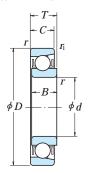


Bearing Number	-S	Abut	ment and Fill (mm		ns	Mass (kg)
With One Shielded	With Two Shields	$d_{\scriptscriptstyle m a}$ min.	$d_{ m b}$ max.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{max}.$	approx.
BL 205 Z	BL 205 ZZ	30	32	47	1	0.133
BL 305 Z	BL 305 ZZ	31.5	36	55.5	1	0.246
BL 206 Z	BL 206 ZZ	35	38.5	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 316 Z	BL 216 ZZ BL 316 ZZ	89 91	95.5 104.5	131 159	2	1.61 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 221 Z	BL 220 ZZ BL 221 ZZ	111 116	121.5 127.5	169 179	2 2 2	3.54 4.23
_	_	121	_	189	2	

B 26 B 27



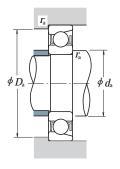
Bore Diameter 4 – 20 mm



Outside Diameter Tolerance (Class N)

Units : μm Single Plane Mean Outside

Nominai Outside Diameter			Siriy	Diameter ΔD_{mp}					
	D (n		E Se	eries	EN S	eries			
	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	Ω	1 0	_11			



Dynamic Equivalent Load

 $P = XF_r + YF_a$

	-			
$F_{\rm a}/F_{\rm r} \leq e$		$F_{\rm a}/I$	r > e	
X	Y	X	Y	e
1	0	0.5	2.5	0.2

	Bound	dary Dim (mm)	ensions		1)	Basic Loa	d Ratings {kg	ιf}	Limiting (mir		Bearing	Numbers
d	D	<i>B, C, T</i>	$r \atop ext{min.}$	$r_1 \atop ext{min.}$	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	E Series	EN Series
4	16	5	0.15	0.1	1 650	288	168	29	34 000	40 000	E 4	EN 4
5	16	5	0.15	0.1	1 650	288	168	29	34 000	40 000	E 5	EN 5
6	21	7	0.3	0.15	2 490	445	254	46	30 000	36 000	E 6	EN 6
7	22	7	0.3	0.15	2 490	445	254	46	30 000	36 000	E 7	EN 7
8	24	7	0.3	0.15	3 450	650	350	66	28 000	34 000	E 8	EN 8
9	28	8	0.3	0.15	4 550	880	465	90	24 000	30 000	E 9	EN 9
10	28	8	0.3	0.15	4 550	880	465	90	24 000	30 000	E 10	EN 10
11	32	7	0.3	0.15	4 400	845	450	86	22 000	26 000	E 11	EN 11
12	32	7	0.3	0.15	4 400	845	450	86	22 000	26 000	E 12	EN 12
13	30	7	0.3	0.15	4 400	845	450	86	22 000	26 000	E 13	EN 13
14	35	8	0.3	0.15	5 800	1 150	590	117	19 000	22 000	—	EN 14
15 16	35 40 38	8 10 10	0.3 0.6 0.6	0.15 0.3 0.2	5 800 7 400 6 900	1 150 1 500 1 380	590 750 705	117 153 141	19 000 17 000 17 000	22 000 20 000 22 000	E 15 BO 15 —	EN 15 — EN 16
17	40 44 44	10 11 11	0.6 0.6 0.6	0.3 0.3 0.3	7 400 7 350 7 350	1 500 1 500 1 500	750 750 750	153 153 153	17 000 16 000 16 000	20 000 19 000 19 000	L 17 BO 17	EN 17 —
18 19	40 40	9	0.6 0.6	0.2 0.2	5 050 5 050	1 030 1 030	515 515	105 105	17 000 17 000	20 000 20 000	E 19	EN 18 EN 19
20	47	12	1	0.6	11 000	2 380	1 120	243	14 000	17 000	E 20	EN 20
	47	14	1	0.6	11 000	2 380	1 120	243	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.

	ment and I ensions (n		Mass (kg)
$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ 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

B 28 B 29

EXTRA SMALL BALL BEARINGS AND MINIATURE BALL **BEARINGS**

EXTRA SMALL BALL BEARINGS · MINIATURE BALL BEARINGS

Metric Design	Bore Diameter 1 – 9mm·····	B34
With Flange	Bore Diameter 1 – 9mm·····	B38
Inch Design	Bore Diameter 1.016 – 9.525mm·····	B42
With Flange	Bore Diameter 1.191 – 9.525mm·····	B44

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 Ba	II Bearings	Miniature Ball Bearings
Metric	Outside diameter Bore diameter		Outside diameter $D < 9$
Inch	Outside diameter Bore diameter	$D \ge 9.525$ $d < 10$	Outside diameter $D < 9.525$

Please refer to NSK Miniature Ball Bearings (CAT. No. E126) for details.









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ZZS

Table 2 Design, Types, and Type Symbols

			Type S	ymbols		
D	Design · Types	Metric	Inch	Spe	cial	Remarks
		ivietric	IIICII	Metric	Inch	
		600	R	MR	_	Shielded · sealed bearings are available.
	Thin section	_	_	SMT	_	
Ball Bearings	With flange	F6 0 0	FR	MF	_	Shielded · sealed bearings are available.
Single-Row Deep Groove Ball Bearings	Extended inner ring	_	_	_	RW	Shielded bearings are available.
Sinç	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	_	

Remarks Single-row angular contact ball bearings are available besides those shown above.

TOLERANCES AND RUNNING ACCURACY

METRIC DESIGN BEARINGS Table 8.2(Pages A60 to A63)

The flange tolerances for metric design bearings are listed in Table 3.

Table 3 Flange Tolerances for Metric Flanged Bearings

(1) Tolerand	ces of Flange	e Outside Diame	ter		Units : µm
Nomina	l Flange		Deviation of Flang	e Outside Diamet	er
Outside (Diameter		Δ	D_{1S}	
D_1 (r	nm)	(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

Remarks ②is 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)		Flange	ation of e Width	Va Flange	Outside Genera with Fla	on of Bea e Surface strix Inclination ange Bac S_{D1}	nation kface	Flange Backface Runout with Raceway $S_{\rm ea1}$ Class 5 Class 4 Class 2					
		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 $\Delta B_{ m S}$	tolerance for d	Use the $\Delta v_{ m BS}$	5	2.5	1.5	8	4	1.5	11	7	3
6 18	of the same bearing of the		tolerance for d of the same bearing		2.5	1.5	8	4	1.5	11	7	3	
18	30	same class		of the same class	5	2.5	1.5	8	4	1.5	11	7	3

Notes (1) 2.5 mm is included

INCH DESIGN BEARINGS Table 8.2 (Pages A60 to A63)

The flange tolerances for inch design flanged bearings are listed in Table 8.8(2) (Pages A76 and A77).

INSTRUMENT BALL BEARINGS Table 8.8 (Pages A76 to A77)

RECOMMENDED FITS

Please refer to NSK Miniature Ball Bearings (CAT.No.E126).

INTERNAL CLEARANCES......Table 9.10 (Page A89)

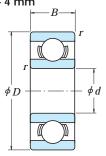
LIMITING SPEEDS

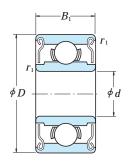
The limiting speeds listed in the bearing tables should be adjusted depending on the bearing toad conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A37 for detailed information



Metric Design

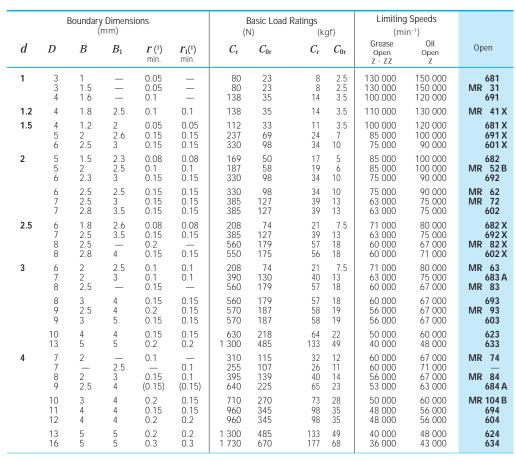
Bore Diameter 1 – 4 mm





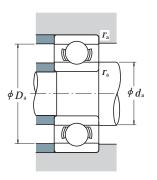
Open Type

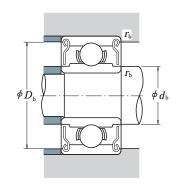
Shielded Type ZZ · ZZ1





Remarks When using bearings with a rotating outer ring, please contact NSK if they are shielded.





Bearing Numbers			Abutn	nent and F (m		nsions		Ma (g	
Shielded	Sealed	$d_{ m a}$ min.	$d_{ m b}$ max.	$D_{ m a}$ max.	$D_{ m b}$ min.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	$\emph{\emph{r}}_{b}$ max.	app Open	rox. Shielded
_ _ _		1.4 1.4 1.8	_	2.6 2.6 3.2	_	0.05 0.05 0.1	_ _ _	0.03 0.04 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 683 AZZ		3.8 3.8 4.2	3.7 4.0	5.2 6.2 6.8	5.4 6.4	0.13 0.1 0.1 0.15	0.1 0.1 0.1	0.20 0.32 0.54	0.27 0.45
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
MR 74 ZZ MR 84 ZZ 684 AZZ		4.8 — 5.2 4.8	4.8 5.0 5.2	6.2 — 6.8 8.2	6.3 7.4 8.1	0.1 0.15 0.1	0.1 0.1 0.1	0.22 0.36 0.63	0.29 0.56 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

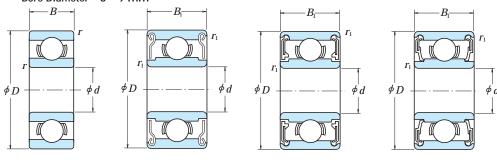
Shielded Type ZZ · ZZ1



Metric Design

Open Type

Bore Diameter 5 – 9 mm



Non-Contact

Sealed Type

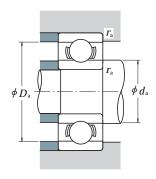
Contact

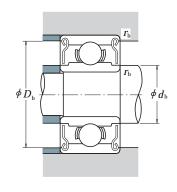
Sealed Type

									V	V		DD	- JF -
	Е		/ Dimens mm)	sions		B (N		d Ratings {kg	gf}	Limitir Grea	ng Speeds (se	min ⁻¹) Oil	
d	D	В	B_1	r (¹) min.	$r_1^{(1)}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Open Z · ZZ V · VV	D · DD	Open Z	Open
5	8 9 10 11	2 2.5 3	2.5 3 4 4	0.1 0.15 0.15	0.1 0.15 0.15 0.15	310 278 430 430 715	120 131 168 168 276	31 28 44 44 73	12 13 17 17 28	53 000 53 000 50 000 50 000 48 000	 	63 000 63 000 60 000 60 000 56 000	MR 85 MR 95 MR 105
	11 13 14	3 4 5	5 4 5	0.15 0.2 0.2	0.15 0.2 0.2	715 1 080 1 330	281 430 505	73 110 135	29 44 52	45 000 43 000 40 000	40 000 38 000	53 000 50 000 50 000	685 695 605
	16 19	5 6	5 6	0.3 0.3	0.3 0.3	1 730 2 340	670 885	177 238	68 90	36 000 32 000	32 000 30 000	43 000 40 000	625 635
6	10 12 13	2.5 3 3.5	3 4 5	0.15 0.2 0.15	0.1 0.15 0.15	495 715 1 080	218 292 440	51 73 110	22 30 45	45 000 43 000 40 000	40 000 38 000	53 000 50 000 50 000	MR 106 MR 126 686 A
	15 17 19 22	5 6 6 7	5 6 6 7	0.2 0.3 0.3 0.3	0.2 0.3 0.3 0.3	1 730 2 260 2 340 3 300	670 835 885 1 370	177 231 238 335	68 85 90 140	40 000 38 000 32 000 30 000	36 000 34 000 30 000 28 000	45 000 45 000 40 000 36 000	696 606 626 636
7	11 13 14	2.5 3 3.5	3 4 5	0.15 0.2 0.15	0.1 0.15 0.15	455 540 1 170	201 276 510	47 55 120	21 28 52	43 000 40 000 40 000	_ 34 000	50 000 48 000 45 000	MR 117 MR 137 687
	17 19 22 26	5 6 7 9	5 6 7 9	0.3 0.3 0.3 0.3	0.3 0.3 0.3 0.3	1 610 2 340 3 300 4 550	710 885 1 370 1 970	164 238 335 465	73 90 140 201	36 000 36 000 30 000 28 000	28 000 32 000 28 000 22 000	43 000 43 000 36 000 34 000	697 607 627 637
8	12 14 16	2.5 3.5 4	3.5 4 5	0.15 0.2 0.2	0.1 0.15 0.2	545 820 1 610	274 385 710	56 83 164	28 39 73	40 000 38 000 36 000	32 000 28 000	48 000 45 000 43 000	MR 128 MR 148 688 A
9	19 22 24 28 17	6 7 8 9	6 7 8 9 5	0.3 0.3 0.3 0.3	0.3 0.3 0.3 0.3	2 240 3 300 3 350 4 550 1 330	910 1 370 1 430 1 970 665	228 335 340 465 136	93 140 146 201 68	36 000 34 000 28 000 28 000 36 000	28 000 28 000 24 000 22 000 24 000	43 000 40 000 34 000 34 000 43 000	698 608 628 638 689
7	20 24 26 30	4 6 7 8 10	6 7 8 10	0.2 0.3 0.3 (0.6) 0.6	0.2 0.3 0.3 (0.6) 0.6	1 720 3 350 4 550	840 1 430 1 970 2 390	175 340 465	86 146 201 244	36 000 34 000 32 000 28 000 24 000	24 000 24 000 24 000 22 000	43 000 40 000 38 000 34 000 30 000	689 699 609 629 639



Remarks 1. When using bearings with a rotating outer ring, please contact NSK if they are sealed or shielded.





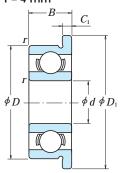
Bearing Numbers		Abutn	nent and F (m		ensions		Ma (g	
Shielded Sealed	$d_{\scriptscriptstyle m a}$ min.	$d_{ m b}$ max.	$D_{ m a}$ max.	$D_{ m b}$ min.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	$r_{ m b}$ max.	app Open	rox. Shielded
MR 85 ZZ	5.8 6.2 6.2 6.2 6.6 6.6	5.8 6.0 6.0 6.3 6.2 6.6 6.9	7.2 7.8 8.8 — 9.8 11.4 12.4	7.4 8.2 8.4 9.8 9.9 11.2 12.2	0.1 0.15 0.15 0.15 0.15 0.2 0.2		0.26 — 0.50 0.95 — 1.2 2.45 3.54	0.34 0.58 1.29 1.49 1.96 2.5 3.48
605 ZZ — DD 625 ZZ1 VV DD 635 ZZ1 VV DD	7.0 7.0	7.5 8.5	14.0 17.0	13.8 16.5	0.2 0.3 0.3	0.2 0.3 0.3	4.95 8.56	4.86 8.34
MR 106 ZZ1 — — — MR 126 ZZ — DD 686 AZZ VV DD	7.2	7.0	8.8	9.3	0.15	0.1	0.56	0.68
	7.6	7.2	10.4	10.9	0.2	0.15	1.27	1.74
	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

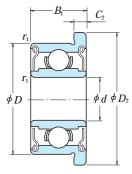
^{2.} Bearings with snap rings are also available, please contact NSK.



Metric Design With Flange

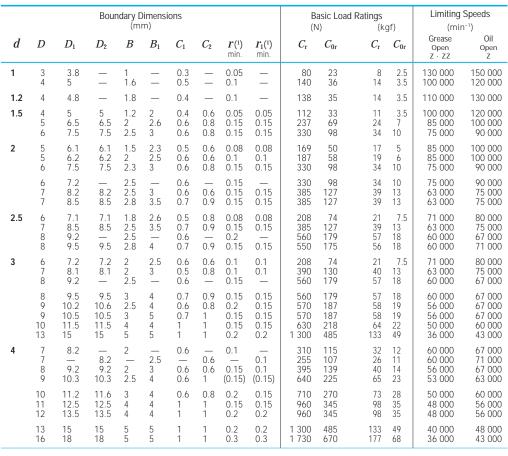
Bore Diameter 1 – 4 mm

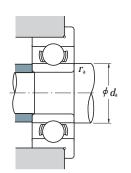


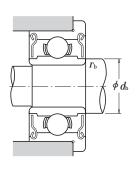


Open Type

Shielded Type ZZ · ZZ1







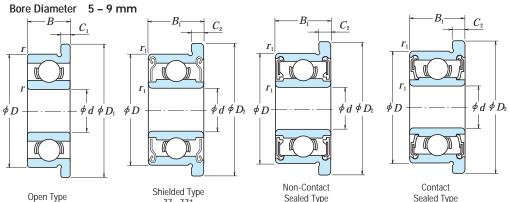
	Bearing Numbers		Abut	ment and (r	Fillet Dim mm)	nensions		ass (g)
Open	Shielded	Sealed	$d_{\scriptscriptstyle a}$ min		$m{r_{ m a}}$ max.	$r_{ m b}$ max.		orox. Shielded
F 681 F 691		= =	· 1.4 · 1.8		0.05 0.1	_	0.04 0.14	_
MF 41 X	_		2.0) —	0.1	_	0.12	_
F 681 X F 691 X F 601 X	F 681 XZZ F 691 XZZ F 601 XZZ		2.7	7 2.5	0.05 0.15 0.15	0.05 0.15 0.15	0.09 0.23 0.42	0.14 0.28 0.52
F 682 MF 52 B F 692	F 682 ZZ MF 52 BZZ F 692 ZZ	= =	2.8	3 2.7	0.08 0.1 0.15	0.08 0.1 0.15	0.16 0.21 0.35	0.22 0.27 0.48
MF 62 MF 72 F 602	MF 72 ZZ F 602 ZZ	= =		3.8	0.15 0.15 0.15	0.15 0.15	0.36 0.52 0.60	0.56 0.71
F 682 X F 692 X MF 82 X F 602 X	F 682 XZZ F 692 XZZ — F 602 XZZ		3.7	7 3.8 I —	0.08 0.15 0.2 0.15	0.08 0.15 — 0.15	0.25 0.51 0.62 0.74	0.36 0.68 — 0.98
MF 63 F 683 A MF 83	MF 63 ZZ F 683 AZZ	= =	3.8	3 4.0	0.1 0.1 0.15	0.1 0.1 —	0.27 0.37 0.56	0.33 0.53 —
F 693 MF 93 F 603 F 623 F 633	F 693 ZZ MF 93 ZZ F 603 ZZ F 623 ZZ F 633 ZZ		4.2	4.3 2 4.3 2 4.3	0.15 0.2 0.15 0.15 0.2	0.15 0.15 0.15 0.15 0.2	0.70 0.81 1.0 1.85 3.73	0.97 1.34 1.63 1.86 3.59
MF 74 MF 84 F 684	MF 74 ZZ MF 84 ZZ F 684 ZZ		5.2	4.8 2 5.0	0.1 - 0.15 0.1	0.1 0.1 0.1	0.29 — 0.44 0.70	0.35 0.63 1.14
MF 104 B F 694 F 604	MF 104 BZZ F 694 ZZ F 604 ZZ	= =	5.2	5.6	0.2 0.15 0.2	0.15 0.15 0.2	1.13 1.91 2.53	1.59 1.96 2.53
F 624 F 634	F 624 ZZ F 634 ZZ1	= =	5.6		0.2 0.3	0.2 0.3	3.38 5.73	3.53 5.62

Note (1) The values in parentheses are not based on ISO 15.

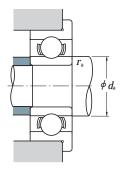
Remarks When using bearings with a rotating outer ring, please contact NSK if they are shielded.

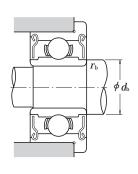






Open Type Bounda							Z · ZZ1				Sealed VV				Sealed Type DD	9
			Bour	idary D (mr		ons				Ba (N		d Ratings {kg	gf}	Limitin Grea	g Speeds (r se	nin ⁻¹) Oil
d	D	D_1	D_2	В	B_1	C_1	C_2	r min.	r_1 min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Open Z · ZZ V · VV	D · DD	Open Z
5	8 8 9 10	9.2 — 10.2 11.2	9.2 10.2 11.6	2 — 2.5 3	2.5 3 4	0.6 0.6 0.6	0.6 0.6 0.8	0.1 0.15 0.15	0.1 0.15 0.15	310 278 430 430	120 131 168 168	31 28 44 44	12 13 17 17	53 000 53 000 50 000 50 000	_ _ _ _	63 000 63 000 60 000 60 000
	11 13 14	12.5 15 16	12.5 15 16	3 4 5	5 4 5	0.8 1 1	1 1 1	0.15 0.2 0.2	0.15 0.2 0.2	715 1 080 1 330	281 430 505	73 110 135	29 44 52	45 000 43 000 40 000	40 000 38 000	53 000 50 000 50 000
	16 19	18 22	18 22	5 6	5 6	1 1.5	1 1.5	0.3 0.3	0.3 0.3	1 730 2 340	670 885	177 238	68 90	36 000 32 000	32 000 30 000	43 000 40 000
6	10 12 13	11.2 13.2 15	11.2 13.6 15	2.5 3 3.5	3 4 5	0.6 0.6 1	0.6 0.8 1.1	0.15 0.2 0.15	0.1 0.15 0.15	495 715 1 080	218 292 440	51 73 110	22 30 45	45 000 43 000 40 000	40 000 38 000	53 000 50 000 50 000
	15 17 19 22	17 19 22 25	17 19 22 25	5 6 6 7	5 6 6 7	1.2 1.2 1.5 1.5	1.2 1.2 1.5 1.5	0.2 0.3 0.3 0.3	0.2 0.3 0.3 0.3	1 730 2 260 2 340 3 300	670 835 885 1 370	177 231 238 335	68 85 90 140	40 000 38 000 32 000 30 000	36 000 34 000 30 000 28 000	45 000 45 000 40 000 36 000
7	11 13 14	12.2 14.2 16	12.2 14.6 16	2.5 3 3.5	3 4 5	0.6 0.6 1	0.6 0.8 1.1	0.15 0.2 0.15	0.1 0.15 0.15	455 540 1 170	201 276 510	47 55 120	21 28 52	43 000 40 000 40 000	<u> </u>	50 000 48 000 45 000
	17 19 22	19 22 25	19 22 25	5 6 7	5 6 7	1.2 1.5 1.5	1.2 1.5 1.5	0.3 0.3 0.3	0.3 0.3 0.3	1 610 2 340 3 300	715 885 1 370	164 238 335	73 90 140	36 000 36 000 30 000	28 000 32 000 28 000	43 000 43 000 36 000
8	12 14 16	13.2 15.6 18	13.6 15.6 18	2.5 3.5 4	3.5 4 5	0.6 0.8 1	0.8 0.8 1.1	0.15 0.2 0.2	0.1 0.15 0.2	545 820 1 610	274 385 710	56 83 164	28 39 73	40 000 38 000 36 000	32 000 30 000	48 000 45 000 43 000
	19 22	22 25	22 25	6 7	6 7	1.5 1.5	1.5 1.5	0.3 0.3	0.3 0.3	2 240 3 300	910 1 370	228 335	93 140	36 000 34 000	28 000 28 000	43 000 40 000
9	17 20	19 23	19 23	4	5 6	1 1.5	1.1 1.5	0.2 0.3	0.2 0.3	1 330 1 720	665 840	136 175	68 86	36 000 34 000	24 000 24 000	43 000 40 000





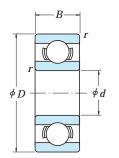
	Bearing Numbers					and Fille ns (mm		Ma (g	
Open	Shielded	Sea	led	$d_{ m a}$ min.	$d_{ m b}$ max.	$m{r_{a}}$ max.	$r_{ m b}$ max.	appı Open	rox. Shielded
MF 85 MF 95 MF 105	MF 85 ZZ MF 95 ZZ1 MF 105 ZZ	_ _ _ _	_ _ _	5.8 — 6.2 6.2	5.8 6.0 6.0	0.1 0.15 0.15	 0.1 0.15 0.15	0.33 — 0.59 1.05	 0.41 0.66 1.46
F 685 F 695 F 605	F 685 ZZ F 695 ZZ F 605 ZZ	vv –	DD DD	6.2 6.6 6.6	6.2 6.6 6.9	0.15 0.2 0.2	0.15 0.2 0.2	1.37 2.79 3.9	2.18 2.84 3.85
F 625 F 635	F 625 ZZ1 F 635 ZZ1	VV VV	DD DD	7.0 7.0	7.5 8.5	0.3 0.3	0.3 0.3	5.37 9.49	5.27 9.49
MF 106 MF 126 F 686 A	MF 106 ZZ1 MF 126 ZZ F 686 AZZ	_ _ VV	DD DD	7.2 7.6 7.2	7.0 7.2 7.4	0.15 0.2 0.15	0.1 0.15 0.15	0.65 1.38 2.25	0.77 1.94 3.04
F 696 F 606 F 626 F 636	F 696 ZZ1 F 606 ZZ F 626 ZZ1 F 636 ZZ	VV VV VV	DD DD DD DD	7.6 8.0 8.0 8.0	7.9 8.2 8.5 10.5	0.2 0.3 0.3 0.3	0.2 0.3 0.3 0.3	4.34 6.58 9.09 14.6	4.26 6.61 9.09 14.7
MF 117 MF 137 F 687	MF 117 ZZ MF 137 ZZ F 687 ZZ1	_ VV	_ _ DD	8.2 8.6 8.2	8.0 9.0 8.5	0.15 0.2 0.15	0.1 0.15 0.15	0.72 1.7 2.48	0.82 2.23 3.37
F 697 F 607 F 627	F 697 ZZ1 F 607 ZZ1 F 627 ZZ	VV VV VV	DD DD DD	9.0 9.0 9.0	10.2 9.1 10.5	0.3 0.3 0.3	0.3 0.3 0.3	5.65 8.66 14.2	5.65 8.66 14.2
MF 128 MF 148 F 688 A	MF 128 ZZ1 MF 148 ZZ F 688 AZZ	VV VV	DD DD	9.2 9.6 9.6	9.0 9.2 10.2	0.15 0.2 0.2	0.1 0.15 0.2	0.82 2.09 3.54	1.15 2.39 4.47
F 698 F 608	F 698 ZZ F 608 ZZ	VV VV	DD DD	10.0 10.0	10.0 10.5	0.3 0.3	0.3 0.3	8.35 13.4	8.3 13.5
F 689 F 699	F 689 ZZ1 F 699 ZZ1	VV VV	DD DD	10.6 11.0	11.5 12.0	0.2 0.3	0.2 0.3	3.97 9.51	4.91 9.51

Remarks When using bearings with a rotating outer ring, please contact NSK if they are shielded.

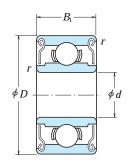


Inch Design

Bore Diameter 1.016 – 9.525 mm

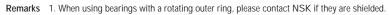




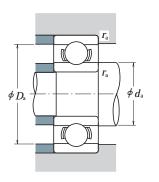


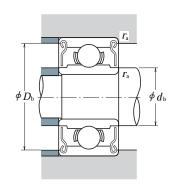
Shielded Type ZZ · ZZS

	Bound	ary Dimens (mm)	ions			Basic Lo V)	ad Ratings {k	gf}	Limiting (mi	•	Bearing
d	D	В	B_1	<i>r</i> min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease Open Z · ZZ	Oil Open Z	Open
1.016	3.175	1.191	_	0.1	80	23	8	2.5	130 000	150 000	R 09
1.191	3.967	1.588	2.380	0.1	138	35	14	3.5	110 000	130 000	R 0
1.397	4.762	1.984	2.779	0.1	231	66	24	6.5	90 000	110 000	R 1
1.984	6.350	2.380	3.571	0.1	310	108	32	11	67 000	80 000	R 1-4
2.380	4.762 4.762 7.938	1.588 — 2.779	2.380 3.571	0.1 0.1 0.15	188 143 550	60 52 175	19 15 56	6 5.5 18	80 000 80 000 60 000	95 000 95 000 71 000	R 133 R 1-5
3.175	6.350 7.938 9.525	2.380 2.779 2.779	2.779 3.571 3.571	0.1 0.1 0.15	283 560 640	95 179 225	29 57 65	9.5 18 23	67 000 60 000 53 000	80 000 67 000 63 000	R 144 R 2-5 R 2-6
	9.525 12.700	3.967 4.366	3.967 4.366	0.3 0.3	630 640	218 225	64 65	22 23	56 000 53 000	67 000 63 000	R 2 R 2A
3.967	7.938	2.779	3.175	0.1	360	149	37	15	53 000	63 000	R 155
4.762	7.938 9.525 12.700	2.779 3.175 3.967	3.175 3.175 4.978	0.1 0.1 0.3	360 710 1 300	149 270 485	37 73 133	15 28 49	53 000 50 000 43 000	63 000 60 000 53 000	R 156 R 166 R 3
6.350	9.525 12.700	3.175 3.175	3.175 4.762	0.1 0.15	420 1 080	204 440	43 110	21 45	48 000 40 000	56 000 50 000	R 168B R 188
	15.875 19.050	4.978 5.558	4.978 7.142	0.3 0.4	1 610 2 620	660 1 060	164 267	68 108	38 000 36 000	45 000 43 000	R 4B R 4AA
7.938	12.700	3.967	3.967	0.15	540	276	55	28	40 000	48 000	R 1810
9.525	22.225	5.558	7.142	0.4	3 350	1 410	340	144	32 000	38 000	R 6



^{2.} Bearings with double shields (ZZ, ZZS) are also available with single shields (Z, ZS).



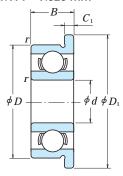


Numbers	А	butment a	S		lass (g)		
Shielded	$d_{ m a}$ min.	$d_{ m b}$ max.	$D_{ m a}$ max.	$D_{ m b}$ min.	$r_{ m a}$ max.	ap Open	prox. Shielded
_	1.9	_	2.3	_	0.1	0.04	_
R 0 ZZ	2.0	1.9	3.1	3.5	0.1	0.09	0.11
R 1 ZZ	2.2	2.3	3.9	4.1	0.1	0.15	0.19
R 1-4 ZZ	2.8	3.9	5.5	5.9	0.1	0.35	0.50
R 133 ZZS R 1-5 ZZ	3.2 — 3.6	3.0 4.1	3.9 - 6.7	 4.2 7.0	0.1 0.1 0.15	0.10 0.60	0.13 0.72
R 144 ZZ R 2-5 ZZ R 2-6 ZZS	4.0 4.0 4.4	3.9 4.3 4.6	5.5 7.1 8.3	5.9 7.3 8.2	0.1 0.1 0.15	0.25 0.55 0.96	0.27 0.72 1.13
R 2 ZZ R 2A ZZ	5.2 5.2	4.8 4.6	7.5 10.7	8.0 8.2	0.3 0.3	1.36 3.3	1.39 3.23
R 155 ZZS	4.8	5.5	7.1	7.3	0.1	0.51	0.56
R 156 ZZS R 166 ZZ R 3 ZZ	5.6 5.6 6.8	5.5 5.9 6.5	7.1 8.7 10.7	7.3 8.8 11.2	0.1 0.1 0.3	0.39 0.81 2.21	0.42 0.85 2.79
R 168 BZZ R 188 ZZ	7.2 7.6	7.0 7.4	8.7 11.5	8.9 11.6	0.1 0.15	0.58 1.53	0.62 2.21
R 4B ZZ R 4AA ZZ	8.4 9.4	8.4 9.0	13.8 16.0	13.8 16.6	0.3 0.4	4.5 7.48	4.43 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

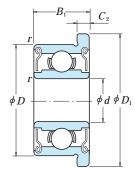


Inch Design With Flange

Bore Diameter 1.191 – 9.525 mm

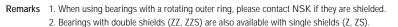


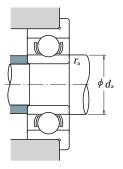
Open Type

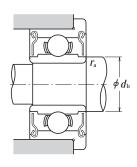


Shielded Type ZZ · ZZS

		Е				oad Ratings					
			(mn	n)				(1	N)	{k	:gf}
d	D	D_1	В	B_1	C_1	C_2	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$
1.191	3.967	5.156	1.588	2.380	0.330	0.790	0.1	138	35	14	3.5
1.397	4.762	5.944	1.984	2.779	0.580	0.790	0.1	231	66	24	6.5
1.984	6.350	7.518	2.380	3.571	0.580	0.790	0.1	310	108	32	11
2.380	4.762 4.762 7.938	5.944 5.944 9.119	1.588 — 2.779	 2.380 3.571	0.460 0.580	— 0.790 0.790	0.1 0.1 0.15	188 143 550	60 52 175	19 15 56	6 5.5 18
3.175	6.350 7.938 9.525 9.525	7.518 9.119 10.719 11.176	2.380 2.779 2.779 3.967	2.779 3.571 3.571 3.967	0.580 0.580 0.580 0.760	0.790 0.790 0.790 0.760	0.1 0.1 0.15 0.3	283 560 640 630	95 179 225 218	29 57 65 64	9.5 18 23 22
3.967	7.938	9.119	2.779	3.175	0.580	0.910	0.1	360	149	37	15
4.762	7.938 9.525 12.700	9.119 10.719 14.351	2.779 3.175 4.978	3.175 3.175 4.978	0.580 0.580 1.070	0.910 0.790 1.070	0.1 0.1 0.3	360 710 1 300	149 270 485	37 73 133	15 28 49
6.350	9.525 12.700 15.875	10.719 13.894 17.526	3.175 3.175 4.978	3.175 4.762 4.978	0.580 0.580 1.070	0.910 1.140 1.070	0.1 0.15 0.3	420 1 080 1 610	204 440 660	43 110 164	21 45 68
7.938	12.700	13.894	3.967	3.967	0.790	0.790	0.15	540	276	55	28
9.525	22.225	24.613	7.142	7.142	1.570	1.570	0.4	3 350	1 410	340	144







Limiting S	Speeds	Beari	ng Numbers	Abutment and Fillet Mas				
(min-	-1)			Dimensions (mm)			(g)	
Grease Open Z · ZZ	Oil Open Z	Open	Shielded	$d_{ m a}$ min.	$d_{ m b}$ max.	$m{r_{a}}$ max.	app Open	rox. 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 80 000 60 000	95 000 95 000 71 000	FR 133 FR 1-5	 FR 133 ZZS FR 1-5 ZZ	3.2 — 3.6	3.0 4.1	0.1 0.1 0.15	0.13 — 0.68	0.19 0.82
67 000 60 000 53 000 56 000	80 000 67 000 63 000 67 000	FR 144 FR 2-5 FR 2-6 FR 2	FR 144 ZZ FR 2-5 ZZ FR 2-6 ZZS FR 2 ZZ	4.0 4.0 4.4 5.2	3.9 4.3 4.6 4.8	0.1 0.1 0.15 0.3	0.31 0.62 1.04 1.51	0.35 0.81 1.25 1.55
53 000	63 000	FR 155	FR 155 ZZS	4.8	5.5	0.1	0.59	0.67
53 000 50 000 43 000	63 000 60 000 53 000	FR 156 FR 166 FR 3	FR 156 ZZS FR 166 ZZ FR 3 ZZ	5.6 5.6 6.8	5.5 5.9 6.5	0.1 0.1 0.3	0.47 0.90 2.97	0.53 0.98 3.09
48 000 40 000 38 000	56 000 50 000 45 000	FR 168B FR 188 FR 4B	FR 168 BZZ FR 188 ZZ FR 4B ZZ	7.2 7.6 8.4	7.0 7.4 8.4	0.1 0.15 0.3	0.66 1.64 4.78	0.75 2.49 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

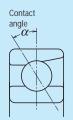
ANGULAR CONTACT BALL BEARINGS

SINGLE-ROW AND MATCHED ANGULAR CONTACT BALL BEARINGS

	Bore Diameter	10 - 65mm·····	B50						
	Bore Diameter	70 – 120 mm ······	B60						
	Bore Diameter	130 – 200 mm ······	B66						
UBLE-ROW ANGULAR CONTACT	Bore Diameter	10 – 85 mm ······	B70						
UR-POINT CONTACT BALL BEARINGS									
	Bore Diameter	30 – 200mm·····	B72						

DESIGN, TYPES, AND FEATURES

SINGLE-ROW ANGULAR CONTACT BALL BEARINGS



DO BA FO

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 10, Preload, Page A96).

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 B50 to B65; 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.

Table 1 Standard Cages for Angular Contact Ball Bearings

Series	Pressed Steel Cages	Machined Brass Cages				
79A5, C	_	7900 – 7940				
70A	7000 – 7018	7019 – 7040				
70C	_	7000 – 7022				
72A, B	7200 – 7222	7224 – 7240				
72C	_	7200 – 7240				
73A, B	7300 – 7320	7321 – 7340				

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 machined brass or synthetic resin cages or molded polyamide cages are used.

The maximum operating temperature of molded polyamide cages is 120°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
a ₀	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 \boldsymbol{a}_0 is big, this type is suitable if moments are applied.
-a0-	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.



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.



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.

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

	SINGLE-ROW ANGULAR CONTACT			
	BALL BEARINGS	Table 8.2	(Pages A60 to A	163)
	NSKHPS ANGULAR CONTACT BALL BEARINGS	Tubic 0.2	(1 ages 7100 to 7	100)
	Tolerance for Dimensions: Class 6,	T.I. 0.0	/D 4/01 4	
	Running Accuracy: Class 5	Table 8.2	(Pages A60 to A	163)
	MATCHEĎ ANGULÁR CONTACT			
	BALL BEARINGS	Table 8.2	(Pages A60 to A	463)
	DOUBLE-ROW ANGULAR CONTACT		. •	
	BALL BEARINGS	Table 8.2	(Pages A60 to A	163)
	FOUR-POINT CONTACT BALL	10010 012	(. agos 7.00 to 7	.00)
	BEARINGS	Table 9.2	(Dance AAO to /	1431
		Table 0.2	(rages Add to F	103)
REC	OMMENDED FITS			
	SINGLE-ROW ANGULAR CONTACT BALL			
	BEARINGS AND HPS ANGULAR CONTACT			
		T-61- 0 0	(Dama 404)	
	BALL BEARINGS	Table 9.2	(Page A84)	
			(Page A85)	
	MATCHED ANGULAR CONTACT BALL BEARINGS			
		Table 9.4	(Page A85)	
	DOUBLE-ROW ANGULAR CONTACT BALL			
	BEARINGS	Table 9.2	(Page A84)	
			(Page A85)	
	FOUR-POINT CONTACT BALL BEARINGS	Table 0.2	(Dago 184)	
	TOOK-TOINT CONTACT DALL DEAKINGS			
		Table 9.4	(Page A85)	

INTERNAL CLEARANCES

MATCHED ANGULAR CONTACT BALL BEARINGS..... Table 9. 17 (Page A94)

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 clearances are adjusted to produce Very Light, Light, Medium, and Heavy Preloads. Their fitting is also special. Concerning these matters, please refer to Tables 10.1 and 10.2 (Pages A98 and A99).

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 Clearances) Units : μm										
Nominal Bo	re Diameter		Axial Internal Clearance							
<i>d</i> (n	nm)	CN	ΝB	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.

FOUR-POINT CONTACT BALL BEARINGS.....Table 9.18 (Page A94)
LIMITING SPEEDS

In cases of single-row and matched angular contact ball bearings, the Limiting speeds listed in the bearing table are for bearings with machined cage. For those with pressed cages, the listed speeds must be reduced by 20%.

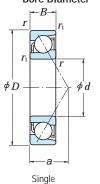
The limiting speeds of bearings with contact angles of 15° (Symbol C) and 25° (Symbol A5) are for bearings with precision of P5 and better (with machined synthetic-resin cages or molded polyamide cages).

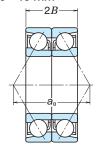
The limiting speeds listed in the bearing tables should be adjusted depending on the bearing load conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A37 for detailed information.

B 48 B 49

SINGLE/MATCHED MOUNTINGS

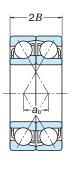
Bore Diameter 10 - 15 mm





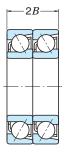
Back-to-Back

DB



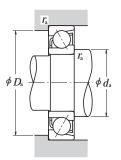
Face-to-Face

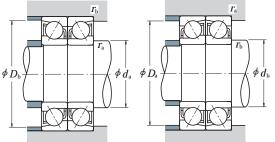
DF

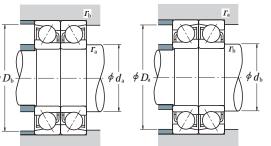


Tandem

DT







Dynamic Equival	ent Load P	$' = X F_r + Y F_s$

Contact		$if_0F_a^*$		Single, DT				DB or DF			
	Contact		e	$F_a/F_r \leq e$		F_a/I	r > e	F_a/I	$r \leq e$	$F_a/F_r > e$	
	Angle	Cor		X	Y	X	Y	X	Y	X	Y
		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
	15°	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
	15.	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 $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c	r DF				
Angle	<i>X</i> ₀	Y 0	X 0	Y 0	Single or DT			
15°	0.5	0.46	1	0.92	mounting When			
25°	0.5	0.38	1	0.76	$F_r > 0.5 F_r + Y_0 F_a$			
30°	0.5	0.33	1	0.66	use $P_0 = F_r$			
40°	0.5	0.26	1	0.52	0 -1			

Bearing Numbers (2)				c Load Rating: N)	. ,	gf}	Speeds (1)	iting (Matched) n-1)	Load (Spacing	s (mm)		nent and nsions (r	
Single	D	uplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	DB	O DF	d _b (³) min.	$D_{ m b}$ max.	Γ _b (³) max.
7900 A5 7900 C 7000 A	DB	DF D DF D	f 4 900	2 900 3 050 5 200	475 500 890	296 310 530	32 000 38 000 24 000	43 000 53 000 34 000	13.5 10.3 18.4	1.5 1.7 2.4	_ _ 11.2	20.8 20.8 24.8	0.15 0.15 0.15
7000 C 7200 A 7200 B	DB	DF D DF D	8 800	5 000 5 400 5 000	880 900 825	510 555 510	36 000 22 000 16 000	50 000 30 000 22 000	12.8 20.5 25.8	3.2 2.5 7.8	— 12.5 12.5	24.8 27.5 27.5	0.15 0.3 0.3
7200 C 7300 A 7300 B	DB	DF DO	1 5 100	5 200 8 600 8 100	895 1 540 1 450	530 880 825	32 000 16 000 14 000	45 000 22 000 20 000	14.4 24.0 29.9	3.6 2.0 7.9	— 12.5 12.5	27.5 32.5 32.5	0.3 0.3 0.3
7901 A5 7901 C 7001 A		DF D DF D	5 450	3 550 3 700 5 950	530 555 955	360 380 610	30 000 36 000 22 000	43 000 50 000 30 000	14.4 10.8 19.5	2.4 1.2 3.5	— — 13.2	22.8 22.8 26.8	0.15 0.15 0.15
7001 C 7201 A 7201 B	DB	DF D DF D	T 13 000	5 800 8 050 7 500	960 1 330 1 230	590 820 765	32 000 20 000 15 000	45 000 28 000 20 000	13.4 22.7 28.5	2.6 2.7 8.5	— 14.5 14.5	26.8 29.5 29.5	0.15 0.3 0.3
*7201 BE 7201 C 7301 A	A DB DB	DF D		7 700 9 000	1 310 1 570	— 785 915	16 000 30 000 15 000	24 000 40 000 20 000	28.5 15.9 26.1	8.5 4.1 2.1	14.5 — 17	29.5 29.5 32	0.3 0.3 0.6
7301 B *7301 BE		DF D	14 400 —	8 400 —	1 460 —	855 —	13 000 15 000	18 000 22 000	32.6 32.6	8.6 8.6	17 17	32 32	0.6 0.6
7902 A5 7902 C 7002 A		DF D DF D	7 750	5 050 5 300 6 850	755 790 1 010	515 540 700	26 000 30 000 19 000	34 000 43 000 26 000	17.0 12.8 22.6	3.0 1.2 4.6	— — 16.2	26.8 26.8 30.8	0.15 0.15 0.15
7002 C 7202 A 7202 B	DB	DF D DF D	T 14 000	6 750 9 300 8 600	1 030 1 430 1 310	690 950 875	28 000 18 000 13 000	38 000 24 000 18 000	15.3 25.4 32.0	2.7 3.4 10.0	— 17.5 17.5	30.8 32.5 32.5	0.15 0.3 0.3
*7202 BE 7202 C 7302 A	DB	DF D		9 050 14 200	1 440 2 220	925 1 440	14 000 26 000 13 000	20 000 36 000 17 000	32.0 17.7 29.5	10.0 4.3 3.5	17.5 — 20	32.5 32.5 37	0.3 0.3 0.6
7302 B *7302 BE		DF D	20 200 —	13 200 —	2 060 —	1 340 —	11 000 13 000	15 000 18 000	36.9 36.9	10.9 10.9	20 20	37 37	0.6 0.6

Note (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.

Remarks The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

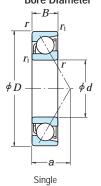
Limiting **Boundary Dimensions** Basic Load Ratings (Single) Factor Eff.Load | Abutment and Fillet | Mass Speeds (1) Centers Dimensions (mm) (mm) (kg) (N) {kgf} (min⁻¹) (mm) Oil. Grease $d D B r r_1$ $C_{\rm r}$ C_{0r} $C_{\rm r}$ C_{0r} f_0 $D_{\rm a}$ $r_{\rm a}$ а min. min. min. max. max. approx. 22 2 880 294 148 40 000 56 000 10 6 0.3 0.15 1 450 12.5 19.5 0.3 0.009 6.7 305 155 63 000 12.5 19.5 0.3 0.009 22 6 0.3 0.15 3 000 1 520 14.1 48 000 5.1 26 8 0.3 0.15 5 350 2 600 550 266 32 000 43 000 9.2 12.5 23.5 0.3 0.019 26 8 0.3 0.15 5 300 2 490 540 45 000 23.5 0.3 0.021 254 12.6 63 000 12.5 6.4 15 15 30 30 9 0.6 0.3 555 276 255 38 000 10.3 12.9 5 400 2 710 28 000 25 25 0.6 | 0.032 _ 9 0.6 0.3 2 500 510 20 000 28 000 5 000 0.6 | 0.032 30 9 0.6 0.3 5 400 2 610 550 266 13.2 40 000 56 000 15 25 0.6 0.036 7.2 35 35 11 0.6 0.3 9 300 4 300 950 440 20 000 26 000 12.0 15 15 30 30 0.6 0.053 _ 11 0.6 0.3 8 750 4 050 890 410 18 000 24 000 14.9 0.6 0.054 12 24 6 0.3 0.15 3 200 1 770 325 181 38 000 21.5 0.3 0.011 53 000 14.5 24 28 340 189 14.7 45 000 63 000 5.4 14.5 21.5 0.3 0.011 25.5 0.3 0.021 6 0.3 0.15 3 350 1 860 590 305 8 0.3 0.15 5 800 2 980 28 000 9.8 14.5 38 000 40 000 25.5 0.3 0.024 28 8 0.3 0.15 5 800 2 900 590 296 13.2 56 000 6.7 14.5 10 0.6 0.3 10 0.6 0.3 32 32 8 000 4 050 815 410 26 000 34 000 11.4 17 27 27 0.6 0.037 _ 3 750 760 380 14.2 17 7 450 18 000 26 000 0.6 32 10 0.6 0.3 8 150 3 750 830 380 20 000 30 000 27 0.6 0.036 14.2 32 37 10 0.6 0.3 7 900 3 850 805 395 12.5 36 000 50 000 7.9 17 27 31 0.6 0.041 12 1 0.6 9 450 4 500 965 460 18 000 24 000 13.1 18 0.060 37 12 8 850 4 200 900 425 16 000 22 000 18 31 0.062 1 0.6 16.3 37 12 1 0.6 11 100 4 950 1 130 505 _ 18 000 26 000 16.3 18 31 0.061 28 465 15 7 0.3 0.15 4 550 2 5 3 0 258 32 000 43 000 25.5 0.3 0.015 28 7 0.3 0.15 4 750 2 640 485 270 14.5 38 000 53 000 17.5 25.5 0.3 0.015 6.4 32 9 0.3 0.15 6 100 3 450 625 350 24 000 32 000 11.3 17.5 29.5 0.3 0.030 9 0.3 0.15 32 35 6 250 3 400 635 345 14.1 34 000 48 000 7.6 17.5 29.5 0.3 0.034 11 0.6 0.3 8 650 880 475 22 000 30 000 12.7 20 30 0.6 0.045 4 650 35 0.6 0.046 11 0.6 0.3 7 950 4 300 810 440 16 000 22 000 16.0 20 30 35 11 0.6 0.3 9 800 4 800 995 490 18 000 26 000 16.0 20 30 0.6 0.044 35 885 30 0.6 0.052 11 0.6 0.3 8 650 4 550 460 | 13.2 | 32 000 45 000 8.8 20 42 13 1 0.6 13 400 7 100 1 370 720 _ 16 000 22 000 14.7 21 36 0.084 42 13 12 500 6 600 1 270 670 14 000 19 000 0.086 1 0.6 18.5 21 36 42 13 1 0.6 14 300 6 900 1 460 705 16 000 22 000 18.5 21 36 0.084 _

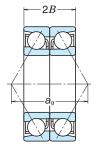
Notes (1) For applications operating near the limiting speed, refer to Page B49.

(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

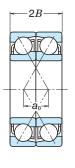
SINGLE/MATCHED MOUNTINGS

Bore Diameter 17 – 25 mm

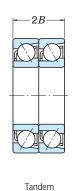


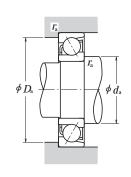


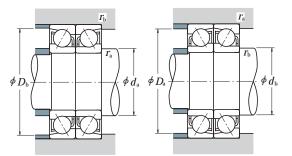
Back-to-Back

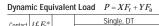


Face-to-Face









Contont	$if_0F_a^*$	l	Sirigle, DT				DD 01 DF			
		e	$F_a/F_r \leq e$		F_a/I	r > e	F_a/I	7 _r ≦e	$F_a/F_r > e$	
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15°	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15.	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 $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c		
Angle	X 0	Y_0	X 0	Y_0	Single or DT
15°	0.5	0.46	1	0.92	mounting When
25°	0.5	0.38	1	0.76	$F_{\rm r}>0.51$
30°	0.5	0.33	1	0.66	use $P_0 = F_r$
40°	0.5	0.26	1	0.52	

_	Single or DT
_	mounting
_	When
_	$F_{\rm r} > 0.5 F_{\rm r} + Y_0 F_{\rm a}$
_	use P_0 = $F_{ m r}$
_	

	JIII	jic				В	,	DF	i acc		DT					
Во	undar	y Dim (mm)	nensio	ensions Basic Load Ratings (Single) Factor (N) {kgf}			Limiting Eff.Load Speeds (¹) Centers (min-¹) (mm)		Abutm Dimer		Mass (kg)					
d	D	В	$m{r}$ min.	$r_{ m 1}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{\rm a}$ max.	арргох.
17	30 30 35	7 7 10	0.3	0.15 0.15 0.15	4 750 5 000 6 400	2 800 2 940 3 800	485 510 655	286 299 390	14.8 —	30 000 34 000 22 000	40 000 48 000 30 000	9.0 6.6 12.5	19.5 19.5 19.5	27.5 27.5 32.5	0.3 0.3 0.3	0.017 0.017 0.040
	35 40 40	10 12 12	0.3 0.6 0.6		6 600 10 800 9 950	3 800 6 000 5 500	675 1 100 1 010	390 610 565	14.5 — —	32 000 20 000 14 000	43 000 28 000 19 000	8.5 14.2 18.0	19.5 22 22	32.5 35 35	0.3 0.6 0.6	0.044 0.067 0.068
	40 40 47	12 12 14	0.6 0.6 1	0.3 0.3 0.6	11 600 10 900 15 900	6 100 5 850 8 650	1 180 1 110 1 630	625 595 880	13.3 —	16 000 28 000 14 000	22 000 38 000 19 000	18.2 9.8 16.2	22 22 23	35 35 41	0.6 0.6 1	0.065 0.075 0.116
	47 47	14 14	1	0.6 0.6	14 800 16 800	8 000 8 300	1 510 1 720	820 850	_	13 000 14 000	17 000 20 000	20.4 20.4	23 23	41 41	1 1	0.118 0.113
20	37 37 42	9 9 12	0.3	0.15 0.15 0.3	6 600 6 950 10 800	4 050 4 250 6 600	675 710 1 110	410 430 670	14.9 —	24 000 28 000 18 000	32 000 38 000 24 000	11.1 8.3 14.9	22.5 22.5 25	34.5 34.5 37	0.3 0.3 0.6	0.036 0.036 0.068
	42 47 47	12 14 14	0.6 1 1	0.3 0.6 0.6	11 100 14 500 13 300	6 550 8 300 7 650	1 130 1 480 1 360	665 845 780	14.0 —	26 000 17 000 12 000	36 000 22 000 16 000	10.1 16.7 21.1	25 26 26	37 41 41	0.6 1 1	0.076 0.106 0.109
	47 47 52	14 14 15	1 1 1.1	0.6 0.6 0.6	15 600 14 600 18 700	8 150 8 050 10 400	1 590 1 480 1 910	830 825 1 060	13.3 —	13 000 24 000 13 000	19 000 34 000 17 000	21.1 11.5 17.9	26 26 27	41 41 45	1 1 1	0.103 0.118 0.146
	52 52	15 15	1.1 1.1	0.6 0.6	17 300 19 800	9 650 10 500	1 770 2 020	985 1 070	_	11 000 13 000	15 000 18 000	22.6 22.6	27 27	45 45	1 1	0.15 0.149
25	42 42 47	9 9 12		0.15 0.15 0.3	7 450 7 850 11 300	5 150 5 400 7 400	760 800 1 150	525 555 750	_ 15.5 _	20 000 24 000 16 000	28 000 34 000 22 000	12.3 9.0 16.4	27.5 27.5 30	39.5 39.5 42	0.3 0.3 0.6	0.043 0.042 0.079
	47 52 52	12 15 15	0.6 1 1	0.3 0.6 0.6	11 700 16 200 14 800	7 400 10 300 9 400	1 190 1 650 1 510	755 1 050 960	14.7 —	22 000 15 000 10 000	30 000 20 000 14 000	10.8 18.6 23.7	30 31 31	42 46 46	0.6 1 1	0.089 0.13 0.133
	52 52 62	15 15 17	1 1 1.1	0.6 0.6 0.6	17 600 16 600 26 400	10 200 10 200 15 800	1 790 1 690 2 690	1 040 1 040 1 610	14.0 —	12 000 22 000 10 000	17 000 28 000 14 000	23.7 12.7 21.1	31 31 32	46 46 55	1 1 1	0.127 0.143 0.235

Notes	(1)	For applications	operating near	the limiting speed, refer	r to Page B49 .
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⁽²⁾ The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

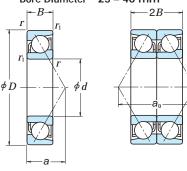
Bearing Numbers (2)			2)	Basic (N	Load Ratings	(Matched) (kg			(Matched)	Load C Spacings	s (mm)	Abutment and Fill Dimensions (mm		
Single	ı	Duple	K	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	n ⁻¹) Oil	DB DB	DF	d _b (³) min.	$D_{ m b}$ max.	Γ _b (³) max.
7903 A 7903 C 7003 A	5 DB DB DB	DF DF DF	DT DT DT	7 750 8 150 10 400	5 600 5 850 7 650	790 830 1 060	570 600 780	24 000 28 000 17 000	32 000 38 000 24 000	18.0 13.3 25.0	4.0 0.7 5.0	_ _ 18.2	28.8 28.8 33.8	0.15 0.15 0.15
7003 C 7203 A 7203 B	DB DB DB	DF DF DF	DT DT DT	10 700 17 600 16 100	7 600 12 000 11 000	1 100 1 790 1 650	775 1 220 1 130	26 000 16 000 11 000	34 000 22 000 15 000	17.0 28.5 35.9	3.0 4.5 11.9	— 19.5 19.5	33.8 37.5 37.5	0.15 0.3 0.3
*7203 BI 7203 C 7303 A	EA DB DB		DT DT	17 600 25 900	11 700 17 300	1 800 2 640	1 190 1 760	13 000 22 000 11 000	18 000 32 000 15 000	36.3 19.6 32.5	12.3 4.4 4.5	19.5 — 22	37.5 37.5 42	0.3 0.3 0.6
7303 B *7303 BI		DF	DT	24 000 —	16 000 —	2 450 —	1 640 —	10 000 11 000	14 000 16 000	40.9 40.9	12.9 12.9	22 22	42 42	0.6 0.6
7904 A 7904 C 7004 A	5 DB DB DB	DF DF DF	DT DT DT	10 700 11 300 17 600	8 100 8 500 13 200	1 090 1 150 1 800	825 865 1 340	19 000 22 000 15 000	26 000 32 000 20 000	22.3 16.6 29.9	4.3 1.4 5.9	_ _ 22.5	35.8 35.8 39.5	0.15 0.15 0.3
7004 C 7204 A 7204 B	DB DB DB	DF DF DF	DT DT DT	18 000 23 500 21 600	13 100 16 600 15 300	1 840 2 400 2 210	1 330 1 690 1 560	20 000 13 000 9 500	30 000 19 000 13 000	20.3 33.3 42.1	3.7 5.3 14.1	 25 25	39.5 42 42	0.3 0.6 0.6
*7204 BI 7204 C 7304 A	EA DB DB	DF DF	DT DT	23 600 30 500	16 100 20 800	2 410 3 100	1 650 2 130	11 000 19 000 10 000	16 000 26 000 13 000	42.1 23.0 35.8	14.1 5.0 5.8	25 — 25	42 42 47	0.6 0.6 0.6
7304 B *7304 BI		DF	DT	28 200 —	19 300 —	2 870 —	1 970 —	9 000 10 000	12 000 14 000	45.2 45.2	15.2 15.2	25 25	47 47	0.6 0.6
7905 A 7905 C 7005 A	5 DB DB DB	DF	DT DT DT	12 100 12 700 18 300	10 300 10 800 14 800	1 230 1 300 1 870	1 050 1 110 1 510	16 000 19 000 13 000	22 000 26 000 17 000	24.6 18.0 32.8	6.6 0.0 8.8	_ _ 27.5	40.8 40.8 44.5	0.15 0.15 0.3
7005 C 7205 A 7205 B	DB DB DB	DF DF DF	DT DT DT	19 000 26 300 24 000	14 800 20 500 18 800	1 940 2 690 2 450	1 510 2 090 1 920	18 000 12 000 8 500	26 000 16 000 11 000	21.6 37.2 47.3	2.4 7.2 17.3	 30 30	44.5 47 47	0.3 0.6 0.6
*7205 BI 7205 C 7305 A	DB	DF DF	DT DT	27 000 43 000	20 400 31 500	2 750 4 400	2 080 3 250	9 500 17 000 8 500	14 000 24 000 11 000	47.3 25.3 42.1	17.3 4.7 8.1	30 — 30	47 47 57	0.6 0.6 0.6
Note	(3)	For h	nearin	ns markad _	in the colum	on for d d	and r	for chafts	ara d (m	in) and r	(may) r	asnactiva	lv	

Note (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.

Remarks 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

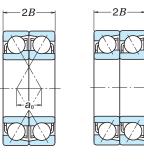
Bore Diameter 25 – 40 mm



Back-to-Back

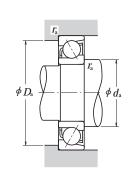
DB

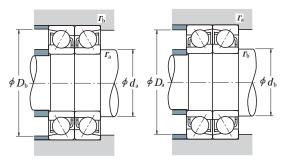
Single

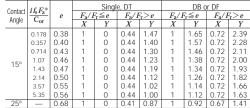


Tandem

DT







*For I, use 2 for DB, DF and 1 for DT

Static Equivalent Load $P_0 = X_0 F_r + Y_0 F_a$

Dynamic Equivalent Load $P = XF_r + YF_a$

ontact	Singl	e, DT	DB c	r DF	
Angle	X 0	Y_0	X 0	Y_0	Single or DT
15°	0.5	0.46	1	0.92	mounting When
25°	0.5	0.38	1	0.76	$F_{\rm r}>0.5F_{\rm r}$
30°	0.5	0.33	1	0.66	use $P_0 = F_r$
40°	0.5	0.26	1	0.52	

_	Single or DT
-	mounting
-	When
_	$F_{\rm r} > 0.5 F_{\rm r} + Y_0 F_{\rm a}$
_	use $P_0 = F_{ m r}$

Во	undar	y Dim mm)	ensio	ons	Basi (N		ngs (Single) {kg	gf}	Factor	Limi Spee	ds (¹)	Eff.Load Centers		ent and sions (r		Mass (kg)
d	D	В	$m{r}$ min.	r_1 min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	(mi Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{r}_{ m a}$ max.	арргох.
25	62 62	17 17	1.1 1.1	0.6 0.6	24 400 27 200	14 600 14 900	2 490 2 770	1 490 1 520	_	9 000 10 000	13 000 15 000	26.7 26.8	32 32	55 55	1 1	0.241 0.229
30	47 47 55	9 9 13	0.3 0.3 1	0.15 0.15 0.6	7 850 8 300 14 500	5 950 6 250 10 100	800 845 1 480	605 640 1 030	 15.9 	18 000 22 000 13 000	24 000 28 000 18 000	13.5 9.7 18.8	32.5 32.5 36	44.5 44.5 49	0.3 0.3 1	0.049 0.049 0.116
	55 62 62	13 16 16	1 1 1	0.6 0.6 0.6	15 100 22 500 20 500	10 300 14 800 13 500	1 540 2 300 2 090	1 050 1 510 1 380	14.9 — —	19 000 12 000 8 500	26 000 17 000 12 000	12.2 21.3 27.3	36 36 36	49 56 56	1 1 1	0.134 0.197 0.202
	62 62 72	16 16 19	1 1 1.1	0.6 0.6 0.6	23 700 23 000 33 500	14 300 14 700 20 900	2 420 2 350 3 450	1 460 1 500 2 130	13.9 —	10 000 18 000 9 000	14 000 24 000 12 000	27.3 14.2 24.2	36 36 37	56 56 65	1 1 1	0.194 0.222 0.346
	72 72	19 19	1.1 1.1	0.6 0.6	31 000 36 500	19 300 20 600	3 150 3 700	1 960 2 100	_	8 000 9 000	11 000 13 000	30.9 30.9	37 37	65 65	1 1	0.354 0.336
35	55 55 62	10 10 14	0.6 0.6 1	0.3 0.3 0.6	11 400 12 100 18 300	8 700 9 150 13 400	1 170 1 230 1 870	885 930 1 370	_ 15.7 _	15 000 18 000 12 000	20 000 24 000 16 000	15.5 11.0 21.0	40 40 41	50 50 56	0.6 0.6 1	0.074 0.074 0.153
	62 72 72	14 17 17	1 1.1 1.1	0.6 0.6 0.6	19 100 29 700 27 100	13 700 20 100 18 400	1 950 3 050 2 760	1 390 2 050 1 870	15.0 — —	17 000 10 000 7 500	22 000 14 000 10 000	13.5 23.9 30.9	41 42 42	56 65 65	1 1 1	0.173 0.287 0.294
	72 72 80	17 17 21	1.1 1.1 1.5	0.6 0.6 1	32 500 30 500 40 000	19 600 19 900 26 300	3 300 3 100 4 050	1 990 2 030 2 680	13.9 —	8 500 15 000 8 000	12 000 20 000 10 000	30.9 15.7 27.1	42 42 44	65 65 71	1 1 1.5	0.271 0.32 0.464
	80 80	21 21	1.5 1.5	1	36 500 40 500	24 200 24 400	3 750 4 100	2 460 2 490	_	7 100 8 000	9 500 11 000	34.6 34.6	44 44	71 71	1.5 1.5	0.474 0.451
40	62 62 68	12 12 15	0.6 0.6 1	0.3 0.3 0.6	14 300 15 100 19 500	11 200 11 700 15 400	1 460 1 540 1 990	1 140 1 200 1 570	_ 15.7 _	14 000 16 000 10 000	18 000 22 000 14 000	17.9 12.8 23.1	45 45 46	57 57 62	0.6 0.6 1	0.11 0.109 0.19
	68 80 80	15 18 18	1 1.1 1.1	0.6 0.6 0.6	20 600 35 500 32 000	15 900 25 100 23 000	2 100 3 600 3 250	1 620 2 560 2 340	15.4 —	15 000 9 500 6 700	20 000 13 000 9 000	14.7 26.3 34.2	46 47 47	62 73 73	1 1 1	0.213 0.375 0.383

Face-to-Face

Notes	(1)	For applications operating near the li	imiting speed, refer to Page B49.
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(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

Bearing	Numl	bers (²)	Basi (1	c Load Ratings	s (Matched) {kg		Speeds (1)	iting (Matched)	Load (Spacing	s (mm)		nent and nsions (r	
Single	[Duplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	in ⁻¹) Oil	а 	O DF	d _b (³) min.	$D_{ m b}$ max.	Г _b (³) max.
7305 B *7305 BE		DF D	39 500 —	29 300 —	4 050	2 980 —	7 500 8 500	10 000 12 000	53.5 53.5	19.5 19.5	30 30	57 57	0.6 0.6
7906 A5 7906 C 7006 A	DB DB DB	DF D DF D	T 13 500	11 900 12 500 20 200	1 300 1 380 2 410	1 210 1 280 2 060	14 000 17 000 11 000	19 000 24 000 15 000	27.0 19.3 37.5	9.0 1.3 11.5	_ _ 35	45.8 45.8 50	0.15 0.15 0.6
7006 C 7206 A 7206 B	DB DB DB	DF D DF D	T 36 500	20 500 29 500 27 000	2 510 3 750 3 400	2 090 3 000 2 760	15 000 10 000 7 100	22 000 13 000 9 500	24.4 42.6 54.6	1.6 10.6 22.6	— 35 35	50 57 57	0.6 0.6 0.6
*7206 BE 7206 C 7306 A	A DB DB	DF D		29 300 41 500	3 800 5 600	2 990 4 250	8 000 14 000 7 100	11 000 20 000 9 500	54.6 28.3 48.4	22.6 3.7 10.4	35 — 35	57 57 67	0.6 0.6 0.6
7306 B *7306 BE		DF D	T 50 500	38 500 —	5 150 —	3 950 —	6 300 7 100	8 500 10 000	61.8 61.8	23.8 23.8	35 35	67 67	0.6 0.6
7907 A5 7907 C 7007 A	DB DB DB	DF D DF D	T 19 600	17 400 18 300 26 800	1 890 2 000 3 050	1 770 1 860 2 740	12 000 14 000 9 500	17 000 20 000 13 000	31.0 22.1 42.0	11.0 2.1 14.0	_ _ 40	52.5 52.5 57	0.3 0.3 0.6
7007 C 7207 A 7207 B	DB DB DB	DF D DF D	T 48 500	27 300 40 000 36 500	3 150 4 900 4 500	2 790 4 100 3 750	13 000 8 500 6 000	19 000 12 000 8 000	27.0 47.9 61.9	1.0 13.9 27.9	- 40 40	57 67 67	0.6 0.6 0.6
*7207BE/ 7207 C 7307 A	DB DB	DF D		40 000 52 500	5 050 6 600	4 050 5 350	6 700 12 000 6 300	9 500 17 000 8 500	61.9 31.3 54.2	27.9 2.7 12.2	40 — 41	67 67 74	0.6 0.6 1
7307 B *7307 BE		DF D	T 59 500	48 500 —	6 100 —	4 950 —	5 600 6 300	7 500 9 000	69.2 69.2	27.2 27.2	41 41	74 74	1 1
7908 A5 7908 C 7008 A	DB DB DB	DF D DF D	T 24 600	22 300 23 500 31 000	2 370 2 510 3 250	2 270 2 390 3 150	11 000 13 000 8 500	15 000 18 000 11 000	35.8 25.7 46.2	11.8 1.7 16.2	_ _ 45	59.5 59.5 63	0.3 0.3 0.6
7008 C 7208 A 7208 B	DB DB DB	DF D DF D	T 57 500	32 000 50 500 46 000	3 400 5 850 5 300	3 250 5 150 4 700	12 000 7 500 5 300	17 000 10 000 7 500	29.5 52.6 68.3	0.5 16.6 32.3	— 45 45	63 75 75	0.6 0.6 0.6
Note	(3)	For box	rings marked	in the colum	on for d	l and n	for abofta	oro d (m	in \ and =	· (may)	roopooth	, alv	

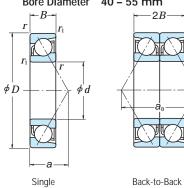
Note (3) For bearings marked — in the column for d_b , d_b and r_b for shafts are d_a (min.) and r_a (max.) respectively. Remarks The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing

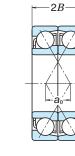
Numbers indicates the universal matching.

DB

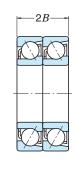
SINGLE/MATCHED MOUNTINGS

Bore Diameter 40 – 55 mm



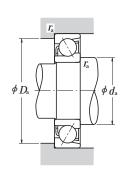


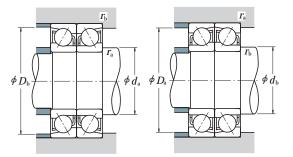
Face-to-Face



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
Angle Cor		e	F_a/I	7 _r ≦e	F_a/I	r > e	F_a/I	$r \leq e$	F_a/I	r > e
Arigie	Cor		X	Y	X	Y	X	Y	X	Y
	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
15°	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
13	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 $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c	r DF	
Angle	<i>X</i> ₀	Y_0	X 0	Y 0	Single or DT
15°	0.5	0.46	1	0.92	mounting When
25°	0.5	0.38	1	0.76	$F_{\rm r} > 0.5 F_{\rm r} +$
30°	0.5	0.33	1	0.66	use $P_0 = F_r$
40°	0.5	0.26	1	0.52	

	Single or DT
	mounting
_	When
	$F_r > 0.5F_r + Y_0F_a$
	use $P_0 = F_r$
	0 -1

Во	oundar	y Dim (mm)		ons	Basic Load Ratings (Single) (N) $\{kgf\}$ C_r C_0 C_r C_0			Factor		iting ds (¹) n-¹)	Eff.Load Centers		nent and nsions		Mass (kg)	
d	D	В	$m{r}$ min.	$r_{ m 1}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	арргох.
40	80 80 90	18 18 23	1.1	0.6 0.6 1	38 500 36 500 49 000	24 500 25 200 33 000	3 900 3 700 5 000	2 500 2 570 3 350	14.1 —	7 500 14 000 7 100	11 000 19 000 9 000	34.2 17.0 30.3	47 47 49	73 73 81	1 1 1.5	0.357 0.418 0.633
	90 90	23 23		1 1	45 000 53 000	30 500 33 000	4 550 5 400	3 100 3 350	_	6 300 7 100	8 500 10 000	38.8 38.8	49 49	81 81	1.5 1.5	0.648 0.619
45	68 68 75	12 12 16	0.6 0.6 1	0.3 0.3 0.6	15 100 16 000 23 100	12 700 13 400 18 700	1 540 1 630 2 360	1 290 1 360 1 910	16.0 —	12 000 14 000 9 500	17 000 20 000 13 000	19.2 13.6 25.3	50 50 51	63 63 69	0.6 0.6 1	0.13 0.129 0.25
	75 85 85	16 19 19	1 1.1 1.1	0.6 0.6 0.6	24 400 39 500 36 000	19 300 28 700 26 200	2 490 4 050 3 650	1 960 2 930 2 680	15.4 — —	14 000 8 500 6 300	19 000 12 000 8 500	16.0 28.3 36.8	51 52 52	69 78 78	1 1 1	0.274 0.411 0.421
	85 85 100	19 19 25	1.1 1.1 1.5	0.6 0.6 1	40 500 41 000 63 500	27 100 28 800 43 500	4 100 4 150 6 450	2 760 2 940 4 450	14.2 —	7 100 12 000 6 300	10 000 17 000 8 500	36.8 18.2 33.4	52 52 54	78 78 91	1 1 1.5	0.40 0.468 0.848
	100 100	25 25	1.5 1.5	1 1	58 500 62 500	40 000 39 500	5 950 6 400	4 100 4 050	_	5 600 6 300	7 500 9 000	42.9 42.9	54 54	91 91	1.5 1.5	0.869 0.823
50	72 72 80	12 12 16	0.6 0.6 1	0.3 0.3 0.6	15 900 16 900 24 500	14 200 15 000 21 100	1 630 1 720 2 500	1 450 1 530 2 150	16.2 —	11 000 13 000 8 500	15 000 18 000 12 000	20.2 14.2 26.8	55 55 56	67 67 74	0.6 0.6 1	0.132 0.13 0.263
	80 90 90	16 20 20	1 1.1 1.1	0.6 0.6 0.6	26 000 41 500 37 500	21 900 31 500 28 600	2 650 4 200 3 800	2 230 3 200 2 920	15.7 — —	12 000 8 000 5 600	17 000 11 000 8 000	16.7 30.2 39.4	56 57 57	74 83 83	1 1 1	0.293 0.466 0.477
	90 90 110	20 20 27	1.1 1.1 2	0.6 0.6 1	42 000 43 000 74 000	29 700 31 500 52 000	4 300 4 350 7 550	3 050 3 250 5 300	14.5 —	6 300 12 000 5 600	9 500 16 000 7 500	39.4 19.4 36.6	57 57 60	83 83 100	1 1 2	0.453 0.528 1.1
	110 110	27 27	2	1 1	68 000 78 000	48 000 50 500	6 950 7 950	4 900 5 150	_ _	5 000 5 600	6 700 8 000	47.1 47.1	60 60	100 100	2	1.12 1.07
55	80 80 90	13 13 18	1 1 1.1	0.6 0.6 0.6	18 100 19 100 32 500	16 800 17 700 27 700	1 840 1 950 3 300	1 710 1 810 2 830	_ 16.3 _	10 000 12 000 7 500	14 000 16 000 11 000	22.2 15.5 29.9	61 61 62	74 74 83	1 1 1	0.184 0.182 0.391

Notes ((1)	For applications	operating near th	e limiting speed,	refer to Page B49.
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(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

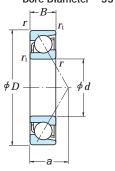
Bearing	Numbers (²)	Ва	asic Load Ratir (N)	ngs (Matched {kg		Speeds (1)	iting (Matched)	Spacing	Center gs (mm)		nent and nsions (r	
Single	Duplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	in ⁻¹) Oil	DB	DF	d _b (³) min.	$D_{ m b}$ max.	Г _b (³) max.
*7208 BEA 7208 C 7308 A	DB DF D	T 59 000 T 79 500		6 000 8 100	5 150 6 700	6 000 11 000 5 600	8 500 15 000 7 500	68.3 34.1 60.5	32.3 1.9 14.5	45 — 46	75 75 84	0.6 0.6 1
7308 B *7308 BE	DB DF D	73 000 -	60 500	7 400	6 200 —	5 000 5 600	6 700 8 000	77.5 77.5	31.5 31.5	46 46	84 84	1 1
7909 A5 7909 C 7009 A	DB DF D	24 600 T 26 000 T 37 500	26 800	2 510 2 660 3 850	2 590 2 730 3 800	9 500 12 000 7 500	13 000 16 000 10 000	38.4 27.1 50.6	14.4 3.1 18.6	— — 50	65.5 65.5 70	0.3 0.3 0.6
7009 C 7209 A 7209 B	DB DF D	39 500 0T 64 500 0T 58 500	57 500	4 050 6 550 5 950	3 950 5 850 5 350	11 000 7 100 5 000	15 000 9 500 6 700	32.1 56.5 73.5	0.1 18.5 35.5	 50 50	70 80 80	0.6 0.6 0.6
*7209 BEA 7209 C 7309 A	DB DF D	T 66 500 T 103 000		6 750 10 500	5 850 8 900	5 600 10 000 5 000	8 000 14 000 6 700	73.5 36.4 66.9	35.5 1.6 16.9	50 — 51	80 80 94	0.6 0.6 1
7309 B *7309 BE	DB DF DA	95 000 -	80 500	9 650 —	8 200 —	4 500 5 000	6 000 7 100	85.8 85.8	35.8 35.8	51 51	94 94	1 1
7910 A5 7910 C 7010 A	DB DF D	25 900 27 27 400 40 000	30 000	2 640 2 800 4 050	2 900 3 050 4 300	9 000 11 000 7 100	12 000 15 000 9 500	40.5 28.3 53.5	16.5 4.3 21.5	— — 55	69.5 69.5 75	0.3 0.3 0.6
7010 C 7210 A 7210 B	DB DF D	42 000 T 67 000 T 60 500	63 000	4 300 6 850 6 200	4 450 6 400 5 850	10 000 6 300 4 500	14 000 9 000 6 300	33.4 60.4 78.7	1.4 20.4 38.7	— 55 55	75 85 85	0.6 0.6 0.6
*7210 BEA 7210 C 7310 A	DB DF D	69 500 T 121 000		7 100 12 300	6 450 10 600	5 000 9 500 4 500	7 500 13 000 6 000	78.7 38.7 73.2	38.7 1.3 19.2	55 — 56	85 85 104	0.6 0.6 1
7310 B *7310 BE		111 000 -	96 000	11 300 —	9 800 —	4 000 4 500	5 600 6 700	94.1 94.1	40.1 40.1	56 56	104 104	1 1
7911 A5 7911 C 7011 A	DB DF D	29 300 T 31 000 T 52 500	35 500	2 990 3 150 5 350	3 400 3 600 5 650	8 000 9 500 6 300	11 000 13 000 8 500	44.5 31.1 59.9	18.5 5.1 23.9	— — 60	75 75 85	0.6 0.6 0.6

Note (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.

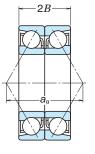
Remarks The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

SINGLE/MATCHED MOUNTINGS

Bore Diameter 55 – 65 mm

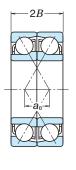


Single



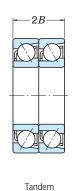
Back-to-Back

DB

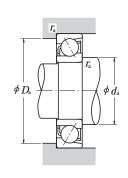


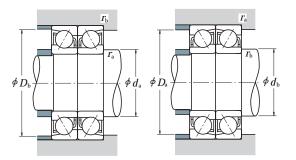
Face-to-Face

DF



DT





Camban	*			Singl	e, DT			DB c	or DF	
Contact			a/	r≦	a/	r>	a/	r≦	a/	r>
Angle	Cor									
	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
15°	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15.	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
*	1100 3	f DD	DF ===	1 f DT						

*For , use 2 for DB, DF and 1 for DT

Dynamic Equivalent Load = r + a

Contact	Singl	e, DT	DB c	r DF	
Angle	0	0	0	0	Single or DT
15°	0.5	0.46	1	0.92	mounting When
25°	0.5	0.38	1	0.76	r>0.5 r
30°	0.5	0.33	1	0.66	use 0= r
40°	0.5	0.26	1	0.52	

Bearing	Numbers (²)	Basi (1	ic Load Rating N)	ıs (Matched {kç		Speeds (1)	iting (Matched)	Load (Spacing	s (mm)		nent and nsions (
Single	Duplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	n ⁻¹) Oil	DB	O DF	d _b (3) min.	$D_{ m b}$ max.	Γ _b (³) max.
7011 C 7211 A 7211 B	DB DF DT DB DF DT	83 000	57 500 79 000 72 000	5 650 8 450 7 650	5 850 8 050 7 350	9 000 6 000 4 000	12 000 8 000 5 600	37.4 65.7 86.0	1.4 23.7 44.0	— 61 61	85 94 94	0.6 1 1
*7211 BE 7211 C 7311 A	A DB DF D1 DB DF D1		80 000 123 000	8 800 14 200	8 150 12 500	4 500 8 500 4 000	6 700 12 000 5 600	86.0 41.7 79.5	44.0 0.3 21.5	61 — 61	94 94 114	1 1 1
7311 B *7311 BE	DB DF D1	128 000	113 000	13 100 —	11 500 —	3 600 4 000	5 000 6 000	102.4 102.4	44.4 44.4	61 61	114 114	1 1
7912 A5 7912 C 7012 A	DB DF DT DB DF DT	31 500	35 500 37 500 59 000	3 050 3 200 5 450	3 600 3 800 6 000	7 500 9 000 6 000	10 000 12 000 8 000	46.8 32.4 62.7	20.8 6.4 26.7	— — 65	80 80 90	0.6 0.6 0.6
7012 C 7212 A 7212 B	DB DF DT DB DF DT	100 000	61 500 97 500 89 000	5 800 10 200 9 300	6 250 9 950 9 050	8 500 5 300 3 800	12 000 7 100 5 300	38.8 71.1 93.3	2.8 27.1 49.3	— 66 66	90 104 104	0.6 1 1
*7212 BE 7212 C 7312 A	A DB DF D1 DB DF D1		98 500 143 000	10 600 16 200	10 000 14 500	4 300 7 500 3 800	6 000 11 000 5 000	93.3 44.8 85.9	49.3 0.8 23.9	66 — 67	104 104 123	1 1 1
7312 B *7312 BE	DB DF DT	146 000	131 000	14 900 —	13 400 —	3 400 3 800	4 500 5 600	110.7 110.7	48.7 48.7	67 67	123 123	1 1
7913 A5 7913 C 7013 A	DB DF DT DB DF DT	33 000	39 000 41 000 65 500	3 150 3 350 5 750	3 950 4 200 6 700	7 100 8 500 5 600	9 500 12 000 7 500	49.1 33.8 65.6	23.1 7.8 29.6	— — 70	85 85 95	0.6 0.6 0.6
7013 C 7213 A 7213 B	DB DF DT DB DF DT	114 000	68 500 116 000 105 000	6 150 11 600 10 500	7 000 11 800 10 700	8 000 4 800 3 400	11 000 6 700 4 800	40.1 76.4 100.6	4.1 30.4 54.6	— 71 71	95 114 114	0.6 1 1
*7213 BE 7213 C 7313 A	A DB DF D1 DB DF D1		117 000 164 000	12 100 18 400	12 000 16 700	3 800 7 100 3 600	5 600 9 500 4 800	100.6 47.8 92.2	54.6 1.8 26.2	71 — 72	114 114 133	1 1 1
7313 B *7313 BE	DB DF DT	166 000	151 000 —	16 900 —	15 400 —	3 200 3 600	4 300 5 000	119.0 119.0	53.0 53.0	72 72	133 133	1 1

Note (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.

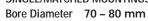
Remarks The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

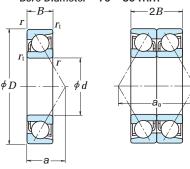
Во	oundar (y Dim mm)		ns	(N) $\{kgf\}$ $C_{\rm r}$ $C_{\rm 0r}$ $C_{\rm r}$ $C_{\rm 0r}$			Factor	Limi Spee (mi	ds (¹)	Eff.Load Centers (mm)		nent and nsions (Mass (kg)	
d	D	В	$m{r}$ min.	$r_{ m 1}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	0	Grease	'' ['] Oil	a	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{r}_{ m a}$ max.	арргох.
55	90 100 100	18 21 21	1.1 1.5 1.5	0.6 1 1	34 000 51 000 46 500	28 600 39 500 36 000	3 500 5 200 4 700	2 920 4 050 3 700	15.5 —	11 000 7 100 5 300	15 000 10 000 7 100	18.7 32.9 43.0	62 64 64	83 91 91	1 1.5 1.5	0.43 0.613 0.627
	100 100 120	21 21 29	1.5 1.5 2	1 1 1	51 500 53 000 86 000	37 000 40 000 61 500	5 250 5 400 8 750	3 800 4 100 6 250	14.5 —	6 000 10 000 5 000	8 500 14 000 6 700	43.0 20.9 39.8	64 64 65	91 91 110	1.5 1.5 2	0.596 0.688 1.41
	120 120	29 29	2	1	79 000 89 000	56 500 58 500	8 050 9 100	5 750 6 000	_	4 500 5 000	6 300 7 500	51.2 51.2	65 65	110 110	2	1.45 1.36
60	85 85 95	13 13 18	1 1 1.1	0.6 0.6 0.6	18 300 19 400 33 000	17 700 18 700 29 500	1 870 1 980 3 350	1 810 1 910 3 000	16.5 —	9 500 11 000 7 100	13 000 15 000 10 000	23.4 16.2 31.4	66 66 67	79 79 88	1 1 1	0.197 0.194 0.417
	95 110 110	18 22 22	1.1 1.5 1.5	0.6 1 1	35 000 62 000 56 000	30 500 48 500 44 500	3 600 6 300 5 700	3 150 4 950 4 550	15.7 — —	10 000 6 700 4 800	14 000 9 000 6 300	19.4 35.5 46.7	67 69 69	88 101 101	1 1.5 1.5	0.46 0.798 0.815
	110 110 130	22 22 31	1.5 1.5 2.1	1 1 1.1	61 500 64 000 98 000	45 000 49 000 71 500	6 300 6 550 10 000	4 600 5 000 7 250	14.4 —	5 300 9 500 4 800	7 500 13 000 6 300	46.7 22.4 42.9	69 69 72	101 101 118	1.5 1.5 2	0.791 0.889 1.74
	130 130	31 31	2.1 2.1	1.1 1.1	90 000 102 000	65 500 68 500	9 200 10 500	6 700 7 000	_	4 300 4 800	5 600 6 700	55.4 55.4	72 72	118 118	2	1.78 1.7
65	90 90 100	13 13 18	1 1 1.1	0.6 0.6 0.6	19 100 20 200 35 000	19 400 20 500 33 000	1 940 2 060 3 550	1 980 2 090 3 350	16.7 —	9 000 10 000 6 700	12 000 14 000 9 500	24.6 16.9 32.8	71 71 72	84 84 93	1 1 1	0.211 0.208 0.455
	100 120 120	18 23 23	1.1 1.5 1.5	0.6 1 1	37 000 70 500 63 500	34 500 58 000 52 500	3 800 7 150 6 500	3 500 5 900 5 350	15.9 — —	10 000 6 000 4 300	13 000 8 500 6 000	20.0 38.2 50.3	72 74 74	93 111 111	1 1.5 1.5	0.493 1.03 1.05
	120 120 140	23 23 33	1.5 1.5 2.1	1 1 1.1	70 000 73 000 111 000	53 500 58 500 82 000	7 150 7 450 11 300	5 450 6 000 8 350	14.6 —	4 800 9 000 4 300	7 100 12 000 6 000	50.3 23.9 46.1	74 74 77	111 111 128	1.5 1.5 2	1.01 1.14 2.12
	140 140	33 33	2.1 2.1	1.1 1.1	102 000 114 000	75 500 77 000	10 400 11 600	7 700 7 850	_	3 800 4 300	5 300 6 300	59.5 59.5	77 77	128 128	2 2	2.17 2.09

Notes (1) For applications operating near the limiting speed, refer to Page B49.

(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

SINGLE/MATCHED MOUNTINGS

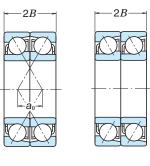




Back-to-Back

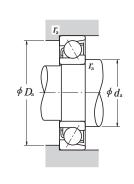
DB

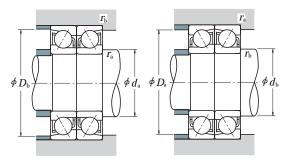
Single



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

if E*			Singl	e, DT			DB c	r DF	
	e	F_a/I	7 _r ≦e	F_a/I	r > e	F_a/I	$r \leq e$	F_a/I	r > e
Cor		X	Y	X	Y	X	Y	X	Y
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
_	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41
	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93
	0.357 0.714 1.07 1.43 2.14 3.57	Cor e 0.178 0.38 0.357 0.40 0.714 0.43 1.07 0.46 1.43 0.47 2.14 0.50 3.57 0.55 5.38 0.56 — 0.68 — 0.80	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						

*For i, use 2 for DB, DF and 1 for DT

Static Equivalent Load $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c	r DF	
Angle	<i>X</i> ₀	Y 0	X 0	Y 0	Single or DT
15°	0.5	0.46	1	0.92	mounting When
25°	0.5	0.38	1	0.76	$F_r > 0.5 F_r + Y_0 F_a$
30°	0.5	0.33	1	0.66	use $P_0 = F_r$
40°	0.5	0.26	1	0.52	0 1

Bear	ring Numb	ers (²)	Basio (N	c Load Rating	s (Matched {kg			iting (Matched)	Load (Spacing <i>a</i>	s (mm)		nent and nsions (
Singl	le D	uplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	DB	O DF	d _b (³) min.	$D_{ m b}$ max.	Γ _b (³) max.
7914 7914 7014	C DB	DF DT DF DT DF DT	43 000 45 500 71 500	52 500 55 500 82 500	4 400 4 650 7 300	5 350 5 650 8 450	6 300 7 500 5 000	9 000 11 000 6 700	55.6 38.8 72.0	23.6 6.8 32.0	— — 75	95 95 105	0.6 0.6 0.6
7014 7214 7214	A DB	DF DT	76 000 124 000 112 000	86 000 127 000 116 000	7 750 12 600 11 500	8 750 13 000 11 800	7 100 4 500 3 200	10 000 6 300 4 500	44.1 80.3 105.8	4.1 32.3 57.8	— 76 76	105 119 119	0.6 1 1
*7214 7214 7314	C DB	DF DT DF DT	129 000 203 000	129 000 187 000	13 200 20 700	13 200 19 100	3 600 6 700 3 200	5 300 9 000 4 300	105.8 50.1 98.5	57.8 2.1 28.5	76 — 77	119 119 143	1 1 1
7314 *7314		DF DT	186 000 —	172 000 —	19 000 —	17 500 —	2 800 3 200	4 000 4 800	127.3 127.3	57.3 57.3	77 77	143 143	1 1
7915 7915 7015	C DB	DF DT DF DT DF DT	44 000 46 500 73 000	55 500 58 500 87 500	4 450 4 750 7 450	5 650 5 950 8 900	6 000 7 100 4 800	8 500 10 000 6 700	58.0 40.1 74.8	26.0 8.1 34.8	— 80	100 100 110	0.6 0.6 0.6
7015 7215 7215	A DB	DF DT DF DT DF DT	78 000 123 000 112 000	91 500 129 000 117 000	7 950 12 600 11 400	9 300 13 100 11 900	6 700 4 300 3 200	9 500 6 000 4 300	45.4 84.2 111.0	5.4 34.2 61.0	81 81	110 124 124	0.6 1 1
*7215 7215 7315 7315	C DB A DB	DF DT DF DT DF DT	134 000 221 000 202 000	140 000 212 000 195 000	13 700 22 500 20 600	14 200 21 600 19 800	3 600 6 300 3 000 2 800	5 000 9 000 4 000 3 800	111.0 52.4 104.8 135.6	61.0 2.4 30.8 61.6	81 — 82 82	124 124 153 153	1 1 1
7916 7916 7016	C DB	DF DT DF DT DF DT	44 500 47 000 89 500	58 000 61 500 106 000	4 550 4 800 9 150	5 900 6 250 10 800	5 600 6 700 4 300	8 000 9 500 6 000	60.3 41.5 81.2	28.3 9.5 37.2	— — 85	105 105 120	0.6 0.6 0.6
7016 7216 7216	A DB	DF DT	95 500 145 000 131 000	111 000 152 000 139 000	9 700 14 700 13 300	11 300 15 600 14 100	6 300 4 000 2 800	9 000 5 600 4 000	49.4 89.5 118.3	5.4 37.5 66.3	— 86 86	120 134 134	0.6 1 1
*7216 7216 7316 7316	C DB A DB	DF DT DF DT DF DT	151 000 239 000 219 000	155 000 238 000 218 000	15 400 24 400 22 400	15 800 24 200 22 300	3 200 6 000 2 800 2 600	4 800 8 000 3 800 3 400	118.3 55.5 111.2 143.9	66.3 3.5 33.2 65.9	86 — 87 87	134 134 163 163	1 1 1 1

Note (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.

Remarks The bearings denoted by an asterisk (*) are NSKHPS Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.

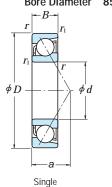
В	oundar (y Dim mm)	nensio	ons	(N) {kgf}			Factor	Lim Spee	ds (¹)	Eff.Load Centers		nent and nsions		Mass (kg)	
d	D	В	$m{r}$ min.	$r_{\scriptscriptstyle 1}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	n ⁻¹) Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	арргох.
70	100	16	1	0.6	26 500	26 300	2 710	2 680	_	8 000	11 000	27.8	76	94	1	0.341
	100	16	1	0.6	28 100	27 800	2 870	2 830	16.4	9 500	13 000	19.4	76	94	1	0.338
	110	20	1.1	0.6	44 000	41 500	4 500	4 200	_	6 300	8 500	36.0	77	103	1	0.625
	110	20	1.1	0.6	47 000	43 000	4 800	4 400	15.7	9 000	12 000	22.1	77	103	1	0.698
	125	24	1.5	1	76 500	63 500	7 800	6 500	—	5 600	8 000	40.1	79	116	1.5	1.11
	125	24	1.5	1	69 000	58 000	7 050	5 900	—	4 000	5 600	52.9	79	116	1.5	1.14
	125 125 150	24 24 35	1.5 1.5 2.1	1 1 1.1	75 500 79 500 125 000	58 500 64 500 93 500	7 700 8 100 12 700	6 000 6 600 9 550	14.6 —	4 500 8 500 4 000	6 700 11 000 5 300	52.9 25.1 49.3	79 79 82	116 116 138	1.5 1.5 2	1.08 1.24 2.6
	150 150	35 35	2.1 2.1	1.1 1.1	114 000 124 000	86 000 87 500	11 700 12 600	8 750 8 900	_	3 600 4 000	5 000 6 000	63.6 63.7	82 82	138 138	2	2.65 2.53
75	105	16	1	0.6	26 900	27 700	2 750	2 820	—	7 500	10 000	29.0	81	99	1	0.355
	105	16	1	0.6	28 600	29 300	2 910	2 980	16.6	9 000	12 000	20.1	81	99	1	0.357
	115	20	1.1	0.6	45 000	43 500	4 600	4 450	—	6 000	8 000	37.4	82	108	1	0.661
	115	20	1.1	0.6	48 000	45 500	4 900	4 650	15.9	8 500	12 000	22.7	82	108	1	0.748
	130	25	1.5	1	76 000	64 500	7 750	6 550	—	5 600	7 500	42.1	84	121	1.5	1.19
	130	25	1.5	1	68 500	58 500	7 000	5 950	—	3 800	5 300	55.5	84	121	1.5	1.22
	130 130 160 160	25 25 37 37	1.5 1.5 2.1 2.1	1 1 1.1 1.1	78 500 83 000 136 000 125 000	63 500 70 000 106 000 97 500	8 000 8 450 13 800 12 700	6 450 7 100 10 800 9 900	14.8 —	4 300 8 000 3 800 3 400	6 300 11 000 5 000 4 800	55.5 26.2 52.4 67.8	84 84 87 87	121 121 148 148	1.5 1.5 2 2	1.18 1.36 3.13 3.19
80	110	16	1	0.6	27 300	29 000	2 790	2 960	_	7 100	10 000	30.2	86	104	1	0.38
	110	16	1	0.6	29 000	30 500	2 960	3 150	16.7	8 500	12 000	20.7	86	104	1	0.376
	125	22	1.1	0.6	55 000	53 000	5 650	5 400	_	5 600	7 500	40.6	87	118	1	0.88
	125	22	1.1	0.6	58 500	55 500	6 000	5 650	15.7	8 000	11 000	24.7	87	118	1	0.966
	140	26	2	1	89 000	76 000	9 100	7 750	—	5 000	7 100	44.8	90	130	2	1.46
	140	26	2	1	80 500	69 500	8 200	7 050	—	3 600	5 000	59.1	90	130	2	1.49
	140	26	2	1	87 500	70 000	8 950	7 150		4 000	6 000	59.2	90	130	2	1.42
	140	26	2	1	93 000	77 500	9 450	7 900	14.7	7 500	10 000	27.7	90	130	2	1.63
	170	39	2.1	1.1	147 000	119 000	15 000	12 100		3 600	4 800	55.6	92	158	2	3.71
	170	39	2.1	1.1	135 000	109 000	13 800	11 100		3 200	4 300	71.9	92	158	2	3.79

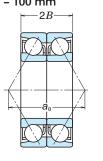
Face-to-Face

Notes	(1)	For applications	operating near	the limiting speed, re	fer to Page B49 .
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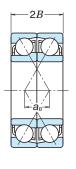
⁽²⁾ The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

SINGLE/MATCHED MOUNTINGS Bore Diameter 85 – 100 mm





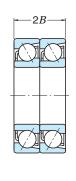
Back-to-Back

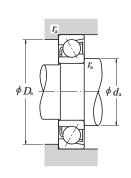


Face-to-Face

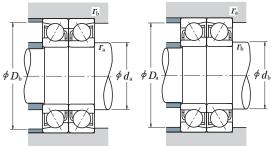
DF

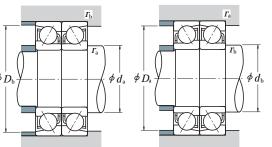
Factor





Eff.Load Abutment and Fillet Mass





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	if ₀ F _a *			Single, DT				DB or DF			
		e	$F_a/F_r \leq e$		$F_a/F_r > e$		$F_a/F_r \leq e$		F_a/I	r > e	
Angle	Cor		X	Y	X	Y	X	Y	X	Y	
	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	
15°	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00	
13.	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 $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c	or DF	
Angle	<i>X</i> ₀	Y 0	X 0	Y 0	Single or DT
15°	0.5	0.46	1	0.92	mounting When
25°	0.5	0.38	1	0.76	$F_r > 0.5F_r + Y_0F_a$
30°	0.5	0.33	1	0.66	use $P_0 = F_r$
40°	0.5	0.26	1	0.52	0 -1

Bearing	Numbers (2)	Basi (N	c Load Rating	s (Matched) {kg		Limii Speeds (¹) (mir	(Matched)	Load (Spacing <i>a</i>	s (mm)		nent and nsions (
Single	Duplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	DB	O DF	d _b (3) min.	$D_{ m b}$ max.	r _b (³) max.
7917 A5	DB DF DT	59 500	77 000	6 100	7 850	5 300	7 500	65.8	29.8	—	115	0.6
7917 C	DB DF DT	63 000	81 500	6 450	8 300	6 300	9 000	45.5	9.5	—	115	0.6
7017 A	DB DF DT	91 500	112 000	9 350	11 400	4 300	5 600	84.1	40.1	90	125	0.6
7017 C 7217 A 7217 B	DB DF DT DB DF DT DB DF DT	98 000 167 000 151 000	117 000 178 000 162 000	9 950 17 100 15 400	12 000 18 200 16 500	6 000 3 800 2 800	8 500 5 300 3 800	50.8 95.8 126.6	6.8 39.8 70.6	91 91	125 144 144	0.6 1 1
7217 C 7317 A 7317 B	DB DF DT DB DF DT DB DF DT	174 000 258 000 236 000	181 000 265 000 244 000	17 800 26 300 24 100	18 500 27 000 24 800	5 600 2 600 2 400	7 500 3 600 3 200	59.5 117.5 152.2	3.5 35.5 70.2	92 92	144 173 173	1 1 1
7918 A5	DB DF DT	64 000	87 000	6 500	8 900	5 000	7 100	68.1	32.1	—	120	0.6
7918 C	DB DF DT	67 500	92 000	6 900	9 400	6 000	8 500	46.8	10.8	—	120	0.6
7018 A	DB DF DT	109 000	133 000	11 200	13 500	3 800	5 300	90.4	42.4	96	134	1
7018 C	DB DF DT	116 000	138 000	11 900	14 100	5 600	8 000	54.8	6.8	—	134	1
7218 A	DB DF DT	191 000	206 000	19 500	21 000	3 600	5 000	102.2	42.2	96	154	1
7218 B	DB DF DT	173 000	188 000	17 700	19 100	2 600	3 400	134.9	74.9	96	154	1
7218 C	DB DF DT	199 000	209 000	20 300	21 400	5 300	7 100	63.5	3.5	—	154	1
7318 A	DB DF DT	277 000	294 000	28 300	30 000	2 600	3 400	123.8	37.8	97	183	1
7318 B	DB DF DT	254 000	270 000	25 900	27 600	2 200	3 000	160.5	74.5	97	183	1
7919 A5	DB DF DT	64 500	91 000	6 600	9 250	4 800	6 700	70.5	34.5	_	125	0.6
7919 C	DB DF DT	68 500	96 000	7 000	9 800	5 600	8 000	48.1	12.1	_	125	0.6
7019 A	DB DF DT	109 000	134 000	11 100	13 600	3 800	5 000	93.3	45.3	_	139	1
7019 C	DB DF DT	119 000	146 000	12 200	14 900	5 300	7 500	56.1	8.1	—	139	1
7219 A	DB DF DT	208 000	221 000	21 200	22 600	3 400	4 500	108.5	44.5	102	163	1
7219 B	DB DF DT	188 000	202 000	19 200	20 500	2 400	3 200	143.2	79.2	102	163	1
7219 C	DB DF DT	216 000	224 000	22 000	22 800	4 800	6 700	67.5	3.5	—	163	1
7319 A	DB DF DT	297 000	325 000	30 500	33 000	2 400	3 200	130.2	40.2	102	193	1
7319 B	DB DF DT	272 000	298 000	27 700	30 500	2 200	3 000	168.7	78.7	102	193	1
7920 A5	DB DF DT	77 000	103 000	7 850	10 500	4 500	6 300	76.0	36.0	_	135	0.6
7920 C	DB DF DT	81 500	108 000	8 300	11 100	5 300	7 500	52.2	12.2	_	135	0.6
7020 A	DB DF DT	111 000	141 000	11 300	14 400	3 600	5 000	96.2	48.2	_	144	1

(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.

	DB
Boundary Dimensions	Basic Load Ratings (Single)

Tandem DT

8 500

4 000

3 600

8 000

9 000

6 000

6 000

3 000

2 600

5 600

6 700

4 500

107

65.1 109

84.3 109

26.1 107

48.1 109

33.7

38.0 107 158

186

186

133

133

3.05

0.804

0.794

2.5 5.83

2.5 5.98

1.5 | 1.48

Limiting

	((mm)			(1)	1)	{k	gf}				Centers				(kg)
d	D	В	$m{r}$ min.	$r_{ m 1}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	approx.
85	120	18	1.1	0.6	36 500	38 500	3 750	3 900	—	6 700	9 000	32.9	92	113	1	0.541
	120	18	1.1	0.6	39 000	40 500	3 950	4 150	16.5	8 000	11 000	22.7	92	113	1	0.534
	130	22	1.1	0.6	56 500	56 000	5 750	5 700	—	5 300	7 100	42.0	92	123	1	0.913
	130	22	1.1	0.6	60 000	58 500	6 150	6 000	15.9	7 500	10 000	25.4	92	123	1	1.01
	150	28	2	1	103 000	89 000	10 500	9 100	—	4 800	6 700	47.9	95	140	2	1.83
	150	28	2	1	93 000	81 000	9 500	8 250	—	3 400	4 800	63.3	95	140	2	1.87
	150 180 180	28 41 41	2 3 3	1 1.1 1.1	107 000 159 000 146 000	90 500 133 000 122 000	10 900 16 200 14 800	9 250 13 500 12 400	14.7 —	6 700 3 400 3 000	9 500 4 500 4 000	29.7 58.8 76.1	95 99 99	140 166 166	2 2.5 2.5	2.04 4.33 4.42
90	125	18	1.1	0.6	39 500	43 500	4 000	4 450	_	6 300	8 500	34.1	97	118	1	0.56
	125	18	1.1	0.6	41 500	46 000	4 250	4 700	16.6	7 500	10 000	23.4	97	118	1	0.563
	140	24	1.5	1	67 500	66 500	6 850	6 750	_	4 800	6 700	45.2	99	131	1.5	1.19
	140	24	1.5	1	71 500	69 000	7 300	7 050	15.7	7 100	9 500	27.4	99	131	1.5	1.34
	160	30	2	1	118 000	103 000	12 000	10 500	—	4 500	6 000	51.1	100	150	2	2.25
	160	30	2	1	107 000	94 000	10 900	9 550	—	3 200	4 300	67.4	100	150	2	2.29
	160 190 190	30 43 43	2 3 3	1 1.1 1.1	123 000 171 000 156 000	105 000 147 000 135 000	12 500 17 400 15 900	10 700 15 000 13 800	14.6 —	6 300 3 200 2 800	9 000 4 300 3 800	31.7 61.9 80.2	100 104 104	150 176 176	2 2.5 2.5	2.51 5.06 5.17
95	130	18	1.1	0.6	40 000	45 500	4 050	4 650	_	6 000	8 500	35.2	102	123	1	0.597
	130	18	1.1	0.6	42 500	48 000	4 300	4 900	16.7	7 100	10 000	24.1	102	123	1	0.591
	145	24	1.5	1	67 000	67 000	6 800	6 800	_	4 500	6 300	46.6	104	136	1.5	1.43
	145	24	1.5	1	73 500	73 000	7 500	7 450	15.9	6 700	9 000	28.1	104	136	1.5	1.42
	170	32	2.1	1.1	128 000	111 000	13 000	11 300	—	4 300	5 600	54.2	107	158	2	2.68
	170	32	2.1	1.1	116 000	101 000	11 800	10 300	—	3 000	4 000	71.6	107	158	2	2.74

13 500 11 400 14.6

5 250

5 100 5 550 16.5

18 600 16 600

17 100 15 200

6 950 7 200

Notes (1) For applications operating near the limiting speed, refer to Page B49.

51 500

54 000

70 500

133 000 112 000

183 000 162 000

167 000 149 000

47 500

50 000

68 500

(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

4 850

32 2.1 1.1 45 3 1.1 45 3 1.1

20 1.1 0.6

20 1.1 0.6

150 24 1.5 1

170

200

140

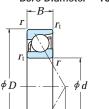
100 140

DB or DF

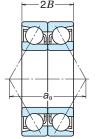
1.65 0.72 1.57 0.72

1.57 0.72 1.46 0.72 1.38 0.72 1.34 0.72 1.26 0.72 1.14 0.72

SINGLE/MATCHED MOUNTINGS Bore Diameter 100 - 120 mm

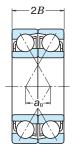


Single

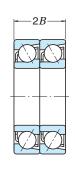


Back-to-Back

DB

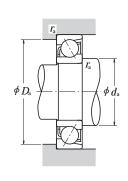


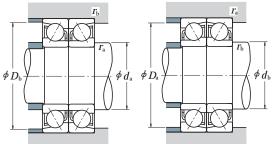
Face-to-Face

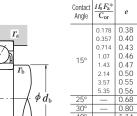


Tandem

DT







40°	_	1.14	1	0	0.35	0.5
*For <i>i</i>	use 2	for DB.	DF and	1 for DT		

Dynamic Equivalent Load $P = XF_r + YF_a$

Static Equivalent Load $P_0 = 1$	$X_0F_r + Y_0F_a$
----------------------------------	-------------------

Contact	Singl	e, DT	DB c		
Angle	<i>X</i> ₀	Y 0	X 0	Y 0	Singl
15°	0.5	0.46	1	0.92	mour
25°	0.5	0.38	1	0.76	Fr>
30°	0.5	0.33	1	0.66	use I
40°	0.5	0.26	1	0.52	

0.44

0 0.44 1.12 0 0.44 1.02 0 0.44 1.00

a

Во	oundar	y Dim mm)		ons		sic Load Rat N)	ings (Single) {k) gf}	Factor	Limi Speed (mir	ls (¹)	Eff.Load Centers		nent and nsions (Mass (kg)
d	D	В	r min.	$r_{\!\scriptscriptstyle 1}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{r_{ m a}}$ max.	approx.
100	150 180 180	24 34 34	1.5 2.1 2.1	1 1.1 1.1	75 500 144 000 130 000	77 000 126 000 114 000	7 700 14 700 13 300	7 900 12 800 11 700	16.0 —	6 300 4 000 2 800	9 000 5 300 3 800	28.7 57.4 75.7	109 112 112	141 168 168	1.5 2 2	1.46 3.22 3.28
	180 215 215	34 47 47	2.1 3 3	1.1 1.1 1.1	149 000 207 000 190 000	127 000 193 000 178 000	15 200 21 100 19 400	12 900 19 700 18 100	14.5 —	5 600 2 800 2 400	8 000 3 800 3 400	35.7 69.0 89.6	112 114 114	168 201 201	2 2.5 2.5	3.65 7.29 7.43
105	145 145 160	20 20 26	1.1 1.1 2	0.6 0.6 1	48 000 51 000 80 000	54 000 57 000 81 500	4 900 5 200 8 150	5 500 5 800 8 350	16.6 —	5 600 6 300 4 300	7 500 9 000 5 600	39.2 26.7 51.2	112 112 115	138 138 150	1 1 2	0.82 0.826 1.84
	160 190 190	26 36 36	2 2.1 2.1	1 1.1 1.1	88 000 157 000 142 000	89 500 142 000 129 000	9 000 16 000 14 500	9 100 14 400 13 100	15.9 — —	6 000 3 800 2 600	8 500 5 000 3 600	30.7 60.6 79.9	115 117 117	150 178 178	2 2 2	1.82 3.84 3.92
	190 225 225	36 49 49	2.1 3 3	1.1 1.1 1.1	162 000 208 000 191 000	143 000 193 000 177 000	16 600 21 200 19 400	14 600 19 700 18 100	14.5 — —	5 300 2 600 2 400	7 500 3 600 3 200	37.7 72.1 93.7	117 119 119	178 211 211	2 2.5 2.5	4.33 9.34 9.43
110	150 150 170	20 20 28	1.1 1.1 2	0.6 0.6 1	49 000 52 000 96 500	56 000 59 500 95 500	5 000 5 300 9 850	5 750 6 050 9 700	_ 16.7 _	5 300 6 300 4 000	7 100 8 500 5 300	40.3 27.4 54.4	117 117 120	143 143 160	1 1 2	0.877 0.867 2.28
	170 200 200	28 38 38	2 2.1 2.1	1 1.1 1.1	106 000 170 000 154 000	104 000 158 000 144 000	10 800 17 300 15 700	10 600 16 100 14 700	15.6 — —	5 600 3 600 2 600	8 000 4 800 3 400	32.7 63.7 84.0	120 122 122	160 188 188	2 2 2	2.26 4.49 4.58
	200 240 240	38 50 50	2.1 3 3	1.1 1.1 1.1	176 000 220 000 201 000	160 000 215 000 197 000	17 900 22 500 20 500	16 300 21 900 20 100	14.5 — —	5 000 2 600 2 200	7 100 3 400 3 000	39.8 75.5 98.4	122 124 124	188 226 226	2 2.5 2.5	5.1 11.1 11.2
120	165 165 180	22 22 28	1.1 1.1 2	0.6 0.6 1	67 500 72 000 102 000	77 000 81 000 107 000	6 900 7 300 10 400	7 850 8 300 10 900	— 16.5 —	4 800 5 600 3 600	6 300 7 500 5 000	44.2 30.1 57.3	127 127 130	158 158 170	1 1 2	1.15 1.15 2.45
	215 215 260 260	40 40 55 55	2.1 2.1 3 3	1.1 1.1 1.1 1.1	183 000 165 000 246 000 225 000	177 000 162 000 252 000 231 000	18 600 16 900 25 100 23 000	18 100 16 500 25 700 23 600	_ _ _ _	3 200 2 400 2 200 2 000	4 500 3 200 3 000 2 800	68.3 90.3 82.3 107.2	132 132 134 134	203 203 246 246		6.22 6.26 14.5 14.4

Notes	(1)	For applications operating near	the limiting speed,	refer to Page B49 .
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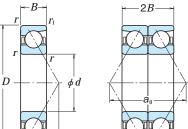
⁽²⁾ The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

Bearing Numbers (2)			Basi (N	c Load Rating I)	l) gf}	Limiting Speeds (1) (Matched) (min ⁻¹)		Load Center Spacings (mm) a_0		Abutment and Fill Dimensions (mn			
Single	Duple	ex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	DB	O DF	d _b (3) min.	$D_{ m b}$ max.	$m{r}_{ m b}$ (3) max.
7020 C	DB DF	DT	122 000	154 000	12 500	15 800	5 300	7 100	57.5	9.5		144	1
7220 A	DB DF		233 000	251 000	23 800	25 600	3 200	4 300	114.8	46.8	107	173	1
7220 B	DB DF		212 000	229 000	21 600	23 300	2 200	3 000	151.5	83.5	107	173	1
7220 C	DB DF	DT	242 000	254 000	24 700	25 900	4 500	6 300	71.5	3.5		173	1
7320 A	DB DF		335 000	385 000	34 500	39 500	2 200	3 000	137.9	43.9	107	208	1
7320 B	DB DF		310 000	355 000	31 500	36 000	2 000	2 800	179.2	85.2	107	208	1
7921 A5	DB DF	DT	78 500	108 000	8 000	11 000	4 300	6 000	78.3	38.3	_	140	0.6
7921 C	DB DF		83 000	114 000	8 450	11 600	5 300	7 100	53.5	13.5	_	140	0.6
7021 A	DB DF		130 000	163 000	13 300	16 700	3 400	4 500	102.5	50.5	_	154	1
7021 C	DB DF	DT	143 000	179 000	14 600	18 200	4 800	6 700	61.5	9.5	—	154	1
7221 A	DB DF		254 000	283 000	25 900	28 900	3 000	4 000	121.2	49.2	112	183	1
7221 B	DB DF		231 000	258 000	23 500	26 300	2 200	3 000	159.8	87.8	112	183	1
7221 C	DB DF	DT	264 000	286 000	26 900	29 100	4 300	6 000	75.5	3.5	_	183	1
7321 A	DB DF		335 000	385 000	34 500	39 500	2 200	2 800	144.3	46.3	_	218	1
7321 B	DB DF		310 000	355 000	31 500	36 000	1 900	2 600	187.4	89.4	_	218	1
7922 A5	DB DF	DT	79 500	112 000	8 100	11 500	4 300	5 600	80.6	40.6	_	145	0.6
7922 C	DB DF		84 500	119 000	8 600	12 100	5 000	6 700	54.8	14.8	_	145	0.6
7022 A	DB DF		157 000	191 000	16 000	19 400	3 200	4 300	108.8	52.8	_	164	1
7022 C	DB DF	DT	172 000	208 000	17 600	21 200	4 500	6 300	65.5	9.5		164	1
7222 A	DB DF		276 000	315 000	28 100	32 500	2 800	4 000	127.5	51.5	117	193	1
7222 B	DB DF		250 000	289 000	25 500	29 400	2 000	2 800	168.1	92.1	117	193	1
7222 C	DB DF	DT	286 000	320 000	29 200	32 500	4 000	5 600	79.5	3.5	_	193	1
7322 A	DB DF		360 000	430 000	36 500	44 000	2 000	2 600	151.0	51.0	_	233	1
7322 B	DB DF		325 000	395 000	33 500	40 000	1 800	2 400	196.8	96.8	_	233	1
7924 A5	DB DF	DT	110 000	154 000	11 200	15 700	3 800	5 300	88.5	44.5	_	160	0.6
7924 C	DB DF		117 000	162 000	11 900	16 600	4 500	6 300	60.2	16.2	_	160	0.6
7024 A	DB DF		166 000	213 000	16 900	21 700	3 000	4 000	114.6	58.6	_	174	1
7224 A 7224 B 7324 A 7324 B	DB DF DB DF DB DF DB DF	DT DT	297 000 269 000 400 000 365 000	355 000 325 000 505 000 460 000	30 500 27 400 41 000 37 500	36 000 33 000 51 500 47 000	2 600 1 900 1 800 1 600	3 600 2 600 2 400 2 200	136.7 180.5 164.7 214.4	56.7 100.5 54.7 104.4	_ _ _ _	208 208 253 253	1 1 1 1

Note (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.

B 64 B 65

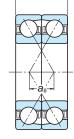
SINGLE/MATCHED MOUNTINGS Bore Diameter 130 – 170 mm



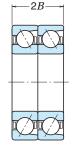
Single

Boundary Dimensions

(mm)



Factor



Tandem

DT

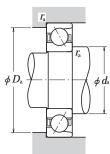
Centers

(mm)

Limiting

Speeds (1)

(min⁻¹)



Eff.Load Abutment and Fillet Mass

Dimensions (mm)

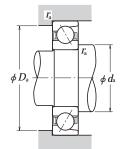
(kg)

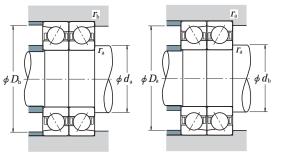


{kgf}

Basic Load Ratings (Single)

(N)





					-					
Cantant	if ₀ F _a *			Singl	e, DT			DB c	or DF	
Contact		e	F_a/I	$r \leq e$	F_a/I	r > e	F_a/I	$r \leq e$	$F_a/F_r > e$	
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15°	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15	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 $P_0 = X_0 F_r + Y_0 F_a$

Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	Singl	e, DT	DB c	r DF	
Angle	<i>X</i> ₀	Y 0	X 0	Y 0	Single or DT
15°	0.5	0.46	1	0.92	mounting When
25°	0.5	0.38	1	0.76	$F_{\rm r} > 0.5 F_{\rm r} + Y_0 F_{\rm a}$
30°	0.5	0.33	1	0.66	use $P_0 = F_r$
40°	0.5	0.26	1	0.52	

Bearing	Numbers (²)	Basi (N	c Load Rating	s (Matched {kg		Limi Speeds (¹)	(Matched)	Spacing	Center Js (mm)		nent and nsions (
Single	Duplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	(mii Grease	Oil	DB	DF	d _b (³) min.	$D_{ m b}$ max.	Г _b (³) max.
7926 A5	DB DF DT	120 000	172 000	12 300	17 500	3 400	4 800	96.3	48.3	_	174	1
7926 C	DB DF DT	128 000	182 000	13 000	18 500	4 000	5 600	65.5	17.5	_	174	1
7026 A	DB DF DT	191 000	251 000	19 400	25 600	2 600	3 600	128.3	62.3	_	194	1
7226 A	DB DF DT	310 000	385 000	31 500	39 500	1 900	2 600	143.9	63.9	_	223	1
7226 B	DB DF DT	278 000	350 000	28 300	35 500	1 700	2 400	191.0	111.0	_	223	1
7326 A	DB DF DT	445 000	585 000	45 500	59 500	1 700	2 200	176.3	60.3	_	271	1.5
7326 B	DB DF DT	405 000	535 000	41 500	54 500	1 500	2 000	230.0	114.0	_	271	1.5
7928 A5	DB DF DT	122 000	180 000	12 400	18 400	3 200	4 500	100.9	52.9	_	184	1
7928 C	DB DF DT	129 000	191 000	13 200	19 400	3 800	5 300	68.2	20.2	_	184	1
7028 A	DB DF DT	194 000	265 000	19 800	27 000	2 600	3 400	134.0	68.0	_	204	1
7228 A	DB DF DT	355 000	470 000	36 000	48 000	1 800	2 400	154.6	70.6	_	243	1
7228 B	DB DF DT	320 000	425 000	32 500	43 500	1 600	2 200	205.6	121.6	_	243	1
7328 A	DB DF DT	490 000	670 000	50 000	68 500	1 600	2 000	189.0	65.0	_	291	1.5
7328 B	DB DF DT	445 000	615 000	45 500	63 000	1 400	1 900	246.6	122.6	_	291	1.5
7930 A5	DB DF DT	157 000	231 000	16 000	23 500	3 000	4 000	112.0	56.0	_	204	1
7930 C	DB DF DT	166 000	244 000	16 900	24 900	3 600	4 800	76.2	20.2	_	204	1
7030 A	DB DF DT	222 000	305 000	22 700	31 500	1 900	2 400	143.3	73.3	_	218	1
7230 A	DB DF DT	405 000	560 000	41 000	57 000	1 600	2 200	166.3	76.3	_	263	1
7230 B	DB DF DT	365 000	510 000	37 000	52 000	1 500	2 000	221.2	131.2	_	263	1
7330 A	DB DF DT	515 000	745 000	52 500	75 500	1 500	1 900	200.7	70.7	_	311	1.5
7330 B	DB DF DT	470 000	680 000	48 000	69 500	1 300	1 800	262.2	132.2	_	311	1.5
7932 C	DB DF DT	173 000	265 000	17 600	27 000	3 000	4 000	78.9	22.9	_	214	1
7032 A	DB DF DT	252 000	355 000	25 700	36 000	1 700	2 400	153.5	77.5	_	233	1
7232 A	DB DF DT	425 000	615 000	43 500	62 500	1 500	2 000	177.9	81.9	_	283	1
7232 B	DB DF DT	385 000	555 000	39 500	57 000	1 400	1 900	236.8	140.8	_	283	1
7332 A	DB DF DT	565 000	845 000	57 500	86 000	1 400	1 800	212.3	76.3	_	331	1.5
7332 B	DB DF DT	515 000	770 000	52 500	78 500	1 200	1 700	277.8	141.8	_	331	1.5
7934 C	DB DF DT	183 000	297 000	18 700	30 000	2 800	3 800	81.6	25.6	_	224	1
7034 A	DB DF DT	300 000	430 000	31 000	43 500	1 600	2 200	166.1	82.1	_	253	1
7234 A	DB DF DT	480 000	715 000	49 000	73 000	1 400	1 900	190.6	86.6	_	301	1.5
7234 B	DB DF DT	435 000	650 000	44 000	66 500	1 300	1 700	253.4	149.4	_	301	1.5
7334 A	DB DF DT	630 000	970 000	64 500	99 000	1 300	1 700	225.0	81.0	_	351	1.5
7334 B	DB DF DT	575 000	890 000	59 000	90 500	1 100	1 600	294.3	150.3	_	351	1.5

Note (3) For bearings marked — in the column for d_{b_1} d_{b_2} and r_{b_3} for shafts are d_{a_3} (min.) and r_{a_3} (max.) respectively.

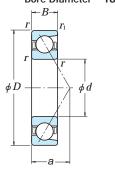
d	D	В	$m{r}$ min.	$oldsymbol{r_1}{ ext{min.}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	Óil	``a''	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{max}.$	approx.
130	180 180 200	24 24 33	1.5 1.5 2	1 1 1	74 000 78 500 117 000	86 000 91 000 125 000	7 550 8 000 12 000	8 750 9 250 12 800	_ 16.5 _	4 300 5 000 3 400	6 000 7 100 4 500	48.1 32.8 64.1	139 139 140	171 171 190	1.5 1.5 2	1.54 1.5 3.68
	230 230 280 280	40 40 58 58	3 4 4	1.1 1.1 1.5 1.5	189 000 171 000 273 000 250 000	193 000 175 000 293 000 268 000	19 300 17 400 27 900 25 500		_ _ _	2 400 2 200 2 200 1 900	3 200 3 000 2 800 2 600	72.0 95.5 88.2 115.0	144 144 148 148	216 216 262 262	2.5 2.5 3 3	7.06 7.1 17.5 17.6
140	190 190 210	24 24 33	1.5 1.5 2	1 1 1	75 000 79 500 120 000	90 000 95 500 133 000	7 650 8 100 12 200	9 200 9 700 13 500	_ 16.7 _	4 000 4 800 3 200	5 600 6 700 4 300	50.5 34.1 67.0	149 149 150	181 181 200	1.5 1.5 2	1.63 1.63 3.9
	250 250 300 300	42 42 62 62	3 4 4	1.1 1.1 1.5 1.5	218 000 197 000 300 000 275 000	234 000 213 000 335 000 310 000	20 100 30 500	23 900 21 700 34 500 31 500	_ _ _	2 200 2 000 2 000 1 700	3 000 2 800 2 600 2 400	77.3 102.8 94.5 123.3	154 154 158 158	236 236 282 282	2.5 2.5 3 3	8.92 8.94 21.4 21.6
150	210 210 225	28 28 35	2 2 2.1	1 1 1.1	96 500 102 000 137 000	115 000 122 000 154 000		11 800 12 400 15 700	_ 16.6 _	3 800 4 300 2 400	5 000 6 000 3 000	56.0 38.1 71.6	160 160 162	200 200 213	2 2 2	2.97 2.96 4.75
	270 270 320 320	45 45 65 65	3 4 4	1.1 1.1 1.5 1.5	248 000 225 000 315 000 289 000	280 000 254 000 370 000 340 000	25 300 22 900 32 500 29 400	28 500 25 900 38 000 34 500	_ _ _	2 000 1 800 1 800 1 600	2 800 2 600 2 400 2 200	83.1 110.6 100.3 131.1	164 164 168 168	256 256 302 302	2.5 2.5 3	11.2 11.2 26 25.9
160	220 240 290	28 38 48	2 2.1 3	1 1.1 1.1	106 000 155 000 263 000	133 000 176 000 305 000	10 800 15 800 26 800		16.7 —	3 800 2 200 1 900	5 000 2 800 2 600	39.4 76.7 89.0	170 172 174	210 228 276	2 2 2.5	3.1 5.77 14.1
	290 340 340	48 68 68	3 4 4	1.1 1.5 1.5	238 000 345 000 315 000	279 000 420 000 385 000	24 200 35 500 32 000	28 400 43 000 39 500	_ _ _	1 700 1 700 1 500	2 400 2 200 2 000	118.4 106.2 138.9	174 178 178	276 322 322	2.5 3 3	14.2 30.7 30.8
170	230 260 310	28 42 52	2 2.1 4	1 1.1 1.5	113 000 186 000 295 000	148 000 214 000 360 000	11 500 19 000 30 000	15 100 21 900 36 500	16.8 — —	3 600 2 000 1 800	4 800 2 600 2 400	40.8 83.1 95.3	180 182 188	220 248 292	2 2 3	3.36 7.9 17.3
	310 360 360	52 72 72	4 4 4	1.5 1.5 1.5	266 000 390 000 355 000	325 000 485 000 445 000	27 200 39 500 36 000	33 000 49 500 45 500	_ _ _	1 600 1 600 1 400	2 200 2 200 2 000	126.7 112.5 147.2	188 188 188	292 342 342	3 3 3	17.6 35.8 35.6

Notes (1) For applications operating near the limiting speed, refer to Page B49.

(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

SINGLE/MATCHED MOUNTINGS

Bore Diameter 180 - 200 mm

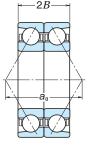


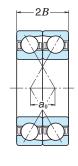
360 420

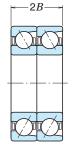
1.5

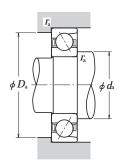
80 5 2

420 80 5 2









Back-to-Back Single DB **Boundary Dimensions** Basic Load Ratings (Single)

Face-to-Face
DF

Tandem DT

1 800 | 146.5 | 218 1 800 | 129.5 | 222

1 600 | 170.1 | 222

1 300

1 300

1 200

Boundary Dimensions (mm)				ons	Basic Load Ratings (Single) (N) {kgf}			Factor	Limiting Speeds (¹) (min-¹)		Eff.Load Centers		Abutment and Fillet Dimensions (mm)			
d	D	В	$m{r}$ min.	$r_{ m 1}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	f_0	Grease	['] Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	арргох.
180	250 280 320	33 46 52	2 2.1 4	1 1.1 1.5	145 000 207 000 305 000	184 000 252 000 385 000	14 800 21 100 31 000	18 800 25 700 39 000	16.6 —	3 200 1 900 1 700	4 500 2 400 2 200	45.3 89.4 98.2	190 192 198	240 268 302	2 2 3	4.9 10.5 18.1
	320 380 380	52 75 75	4 4 4	1.5 1.5 1.5	276 000 410 000 375 000	350 000 535 000 490 000	28 100 41 500 38 000	35 500 54 500 50 000	_ _ _	1 500 1 500 1 300	2 000 2 000 1 800	130.9 118.3 155.0	198 198 198	302 362 362	3 3 3	18.4 42.1 42.6
190	260 290 340	33 46 55	2 2.1 4	1 1.1 1.5	147 000 224 000 315 000	192 000 280 000 410 000	15 000 22 800 32 000	19 600 28 600 42 000	16.7 — —	3 000 1 800 1 600	4 300 2 400 2 200	46.6 92.3 104.0	200 202 208	250 278 322	2 2 3	4.98 11.3 22.4
	340 400 400	55 78 78	4 5 5	1.5 2 2	284 000 450 000 410 000	375 000 600 000 550 000	28 900 46 000 42 000	38 000 61 000 56 000	_ _ _	1 400 1 400 1 300	2 000 1 900 1 700	138.7 124.2 162.8	208 212 212	322 378 378	3 4 4	22.5 47.5 47.2
200	280 310 360	38 51 58	2.1 2.1 4	1.1 1.1 1.5	189 000 240 000 335 000	244 000 310 000 450 000	19 300 24 500 34 500	24 900 31 500 46 000	16.5 —	2 800 1 700 1 500	4 000 2 200 2 000	51.2 99.1 109.8	212 212 218	268 298 342	2 2 3	6.85 13.7 26.5

Notes (1) For applications operating near the limiting speed, refer to Page B49.

305 000 410 000

475 000 660 000

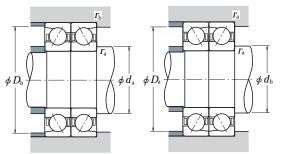
430 000 600 000

(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

31 000 41 500

48 500 67 000

44 000 61 500



Dynamic Equivalent Load $P = XF_r + YF_a$

	Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
			e	F_a/I	$r \leq e$	F_a/I	r > e	F_a/I	$r \leq e$	F _a /F	r > e
	Angle	Cor		X	Y	X	Y	X	Y	X	Y
		0.178	0.38	1	0	0.44	1.47	1	1.65	0.72	2.39
1		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
	15°	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
	10.	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 $P_0 = X_0 F_r + Y_0 F_a$

Angle X_0 Y_0 X_0 Y_0 Single or DT	
15° 0.5 0.46 1 0.92 mounting When	
25° 0.5 0.38 1 0.76 E > 0.5E	Vo F.
30° 0.5 0.33 1 0.66 use $P_0 = F_r$	1013
40° 0.5 0.26 1 0.52	

Bearing	Numbers (²)	Bas (1	Limiting Speeds (¹) (Matched) (min-¹)		Load Center Spacings (mm)		Abutment and Fillet Dimensions (mm)					
Single	Duplex	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease Oil		DB	DF	d _b (3) min.	$D_{ m b}$ max.	$r_{ m b}$ (3) max.
7936 C	DB DF DT	236 000	370 000	24 000	37 500	2 600	3 600	90.6	24.6	_	244	1
7036 A	DB DF DT	335 000	505 000	34 500	51 500	1 500	2 000	178.8	86.8	_	273	1
7236 A	DB DF DT	495 000	770 000	50 500	78 500	1 400	1 800	196.3	92.3	_	311	1.5
7236 B	DB DF DT	450 000	700 000	45 500	71 000	1 200	1 700	261.8	157.8	_	311	1.5
7336 A	DB DF DT	665 000	1 070 000	68 000	109 000	1 200	1 600	236.6	86.6	_	371	1.5
7336 B	DB DF DT	605 000	975 000	62 000	99 500	1 100	1 500	309.9	159.9	_	371	1.5
7938 C	DB DF DT	239 000	385 000	24 400	39 000	2 400	3 400	93.3	27.3	_	254	1
7038 A	DB DF DT	365 000	560 000	37 000	57 000	1 400	1 900	184.6	92.6	_	283	1
7238 A	DB DF DT	510 000	825 000	52 000	84 000	1 300	1 700	208.0	98.0	_	331	1.5
7238 B 7338 A 7338 B	DB DF DT DB DF DT DB DF DT	460 000 730 000 670 000	750 000 1 200 000 1 100 000		76 000 122 000 112 000	1 100 1 100 1 000	1 600 1 500 1 400	277.3 248.3 325.5	167.3 92.3 169.5	_ _ _	331 390 390	1.5 2 2
7940 C	DB DF DT	305 000	490 000	31 500	50 000	2 200	3 200	102.3	26.3	_	273	1
7040 A	DB DF DT	390 000	620 000	40 000	63 500	1 300	1 800	198.2	96.2	_	303	1
7240 A	DB DF DT	550 000	900 000	56 000	92 000	1 200	1 600	219.6	103.6	_	351	1.5
7240 B 7340 A 7340 B	DB DF DT DB DF DT DB DF DT	495 000 770 000 700 000	815 000 1 320 000 1 200 000		83 000 134 000 123 000	1 100 1 100 950	1 500 1 400 1 300	292.9 259.0 340.1	176.9 99.0 180.1	_ _ _	351 410 410	

Note (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.

B 68 B 69

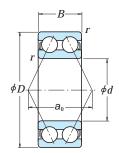
26.6 54.4

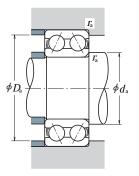
4 55.3

398 4

398

Bore Diameter 10 – 85 mm





Dynamic Equivalent Load							
$P = XF_r + YF_a$							
$F_{\rm a}/F_{\rm r} \leq e$	$F_{\rm a}/F_{\rm r}>e$	ĺ					

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e	
X	Y	X	Y	e
1	0.92	0.67	1.41	0.68

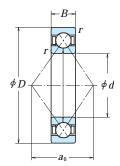
Static Equiva	ien	ιL	.0a
$P_0 = F_r + 0$).7	6	F_{z}

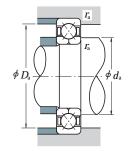
	Boundary Dimensions (mm)		1)	Basic Loa	9	gf}	١ ،	Limiting Speeds (min ⁻¹)		
d	D	В	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers
10	30	14.3	0.6	7 150	3 900	730	400	17 000	22 000	5200
12	32	15.9	0.6	10 500	5 800	1 070	590	15 000	20 000	5201
15	35	15.9	0.6	11 700	7 050	1 190	715	13 000	17 000	5202
	42	19	1	17 600	10 200	1 800	1 040	11 000	15 000	5302
17	40	17.5	0.6	14 600	9 050	1 490	920	11 000	15 000	5203
	47	22.2	1	21 000	12 600	2 140	1 280	10 000	13 000	5303
20	47	20.6	1	19 600	12 400	2 000	1 270	10 000	13 000	5204
	52	22.2	1.1	24 600	15 000	2 510	1 530	9 000	12 000	5304
25	52	20.6	1	21 300	14 700	2 170	1 500	8 500	11 000	5205
	62	25.4	1.1	32 500	20 700	3 350	2 110	7 500	10 000	5305
30	62	23.8	1	29 600	21 100	3 000	2 150	7 100	9 500	5206
	72	30.2	1.1	40 500	28 100	4 150	2 870	6 300	8 500	5306
35	72	27	1.1	39 000	28 700	4 000	2 920	6 300	8 000	5207
	80	34.9	1.5	51 000	36 000	5 200	3 700	5 600	7 500	5307
40	80	30.2	1.1	44 000	33 500	4 500	3 400	5 600	7 100	5208
	90	36.5	1.5	56 500	41 000	5 800	4 200	5 300	6 700	5308
45	85	30.2	1.1	49 500	38 000	5 050	3 900	5 000	6 700	5209
	100	39.7	1.5	68 500	51 000	7 000	5 200	4 500	6 000	5309
50	90	30.2	1.1	53 000	43 500	5 400	4 400	4 800	6 000	5210
	110	44.4	2	81 500	61 500	8 300	6 250	4 300	5 600	5310
55	100	33.3	1.5	56 000	49 000	5 700	5 000	4 300	5 600	5211
	120	49.2	2	95 000	73 000	9 700	7 450	3 800	5 000	5311
60	110	36.5	1.5	69 000	62 000	7 050	6 300	3 800	5 000	5212
	130	54	2.1	125 000	98 500	12 800	10 000	3 400	4 500	5312
65	120	38.1	1.5	76 500	69 000	7 800	7 050	3 600	4 500	5213
	140	58.7	2.1	142 000	113 000	14 500	11 500	3 200	4 300	5313
70	125	39.7	1.5	94 000	82 000	9 600	8 400	3 400	4 500	5214
	150	63.5	2.1	159 000	128 000	16 200	13 100	3 000	3 800	5314
75	130	41.3	1.5	93 500	83 000	9 550	8 500	3 200	4 300	5215
80	140	44.4	2	99 000	93 000	10 100	9 500	3 000	3 800	5216
85	150	49.2	2	116 000	110 000	11 800	11 200	2 800	3 600	5217

Load Center Spacings		utment and Fi mensions (m		Mass (kg)
(mm) a₀	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{max}.$	approx.
14.5	15	25	0.6	0.050
16.7	17	27	0.6	0.060
18.3	20	30	0.6	0.070
22.0	21	36	1	0.11
20.8	22	35	0.6	0.090
25.0	23	41	1	0.14
24.3	26	41	1	0.12
26.7	27	45	1	0.23
26.8	31	46	1	0.19
31.8	32	55	1	0.34
31.6	36	56	1	0.29
36.5	37	65	1	0.51
36.6	42	65	1	0.43
41.6	44	71	1.5	0.79
41.5	47	73	1	0.57
45.5	49	81	1.5	1.05
43.4	52	78	1	0.62
50.6	54	91	1.5	1.4
45.9	57	83	1	0.67
55.6	60	100	2	1.95
50.1	64	91	1.5	0.96
60.6	65	110	2	2.3
56.5	69	101	1.5	1.35
69.2	72	118	2	3.15
59.7	74	111	1.5	1.65
72.8	77	128	2	3.85
63.8	79	116	1.5	1.8
78.3	82	138	2	4.9
66.1	84	121	1.5	1.9
69.6	90	130	2	2.5
75.3	95	140	2	3.4

<u>NSK</u>

Bore Diameter 30 – 95 mm





Dynamic Equivalent Load $P_{\rm a} = F_{\rm a}$

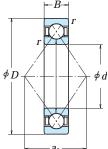
Static Equivalent Load $P_{0a} = F_a$

	Boundary D (mr		5	(Basic Load	9	gf}	Limiting (mi	•
d	D	В	r min.	$C_{\rm a}$	C_{0a}	C_{a}	C_{0a}	Grease	Oil
30	62	16	1	31 000	45 000	3 150	4 600	8 500	12 000
	72	19	1.1	46 000	63 000	4 700	6 450	8 000	11 000
35	72	17	1.1	41 000	61 500	4 200	6 250	7 500	10 000
	80	21	1.5	55 000	80 000	5 600	8 150	7 100	9 500
40	80	18	1.1	49 000	77 500	5 000	7 900	6 700	9 000
	90	23	1.5	67 000	100 000	6 850	10 200	6 300	8 500
45	85	19	1.1	55 000	88 500	5 600	9 000	6 300	8 500
	100	25	1.5	87 500	133 000	8 900	13 500	5 600	7 500
50	90	20	1.1	57 000	97 000	5 850	9 900	5 600	8 000
	110	27	2	102 000	159 000	10 400	16 200	5 000	6 700
55	100	21	1.5	71 000	122 000	7 200	12 500	5 300	7 100
	120	29	2	118 000	187 000	12 000	19 100	4 500	6 300
60	110	22	1.5	85 500	150 000	8 750	15 300	4 800	6 300
	130	31	2.1	135 000	217 000	13 800	22 200	4 300	5 600
65	120	23	1.5	97 500	179 000	9 950	18 300	4 300	6 000
	140	33	2.1	153 000	250 000	15 600	25 500	3 800	5 300
70	125	24	1.5	106 000	197 000	10 800	20 100	4 000	5 600
	150	35	2.1	172 000	285 000	17 500	29 100	3 600	5 000
75	130	25	1.5	110 000	212 000	11 200	21 700	3 800	5 300
	160	37	2.1	187 000	320 000	19 100	33 000	3 400	4 800
80	125	22	1.1	77 000	167 000	7 850	17 000	3 800	5 300
	140	26	2	124 000	236 000	12 600	24 100	3 600	5 000
	170	39	2.1	202 000	360 000	20 600	37 000	3 200	4 300
85	130	22	1.1	79 000	176 000	8 050	18 000	3 800	5 000
	150	28	2	143 000	276 000	14 600	28 200	3 400	4 800
	180	41	3	218 000	405 000	22 300	41 000	3 000	4 000
90	140	24	1.5	94 000	208 000	9 600	21 200	3 400	4 800
	160	30	2	164 000	320 000	16 700	32 500	3 200	4 300
	190	43	3	235 000	450 000	23 900	45 500	2 800	3 800
95	145	24	1.5	96 500	220 000	9 800	22 500	3 400	4 500
	170	32	2.1	177 000	340 000	18 000	35 000	3 000	4 000
	200	45	3	251 000	495 000	25 600	50 500	2 600	3 600

Bearing	Load Center Spacings		butment and f Dimensions (m		Mass (kg)
Numbers	a_0	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{r_{a}}{}_{max.}$	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

Remarks When using four-point contact ball bearings, please contact NSK.

Bore Diameter 100 – 200 mm





Dynamic Equivalent Load $P_{\rm a} = F_{\rm a}$

Static Equivalent Load $P_{0a} = F_a$

E	Boundary D				Basic Load (.gf}	Limiting (min	•
d	D	В	$m{r}$ min.	$C_{\rm a}$	$C_{0\mathrm{a}}$	C_{a}	C_{0a}	Grease	Oil
100	150	24	1.5	98 500	232 000	10 000	23 700	3 200	4 300
	180	34	2.1	199 000	390 000	20 300	39 500	2 800	3 800
	215	47	3	300 000	640 000	31 000	65 500	2 400	3 400
105	160	26	2	115 000	269 000	11 800	27 400	3 000	4 000
	190	36	2.1	217 000	435 000	22 100	44 500	2 600	3 600
	225	49	3	305 000	640 000	31 000	65 500	2 400	3 200
110	170	28	2	139 000	315 000	14 200	32 000	2 800	3 800
	200	38	2.1	235 000	490 000	24 000	50 000	2 600	3 400
	240	50	3	320 000	710 000	32 500	72 500	2 200	3 000
120	180	28	2	147 000	350 000	15 000	36 000	2 600	3 600
	215	40	2.1	265 000	585 000	27 000	60 000	2 400	3 200
	260	55	3	360 000	835 000	36 500	85 500	2 000	2 800
130	200	33	2	169 000	415 000	17 300	42 000	2 400	3 200
	230	40	3	274 000	635 000	28 000	65 000	2 200	3 000
	280	58	4	400 000	970 000	40 500	99 000	1 900	2 600
140	210	33	2	172 000	435 000	17 600	44 500	2 200	3 000
	250	42	3	239 000	710 000	29 900	72 500	2 000	2 800
	300	62	4	440 000	1 110 000	44 500	114 000	1 700	2 400
150	225	35	2.1	197 000	505 000	20 100	51 500	2 000	2 800
	270	45	3	315 000	785 000	32 000	80 000	1 800	2 600
	320	65	4	460 000	1 230 000	47 000	125 000	1 600	2 200
160	240	38	2.1	224 000	580 000	22 800	59 000	1 900	2 600
	290	48	3	380 000	1 010 000	39 000	103 000	1 700	2 400
	340	68	4	505 000	1 400 000	51 500	143 000	1 500	2 000
170	260	42	2.1	268 000	705 000	27 300	72 000	1 800	2 400
	310	52	4	425 000	1 180 000	43 500	121 000	1 600	2 200
	360	72	4	565 000	1 610 000	57 500	164 000	1 400	2 000
180	280	46	2.1	299 000	830 000	30 500	84 500	1 700	2 200
	320	52	4	440 000	1 270 000	45 000	130 000	1 500	2 000
	380	75	4	595 000	1 770 000	60 500	180 000	1 300	1 800
190	290	46	2.1	325 000	925 000	33 000	94 000	1 600	2 200
	340	55	4	440 000	1 290 000	44 500	131 000	1 400	2 000
	400	78	5	655 000	1 980 000	67 000	202 000	1 300	1 700
200	310	51	2.1	345 000	1 020 000	35 500	104 000	1 500	2 000
	360	58	4	490 000	1 480 000	49 500	151 000	1 300	1 800
	420	80	5	690 000	2 180 000	70 500	222 000	1 200	1 600

Bearing	Load Center Spacings	Al D	Mass (kg)		
Numbers	(mm) a_0	d a min.	$D_{ m a}$ max.	$oldsymbol{r_a}{ ext{max}}.$	арргох.
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

Remarks When using four-point contact ball bearings, please contact NSK.

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SELF-ALIGNING BALL BEARINGS

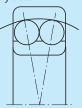
SELF-ALIGNING BALL BEARINGS

Bore Diameter 5 – 110 mm ---- B78

DESIGN, TYPES, AND FEATURES

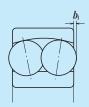
The outer ring has a spherical raceway and its center of curvature coincides with that of the bearing; therefore, the axis of the inner ring, balls and cage can deflect to some extent around the bearing center. This type is recommended when the alignment of the shaft and housing is difficult and when 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) 2321 , 2322(K)	0.5
1318(K)	1.5
1319(K)	2
1320(K), 1321 1322(K)	3

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TOLERANCES AND RUNNING

ACCURACY Table 8.2 (Pages A60 to A63)

RECOMMENDED FITS...... Table 9.2 (Page A84)
Table 9.4 (Page A85)

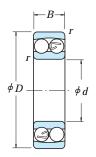
INTERNAL CLEARANCE...... Table 9.12 (Page A90)

PERMISSIBLE MISALIGNMENT

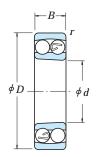
The permissible misalignment of self-aligning ball bearings is approximately 0.07 to 0.12 radian (4° to 7°) under normal loads. However, depending on the surrounding structure, such an angle may not be possible. Use care in the structural design.



Bore Diameter 5 – 30 mm



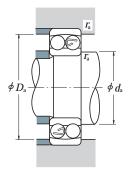




Tapered Bore

								ı		
Во	oundary Di mn)	imensior	ns	(N		ad Ratings	gf}	"	Speeds n ⁻¹)	Bearing
d	D	В	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
5	19	6	0.3	2 530	475	258	49	30 000	36 000	135
6	19	6	0.3	2 530	475	258	49	30 000	36 000	126
7	22	7	0.3	2 750	600	280	61	26 000	32 000	127
8	22	7	0.3	2 750	600	280	61	26 000	32 000	108
9	26	8	0.6	4 150	895	425	91	26 000	30 000	129
10	30	9	0.6	5 550	1 190	570	121	22 000	28 000	1200
	30	14	0.6	7 450	1 590	760	162	24 000	28 000	2200
	35	11	0.6	7 350	1 620	750	165	20 000	24 000	1300
	35	17	0.6	9 200	2 010	935	205	18 000	22 000	2300
12	32 32 37 37	10 14 12 17	0.6 0.6 1	5 700 7 750 9 650 12 100	1 270 1 730 2 160 2 730	580 790 985 1 240	130 177 221 278	22 000 22 000 18 000 17 000	26 000 26 000 22 000 22 000	1201 2201 1301 2301
15	35 35 42 42	11 14 13 17	0.6 0.6 1	7 600 7 800 9 700 12 300	1 750 1 850 2 290 2 910	775 795 990 1 250	179 188 234 296	18 000 18 000 16 000 14 000	22 000 22 000 20 000 18 000	1202 2202 1302 2302
17	40 40 47 47	12 16 14 19	0.6 0.6 1	8 000 9 950 12 700 14 700	2 010 2 420 3 200 3 550	815 1 010 1 300 1 500	205 247 325 365	16 000 16 000 14 000 13 000	20 000 20 000 17 000 16 000	1203 2203 1303 2303
20	47	14	1	10 000	2 610	1 020	266	14 000	17 000	1204
	47	18	1	12 800	3 300	1 310	340	14 000	17 000	2204
	52	15	1.1	12 600	3 350	1 280	340	12 000	15 000	1304
	52	21	1.1	18 500	4 700	1 880	480	11 000	14 000	2304
25	52	15	1	12 200	3 300	1 250	335	12 000	14 000	1205
	52	18	1	12 400	3 450	1 270	350	12 000	14 000	2205
	62	17	1.1	18 200	5 000	1 850	510	10 000	13 000	1305
	62	24	1.1	24 900	6 600	2 530	675	9 500	12 000	2305
30	62	16	1	15 800	4 650	1 610	475	10 000	12 000	1206
	62	20	1	15 300	4 550	1 560	460	10 000	12 000	2206
	72	19	1.1	21 400	6 300	2 190	645	8 500	11 000	1306
	72	27	1.1	32 000	8 750	3 250	895	8 000	10 000	2306

Note (1) The suffix K represents bearings with tapered bores (1 : 12) Remarks For the dimensions related to adapters, refer to Page B358.



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$T_{\rm r} \leq e$	$F_{\rm a}/I$	r > e	
X	Y	X Y		
1	Y ₃	0.65	Y_2	

Static Equivalent Load

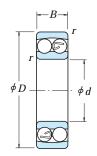
 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are listed in the table below.

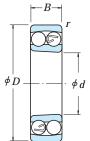
Numbers	Abutment and Fillet Dimensions (mm)		Constant	Axial Load Factors			Mass (kg)	
Tapered Bore(1)	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
_ _ _	7 8 9	17 17 20	0.3 0.3 0.3	0.34 0.34 0.31	2.9 2.9 3.1	1.9 1.9 2.0	1.9 1.9 2.1	0.009 0.008 0.013
_	10 13	20 22	0.3 0.6	0.31 0.32	3.1 3.1	2.0 2.0	2.1 2.1	0.016 0.021
_ _ _ _	14 14 14 14	26 26 31 31	0.6 0.6 0.6 0.6	0.32 0.64 0.35 0.71	3.1 1.5 2.8 1.4	2.0 0.98 1.8 0.89	2.1 1.0 1.9 0.93	0.033 0.042 0.057 0.077
_ _ _ _	16 16 17 17	28 28 32 32	0.6 0.6 1	0.36 0.58 0.33 0.60	2.7 1.7 2.9 1.6	1.8 1.1 1.9 1.1	1.8 1.1 2.0 1.1	0.039 0.048 0.066 0.082
_ _ _ _	19 19 20 20	31 31 37 37	0.6 0.6 1	0.32 0.50 0.33 0.51	3.1 1.9 2.9 1.9	2.0 1.3 1.9 1.2	2.1 1.3 2.0 1.3	0.051 0.055 0.093 0.108
_ _ _ _	21 21 22 22	36 36 42 42	0.6 0.6 1	0.31 0.50 0.32 0.51	3.1 1.9 3.1 1.9	2.0 1.3 2.0 1.2	2.1 1.3 2.1 1.3	0.072 0.085 0.13 0.15
1204 K 2204 K 1304 K 2304 K	25 25 26.5 26.5	42 42 45.5 45.5	1 1 1	0.29 0.47 0.29 0.50	3.4 2.1 3.4 1.9	2.2 1.3 2.2 1.2	2.3 1.4 2.3 1.3	0.12 0.133 0.165 0.193
1205 K 2205 K 1305 K 2305 K	30 30 31.5 31.5	47 47 55.5 55.5	1 1 1	0.28 0.41 0.28 0.47	3.5 2.4 3.5 2.1	2.3 1.5 2.3 1.4	2.4 1.6 2.4 1.4	0.14 0.15 0.255 0.319
1206 K 2206 K 1306 K 2306 K	35 35 36.5 36.5	57 57 65.5 65.5	1 1 1 1	0.25 0.38 0.26 0.44	3.9 2.5 3.7 2.2	2.5 1.6 2.4 1.4	2.6 1.7 2.5 1.5	0.22 0.249 0.385 0.48

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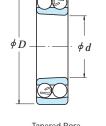
Bore Diameter 35 - 70 mm







Tapered Bore



<u> </u>	r _a	
	$\overline{I_a}$	
$\phi D_a $		$\phi d_{\rm a}$

Dynamic Equivalent Load

$P = XF_{\rm r} + YF_{\rm a}$						
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}>e$				
X	Y	X	Y			
1	Y ₃	0.65	Y_2			

Static Equivalent Load $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are listed in the table below.

В	Boundary D (mr		ns	(N	Basic Loa	d Ratings {kg	ıf}	Limiting (mi	•	Bearing	Numb
d	D	B	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore	Ta Bo
35	72 72 80 80	17 23 21 31	1.1 1.1 1.5 1.5	15 900 21 700 25 300 40 000	5 100 6 600 7 850 11 300	1 620 2 210 2 580 4 100	520 675 800 1 150	8 500 8 500 7 500 7 100	10 000 10 000 9 500 9 000	1207 2207 1307 2307	1
40	80 80 90 90	18 23 23 33	1.1 1.1 1.5 1.5	19 300 22 400 29 800 45 500	6 500 7 350 9 700 13 500	1 970 2 290 3 050 4 650	665 750 990 1 380	7 500 7 500 6 700 6 300	9 000 9 000 8 500 8 000	1208 2208 1308 2308	1 2 1 2
45	85 85 100 100	19 23 25 36	1.1 1.1 1.5 1.5	22 000 23 300 38 500 55 000	7 350 8 150 12 700 16 700	2 240 2 380 3 900 5 600	750 830 1 300 1 700	7 100 7 100 6 000 5 600	8 500 8 500 7 500 7 100	1209 2209 1309 2309	1 2 1 2
50	90 90 110 110	20 23 27 40	1.1 1.1 2 2	22 800 23 300 43 500 65 000	8 100 8 450 14 100 20 200	2 330 2 380 4 450 6 650	830 865 1 440 2 060	6 300 6 300 5 600 5 000	8 000 8 000 6 700 6 300	1210 2210 1310 2310	1 2 1 2
55	100 100 120 120	21 25 29 43	1.5 1.5 2 2	26 900 26 700 51 500 76 500	10 000 9 900 17 900 24 000	2 750 2 720 5 250 7 800	1 020 1 010 1 820 2 450	6 000 6 000 5 000 4 800	7 100 7 100 6 300 6 000	1211 2211 1311 2311	1 2 1 2
60	110 110 130 130	22 28 31 46	1.5 1.5 2.1 2.1	30 500 34 000 57 500 88 500	11 500 12 600 20 800 28 300	3 100 3 500 5 900 9 000	1 180 1 290 2 130 2 880	5 300 5 300 4 500 4 300	6 300 6 300 5 600 5 300	1212 2212 1312 2312	1 2 1 2
65	120 120 140 140	23 31 33 48	1.5 1.5 2.1 2.1	31 000 43 500 62 500 97 000	12 500 16 400 22 900 32 500	3 150 4 450 6 350 9 900	1 280 1 670 2 330 3 300	4 800 4 800 4 300 3 800	6 000 6 000 5 300 4 800	1213 2213 1313 2313	1 2 1 2
70	125 125 150 150	24 31 35 51	1.5 1.5 2.1 2.1	35 000 44 000 75 000 111 000	13 800 17 100 27 700 37 500	3 550 4 500 7 650 11 300	1 410 1 740 2 830 3 850	4 800 4 500 4 000 3 600	5 600 5 600 5 000 4 500	1214 2214 1314 2314	

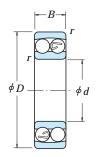
Note (1) The suffix K represents bearings with tapered bores (1 : 12)

Remarks For the dimensions related to adapters, refer to Page B358 and B359.

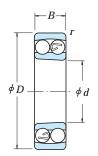
Numbers	Abutment	and Fillet Din (mm)	nensions	Constant	Axial Load Factors			Mass (kg)
Tapered Bore(1)	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	e	Y_2	Y_3	Y_0	approx.
1207 K	41.5	65.5	1	0.23	4.2	2.7	2.8	0.32
2207 K	41.5	65.5	1	0.37	2.6	1.7	1.8	0.378
1307 K	43	72	1.5	0.26	3.8	2.5	2.6	0.51
2307 K	43	72	1.5	0.46	2.1	1.4	1.4	0.642
1208 K	46.5	73.5	1	0.22	4.3	2.8	2.9	0.415
2208 K	46.5	73.5	1	0.33	3.0	1.9	2.0	0.477
1308 K	48	82	1.5	0.24	4.0	2.6	2.7	0.715
2308 K	48	82	1.5	0.43	2.3	1.5	1.5	0.889
1209 K	51.5	78.5	1	0.21	4.7	3.0	3.1	0.465
2209 K	51.5	78.5	1	0.30	3.2	2.1	2.2	0.522
1309 K	53	92	1.5	0.25	4.0	2.6	2.7	0.955
2309 K	53	92	1.5	0.41	2.4	1.5	1.6	1.2
1210 K	56.5	83.5	1	0.21	4.7	3.1	3.2	0.525
2210 K	56.5	83.5	1	0.28	3.4	2.2	2.3	0.564
1310 K	59	101	2	0.23	4.2	2.7	2.8	1.25
2310 K	59	101	2	0.42	2.3	1.5	1.6	1.58
1211 K	63	92	1.5	0.20	4.9	3.2	3.3	0.705
2211 K	63	92	1.5	0.28	3.5	2.3	2.4	0.746
1311 K	64	111	2	0.23	4.2	2.7	2.8	1.6
2311 K	64	111	2	0.41	2.4	1.5	1.6	2.03
1212 K	68	102	1.5	0.18	5.3	3.4	3.6	0.90
2212 K	68	102	1.5	0.28	3.5	2.3	2.4	1.03
1312 K	71	119	2	0.23	4.3	2.8	2.9	2.03
2312 K	71	119	2	0.40	2.4	1.6	1.6	2.57
1213 K	73	112	1.5	0.17	5.7	3.7	3.8	1.15
2213 K	73	112	1.5	0.28	3.5	2.3	2.4	1.4
1313 K	76	129	2	0.23	4.2	2.7	2.9	2.54
2313 K	76	129	2	0.39	2.5	1.6	1.7	3.2
_	78	117	1.5	0.18	5.3	3.4	3.6	1.3
_	78	117	1.5	0.26	3.7	2.4	2.5	1.52
_	81	139	2	0.22	4.4	2.8	3.0	3.19
_	81	139	2	0.38	2.6	1.7	1.8	3.9

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Bore Diameter 75 – 110 mm







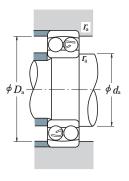
Tapered Bore

В	oundary Di (mn		ns	(N		oad Ratings {kg	nf}	Limiting (min	•	Bearing
d	D	В	r min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
75	130	25	1.5	39 000	15 700	4 000	1 600	4 300	5 300	1215
	130	31	1.5	44 500	17 800	4 550	1 820	4 300	5 300	2215
	160	37	2.1	80 000	30 000	8 150	3 050	3 800	4 500	1315
	160	55	2.1	125 000	43 000	12 700	4 400	3 400	4 300	2315
80	140	26	2	40 000	17 000	4 100	1 730	4 000	5 000	1216
	140	33	2	49 000	19 900	5 000	2 030	4 000	5 000	2216
	170	39	2.1	89 000	33 000	9 100	3 400	3 600	4 300	1316
	170	58	2.1	130 000	45 000	13 200	4 600	3 200	4 000	* 2316
85	150	28	2	49 500	20 800	5 050	2 120	3 800	4 500	1217
	150	36	2	58 500	23 600	5 950	2 400	3 800	4 800	2217
	180	41	3	98 500	38 000	10 000	3 850	3 400	4 000	1317
	180	60	3	142 000	51 500	14 500	5 250	3 000	3 800	2317
90	160	30	2	57 500	23 500	5 850	2 400	3 600	4 300	1218
	160	40	2	70 500	28 700	7 200	2 930	3 600	4 300	2218
	190	43	3	117 000	44 500	12 000	4 550	3 200	3 800	* 1318
	190	64	3	154 000	57 500	15 700	5 850	2 800	3 600	2318
95	170	32	2.1	64 000	27 100	6 550	2 770	3 400	4 000	1219
	170	43	2.1	84 000	34 500	8 550	3 500	3 400	4 000	2219
	200	45	3	129 000	51 000	13 200	5 200	3 000	3 600	* 1319
	200	67	3	161 000	64 500	16 400	6 550	2 800	3 400	* 2319
100	180	34	2.1	69 500	29 700	7 100	3 050	3 200	3 800	1220
	180	46	2.1	94 500	38 500	9 650	3 900	3 200	3 800	2220
	215	47	3	140 000	57 500	14 300	5 850	2 800	3 400	* 1320
	215	73	3	187 000	79 000	19 100	8 050	2 400	3 200	* 2320
105	190	36	2.1	75 000	32 500	7 650	3 300	3 000	3 600	1221
	190	50	2.1	109 000	45 000	11 100	4 550	3 000	3 600	2221
	225	49	3	154 000	64 500	15 700	6 600	2 600	3 200	* 1321
	225	77	3	200 000	87 000	20 400	8 850	2 400	3 000	* 2321
110	200	38	2.1	87 000	38 500	8 900	3 950	2 800	3 400	1222
	200	53	2.1	122 000	51 500	12 500	5 250	2 800	3 400	* 2222
	240	50	3	161 000	72 000	16 400	7 300	2 400	3 000	* 1322
	240	80	3	211 000	94 500	21 600	9 650	2 200	2 800	* 2322

Notes (1) The suffix K represents bearings with tapered bores (1:12)

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Remarks For the dimensions related to adapters, refer to Pages B360 and B361.



Dynamic Equivalent Load

$P = XF_{\rm r}$	+	YF_{a}	

$F_{\rm a}/I$	$T_{\rm r} \leq e$	$F_{\rm a}/F_{\rm r}>e$			
X	Y	X	Y		
1	Y ₃	0.65	Y_2		

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are listed in the table below.

Numbers	Abutment and Fillet Dimensions (mm)		Constant	Axial Load Factors			Mass (kg)	
Tapered Bore(1)	$d_{\scriptscriptstyle a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
1215 K	83	122	1.5	0.17	5.6	3.6	3.8	1.41
2215 K	83	122	1.5	0.25	3.9	2.5	2.6	1.6
1315 K	86	149	2	0.22	4.4	2.8	2.9	3.65
2315 K	86	149	2	0.38	2.5	1.6	1.7	4.77
1216 K	89	131	2	0.16	6.0	3.9	4.1	1.73
2216 K	89	131	2	0.25	3.9	2.5	2.7	1.97
1316 K	91	159	2	0.22	4.5	2.9	3.1	4.31
* 2316 K	91	159	2	0.39	2.5	1.6	1.7	5.54
1217 K	94	141	2	0.17	5.7	3.7	3.8	2.09
2217 K	94	141	2	0.25	3.9	2.5	2.6	2.48
1317 K	98	167	2.5	0.21	4.6	2.9	3.1	5.13
2317 K	98	167	2.5	0.37	2.6	1.7	1.8	6.56
1218 K	99	151	2	0.17	5.8	3.8	3.9	2.55
2218 K	99	151	2	0.27	3.7	2.4	2.5	3.13
* 1318 K	103	177	2.5	0.22	4.3	2.8	2.9	5.94
2318 K	103	177	2.5	0.38	2.6	1.7	1.7	7.76
1219 K	106	159	2	0.17	5.8	3.7	3.9	3.21
2219 K	106	159	2	0.27	3.7	2.4	2.5	3.87
* 1319 K	108	187	2.5	0.23	4.3	2.8	2.9	6.84
* 2319 K	108	187	2.5	0.38	2.6	1.7	1.8	9.01
1220 K	111	169	2	0.17	5.6	3.6	3.8	3.82
2220 K	111	169	2	0.27	3.7	2.4	2.5	4.53
* 1320 K	113	202	2.5	0.24	4.1	2.7	2.8	8.46
* 2320 K	113	202	2.5	0.38	2.6	1.7	1.8	11.6
_	116	179	2	0.18	5.5	3.6	3.7	4.52
_	116	179	2	0.28	3.5	2.3	2.4	5.64
_	118	212	2.5	0.23	4.2	2.7	2.9	10
_	118	212	2.5	0.38	2.6	1.7	1.7	14.4
1222 K	121	189	2	0.17	5.7	3.7	3.9	5.33
* 2222 K	121	189	2	0.28	3.5	2.2	2.3	6.64
* 1322 K	123	227	2.5	0.22	4.4	2.8	3.0	12
* 2322 K	123	227	2.5	0.37	2.6	1.7	1.8	17.4

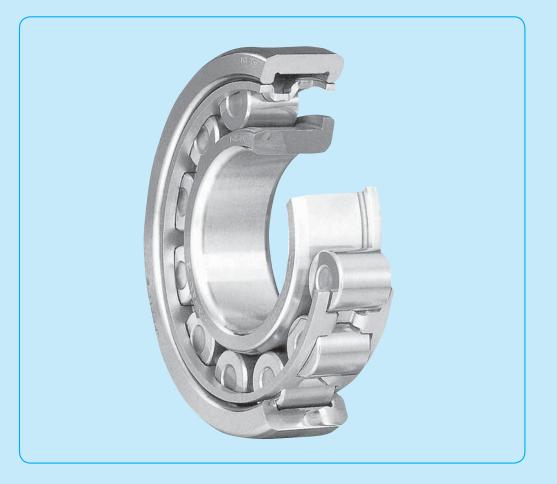
^(*) The balls of the bearings marked * protrude slightly from the bearing face. The protrusion amounts are shown on Page B77.



CYLINDRICAL ROLLER BEARINGS

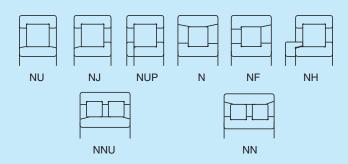
SINGLE-ROW CYLINDRICAL ROLLER BEARINGS	Bore Diameter	20 –	65 mm ······	В	88
	Bore Diameter	70 – 1	60 mm ······	В	94
	Bore Diameter	170 – 5	00 mm ······	В1	02
L-SHAPED THRUST COLLARS FOR CYLINDRICAL ROLLER BEARINGS	Bore Diameter	20 – 3	20 mm ······	B1	06
DOUBLE-ROW CYLINDRICAL ROLLER BEARINGS	Bore Diameter	25 – 3	60 mm ·····	В1	110

Four-Row Cylindrical Roller Bearings are described on Pages B334 to B343.



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 Page B104 to B105).

The inner ring loose rib of a NUP-type cylindrical roller bearing should be mounted so that the marked side is on the outside.

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Use pressed, machined, or molded cages for standard cylindrical roller bearings as shown in Table 1.

Table 1 Standard Cages for Cylindrical Roller Bearings

Series	Pressed Steel Cages (W)	Machined Brass Cages (M)	Molded Polyamide Cages (T)
NU10**	_	1005 – 10/500	_
N2**	204 – 230	232 - 264	_
NU2**	214 – 230	232 - 264	_
NU2**E	205E – 213E	214E - 240E	204E
NU22**	2204 - 2230	2232 – 2252	_
NU22**E	_	2222E - 2240E	2204E – 2220E
N3 **	304 - 324	326 – 352	_
NU3**	312 – 330	332 - 352	_
NU3**E	305E - 311E	312E - 340E	304E
NU23**	2304 - 2320	2322 - 2340	_
NU23**E	_	2322E - 2340E	2304E - 2320E
NU4**	405 – 416	417 – 430	_

The basic load ratings listed in the bearing tables are based on the Cage Classification in Table 1.

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.

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

CYLINDRICAL ROLLER BEARINGS	Table 8	3.2 (Pages	A60	to .	A63)
DOUBLE-ROW CYLINDRICAL ROLLER						
BEARINGS	Table 8	3.2 (Pages	A60 1	to i	A63)

Nomin Diameter	al Bore d (mm)	Tolerances fo NU, NJ, NUP, NH	or $F_{ m w}$ of types H, and NNU ${ extstyle \int_{ m w}}$	Tolerance types N, NF,	es for $E_{ m w}$ of and NN \varDelta $E_{ m w}$
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

CYLINDRICAL ROLLER BEARINGS	Table 9.2 (Page A84)
	Table 9.4 (Page A85)
DOUBLE-ROW CYLINDRICAL ROLLER	
BEARINGS	Table 9.2 (Page A84)
	Table 9.4 (Page A85)

INTERNAL CLEARANCES

CYLINDRICAL ROLLER BEARINGS..... Table 9.14 (Page A91)

DOUBLE-ROW CYLINDRICAL ROLLER BEARINGS.... Table 9.14 (Page A91)

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:

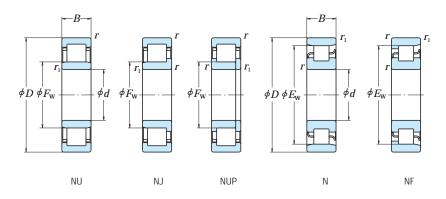
For double-row cylindrical roller bearings, nearly no misalignment is allowed.

LIMITING SPEEDS

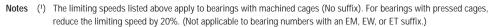
The limiting speeds listed in the bearing tables should be adjusted depending on the bearing load conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A37 for detailed information.

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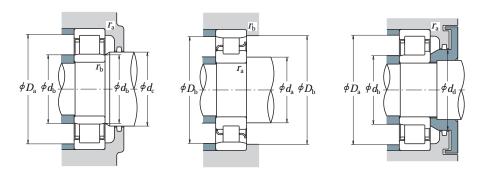
Bore Diameter 20 – 35 mm



		Bou	ndary Dir (mm	mensions)			Basic Load (N)		Limiting S (min	
d	D	В	$m{r}$ min.	$r_1 \atop ext{min.}$	F_{W}	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
20	47 47 47	14 14 18	1 1 1	0.6 0.6 0.6	 26.5 27	40 	15 400 25 700 20 700	12 700 22 600 18 400	15 000 13 000 13 000	18 000 16 000 16 000
	47 52 52	18 15 15	1 1.1 1.1	0.6 0.6 0.6	26.5 — 27.5	44.5 —	30 500 21 400 31 500	28 300 17 300 26 900	13 000 12 000 12 000	16 000 15 000 15 000
	52 52	21 21	1.1 1.1	0.6 0.6	28.5 27.5	_	30 500 42 000	27 200 39 000	11 000 11 000	14 000 14 000
25	47 52 52	12 15 15	0.6 1 1	0.3 0.6 0.6	30.5 — 31.5	 45 	14 300 17 700 29 300	13 100 15 700 27 700	15 000 13 000 12 000	18 000 16 000 14 000
	52 62 62	18 17 17	1 1.1 1.1	0.6 1.1 1.1	31.5 — 34	53 —	35 000 29 300 41 500	34 500 25 200 37 500	12 000 10 000 10 000	14 000 13 000 12 000
	62 80	24 21	1.1 1.5	1.1 1.5	34 38.8	<u> </u>	57 000 46 500	56 000 40 000	9 000 9 000	11 000 11 000
30	55 62 62	13 16 16	1 1 1	0.6 0.6 0.6	36.5 — 37.5	48.5 53.5 —	19 700 24 900 39 000	19 600 23 300 37 500	12 000 11 000 9 500	15 000 13 000 12 000
	62 72 72	20 19 19	1 1.1 1.1	0.6 1.1 1.1	37.5 — 40.5	62 —	49 000 38 500 53 000	50 000 35 000 50 000	9 500 8 500 8 500	12 000 11 000 10 000
	72 90	27 23	1.1 1.5	1.1 1.5	40.5 45	-	74 500 62 500	77 500 55 000	8 000 7 500	9 500 9 500
35	62 72 72	14 17 17	1 1.1 1.1	0.6 0.6 0.6	42 — 44	55 61.8 —	22 600 35 500 50 500	23 200 34 000 50 000	11 000 9 500 8 500	13 000 11 000 10 000
	72 80 80	23 21 21	1.1 1.5 1.5	0.6 1.1 1.1	44 — 46.2	68.2 —	61 500 49 500 66 500	65 500 47 000 65 500	8 500 8 000 7 500	10 000 9 500 9 500
	80 100	31 25	1.5 1.5	1.1 1.5	46.2 53	— 83	93 000 75 500	101 000 69 000	6 700 6 700	8 500 8 000



⁽²) The bearings with suffix ET have polyamide cage. The maximum operating temperature should be less than 120 °C.

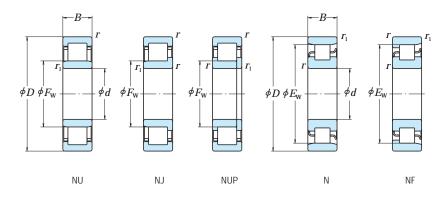


Bea	Bearing Numbers ⁽²⁾ (3)						P	butmer	nt and Fi (mi	llet Dime m)	nsions				Mass (kg)
	NU NJ	NUP	N	NF	d _a (4) min.	$d_{ m b}$ min.	d ₀ ⁽⁵⁾ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(4)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$\emph{\textbf{r}}_{a}$ max.	$r_{ m b}$ max.	арргох.
N 204 NU 204 ET NU2204	 NU NJ	NUP	N 	NF 	25 25 25	 24 24	 25 25	 29 29	— 32 32	— 42 42	43 	42 —	1 1 1	0.6 0.6 0.6	0.107 0.107 0.144
NU2204 ET N 304 NU 304 ET		NUP NUP	_ N _	NF	25 26.5 26.5	24 24	25 — 26	29 — 30	32 — 33	42 — 45.5	 48 	 46 	1 1 1	0.6 0.6 0.6	0.138 0.148 0.145
NU2304 NU2304 ET		NUP NUP	_	_	26.5 26.5	24 24	27 26	30 30	33 33	45.5 45.5	_	_	1 1	0.6 0.6	0.217 0.209
NU1005 N 205 NU 205 EW	NU — — — NU NJ	_ NUP	_ N _	NF	— 30 30	27 — 29	30 — 30	32 — 34	_ 37	43 — 47	 48 	_ 46 _	0.6 1 1	0.3 0.6 0.6	0.094 0.135 0.136
NU2205 ET N 305 NU 305 EW		NUP NUP	_ N _	NF	30 31.5 31.5	29 — 31.5	30 — 32	34 — 37	37 - 40	47 — 55.5	 55.5 _	 50 	1 1 1	0.6 1 1	0.16 0.233 0.269
NU2305 ET NU 405	NU NJ	NUP —	_ N	_ NF	31.5 33	31.5 33	32 37	37 41	40 46	55.5 72	— 72	<u> </u>	1 1.5	1 1.5	0.338 0.57
NU1006 N 206 NU 206 EW	NU — — — NU NJ	_ NUP	N N	NF —	35 35 35	34 34	36 — 36	38 — 40	<u> </u>	50 — 57	51 58 —	49 56 —	1 1 1	0.5 0.6 0.6	0.136 0.208 0.205
NU2206 ET N 306 NU 306 EW		NUP NUP	N	NF —	35 36.5 36.5	34 — 36.5	36 — 39	40 — 44	44 — 48	57 — 65.5	 65.5 _	64 —	1 1 1	0.6 1 1	0.255 0.353 0.409
NU2306 ET NU 406	NU NJ	NUP —	N	_ NF	36.5 38	36.5 38	39 43	44 47	48 52	65.5 82	— 82	 75	1 1.5	1 1.5	0.518 0.758
NU1007 N 207 NU 207 EW	NO N1	_ NUP	N N	NF	40 41.5 41.5	39 39	41 — 42	44 — 46	 50	57 — 65.5	58 68 —	56 64 —	1 1 1	0.5 0.6 0.6	0.18 0.301 0.304
NU2207 ET N 307 NU 307 EW		NUP — NUP	_ N _	NF	41.5 43 41.5	39 — 41.5	42 — 44	46 — 48	50 — 53	65.5 — 72	73.5 —	 70 	1 1.5 1.5	0.6 1 1	0.40 0.476 0.545
NU2307 ET NU 407	NN NN NN NN	NUP —	_ N	_ NF	43 43	41.5 43	44 51	48 55	53 61	72 92	— 92	— 85	1.5 1.5	1 1.5	0.711 1.01

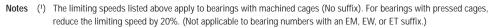
Notes (3) When L-shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B104**) are used, the bearings become the NH type.

- (4) If axial loads are applied, increase d_a and reduce D_a from the values listed above.
- (5) d_b (max.) are values for adjusting rings for NU, NJ Types.

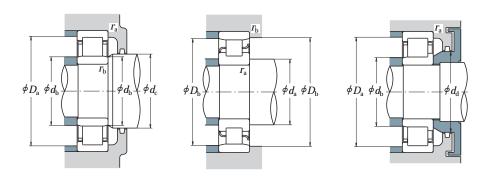
Bore Diameter 40 – 55 mm



Boundary Dimensions (mm) d D B r r_1 r_W							Basic Load		Limiting S (min	
d	D	В	$m{r}$ min.	$r_{\scriptscriptstyle 1}$ min.	$F_{ m W}$	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
40	68	15	1	0.6	47	61	27 300	29 000	10 000	12 000
	80	18	1.1	1.1	—	70	43 500	43 000	8 500	10 000
	80	18	1.1	1.1	49.5	—	55 500	55 500	7 500	9 000
	80	23	1.1	1.1	49.5	—	72 500	77 500	7 500	9 000
	90	23	1.5	1.5	—	77.5	58 500	57 000	6 700	8 500
	90	23	1.5	1.5	52	—	83 000	81 500	6 700	8 000
	90 110	33 27	1.5 2	1.5 2	52 58	<u> </u>	114 000 95 500	122 000 89 000	6 000 6 000	7 500 7 500
45	75	16	1	0.6	52.5	67.5	32 500	35 500	9 000	11 000
	85	19	1.1	1.1	—	75	46 000	47 000	7 500	9 000
	85	19	1.1	1.1	54.5	—	63 000	66 500	6 700	8 000
	85 100 100	23 25 25	1.1 1.5 1.5	1.1 1.5 1.5	54.5 — 58.5	86.5 —	76 000 79 000 97 500	84 500 77 500 98 500	6 700 6 300 6 000	8 500 7 500 7 500
	100	36	1.5	1.5	58.5		137 000	153 000	5 300	6 700
	120	29	2	2	64.5	100.5	107 000	102 000	5 600	6 700
50	80	16	1	0.6	57.5	72.5	32 000	36 000	8 000	10 000
	90	20	1.1	1.1	—	80.4	48 000	51 000	7 100	8 500
	90	20	1.1	1.1	59.5	—	69 000	76 500	6 300	7 500
	90 110 110	23 27 27	1.1 2 2	1.1 2 2	59.5 — 65	95 —	83 500 87 000 110 000	97 000 86 000 113 000	6 300 5 600 5 000	8 000 6 700 6 000
	110	40	2	2	65		163 000	187 000	5 000	6 300
	130	31	2.1	2.1	—	110.8	139 000	136 000	5 000	6 000
	130	31	2.1	2.1	70.8	110.8	129 000	124 000	5 000	6 000
55	90	18	1.1	1	64.5	80.5	37 500	44 000	7 500	9 000
	100	21	1.5	1.1	—	88.5	58 000	62 500	6 300	7 500
	100	21	1.5	1.1	66	—	86 500	98 500	5 600	7 100
	100 120 120	25 29 29	1.5 2 2	1.1 2 2	66 — 70.5	104.5 —	101 000 111 000 137 000	122 000 111 000 143 000	5 600 5 000 4 500	7 100 6 300 5 600
	120	43	2	2	70.5		201 000	233 000	4 500	5 600
	140	33	2.1	2.1	77.2	117.2	139 000	138 000	4 500	5 600



⁽²) The bearings with suffix ET have polyamide cage. The maximum operating temperature should be less than 120 °C.

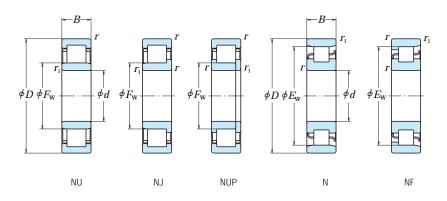


Bear	Bearing Numbers ⁽²⁾ (3) NU NJ NUP N NE					ļ	Abutme	nt and F (m	illet Dime m)	ensions				Mass (kg)
	NN NY N	UP N	NF	$d_{\!\scriptscriptstyle a}^{(4)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(5)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(4)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$m{r_{\mathrm{a}}}$ max.	$r_{ m b}$ max.	арргох.
NU1008 N 208 NU 208 EW		UP N - N UP -	NF	45 46.5 46.5	44 — 46.5	46 — 48	49 — 52	— 56	63 — 73.5	64 73.5 —	62 72 —	1 1 1	0.6 1 1	0.223 0.375 0.379
NU2208 ET N 308 NU 308 EW		UP — — N UP —	NF	46.5 48 48	46.5 — 48	48 — 50	52 — 55	56 — 60	73.5 — 82	— 82 —	_ 79 _	1 1.5 1.5	1 1.5 1.5	0.480 0.649 0.747
NU2308 ET NU 408		UP — UP N	_ NF	48 49	48 49	50 56	55 60	60 67	82 101	_ 101	<u> </u>	1.5 2	1.5 2	0.933 1.28
NU1009 N 209 NU 209 EW	NU NJ N	– N – N UP –	NF NF	50 51.5 51.5	49 — 51.5	51 — 52	54 — 57	_ 61	70 — 78.5	71 78.5 —	68 77 —	1 1 1	0.6 1 1	0.279 0.429 0.438
NU2209 ET N 309 NU 309 EW		UP — — N UP —	NF	51.5 53 53	51.5 — 53	52 — 56	57 — 60	61 — 66	78.5 — 92	— 92 —	_ 77 _	1 1.5 1.5	1 1.5 1.5	0.521 0.869 1.01
NU2309 ET NU 409		UP — UP N	_ NF	53 54	53 54	56 62	60 66	66 74	92 111	_ 111	 103	1.5 2	1.5 2	1.28 1.62
NU1010 N 210 NU 210 EW		UP N - N UP -	NF	55 56.5 56.5	54 — 56.5	56 — 57	59 — 62	— — 67	75 — 83.5	76 83.5 —	73 82 —	1 1 1	0.6 1 1	0.301 0.483 0.50
NU2210 ET N 310 NU 310 EW		UP — — N UP —	NF	56.5 59 59	56.5 — 59	57 — 63	62 — 67	67 — 73	83.5 — 101	 101 	— 97 —	1 2 2	1 2 2	0.562 1.11 1.3
NU2310 ET N 410 NU 410		UP — — N UP N	NF NF	59 65 61	59 — 61	63 — 68	67 — 73	73 — 81	101 — 119	— 117 119	— 113 113.3	2 2 2	2 2 2	1.7 2.0 1.99
NU1011 N 211 NU 211 EW	NO NY -	– N – N UP –	NF	61.5 63 63	60 — 61.5	63 — 64	66 — 68	_ 73	83.5 — 92	85 93.5 —	82 91 —	1 1.5 1.5	1 1 1	0.445 0.634 0.669
NU2211 ET N 311 NU 311 EW		UP — — N UP —	NF	63 64 64	61.5 — 64	64 — 68	68 — 72	73 — 80	92 — 111	111 —	107 —	1.5 2 2	1 2 2	0.783 1.42 1.64
NU2311 ET NU 411		UP — UP N	_ NF	64 66	64 66	68 75	72 79	80 87	111 129	_ 129	_ 119	2 2	2 2	2.18 2.5

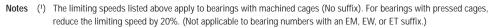
Notes (3) When L-shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B104**) are used, the bearings become the NH type.

- (4) If axial loads are applied, increase d_a and reduce D_a from the values listed above.
- (5) d_b (max.) are values for adjusting rings for NU, NJ Types.

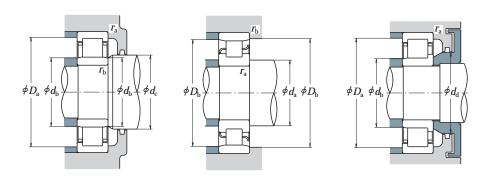
Bore Diameter 60 – 75 mm



		Bou	ndary Dir (mm	mensions ı)			Basic Load (N		Limiting Sp (min	
d	D	В	$m{r}$ min.	$oldsymbol{r_1}{ ext{min.}}$	$F_{ m W}$	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
60	95 110 110 110 130 130 130	18 22 22 28 31 31 31 46	1.1 1.5 1.5 1.5 2.1 2.1 2.1 2.1	1 1.5 1.5 1.5 2.1 2.1 2.1 2.1	69.5 — 72 72 — 77 77 77	85.5 97.5 — — 113 — —	40 000 68 500 97 500 131 000 124 000 124 000 150 000 222 000	48 500 75 000 107 000 157 000 126 000 126 000 157 000 262 000	6 700 6 000 5 300 5 300 4 800 4 800 4 800 4 300	8 500 7 100 6 300 6 300 5 600 5 600 5 600 5 300
65	150 100 120 120 120	35 18 23 23 31	2.1 1.1 1.5 1.5	2.1 1 1.5 1.5 1.5	74.5 — 78.5 78.5	127 90.5 105.6 —	167 000 41 000 84 000 108 000 149 000	168 000 51 000 94 500 119 000 181 000	4 300 6 300 5 300 4 800 4 800	5 300 8 000 6 300 5 600 6 000
	140 140 140 140 160	33 33 33 48 37	2.1 2.1 2.1 2.1 2.1	2.1 2.1 2.1 2.1 2.1	83.5 82.5 82.5 89.3	121.5 — — — 135.3	135 000 135 000 181 000 233 000 182 000	139 000 139 000 191 000 265 000 186 000	4 300 4 300 4 300 3 800 4 000	5 300 5 300 5 300 4 800 4 800
70	110 125 125 125 150 150	20 24 24 31 35 35	1.1 1.5 1.5 1.5 2.1 2.1	1 1.5 1.5 1.5 2.1 2.1	80 — 83.5 83.5 — 90	100 110.5 — — 130	58 500 83 500 119 000 156 000 149 000	70 500 95 000 137 000 194 000 156 000	6 000 5 000 5 000 4 500 4 000 4 000	7 100 6 300 6 300 5 600 5 000 5 000
75	150 150 150 180 115	35 51 42 20	2.1 2.1 2.1 3	2.1 2.1 2.1 3	89 89 100 85	— — 152 105	158 000 205 000 274 000 228 000 60 000	168 000 222 000 325 000 236 000 74 500	4 000 4 000 3 600 3 600 5 600	5 000 5 000 4 500 4 300 6 700
73	130 130 130 130 160 160 160 160	25 25 25 31 37 37 37 55 45	1.5 1.5 1.5 2.1 2.1 2.1 2.1 3	1.5 1.5 1.5 2.1 2.1 2.1 2.1 3	88.5 88.5 — 95.5 95 95	116.5 — — 139.5 — — — — 160.5	96 500 130 000 162 000 179 000 179 000 240 000 330 000 262 000	111 000 156 000 207 000 189 000 189 000 263 000 395 000 274 000	4 800 4 800 4 300 3 800 3 800 3 400 3 400	6 000 6 000 5 300 4 800 4 800 4 800 4 300 4 000



⁽²) The bearings with suffix ET have polyamide cage. The maximum operating temperature should be less than 120 °C.

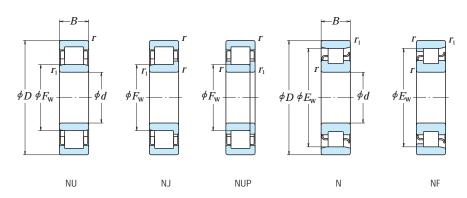


Bear	ring Numbers	S(2)				ļ	Abutmer	nt and Fi (m	illet Dime m)	ensions				Mass (kg)
	(3) NU NJ I	NUP N	I NF	$d_{\!\scriptscriptstyle a}^{(4)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(5)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(4)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$r_{ m a}$ max.	$r_{ m b}$ max.	approx.
NU1012 N 212 NU 212 EW	 ИИ ИЛ	- 1 - 1 - QUV		66.5 68 68	65 — 68	68 — 70	71 — 75	_ _ 80	88.5 — 102	90 102 —	87 100 —	1 1.5 1.5	1 1.5 1.5	0.474 0.823 0.824
NU2212 ET N 312 NU 312		NUP - - 1 NUP -	NF	68 71 71	68 — 71	70 — 75	75 — 79	80 — 86	102 — 119	119 —	115 —	1.5 2 2	1.5 2 2	1.06 1.78 1.82
NU 312 EM NU2312 ET NU 412	NO NO I	NUP -		71 71 71 71	71 71 71 71	75 75	79 79 85	86 86	119 119 139	_ 139	_ 130	2 2 2	2 2 2	2.06 2.7 3.04
NU1013 N 213	NU NJ	! !	I NF	71.5 73	70 —	80 73 —	76 —	94 — —	93.5	95 112	92 108	1 1.5	1 1.5	0.504 1.05
NU 213 EW NU2213 ET N 313	NU NJ I	NUP - NUP - 1	 J NF	73 73 76	73 73 —	76 76 —	81 81 —	87 87 —	112 112 —	_ 129	_ _ 125	1.5 1.5 2	1.5 1.5 2	1.05 1.41 2.17
NU 313 NU 313 EM NU2313 ET	NO NO I	NUP -	 	76 76 76	76 76 76	81 80 80	85 85 85	93 93 93	129 129 129	_	_	2 2 2	2 2 2	2.23 2.56 3.16
NU 413 NU1014 N 214	— — ИП ИЛ I	1 — 1 QU <i>N</i> 1 —	I NF	76 76.5 78	76 75 —	86 79 —	91 82 —	100	149 103.5 —	149 105 117	138.8 101 113	2 1 1.5	2 1 1.5	3.63 0.693 1.14
NU 214 EM NU2214 ET N 314		NUP - NUP - - 1		78 78 81	78 78 —	81 81 —	86 86	92 92	117 117 —	139	133.5	1.5 1.5 2	1.5 1.5 2	1.29 1.49 2.67
NU 314 NU 314 EM	NU NJ I	NUP - NUP -		81 81	81 81	87 86	92 92	100	139 139	_	_	2	2	2.75 3.09
NU2314 ET NU 414 NU1015		NUP – NUP N 1 —	l NF	81 83 81.5	81 83 80	86 97 83	92 102 87	100 112 —	139 167 108.5	167 110	155 106	2 2.5 1	2 2.5 1	3.92 5.28 0.731
N 215 NU 215 EM NU2215 ET		- 1 NUP - NUP -	NF 	83 83 83	83 83	— 86 86	90 90	96 96	— 122 122	122 —	119 — —	1.5 1.5 1.5	1.5 1.5 1.5	1.23 1.44 1.57
N 315 NU 315 NU 315 EM	NU NJ I	_ NUP -	NF — —	86 86 86	— 86 86	93 92	97 97	106 106	149 149	149 —	143	2 2 2	2 2 2	3.2 3.26 3.73
NU2315 ET NU 415		NUP - - I	- —	86 88	86 88	92 102	97 97 107	106 106 118	149 149 177	_ 177	 164	2 2.5	2 2.5	4.86 6.27

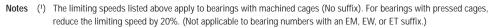
Notes (3) When L-shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B104**) are used, the bearings become the NH type.

- (4) If axial loads are applied, increase d_a and reduce D_a from the values listed above.
- (5) d_b (max.) are values for adjusting rings for NU, NJ Types.

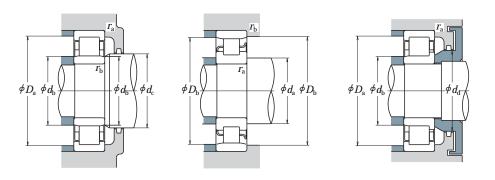
Bore Diameter 80 – 95 mm



		Bou	ndary Di (mm	mensions n)			Basic Load (N		Limiting Sp (min	
d	D	В	$m{r}$ min.	$oldsymbol{r_1}{min.}$	F_{W}	$E_{ m W}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
80	125 140 140	22 26 26	1.1 2 2	1 2 2	91.5 — 95.3	113.5 125.3 —	72 500 106 000 139 000	90 500 122 000 167 000	5 300 4 500 4 500	6 300 5 300 5 300
	140 170 170	33 39 39	2 2.1 2.1	2 2.1 2.1	95.3 — 101	147 —	186 000 190 000 256 000	243 000 207 000 282 000	4 000 3 600 3 600	5 000 4 300 4 300
	170 200	58 48	2.1	2.1 3	101 110	 170	355 000 299 000	430 000 315 000	3 200 3 200	4 000 3 800
85	130 150 150	22 28 28	1.1 2 2	1 2 2	96.5 — 100.5	118.5 133.8 —	74 500 120 000 167 000	95 500 140 000 199 000	5 000 4 300 4 300	6 000 5 000 5 000
	150 180 180	36 41 41	2 3 3	2 3 3	100.5 — 108	156 —	217 000 225 000 212 000	279 000 247 000 228 000	3 800 3 400 3 400	4 500 4 000 4 000
	180 180 210	41 60 52	3 3 4	3 3 4	108 108 113	_ _ 177	291 000 395 000 335 000	330 000 485 000 350 000	3 400 3 000 3 000	4 000 3 800 3 800
90	140 160 160	24 30 30	1.5 2 2	1.1 2 2	103 — 107	127 143 —	88 000 152 000 182 000	114 000 178 000 217 000	4 500 4 000 4 000	5 600 4 800 4 800
	160 190 190	40 43 43	2 3 3	2 3 3	107 — 115	165 —	242 000 240 000 240 000	315 000 265 000 265 000	3 600 3 200 3 200	4 300 3 800 3 800
	190 190 225	43 64 54	3 3 4	3 3 4	113.5 113.5 123.5	_ _ 191.5	315 000 435 000 375 000	355 000 535 000 400 000	3 200 2 800 2 800	3 800 3 400 3 400
95	145 170 170	24 32 32	1.5 2.1 2.1	1.1 2.1 2.1	108 — 112.5	132 151.5 —	90 500 166 000 220 000	120 000 196 000 265 000	4 300 3 800 3 800	5 300 4 500 4 500
	170 200 200	43 45 45	2.1 3 3	2.1 3 3	112.5 — 121.5	173.5 —	286 000 259 000 259 000	370 000 289 000 289 000	3 400 3 000 3 000	4 000 3 600 3 600
	200 200 240	45 67 55	3 3 4	3 3 4	121.5 121.5 133.5	_ _ 201.5	335 000 460 000 400 000	385 000 585 000 445 000	3 000 2 600 2 600	3 600 3 400 3 200



⁽²) The bearings with suffix ET have polyamide cage. The maximum operating temperature should be less than 120 °C.

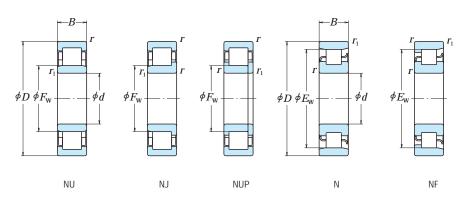


Bear	Bearing Numbers ⁽²⁾ (3) NU NJ NUP N NE						ŀ	Abutmer	nt and Fi (m	illet Dime m)	ensions				Mass (kg)
	NN NY	NUP	N	NF	d _a (4) min.	$d_{ m b}$ min.	d ₀(5) max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(4)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$r_{ m a}$ max.	$r_{ m b}$ max.	арргох.
NU1016 N 216 NU 216 EM	NU — — — NU NJ	NUP NUP	N N	NF	86.5 89 89	85 — 89	90 — 92	94 — 97	_ 104	118.5 — 131	120 131 —	115 128 —	1 2 2	1 2 2	0.969 1.47 1.7
NU2216 ET N 316 NU 316 EM	NO NJ	NUP NUP	_ N	NF	89 91 91	89 — 91	92 — 98	97 — 105	104 — 114	131 — 159	_ 159 _	_ 150 _	2 2 2	2 2 2	1.96 3.85 4.45
NU2316 ET NU 416	NN NN	NUP —	_ N	_ NF	91 93	91 93	98 107	105 112	114 124	159 187	_ 187	 173	2 2.5	2 2.5	5.73 7.36
NU1017 N 217 NU 217 EM	UU LU UU	_ NUP	N N	NF	91.5 94 94	90 — 94	95 — 98	99 — 104	_ 110	123.5 — 141	125 141 —	120 137 —	1 2 2	1 2 2	1.01 1.87 2.11
NU2217 ET N 317 NU 317	NU NJ	NUP NUP	N	NF	94 98 98	94 — 98	98 — 105	104 — 110	110 — 119	141 — 167	_ 167 _	_ 159 _	2 2.5 2.5	2 2.5 2.5	2.44 4.53 4.6
NU 317 EM NU2317 ET NU 417	NU NJ NU NJ	NUP NUP	_ _ N	_ NF	98 98 101	98 98 101	105 105 110	110 110 115	119 119 128	167 167 194	_ _ 194	_ _ 180	2.5 2.5 3	2.5 2.5 3	5.26 6.77 9.56
NU1018 N 218 NU 218 EM	NU — — — NU NJ	NUP NUP	N N	NF	98 99 99	96.5 — 99	101 104	106 — 109	_ 116	132 — 151	133.5 151 —	129 146 —	1.5 2 2	1 2 2	1.35 2.31 2.6
NU2218 ET N 318 NU 318	NU NJ	NUP NUP	N	NF	99 103 103	99 — 103	104 — 112	109 — 117	116 — 127	151 — 177	_ 177 _	168 —	2 2.5 2.5	2 2.5 2.5	3.11 5.31 5.38
NU 318 EM NU2318 ET NU 418	NU NJ	NUP NUP	_ N	_ NF	103 103 106	103 103 106	111 111 120	117 117 125	127 127 139	177 177 209	_ _ 209	_ _ 196	2.5 2.5 3	2.5 2.5 3	6.1 7.9 11.5
NU1019 N 219 NU 219 EM	NU NJ	_ NUP	N N	NF	103 106 106	101.5 — 106	106 — 110	111 — 116	_ 123	137 — 159	138.5 159 —	134 155 —	1.5 2 2	1 2 2	1.41 2.79 3.17
NU2219 ET N 319 NU 319	NU NJ	NUP NUP	N	NF	106 108 108	106 — 108	110 — 118	116 — 124	123 — 134	159 — 187	_ 187 _	 177 	2 2.5 2.5	2 2.5 2.5	3.81 6.09 6.23
NU 319 EM NU2319 ET NU 419	MN MY MN MY MO MY	NUP NUP NUP	_ _ _	_ NF	108 108 108 111	108 108 111	118 118 130	124 124 124 136	134 134 134 149	187 187 187 224	 224	 206	2.5 2.5 2.5 3	2.5 2.5 2.5 3	7.13 9.21 13.6

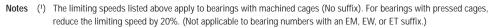
Notes (3) When L-shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B104**) are used, the bearings become the NH type.

- (4) If axial loads are applied, increase d_a and reduce D_a from the values listed above.
- (5) d_b (max.) are values for adjusting rings for NU, NJ Types.

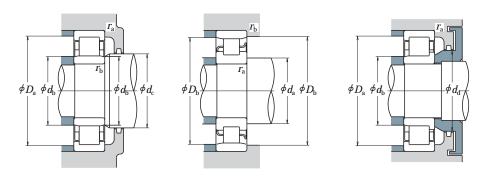
Bore Diameter 100 – 120 mm



		Bou	ndary Dii (mm	mensions n)				ad Ratings N)	Limiting Sp (min	
d	D	В	$m{r}$ min.	$oldsymbol{r_1}{ ext{min.}}$	F_{W}	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
100	150	24	1.5	1.1	113	137	93 000	126 000	4 300	5 300
	180	34	2.1	2.1	—	160	183 000	217 000	3 600	4 300
	180	34	2.1	2.1	119	—	249 000	305 000	3 600	4 300
	180 215 215	46 47 47	2.1 3 3	2.1 3 3	119 — 129.5	185.5 —	335 000 299 000 299 000	445 000 335 000 335 000	3 200 2 800 2 800	3 800 3 400 3 400
	215	47	3	3	127.5	_	380 000	425 000	2 800	3 400
	215	73	3	3	127.5	_	570 000	715 000	2 400	3 000
	250	58	4	4	139	211	450 000	500 000	2 600	3 000
105	160	26	2	1.1	119.5	145.5	109 000	149 000	4 000	4 800
	190	36	2.1	2.1	—	168.8	201 000	241 000	3 400	4 000
	190	36	2.1	2.1	125	—	262 000	310 000	3 400	4 000
	225	49	3	3	—	195	340 000	390 000	2 600	3 200
	225	49	3	3	133	—	425 000	480 000	2 600	3 200
	260	60	4	4	144.5	220.5	495 000	555 000	2 400	3 000
110	170	28	2	1.1	125	155	131 000	174 000	3 800	4 500
	200	38	2.1	2.1	—	178.5	229 000	272 000	3 200	3 800
	200	38	2.1	2.1	132.5	—	293 000	365 000	3 200	3 800
	200 240 240 280	53 50 50 65	2.1 3 3 4	2.1 3 3 4	132.5 — 143 155	207 — —	385 000 380 000 450 000 550 000	515 000 435 000 525 000 620 000	2 800 2 600 2 600 2 200	3 400 3 000 3 000 2 800
120	180	28	2	1.1	135	165	139 000	191 000	3 400	4 300
	215	40	2.1	2.1	—	191.5	260 000	320 000	3 000	3 400
	215	40	2.1	2.1	143.5	—	335 000	420 000	3 000	3 400
	215 260 260	58 55 55	2.1 3 3	2.1 3 3	143.5 — 154	226 —	450 000 450 000 530 000	620 000 510 000 610 000	2 600 2 200 2 200	3 200 2 800 2 800
	260	86	3	3	154		795 000	1 030 000	2 000	2 600
	310	72	5	5	170	260	675 000	770 000	2 000	2 400



⁽²) The bearings with suffix ET have polyamide cage. The maximum operating temperature should be less than 120 °C.



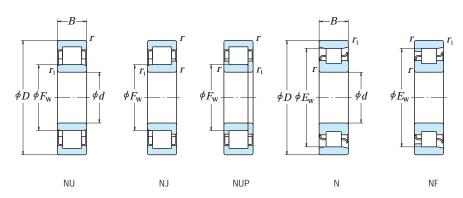
Bear	Bearing Numbers ⁽²⁾ (3) NU NJ NUP N NI						P	butmer	it and Fi (mi	illet Dime m)	ensions				Mass (kg)
		NUP	N	NF	$d_{\!\scriptscriptstyle a}^{(4)}$ min.	$d_{ m b}$ min.	d ₀ ⁽⁵⁾ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(4)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$r_{ m a}$ max.	$r_{ m b}$ max.	арргох.
NU1020 N 220 NU 220 EM	NN NY NN NY	NUP — NUP	N N	NF	108 111 111	106.5 — 111	111 — 116	116 — 122	_ _ 130	142 — 169	143.5 169 —	139 163 —	1.5 2 2	1 2 2	1.47 3.36 3.81
NU2220 ET N 320 NU 320	ИП ИЛ — — ИП ИЛ	NUP — NUP	_ N _	NF —	111 113 113	111 113	116 — 126	122 — 132	130 — 143	169 — 202	 202 	_ 190 _	2 2.5 2.5	2 2.5 2.5	4.69 7.59 7.69
NU 320 EM NU2320 ET NU 420	ИП ИЛ ИП ИЛ ИП ИЛ	NUP NUP	_ _ N	_ _ NF	113 113 116	113 113 116	124 124 135	132 132 141	143 143 156	202 202 234	 234	_ _ 215	2.5 2.5 3	2.5 2.5 3	8.63 11.8 15.5
NU1021 N 221 NU 221 EM	NO N7	_ NUP	N N	NF NF	114 116 116	111.5 — 116	118 — 121	122 — 129	_ _ 137	151 — 179	153.5 179 —	147 172 —	2 2 2	1 2 2	1.83 4.0 4.58
N 321 NU 321 EM NU 421	NO N1 NO N1	NUP	N — N	NF — NF	118 118 121	— 118 121	— 131 141	— 137 147	— 149 162	— 212 244	212 — 244	199 — 225	2.5 2.5 3	2.5 2.5 3	8.69 9.84 17.3
NU1022 N 222 NU 222 EM	NO N7 NO N7	_ NUP	N N	NF NF	119 121 121	116.5 — 121	123 — 129	128 — 135	_ _ 144	161 — 189	163.5 189 —	157 182 —	2 2 2	1 2 2	2.27 4.64 5.37
NU2222 EM N 322 NU 322 EM NU 422	NN NY NN NY	NUP NUP	_ N _	_ NF _ _	121 123 123 126	121 — 123 126	129 — 139 151	135 — 145 157	144 — 158 173	189 — 227 264	_ 227 _ _	211 — —	2 2.5 2.5 3	2 2.5 2.5 3	7.65 10.3 11.8 22.1
NU1024 N 224 NU 224 EM	NN NN — — NN NN	NUP — NUP	N N	NF	129 131 131	126.5 — 131	133 — 140	138 — 146	_ _ 156	171 — 204	173.5 204 —	167 196 —	2 2 2	1 2 2	2.43 5.63 6.43
NU2224 EM N 324 NU 324 EM	NN NN — — NN NN	NUP — NUP	_ N _	NF	131 133 133	131 — 133	140 — 150	146 — 156	156 — 171	204 — 247	247 —	230 —	2 2.5 2.5	2 2.5 2.5	9.51 12.9 15
NU2324 EM NU 424	NN NY	NUP NUP	_ N	_ _	133 140	133 140	150 166	156 172	171 190	247 290	_ 290	_ 266	2.5 4	2.5 4	25 30.2

Notes (3) When L-shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B104**) are used, the bearings become the NH type.

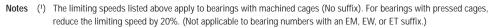
⁽⁴⁾ If axial loads are applied, increase d_a and reduce D_a from the values listed above.

⁽⁵⁾ d_b (max.) are values for adjusting rings for NU, NJ Types.

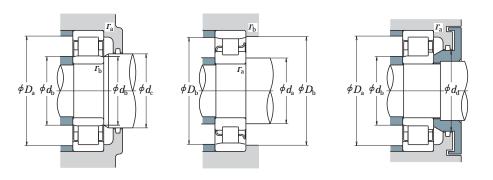
Bore Diameter 130 – 160 mm



		Bou	ndary Dii (mm	mensions n)				nd Ratings N)	Limiting S _I	
d	D	В	$m{r}$ min.	$r_1 \atop ext{min.}$	$F_{ m W}$	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
130	200 230 230	33 40 40	2 3 3	1.1 3 3	148 — 153.5	182 204 —	172 000 270 000 365 000	238 000 340 000 455 000	3 200 2 600 2 600	3 800 3 200 3 200
	230 280 280	64 58 58	3 4 4	3 4 4	153.5 — 167	243 —	530 000 500 000 615 000	735 000 570 000 735 000	2 400 2 200 2 200	3 000 2 600 2 600
	280 340	93 78	4 5	4 5	167 185	 285	920 000 825 000	1 230 000 955 000	1 900 1 800	2 400 2 200
140	210 250 250	33 42 42	2 3 3	1.1 3 3	158 — 169	192 221 —	176 000 297 000 395 000	250 000 375 000 515 000	3 000 2 400 2 400	3 600 3 000 3 000
	250 300 300	68 62 62	3 4 4	3 4 4	169 — 180	260 —	550 000 550 000 665 000	790 000 640 000 795 000	2 200 2 000 2 000	2 800 2 400 2 400
	300 360	102 82	4 5	4 5	180 198	302	1 020 000 875 000	1 380 000 1 020 000	1 700 1 700	2 200 2 000
150	225 270 270	35 45 45	2.1 3 3	1.5 3 3	169.5 — 182	205.5 238 —	202 000 360 000 450 000	294 000 465 000 595 000	2 800 2 200 2 200	3 400 2 800 2 800
	270 320 320	73 65 65	3 4 4	3 4 4	182 — 193	277 —	635 000 665 000 760 000	930 000 805 000 920 000	2 000 1 800 1 800	2 600 2 200 2 200
	320 380	108 85	4 5	4 5	193 213	_	1 160 000 930 000	1 600 000 1 120 000	1 600 1 600	2 000 2 000
160	240 290 290	38 48 48	2.1 3 3	1.5 3 3	180 — 195	220 255 —	238 000 430 000 500 000	340 000 570 000 665 000	2 600 2 200 2 200	3 200 2 600 2 600
	290 340 340 340	80 68 68 114	3 4 4 4	3 4 4 4	193 — 204 204	292 — —	810 000 700 000 860 000 1 310 000	1 190 000 875 000 1 050 000 1 820 000	1 900 1 700 1 700 1 500	2 400 2 000 2 000 1 900



⁽²) The bearings with suffix ET have polyamide cage. The maximum operating temperature should be less than 120 °C.

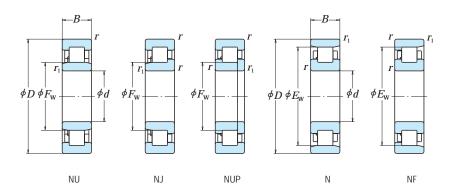


Bearing Numbers ⁽²⁾	Abutment and Fillet Dimensions (mm)									Mass (kg)	
(3) NU NJ NUP N NF	$d_{\!\scriptscriptstyle a}^{(4)}$ min.	$d_{ m b}$ min.	$d_{\mathrm{b}}^{(5)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(4)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$r_{ m a}$ max.	$r_{ m b}$ max.	арргох.
NU1026 NU NJ — N NE		136.5	146	151	—	191	193.5	184	2	1	3.66
N 226 — — N NE		—	—	—	—	—	217	208	2.5	2.5	6.48
NU 226 EM NU NJ NUP — —		143	150	158	168	217	—	—	2.5	2.5	8.03
NU2226 EM NU NJ NUP — — N 326 — — N NI NU326EM NU NJ NUP — —	143 146 146	143 — 146	150 — 163	158 — 169	168 — 184	217 — 264	264 —	 247.5 _	2.5 3 3	2.5 3 3	9.44 17.7 18.7
NU2326EM NU NJ NUP — —	146	146	163	169	184	264			3	3	30
NU 426 NU NJ — — NF	150	150	180	187	208	320	320	291	4	4	39.6
NU1028 NU NJ NUP N —	149	146.5	156	161	_	201	203.5	194	2	1	3.87
N 228 — — N NF	153	—	—	—	_	—	237	225	2.5	2.5	8.08
NU228EM NU NJ NUP — —	153	153	165	171	182	237	—	—	2.5	2.5	9.38
NU2228EM NU NJ NUP	153	153	165	171	182	237		_	2.5	2.5	15.2
N 328 N NF	156	—	—	—	—	—	284	266	3	3	21.7
NU328EM NU NJ NUP	156	156	176	182	198	284		_	3	3	22.8
NU2328EM NU NJ NUP	156	156	176	182	198	284		308	3	3	37.7
NU 428 NU NJ N	160	160	193	200	222	340	340		4	4	46.4
NU1030 NU NJ — N NE	161	158	167	173	_	214	217	208	2	1.5	4.77
N 230 — — N NE	163	—	—	—	_	—	257	242	2.5	2.5	10.4
NU230EM NU NJ NUP — —	163	163	177	184	196	257	—	—	2.5	2.5	11.9
NU2230EM NU NJ NUP N 330 N NI NU330EM NU NJ NUP	163 166 166	163 — 166	177 — 188	184 — 195	196 — 213	257 — 304	304 —	283 —	2.5 3 3	2.5 3 3	19.3 25.8 27.1
NU2330EM NU NJ NUP NU 430 NU NJ	166 170	166 170	188 208	195 216	213 237	304 360	_	_	3 4	3 4	45.1 55.8
NU1032 NU NJ — N NE	171	168	178	184	_	229	232	222	2	1.5	5.81
N 232 — — N NE	173	—	—	—	_	—	277	261	2.5	2.5	14.1
NU232EM NU NJ NUP — —	173	173	190	197	210	277	—	—	2.5	2.5	14.7
NU2232EM NU NJ NUP N 332 N NU332EM NU NJ NUP NU2332EM NU NJ NUP	173 176 176 176	173 — 176 176	188 — 199 199	197 — 211 211	210 — 228 228	277 — 324 324	324 — —	_ 298 _ _	2.5 3 3 3	2.5 3 3 3	24.5 30.8 32.1 53.9

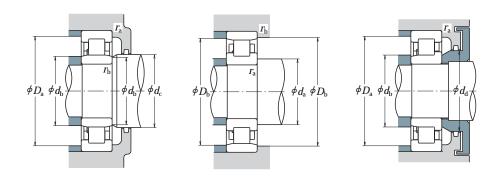
Notes (3) When L-shaped thrust collars (See section for L-Shaped Thrust Collars starting on page **B104**) are used, the bearings become the NH type.

- (4) If axial loads are applied, increase d_a and reduce D_a from the values listed above.
- (5) d_b (max.) are values for adjusting rings for NU, NJ Types.

Bore Diameter 170 – 220 mm



		Bou	ndary Dii (mm	mensions ı)				d Ratings N)	Limiting Speeds (min ⁻¹)		
d	D	В	$m{r}$ min.	$r_{\scriptscriptstyle 1}$ min.	$F_{ m W}$	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
170	260	42	2.1	2.1	193	237	287 000	415 000	2 400	2 800	
	310	52	4	4	—	272	475 000	635 000	2 000	2 400	
	310	52	4	4	207	—	605 000	800 000	2 000	2 400	
	310 360 360 360	86 72 72 120	4 4 4 4	4 4 4	205 — 218 216	310 — —	925 000 795 000 930 000 1 490 000	1 330 000 1 010 000 1 150 000 2 070 000	1 800 1 600 1 600 1 400	2 200 2 000 2 000 1 800	
180	280	46	2.1	2.1	205	255	355 000	510 000	2 200	2 600	
	320	52	4	4	—	282	495 000	675 000	1 900	2 200	
	320	52	4	4	217	—	625 000	850 000	1 900	2 200	
	320 380 380 380	86 75 75 126	4 4 4	4 4 4 4	215 — 231 227	328 — —	1 010 000 905 000 985 000 1 560 000	1 510 000 1 150 000 1 230 000 2 220 000	1 700 1 500 1 500 1 300	2 000 1 800 1 800 1 700	
190	290	46	2.1	2.1	215	265	365 000	535 000	2 000	2 600	
	340	55	4	4	—	299	555 000	770 000	1 800	2 200	
	340	55	4	4	230	—	695 000	955 000	1 800	2 200	
	340 400 400 400	92 78 78 132	4 5 5 5	4 5 5 5	228 — 245 240	345 —	1 100 000 975 000 1 060 000 1 770 000	1 670 000 1 260 000 1 340 000 2 520 000	1 600 1 400 1 400 1 300	2 000 1 700 1 700 1 600	
200	310	51	2.1	2.1	229	281	390 000	580 000	2 000	2 400	
	360	58	4	4	—	316	620 000	865 000	1 700	2 000	
	360	58	4	4	243	—	765 000	1 060 000	1 700	2 000	
	360 420 420 420	98 80 80 138	4 5 5 5	4 5 5 5	241 — 258 253	360 —	1 220 000 975 000 1 140 000 1 910 000	1 870 000 1 270 000 1 450 000 2 760 000	1 500 1 300 1 300 1 200	1 800 1 600 1 600 1 500	
220	340	56	3	3	250	310	500 000	750 000	1 800	2 200	
	400	65	4	4	—	350	760 000	1 080 000	1 500	1 800	
	400	65	4	4	270	—	760 000	1 080 000	1 500	1 800	
	400	108	4	4	270		1 140 000	1 810 000	1 300	1 600	
	460	88	5	5	—	396	1 190 000	1 570 000	1 200	1 500	
	460	88	5	5	284		1 190 000	1 570 000	1 200	1 500	



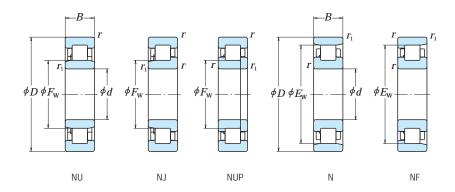
Bearing Numbers		Abutment and Fillet Dimensions (mm)									Mass (kg)
(1) NU NJ NUP N NI	d _a (2) min.	$d_{ m b}$ min.	$d_{\mathrm{b}}^{\mathrm{(3)}}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}^{(2)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$r_{ m a}$ max.	$r_{ m b}$ max.	approx.
NU1034 NU NJ — N — N 234 — — N N NU234EM NU NJ NUP — —	186	181 — 186	190 — 202	197 — 211	_ _ 223	249 — 294	249 294 —	239 278 —	2 3 3	2 3 3	7.91 17.4 18.3
NU2234EM NU NJ NUP N 334 N NU334EM NU NJ NUP NU2334EM NU NJ NUP		186 — 186 186	200 — 213 210	211 — 223 223	223 — 241 241	294 — 344 344	344 — —	316 — —	3 3 3	3 3 3	29.9 36.6 37.9 63.4
NU1036 NU NJ — N N N 236 — — N N NU236EM NU NJ NUP — —	196	191 — 196	202 — 212	209 — 221	_ 233	269 — 304	269 304 —	258 288 —	2 3 3	2 3 3	10.2 18.1 19
NU2236EM NU NJ NUP — — N 336 — — N N NU336EM NU NJ NUP — — NU2336EM NU NJ NUP — —	196 196	196 — 196 196	210 — 226 222	221 — 235 235	233 — 255 255	304 — 364 364	364 —	335 —	3 3 3 3	3 3 3	31.4 42.6 44 74.6
NU1038 NU NJ — N — N 238 — — — N N NU238EM NU NJ NUP — —	206	201 — 206	212 — 225	219 — 234	_ 247	279 — 324	279 324 —	268 305 —	2 3 3	2 3 3	10.7 22 23
NU2238EM NU NJ NUP — — N 338 — — N N NUP — N NU338EM NU NJ NUP — NU2338EM NU NJ NUP — NU2338EM NU NJ NUP — NU2338EM	210	206 — 210 210	223 — 240 235	234 — 248 248	247 — 268 268	324 — 380 380	380 —	352 —	3 4 4 4	3 4 4 4	38.3 48.7 50.6 86.2
NU1040 NU NJ — N N N 240 — — N N NU240EM NU NJ NUP — —	216	211 216	226 — 238	233 — 247	_ _ 261	299 — 344	299 344 —	284 323 —	2 3 3	2 3 3	14 26.2 27.4
NU2240EM NU NJ NUP — — N 340 — — N N NU340EM NU NJ NUP — — NU2340EM NU NJ NUP — —	220 220	216 — 220 220	235 — 252 247	247 — 263 263	261 — 283 283	344 — 400 400	400 —	367 —	3 4 4 4	3 4 4 4	46.1 55.3 57.1 99.3
NU1044 NU NJ — N — N 244 — — N N NU 244 NU NJ NUP — —	236	233 236	247 — 264	254 — 273	_ 289	327 — 384	327 384 —	313 357 —	2.5 3 3	2.5 3 3	18.2 37 37.3
NU2244 NU — — — — N 344 — — N NU 344 NU NJ — — —	210	236 — 240	264 — 278	273 — 287	289 — 307	384 — 440	440 —	403 —	3 4 4	3 4 4	61.8 72.8 74.6

Notes (1) When L-shaped thrust collars (Refer to page B105) are used, the bearings become the NH Type.

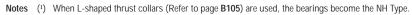
⁽²⁾ If axial loads are applied, increase d_a and reduce D_a from the values listed above.

⁽³⁾ $d_{\rm b}$ (max.) are values for adjusting rings for NU, NJ Types.

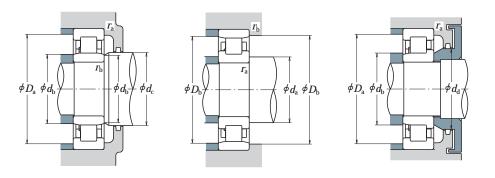
Bore Diameter 240 – 500 mm



		Bou	ndary Di (mm	mensions n)				nd Ratings N)	Limiting Speeds (min ⁻¹)		
d	D	В	$m{r}$ min.	$r_1 \ ext{min.}$	$F_{ m W}$	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
240	360 440 440	56 72 72	3 4 4	3 4 4	270 — 295	330 385 —	530 000 935 000 935 000	820 000 1 340 000 1 340 000	1 600 1 300 1 300	2 000 1 600 1 600	
	440 500 500	120 95 95	4 5 5	4 5 5	295 — 310	430	1 440 000 1 360 000 1 360 000	2 320 000 1 820 000 1 820 000	1 200 1 100 1 100	1 500 1 300 1 300	
260	400 480 480	65 80 80	4 5 5	4 5 5	296 — 320	364 420 —	645 000 1 100 000 1 100 000	1 000 000 1 580 000 1 580 000	1 500 1 200 1 200	1 800 1 500 1 500	
	480 540	130 102	5 6	5 6	320 336	_	1 710 000 1 540 000	2 770 000 2 090 000	1 100 1 000	1 300 1 200	
280	420 500 500	65 80 80	4 5 5	4 5 5	316 — 340	384 440 —	660 000 1 140 000 1 140 000	1 050 000 1 680 000 1 680 000	1 400 1 100 1 100	1 700 1 400 1 400	
300	460 540	74 85	4 5	4 5	340 364	420 —	885 000 1 400 000	1 400 000 2 070 000	1 300 1 100	1 500 1 300	
320	480 580 580	74 92 92	4 5 5	4 5 5	360 — 390	440 510 —	905 000 1 540 000 1 540 000	1 470 000 2 270 000 2 270 000	1 200 950 950	1 400 1 200 1 200	
340	520	82	5	5	385	475	1 080 000	1 740 000	1 100	1 300	
360	540	82	5	5	405	495	1 110 000	1 830 000	1 000	1 300	
380	560	82	5	5	425	_	1 140 000	1 910 000	1 000	1 200	
400	600	90	5	5	450	550	1 360 000	2 280 000	900	1 100	
420	620	90	5	5	470	570	1 390 000	2 380 000	850	1 100	
440	650	94	6	6	493	_	1 470 000	2 530 000	800	1 000	
460	680	100	6	6	516	624	1 580 000	2 740 000	750	950	
480	700	100	6	6	536	644	1 620 000	2 860 000	750	900	
500	720	100	6	6	556	664	1 660 000	2 970 000	710	850	



⁽²⁾ If axial loads are applied, increase $d_{\rm a}$ and reduce $D_{\rm a}$ from the values listed above.

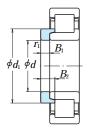


	Bearing Numbers (1)			Abutment and Fillet Dimensions (mm)									Mass (kg)
	ии уј иир	N NF	$d_{\mathrm{a}}^{(2)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(3)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(2)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$r_{\rm a}$ max.	$r_{ m b}$ max.	арргох.
NU1048 N 248 NU 248	NO NJ — NO NJ NOP	N – N N	F 256	253 — 256	266 — 289	275 — 298	_ 316	347 — 424	347 424 —	333 392 —	2.5 3 3	2.5 3 3	19.5 49.6 50.4
NU2248 N 348 NU 348	NU — — NU NJ —	 N	200	256 — 260	289 — 304	298 — 313	316 — 333	424 — 480	480 —	438	3 4 4	3 4 4	84.9 92.3 94.6
NU1052 N 252 NU 252	NO NY — NO NJ —	N N N –	- 280	276 — 280	292 — 314	300 — 323	_ _ 343	384 — 460	384 460	367 428 —	3 4 4	3 4 4	29.1 66.2 67.1
NU2252 NU 352	NU — NUP NU NJ —		280 286	280 286	314 330	323 339	343 359	460 514	_	_	4 5	4 5	111 118
NU1056 N 256 NU 256	NU NJ NUP NU NJ —	N N N N		296 — 300	312 — 334	320 — 344	_ 364	404 — 480	404 480 —	387 448 —	3 4 4	3 4 4	30.8 69.6 70.7
NU1060 NU 260	NU NJ —	N N	320	316 320	336 358	344 368	_ 391	444 520	444	424 —	3 4	3 4	43.7 89.2
NU1064 N 264 NU 264	NU — — NU NJ —	N N N –	- 340	336 — 340	356 — 384	365 — 394	_ 420	464 — 560	464 560 —	444 519 —	3 4 4	3 4 4	46.1 110 112
NU1068 NU1072	NU NJ — NU — —	N N N N		360 380	381 400	390 410	_	500 520	500 520	479 499	4	4	61.8 64.6
NU1076	NU — —			400	420	430	_	540	_	_	4	4	67.5
NU1080 NU1084	NU — NUP NU — —	N – N –	120	420 440	445 465	455 475	_	580 600	580 600	554.5 574.5	4 4	4	88.2 91.7
NU1088 NU1092	NU — — NU — NUP		- — - 486	466 486	488 511	498 521	_	624 654	— 654	— 628.5	5 5	5 5	105 123
NU1096 NU10/50	NU NJ —	N –		506 526	531 551	541 558	_	674 694	674 694	654 674	5 5	5 5	127

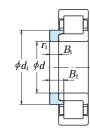
⁽³⁾ $d_{\rm b}$ (max.) are values for adjusting rings for NU, NJ Types.

L-Shaped Thrust Collars
Bore Diameter 20 – 85 mm

Bore Diameter 90 – 320 mm



L-Shaped Thrust Collar



L-Shaped Thrust Collar

	Bounda	ry Dim (mm)	ensions		Bearing	Mass (kg)
d	d_1	B_1	B_2	$r_1 \atop ext{min.}$	Numbers	арргох.
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 31.4	4	8.5 7.5	0.6	HJ 2304 HJ 2304 E	0.017 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

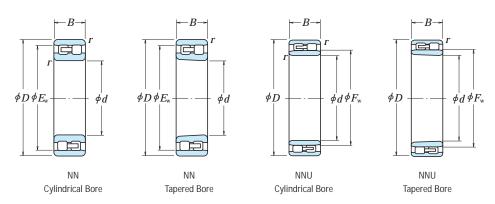
	Bounda	ıry Dim (mm)	ensions		Bearing	Mass (kg)
d	d_1	B_1	B_2	$r_{\scriptscriptstyle 1}$ min.	Numbers	approx.
55	70.9	6	9.5	1.1	HJ 211 E	0.087
	70.9	6	10	1.1	HJ 2211 E	0.088
	77.6	9	14	2	HJ 311 E	0.195
	77.6	9	15.5	2	HJ 2311 E	0.20
	85.2	10	16.5	2.1	HJ 411	0.29
60	77.7	6	10	1.5	HJ 212 E	0.108
	77.7	6	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

	Bounda	ry Dim (mm)	ensions		Bearing	Mass (kg)
d	$d_{\scriptscriptstyle 1}$	B_1	B_2	$r_{ m 1}$ min.	Numbers	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

		Bounda	ry Dime (mm)	ensions		Bearing	Mass (kg)
	d	d_1	B_1	B_2	$r_1 \ ext{min.}$	Numbers	approx.
•	150	193.7 193.7 210	12 12 15	19.5 24.5 25	3 3 4	HJ 230 E HJ 2230 E HJ 330 E	1.26 1.35 2.35
		210 234	15 20	31.5 36.5	4 5	HJ 2330 E HJ 430	2.48 4.7
	160	207.3 206.1 222 222.1	12 12 15 15	20 24.5 25 32	3 3 4 4	HJ 232 E HJ 2232 E HJ 332 E HJ 2332 E	1.48 1.55 2.59 2.76
	170	220.8 219.5 238	12 12 16	20 24 33.5	4 4 4	HJ 234 E HJ 2234 E HJ 2334 E	1.7 1.79 3.25
	180	230.8 229.5 252	12 12 17	20 24 35	4 4 4	HJ 236 E HJ 2236 E HJ 2336 E	1.79 1.88 3.85
	190	244.5 243.2 260.6	13 13 18	21.5 26.5 36.5	4 4 5	HJ 238 E HJ 2238 E HJ 2338 E	2.19 2.31 4.45
	200	258.2 258 256.9 280	14 14 14 18	23 34 28 30	4 4 4 5	HJ 240 E HJ 2240 HJ 2240 E HJ 340 E	2.65 2.6 2.78 5.0
	220	286 286 307	15 15 20	27.5 36.5 36	4 4 5	HJ 244 HJ 2244 HJ 344	3.55 3.55 7.05
	240	313 313 334	16 16 22	29.5 38.5 39.5	4 4 5	HJ 248 HJ 2248 HJ 348	4.65 4.65 8.2
	260	340 340 362	18 18 24	33 40.5 43	5 5 6	HJ 252 HJ 2252 HJ 352	6.2 6.2 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



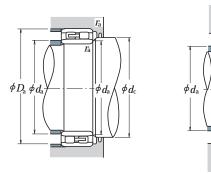
Bore Diameter 25 – 140 mm



			ry Dimensio (mm)	ons		Basic Load (N		Limiting Speeds (min ⁻¹)		
d	D	В	$m{r}$ min.	$F_{ m W}$	E_{W}	$C_{ m r}$	$C_{0\mathrm{r}}$	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	140 150	40 37	1.1 1.5	112 —	137	155 000 157 000	295 000 265 000	4 000 4 000	5 000 4 800	
105	145 160	40 41	1.1 2	117 —	146	161 000 198 000	315 000 320 000	3 800 3 800	4 800 4 500	
110	150 170	40 45	1.1 2	122 —	 155	167 000 229 000	335 000 375 000	3 600 3 400	4 500 4 300	
120	165 180	45 46	1.1 2	133.5	 165	183 000 239 000	360 000 405 000	3 200 3 200	4 000 3 800	
130	180 200	50 52	1.5 2	144	 182	274 000 284 000	545 000 475 000	3 000 3 000	3 800 3 600	
140	190 210	50 53	1.5 2	154 —	 192	283 000 298 000	585 000 515 000	2 800 2 800	3 600 3 400	



Remarks Production of double-row cylindrical roller bearings is generally in the high precision classes (Class 5 or better).



Bearing	Numbers		Ab	utment a	nd Fillet (mm)	Dimension	S		Mass (kg)
Cylindrical Bore	Tapered Bore(1)	$d_{\!\scriptscriptstyle a}$	max.	$d_{ ext{1a}} \atop ext{min.}$	$d_{ m c}$ min.	max.	a min.	$r_{ m a}$ max.	арргох.
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 NN 3020	NNU 4920 K NN 3020 K	106.5 108	111 —	108 109	115 —	133.5 142	_ 139	1 1.5	1.9 2.28
NNU 4921 NN 3021	NNU 4921 K NN 3021 K	111.5 114	116 —	113 115	120 —	138.5 151	148	1 2	1.99 2.88
NNU 4922 NN 3022	NNU 4922 K NN 3022 K	116.5 119	121 —	118 121	125 —	143.5 161	 157	1 2	2.07 3.71
NNU 4924 NN 3024	NNU 4924 K NN 3024 K	126.5 129	133 —	128 131	137 —	158.5 171	_ 167	1 2	2.85 4.04
NNU 4926 NN 3026	NNU 4926 K NN 3026 K	138 139	143 —	140 141	148 —	172 191	 185	1.5 2	3.85 5.88

151

153 150

201

158 182

4.08

6.34

195

2

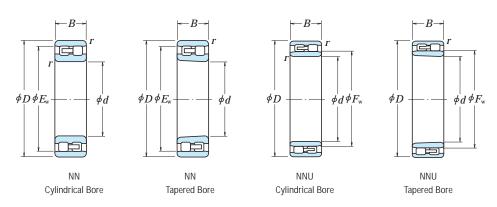
Note (2) d_a (max.) are values for adjusting rings for the NNU Type.

NNU 4928 NNU 4928 K 148

NN 3028 NN 3028 K 149

B 106 B 107

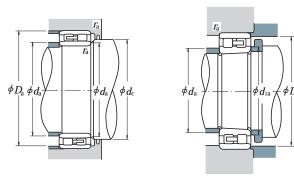
Bore Diameter 150 – 360 mm



			ry Dimensio (mm)	ons		ad Ratings N)	Limiting Speeds (min ⁻¹)		
d	D	В	$m{r}$ min.	$F_{ m W}$	$E_{ m W}$	$C_{ m r}$	$C_{ m 0r}$	Grease	Oil
150	210 225	60 56	2 2.1	167 —	 206	350 000 335 000	715 000 585 000	2 600 2 600	3 200 3 000
160	220 240	60 60	2 2.1	177 —	219	365 000 375 000	760 000 660 000	2 400 2 400	3 000 2 800
170	230 260	60 67	2 2.1	187 —	236	375 000 450 000	805 000 805 000	2 400 2 200	2 800 2 600
180	250 280	69 74	2 2.1	200 —	 255	480 000 565 000	1 020 000 995 000	2 200 2 000	2 600 2 400
190	260 290	69 75	2 2.1	211.5 —	 265	485 000 595 000	1 060 000 1 080 000	2 000 2 000	2 600 2 400
200	280 310	80 82	2.1 2.1	223	 282	570 000 655 000	1 220 000 1 170 000	1 900 1 800	2 400 2 200
220	300 340	80 90	2.1 3	243	310	600 000 815 000	1 330 000 1 480 000	1 700 1 700	2 200 2 000
240	320 360	80 92	2.1 3	263 —	330	625 000 855 000	1 450 000 1 600 000	1 600 1 500	2 000 1 800
260	360 400	100 104	2.1 4	289 —	364	935 000 1 030 000	2 100 000 1 920 000	1 400 1 400	1 800 1 700
280	380 420	100 106	2.1 4	309	384	960 000 1 080 000	2 230 000 2 080 000	1 300 1 300	1 700 1 500
300	420 460	118 118	3 4	336	418	1 230 000 1 290 000	2 870 000 2 460 000	1 200 1 200	1 500 1 400
320	440 480	118 121	3 4	356 —	438	1 260 000 1 350 000	3 050 000 2 670 000	1 100 1 100	1 400 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



Remarks 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)						
Cylindrical Bore Tapered Borel	(1) min	$d_{\mathrm{a}}^{(2)}$ max.	$d_{ ext{1a}} \atop ext{min.}$	$d_{ m c}$ min.	max.	D_{a} min.	$r_{ m a}$ max.	approx.
NNU 4930 NNU 4930 NN 3030 NN 3030		166 —	162 162	171 —	201 214	 209	2 2	6.39 7.77
NNU 4932 NNU 4932 NN 3032 NN 3032		176 —	172 172	182 —	211 229	 222	2 2	6.76 9.41
NNU 4934 NNU 4934 NN 3034 NN 3034		186 —	182 183	192 —	221 249	 239	2 2	7.12 12.8
NNU 4936 NNU 4936 NN 3036 NN 3036		199 —	193 193	205 —	241 269	 258	2 2	10.4 16.8
NNU 4938 NNU 4938 NN 3038 NN 3038		211 —	203 203	217 —	251 279	 268	2 2	10.9 17.8
NNU 4940 NNU 4940 NN 3040 NN 3040		222 —	214 214	228 —	269 299	 285	2 2	15.3 22.7
NNU 4944 NNU 4944 NN 3044 NN 3044		242	234 236	248 —	289 327	 313	2 2.5	16.6 29.6
NNU 4948 NNU 4948 NN 3048 NN 3048		262 —	254 256	269 —	309 347	334	2 2.5	18 32.7
NNU 4952 NNU 4952 NN 3052 NN 3052		288 —	275 278	295 —	349 384	 368	2 3	31.1 47.7
NNU 4956 NNU 4956 NN 3056 NN 3056		308	295 298	315 —	369 404	388	2 3	33 51.1
NNU 4960 NNU 4960 NN 3060 NN 3060		335 —	318 319	343	407 444	 422	2.5 3	51.9 70.7
NNU 4964 NNU 4964 NN 3064 NN 3064		355 —	338 340	363 —	427 464	 442	2.5 3	54.9 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.

TAPERED ROLLER BEARINGS

METRIC DESIGN TAPERED ROLLER READINGS

INCH

The DOU

angle

KIC DESIGN I	APERED RULLER	T DEAKINGS	
	Bore Diameter	15 – 100mm·····	B120
	Bore Diameter	105 – 240mm····	B128
	Bore Diameter 2	260 – 440mm····	B134
DESIGN TAPI	ERED ROLLER B	EARINGS	
	Bore Diameter	12.000 - 47.625mm	B136
	Bore Diameter	48.412 - 69.850mm·····	B150
	Bore Diameter	70.000 – 206.375mm·····	B158
ndex for inch	design tapered	roller bearings is in Appendix 14 (Page C26).	
BLE-ROW TAP	PERED ROLLER E	BEARINGS	
	Bore Diameter	40 – 260mm·····	B172

Four-Row Tapered Roller Bearings are described on pages B334 to B339.



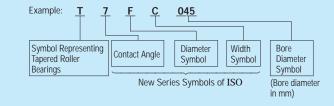
DESIGN, TYPES, AND FEATURES

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 than 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 than that for past metric design, is as follows:



B 110 B 111





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, besides shighe row bearings, various combinations of bearings.

The cages of tapered roller bearings are usually pressed steel.

Table 1 Design and Featured 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 clearances are adjusted by cone spacers or cup spacers. The cones and cups and spacers are marked with serial numbers and		
	Face-to-face	HR30210JDF+KR	mating marks. Components with the same serial number can be assembled referring to the matching symbols.		
	КВЕ Туре	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		
	КН Туре	110KH31+K	bearing clearance is adjusted using spacers, it is necessary for components to have the same serial number for assembly with reference to matching symbols.		

TOLERANCES AND RUNNING ACCURACY

METRIC DESIGN TAPERED ROLLER

BEARINGS Table 8.3 (Pages A64 to A67) INCH DESIGN TAPERED ROLLER BEARINGS Table 8.4 (Pages A68 and A69) 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 for Cones(CLASS K)

Units: µm

отте триг										
(ore Diameter d m)	Δ	<i>d</i> mp	$V_{d\mathrm{p}}$	$V_{d\mathrm{mp}}$	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 for Cups(CALSS K)

Units: µm

						<u> </u>
Nominal Diam D (r		Δ	Dmp	V_{Dp}	$V_{D{ m mp}}$	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

B 112 B 113



Table 4 Tolerances for Effective Widths of Cone Assemblies and Cups, and Overall Width (CLASS K)

Units: µm

	ore Diameter d nm)	of Cone	fidth Deviation Assembly $T_{1\mathrm{S}}$	Deviatio	e Width n of Cup T _{2s}	Overall Width Deviation Δ_{T_8}		
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 for Bore Diameter and Overall Width

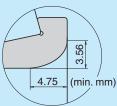
Units: µm

1	Nominal Boo	re Diameter 1		Bore Di Devia ⊿	ation	Overall Width Deviation ${\it \Delta}_{\it Ts}$	
(mm)	ver 1/25.4	(mm)	icl. 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 8.4.2 (Pages A68 and A69).

(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

METRIC DESIGN TAPERED ROLLER	
BEARINGS	·· Table 9.2 (Page A84)
	Table 9.4 (Page A85)
INCH DESIGN TAPERED ROLLER BEARINGS	· Table 9.6 (Page A86)
	Table 9.7 (Page A87)

INTERNAL CLEARANCE

METRIC DESIGN TAPERED ROLLER BEARINGS	
(Matched and Double-Row) ······	Table 9.16 (Page A93)
INCH DESIGN TAPERED ROLLER BEARINGS	
(Matched and Double-Row)	Table 9.16 (Page A93)

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

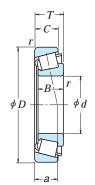
The limiting speeds listed in the bearing tables should be adjusted depending on the bearing load conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A37 for detailed information.

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 $D_{\rm a}$, $D_{\rm b}$, $S_{\rm a}$, $S_{\rm b}$ at the time of the HR series adoption.

B 114 B 115

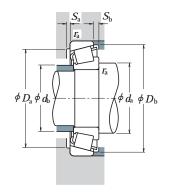
Bore Diameter 15 – 28 mm



		Bounda	ary Dimen	sions			Basic Load Ratings				Limiting Speeds		
			(mm)		Cone	Cup	1)	۷)	{k	gf}	(mii	n ⁻¹)	
d	D	T	B	C		r	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
						nin.							
15	35 42	11.75 14.25	11 13	10 11	0.6 1	0.6 1	14 800 23 600	13 200 21 100	1 510 2 400	1 350 2 160	11 000 9 500	15 000 13 000	
17	40	13.25	12	11	1	1	20 100	19 900	2 050	2 030	9 500	13 000	
	40	17.25	16	14	1	1	27 100	28 000	2 770	2 860	9 500	13 000	
	47 47	15.25 15.25	14 14	12 10.5	1 1	1 1	29 200 22 000	26 700 20 300	2 980 2 240	2 720 2 070	8 500 8 000	12 000 11 000	
	47	20.25	19	16	i	i	37 500	36 500	3 800	3 750	8 500	11 000	
20	42	15	15	12	0.6	0.6	24 600	27 400	2 510	2 800	9 000	12 000	
	47 47	15.25 15.25	14 14	12 12	1 0.3	1 1	27 900 23 900	28 500 24 000	2 850 2 430	2 900 2 450	8 000 8 000	11 000 11 000	
	47	19.25	18	15	1	1	35 500	37 500	3 650	3 850	8 500	11 000	
	47 52	19.25 16.25	18 15	15 13	1 1.5	1 1.5	31 500 35 000	33 500 33 500	3 200 3 550	3 400 3 400	8 000 7 500	11 000 10 000	
	52	16.25	15	12	1.5	1.5	25 300	24 500	2 580	2 490	7 100	10 000	
22	52	22.25	21	18	1.5	1.5	45 500	47 500	4 650	4 850	8 000	11 000	
22	44 50	15 15.25	15 14	11.5 12	0.6 1	0.6 1	25 600 29 200	29 400 30 500	2 610 2 980	3 000 3 150	8 500 7 500	11 000 10 000	
	50	15.25	14	12	1	1	27 200	29 500	2 780	3 000	7 500	10 000	
	50 50	19.25 19.25	18 18	15 15	1 1	1 1	36 500 33 500	40 500 39 500	3 750 3 400	4 100 4 000	7 500 7 500	11 000 10 000	
	56	17.25	16	14	1.5	1.5	37 000	36 500	3 750	3 750	7 100	9 500	
25	56 47	17.25 15	16 15	13 11.5	1.5 0.6	1.5 0.6	34 500 27 400	34 000 33 000	3 500 2 800	3 500 3 400	6 700 8 000	9 500 11 000	
23	47	17	17	14	0.6	0.6	31 000	38 000	3 150	3 900	8 000	11 000	
	52 52	16.25 16.25	15 15	13 12	1 1	1 1	32 000	35 000 31 500	3 300	3 550 3 200	7 100 9 700	10 000 9 500	
	52	19.25	18	16	1	1	28 100 40 000	45 000	2 860 4 050	3 200 4 600	7 100	10 000	
	52	19.25	18	15	1	1	35 000	42 000	3 550	4 250	7 100	9 500	
	52 62	22 18.25	22 17	18 15	1 1.5	1 1.5	47 500 47 500	56 500 46 000	4 850 4 850	5 750 4 700	7 500 6 300	10 000 8 500	
	62	18.25	17	14	1.5	1.5	42 000	45 000	4 300	4 550	6 000	8 500	
	62 62	18.25 18.25	17 17	13 13	1.5 1.5	1.5 1.5	38 000 38 000	40 500 40 500	3 900 3 900	4 100 4 100	5 600 5 600	8 000 8 000	
	62	25.25	24	20	1.5	1.5	62 500	66 000	6 400	6 750	6 300	8 500	
28	52 58	16 17.25	16 16	12 14	1 1	1 1	32 000 39 500	39 000 41 500	3 300 4 050	3 950 4 200	7 100 6 300	9 500 9 000	
	58	17.25	16	12	1	1	34 000	38 500	3 450	3 900	6 300	8 500	
	58	20.25	19	16	1	1	47 500	54 000	4 850	5 500	6 300	9 000	
	58 68	20.25 19.75	19 18	16 15	1 1.5	1 1.5	42 000 55 000	49 500 55 500	4 300 5 650	5 050 5 650	6 300 6 000	9 000 8 000	
	68	19.75	18	14	1.5	1.5	49 500	50 500	5 000	5 150	5 600	7 500	

Remarks 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 $P = XF_r + YF_a$

$F = A F_{r} + I F_{a}$									
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$							
X	Y	X	Y						
1	0	0.4	Y ₁						

Static Equivalent Load

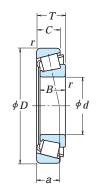
 $P_0 = 0.5F_r + Y_0 F_a$

When $F_r > 0.5 F_r + Y_0 F_a$, use $P_0 = F_r$ The values of e, Y_1 , and Y_0 are given in the table below.

	ISO355			Abutn		d Fillet I (mm)	Dimens	ions			Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone r a max	1	(mm) a	e	Y_1	Y_0	арргох.
30202 HR 30302 J HR 30203 J	_ 2FB 2DB	23 24 26	19 22 23	30 36 34	30 36 34	33 38.5 37.5	2 2 2	1.5 3 2	1	0.6 1 1	8.2 9.5 9.7	0.32 0.29 0.35	1.9 2.1 1.7	1.0 1.2 0.96	0.053 0.098 0.079
HR 32203 J HR 30303 J	2DD 2FB	26 26	22 24	34 41	34 40	37 43	2	3	1	i 1	11.2 10.4	0.31 0.29	1.9 2.1	1.1	0.103 0.134
30303 D HR 32303 J	2FD	29 28	23 23	41 41	34 39	44 43	2	4.5	1	1	15.4 12.5	0.81	0.74 2.1	0.41	0.129 0.178
HR 32004 XJ HR 30204 J HR 30204 C-A-	3CC 2DB —	28 29 29	24 27 26	37 41 41	35 40 37	40 44 44	3 2 2	3 3 3	1	0.6 1 1	10.6 11.0 13.0	0.37 0.35 0.55	1.6 1.7 1.1	0.88 0.96 0.60	0.097 0.127 0.126
HR 32204 J HR 32204 CJ HR 30304 J	2DD 5DD 2FB	29 29 31	25 25 27	41 41 44	38 36 44	44.5 44 47.5	3 2 2	4 4 3	1	1 1 1.5	12.6 14.5 11.6	0.33 0.52 0.30	1.8 1.2 2.0	1.0 0.64 1.1	0.161 0.166 0.172
30304 D HR 32304 J	2FD	34 33	26 26	43 43	37 42	49 48	2	4	1.5	1.5 1.5	16.7 13.9	0.81	0.74	0.41	0.168
HR 320/22 XJ HR 302/22 HR 302/22 C	3CC	30 31 31	27 29 29	39 44 44	37 42 40	42 47 47	3 2 2	3.5 3 3	1	0.6 1 1	11.1 11.6 13.0	0.40 0.37 0.49	1.5 1.6 1.2	0.83 0.90 0.67	0.103 0.139 0.144
HR 322/22 HR 322/22 C HR 303/22 HR 303/22 C	_ _ _	31 31 33 33	28 29 30 30	44 44 47 47	41 39 46 44	47 48 50 52.5	2 2 2 3	4 4 3 4	1 1.5	1 1 1.5 1.5	13.5 15.2 12.4 15.9	0.37 0.51 0.32 0.59	1.6 1.2 1.9 1.0	0.89 0.65 1.0 0.56	0.18 0.185 0.208 0.207
HR 32005 XJ HR 33005 J HR 30205 J	4CC 2CE 3CC	33 33 34	30 29 31	42 42 46	40 41 44	45 44 48.5	3 2	3.5 3 3	0.6 1	0.6 0.6 1	11.8 11.0 12.7	0.43 0.29 0.37	1.4 2.1 1.6	0.77 1.1 0.88	0.116 0.131 0.157
HR 30205 C HR 32205 J HR 32205 C	2CD	34 34 34	32 30 30	46 46 46	43 44 40	49.5 50 50	2 2 2	4 3 4	1	1 1 1	14.4 13.5 15.8	0.53 0.36 0.53	1.1 1.7 1.1	0.62 0.92 0.62	0.155 0.189 0.19
HR 33205 J HR 30305 J HR 30305 C	2DE 2FB —	34 36 36	29 34 35	46 54 53	43 54 49	49.5 57 58.5	4 2 3	4 3 4	1.5 1.5	1 1.5 1.5	14.1 13.2 16.4	0.35 0.30 0.55	1.7 2.0 1.1	0.94 1.1 0.60	0.221 0.27 0.276
HR 30305 DJ HR 31305 J HR 32305 J	(7FB) 7FB 2FD	39 39 38	34 33 32	53 53 53	47 47 51	59 59 57	2 3 3	5 5 5	1.5	1.5 1.5 1.5	19.9 19.9 15.6	0.83 0.83 0.30	0.73 0.73 2.0	0.40 0.40 1.1	0.265 0.265 0.376
HR 320/28 XJ HR 302/28 HR 302/28 C	4CC — —	37 37 37	33 34 34	46 52 52	44 50 48	50 55 54	3 2 2	4 3 5	1	1 1 1	12.8 13.2 16.9	0.43 0.35 0.64	1.4 1.7 0.94	0.77 0.93 0.52	0.146 0.203 0.198
HR 322/28 HR 322/28 CJ HR 303/28	 5DD 	37 37 39	34 33 37	52 52 59	49 45 58	55 55 61	2 2 2	4 4 4.5	1 1.5	1 1 1.5	14.6 16.8 14.5	0.37 0.56 0.31	1.6 1.1 1.9	0.89 0.59 1.1	0.243 0.251 0.341
HR 303/28 C	_	39	38	59	57	63	3	5.5		1.5	17.4	0.52	1.2	0.64	0.335

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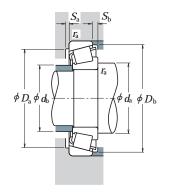
Bore Diameter 30 – 35 mm



		Bound	ary Dimen	sions				Basic Load	0		Limiting	
			(mm)		Cone	Cup		(N)	{kg	gf}	(mii	,
d	D	T	В	С		r nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
30	47	12	12	9	0.3	0.3	17 600	24 400	1 800	2 490	7 500	10 000
	55	17	17	13	1	1	36 000	44 500	3 700	4 550	6 700	9 000
	55	20	20	16	1	1	42 000	54 000	4 250	5 500	6 700	9 000
	62	17.25	16	14	1	1	43 000	47 500	4 400	4 850	6 000	8 000
	62	17.25	16	12	1	1	35 500	37 000	3 650	3 800	5 600	7 500
	62	21.25	20	17	1	1	52 000	60 000	5 300	6 150	6 000	8 500
	62	21.25	20	16	1	1	48 000	56 000	4 900	5 750	6 000	8 000
	62	25	25	19.5	1	1	66 500	79 500	6 800	8 100	6 000	8 000
	72	20.75	19	16	1.5	1.5	59 500	60 000	6 050	6 100	5 300	7 500
	72	20.75	19	14	1.5	1.5	56 500	55 500	5 800	5 650	5 300	7 100
	72	20.75	19	14	1.5	1.5	49 000	52 500	5 000	5 350	4 800	6 700
	72	20.75	19	14	1.5	1.5	49 000	52 500	5 000	5 350	4 800	6 800
	72	28.75	27	23	1.5	1.5	80 000	88 500	8 150	9 000	5 600	7 500
	72	28.75	27	23	1.5	1.5	76 000	86 500	7 750	8 800	5 600	7 500
32	58 58 65 65	17 21 18.25 18.25	17 20 17 17	13 16 15 14	1 1 1 1	1 1 1	37 500 41 000 48 500 45 500	47 000 50 000 54 000 52 500	3 800 4 150 4 950 4 650	4 800 5 100 5 500 5 350	6 300 6 300 5 600 5 600	8 500 8 500 8 000 7 500
	65	22.25	21	18	1	1	56 000	65 000	5 700	6 650	6 000	8 000
	65	22.25	21	17	1	1	49 500	60 000	5 050	6 100	5 600	7 500
	65	26	26	20.5	1	1	70 000	86 500	7 150	8 850	5 600	8 000
	75	21.75	20	17	1.5	1.5	56 000	56 000	5 700	5 700	5 300	7 100
35	55	14	14	11.5	0.6	0.6	27 400	39 000	2 790	3 950	6 300	8 500
	62	18	18	14	1	1	43 500	55 500	4 400	5 650	5 600	8 000
	62	21	21	17	1	1	49 000	65 000	4 950	6 650	5 600	8 000
	72	18.25	17	15	1.5	1.5	54 000	59 500	5 500	6 050	5 300	7 100
	72	18.25	17	13	1.5	1.5	47 000	54 500	4 750	5 550	5 000	6 700
	72	24.25	23	19	1.5	1.5	70 500	83 500	7 150	8 550	5 300	7 100
	72	24.25	23	18	1.5	1.5	60 500	71 500	6 200	7 300	5 000	7 100
	72	28	28	22	1.5	1.5	86 500	108 000	8 850	11 100	5 300	7 100
	80	22.75	21	18	2	1.5	76 000	79 000	7 750	8 050	4 800	6 700
	80	22.75	21	16	2	1.5	68 000	70 500	6 900	7 200	4 800	6 300
	80	22.75	21	15	2	1.5	62 000	68 000	6 350	6 950	4 300	6 000
	80	22.75	21	15	2	1.5	62 000	68 000	6 350	6 950	4 300	6 000
	80	32.75	31	25	2	1.5	99 000	111 000	10 100	11 300	5 000	6 700

Remarks 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

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

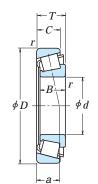
 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\rm r}\!>\!0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of $\emph{e},~Y_1$, and Y_0 are

given in the table below.

Davidson Namehouse	ISO355			Abutm	nent an	d Fillet [(mm)	Dimens	ions		0	Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	$_{ m max.}$ I	O _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.		$r_{ m a}$	(mm) a	e	<i>Y</i> 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 HR 31306 J HR 32306 J HR 32306 CJ	(7FB) 7FB 2FD 5FD	44 44 43 43	40 40 38 36	63 63 63	55 55 59 54	68 68 66 68	3 3 3	6.5 6.5 5.5 5.5	1.5 1.5 1.5 1.5	1.5 1.5 1.5 1.5	23.1 23.1 18.0 22.0	0.83 0.83 0.32 0.55	0.73 0.73 1.9 1.1	0.40 0.40 1.1 0.60	0.393 0.393 0.57 0.583
HR 320/32 XJ 330/32 HR 302/32 HR 302/32 C	4CC — —	41 41 41 41	37 37 39 39	52 52 59 59	49 50 56 54	55 55 61 62	3 2 3 3	4 4 3 4	1 1 1 1	1 1 1	14.2 13.8 14.7 16.9	0.45 0.31 0.37 0.55	1.3 1.9 1.6 1.1	0.73 1.1 0.88 0.60	0.191 0.225 0.277 0.273
HR 322/32 HR 322/32 C HR 332/32 J 303/32	_ 2DE _	41 41 41 44	38 39 38 42	59 59 59 66	54 51 55 64	61 62 62 68	3 3 5 3	4 5 5.5 4.5	1 1 1 1.5	1 1 1 1.5	15.9 20.2 17.0 15.9	0.37 0.59 0.35 0.33	1.6 1.0 1.7 1.8	0.88 0.56 0.95 1.0	0.336 0.335 0.40 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 HR 30307 DJ HR 31307 J HR 32307 J	TFB 7FB 2FE	47 51 51 49	44 44 44 43	71 71 71 71	65 62 62 66	74 77 77 74	3 3 3	6.5 7.5 7.5 7.5	2 2 2 2	1.5 1.5 1.5 1.5	20.3 25.2 25.2 20.7	0.55 0.83 0.83 0.32	1.1 0.73 0.73 1.9	0.60 0.40 0.40 1.1	0.518 0.519 0.52 0.765

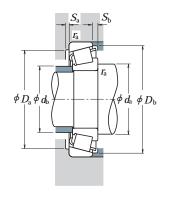
Bore Diameter 40 – 50 mm



	Boundary Dimensions (mm) Cone							Basic Load	0		Limiting	•
_	(mm) Co					Cup		N)	{kg	-	(min	,
d	D	T	В	С		$oldsymbol{r}$ nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
40	62	15	15	12	0.6	0.6	34 000	47 000	3 450	4 800	5 600	7 500
	68	19	19	14.5	1	1	53 000	71 000	5 400	7 250	5 300	7 100
	68	22	22	18	1	1	59 000	81 500	6 000	8 300	5 300	7 100
	75	26	26	20.5	1.5	1.5	78 500	101 000	8 000	10 300	4 800	6 700
	80	19.75	18	16	1.5	1.5	63 500	70 000	6 450	7 150	4 800	6 300
	80	24.75	23	19	1.5	1.5	77 000	90 500	7 900	9 200	4 800	6 300
	80	24.75	23	19	1.5	1.5	74 000	90 500	7 550	9 200	4 500	6 300
	80	32	32	25	1.5	1.5	107 000	137 000	10 900	14 000	4 800	6 300
	90	25.25	23	20	2	1.5	90 500	101 000	9 250	10 300	4 300	5 600
	90	25.25	23	18	2	1.5	84 500	93 500	8 600	9 500	4 300	5 600
	90	25.25	23	17	2	1.5	80 000	89 500	8 150	9 150	3 800	5 300
	90	25.25	23	17	2	1.5	80 000	89 500	8 150	9 150	3 800	5 300
	90	35.25	33	27	2	1.5	120 000	145 000	12 200	14 800	4 300	6 000
45	68	15	15	12	0.6	0.6	34 500	50 500	3 550	5 150	5 000	6 700
	75	20	20	15.5	1	1	60 000	83 000	6 150	8 450	4 500	6 300
	75	24	24	19	1	1	69 000	99 000	7 050	10 100	4 800	6 300
	80	26	26	20.5	1.5	1.5	84 000	113 000	8 550	11 600	4 500	6 000
	85	20.75	19	16	1.5	1.5	68 500	79 500	6 950	8 100	4 300	6 000
	85	24.75	23	19	1.5	1.5	83 000	102 000	8 500	10 400	4 300	6 000
	85	24.75	23	19	1.5	1.5	75 500	95 500	7 700	9 750	4 300	5 600
	85	32	32	25	1.5	1.5	111 000	147 000	11 300	15 000	4 300	6 000
	95	29	26.5	20	2.5	2.5	88 500	109 000	9 050	11 100	3 600	5 000
	95	36	35	30	2.5	2.5	139 000	174 000	14 200	17 800	4 000	5 300
	100	27.25	25	22	2	1.5	112 000	127 000	11 400	12 900	3 800	5 300
	100	27.25	25	18	2	1.5	95 500	109 000	9 750	11 100	3 400	4 800
	100 100	27.25 38.25	25 36	18 30	2	1.5 1.5	95 500 144 000	109 000 177 000	9 750 14 700	11 100 18 000	3 400 3 800	4 800 5 300
50	100	36	35	30	2.5	2.5	144 000	185 000	14 600	18 800	3 800	5 000
	72	15	15	12	0.6	0.6	36 000	54 000	3 650	5 500	4 500	6 300
	80	20	20	15.5	1	1	61 000	87 000	6 250	8 900	4 300	6 000
	80	24	24	19	1	1	70 500	104 000	7 150	10 600	4 300	6 000
	85	26	26	20	1.5	1.5	89 000	126 000	9 100	12 800	4 300	5 600
	90	21.75	20	17	1.5	1.5	76 000	91 500	7 750	9 300	4 000	5 300
	90	24.75	23	19	1.5	1.5	87 500	109 000	8 900	11 100	4 000	5 300
	90	24.75	23	18	1.5	1.5	77 500	102 000	7 900	10 400	3 800	5 300
	90	32	32	24.5	1.5	1.5	118 000	165 000	12 100	16 800	4 000	5 300
	105	32	29	22	3	3	109 000	133 000	11 100	13 600	3 200	4 500
	110	29.25	27	23	2.5	2	130 000	148 000	13 300	15 100	3 400	4 800
	110	29.25	27	19	2.5	2	114 000	132 000	11 700	13 400	3 200	4 300
	110	29.25	27	19	2.5	2	114 000	132 000	11 700	13 400	3 200	4 300
	110	42.25	40	33	2.5	2	176 000	220 000	17 900	22 400	3 600	4 800
	110	42.25	40	33	2.5	2	164 000	218 000	16 800	22 200	3 400	4 800

Remarks 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 + VF

P = X	$F_{\rm r} + Y F_{\rm a}$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

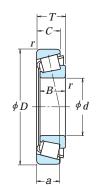
Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}>0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are given in the table below.

	ISO355			Abutn	nent an	d Fillet I (mm)	Dimens	sions			Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	i	$r_{ m a}$	(mm) a	e	Y_1	Y_0	арргох.
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 HR 30308 DJ HR 31308 J HR 32308 J	— 7FB 7FB 2FD	52 56 56 54	50 50 50 50	81 81 81 81	72 70 70 73	84 87 87 82	3 3 3	7 8 8 8	2 2 2 2	1.5 1.5 1.5 1.5	22.8 28.7 28.7 23.4	0.53 0.83 0.83 0.35	1.1 0.73 0.73 1.7	0.62 0.40 0.40 0.96	0.735 0.728 0.728 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
T 7 FC045	7FC	60	53	83	71	91	3	9	2	2	32.1	0.87	0.69	0.38	0.918
T 2 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 HR 32309 J	7FB 2FD	61 59	57 56	91 91	79 82	96 93	3	9 8	2	1.5 1.5	31.5 25.0	0.83 0.35	0.73 1.7	0.40 0.96	0.947 1.42
T 2 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
T 7 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

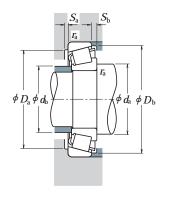
Bore Diameter 55 – 65 mm



		Bounda	ary Dimens	ions	Cone Cup			Basic Load	0		Limiting	
	(mm)			Cone	Cup	1)	1)	{kṛ	gf}	(min	ı ⁻¹)	
d	D	T	В	С		$oldsymbol{r}$ nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
55	80	17	17	14	1	1	45 500	74 500	4 600	7 600	4 300	5 600
	90	23	23	17.5	1.5	1.5	81 500	117 000	8 300	11 900	3 800	5 300
	90	27	27	21	1.5	1.5	91 500	138 000	9 300	14 000	3 800	5 300
	95	30	30	23	1.5	1.5	112 000	158 000	11 500	16 100	3 800	5 000
	100	22.75	21	18	2	1.5	94 500	113 000	9 650	11 500	3 600	5 000
	100	26.75	25	21	2	1.5	110 000	137 000	11 200	14 000	3 600	5 000
	100	35	35	27	2	1.5	141 000	193 000	14 400	19 700	3 600	5 000
	115	34	31	23.5	3	3	126 000	164 000	12 800	16 700	3 000	4 300
	120	31.5	29	25	2.5	2	150 000	171 000	15 200	17 500	3 200	4 300
	120	31.5	29	21	2.5	2	131 000	153 000	13 400	15 600	2 800	4 000
	120	31.5	29	21	2.5	2	131 000	153 000	13 400	15 600	2 800	4 000
	120	45.5	43	35	2.5	2	204 000	258 000	20 800	26 300	3 200	4 300
	120	45.5	43	35	2.5	2	195 000	262 000	19 900	26 700	3 200	4 300
60	85	17	17	14	1	1	49 000	84 500	5 000	8 650	3 800	5 300
	95	23	23	17.5	1.5	1.5	85 500	127 000	8 700	12 900	3 600	5 000
	95	27	27	21	1.5	1.5	96 000	150 000	9 800	15 300	3 600	5 000
	100	30	30	23	1.5	1.5	115 000	166 000	11 700	16 900	3 400	4 800
	110	23.75	22	19	2	1.5	104 000	123 000	10 600	12 500	3 400	4 500
	110	29.75	28	24	2	1.5	131 000	167 000	13 400	17 000	3 400	4 500
	110	38	38	29	2	1.5	166 000	231 000	16 900	23 600	3 400	4 500
	125	37	33.5	26	3	3	151 000	197 000	15 400	20 100	2 800	3 800
	130	33.5	31	26	3	2.5	174 000	201 000	17 700	20 500	3 000	4 000
	130	33.5	31	22	3	2.5	151 000	177 000	15 400	18 100	2 600	3 800
	130	33.5	31	22	3	2.5	151 000	177 000	15 400	18 100	2 600	3 800
	130	48.5	46	37	3	2.5	233 000	295 000	23 700	30 000	3 000	4 000
	130	48.5	46	35	3	2.5	196 000	249 000	20 000	25 400	2 800	3 800
65	90	17	17	14	1	1	49 000	86 500	5 000	8 800	3 600	5 000
	100	23	23	17.5	1.5	1.5	86 500	132 000	8 800	13 500	3 400	4 500
	100	27	27	21	1.5	1.5	97 500	156 000	9 950	15 900	3 400	4 500
	110	34	34	26.5	1.5	1.5	148 000	218 000	15 100	22 200	3 200	4 300
	120	24.75	23	20	2	1.5	122 000	151 000	12 500	15 400	3 000	4 000
	120	32.75	31	27	2	1.5	157 000	202 000	16 000	20 600	3 000	4 000
	120	41	41	32	2	1.5	202 000	282 000	20 600	28 800	3 000	4 000
	140	36	33	28	3	2.5	200 000	233 000	20 400	23 800	2 600	3 600
	140	36	33	23	3	2.5	173 000	205 000	17 700	20 900	2 400	3 400
De	140 140	36 51	33 48	23 39	3	2.5 2.5	173 000 267 000	205 000 340 000	17 700 27 300	20 900 35 000	2 400 2 800	3 400 3 800

Remarks 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 + VF

P = X	$F_{\rm r} + Y F_{\rm a}$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	7×
X	Y	X	

0

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

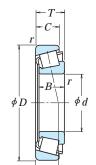
When $F_{\rm r}\!>\!0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of $\emph{e},~Y_1$, and Y_0 are

0.4

given in the table below.

	ISO355			Abutr	nent ar	nd Fillet (mm)	Dimens	sions			Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	1	$r_{ m a}$	(mm) a	e	Y_1	Y_0	арргох.
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
T 7 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
T 7 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 HR 32313 J	7GB 2GD	89 86	80 80	128 128	111 116	133 130	4	13 12	2.5 2.5	2	43.2 34.0	0.83 0.35	0.73 1.7	0.40 0.96	2.43 3.6

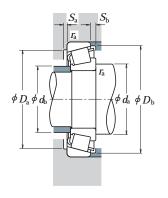
Bore Diameter 70 – 80 mm



	Boundary Dimensions (mm) Cone							Basic Load	0		Limiting	
,		<i>m</i>	,	<i>a</i>		Cup	(1)	•	{kg		(min	,
d	D	T	В	C		r nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
70	100	20	20	16	1	1	70 000	113 000	7 150	11 500	3 200	4 500
	110	25	25	19	1.5	1.5	104 000	158 000	10 600	16 100	3 200	4 300
	110	31	31	25.5	1.5	1.5	127 000	204 000	12 900	20 800	3 000	4 300
	120	37	37	29	2	1.5	177 000	262 000	18 100	26 700	3 000	4 000
	125	26.25	24	21	2	1.5	132 000	163 000	13 500	16 700	2 800	4 000
	125	33.25	31	27	2	1.5	157 000	205 000	16 100	20 900	2 800	4 000
	125	41	41	32	2	1.5	209 000	299 000	21 300	30 500	2 800	4 000
	140	39	35.5	27	3	3	177 000	229 000	18 000	23 400	2 400	3 400
	150	38	35	30	3	2.5	227 000	268 000	23 200	27 400	2 400	3 400
	150	38	35	25	3	2.5	192 000	229 000	19 600	23 300	2 200	3 200
	150	38	35	25	3	2.5	192 000	229 000	19 600	23 300	2 200	3 200
	150	54	51	42	3	2.5	300 000	390 000	30 500	39 500	2 600	3 400
	150	54	51	42	3	2.5	280 000	390 000	28 600	39 500	2 400	3 400
75	105	20	20	16	1	1	72 500	120 000	7 400	12 300	3 200	4 300
	115	25	25	19	1.5	1.5	109 000	171 000	11 100	17 400	3 000	4 000
	115	31	31	25.5	1.5	1.5	133 000	220 000	13 500	22 500	3 000	4 000
	125	37	37	29	2	2	182 000	275 000	18 600	28 100	2 800	3 800
	130	27.25	25	22	2	1.5	143 000	182 000	14 600	18 500	2 800	3 800
	130	33.25	31	27	2	1.5	165 000	219 000	16 900	22 400	2 800	3 800
	130	41	41	31	2	1.5	215 000	315 000	21 900	32 000	2 800	3 800
	160	40	37	31	3	2.5	253 000	300 000	25 800	30 500	2 400	3 200
	160	40	37	26	3	2.5	211 000	251 000	21 500	25 600	2 200	3 000
	160	40	37	26	3	2.5	211 000	251 000	21 500	25 600	2 200	3 000
	160	58	55	45	3	2.5	340 000	445 000	35 000	45 500	2 400	3 200
	160	58	55	43	3	2.5	310 000	420 000	32 000	43 000	2 200	3 200
80	110	20	20	16	1	1	75 000	128 000	7 650	13 100	3 000	4 000
	125	29	29	22	1.5	1.5	140 000	222 000	14 300	22 700	2 800	3 600
	125	36	36	29.5	1.5	1.5	172 000	282 000	17 500	28 800	2 800	3 600
	130	37	37	29	2	1.5	186 000	289 000	19 000	29 400	2 600	3 600
	140	28.25	26	22	2.5	2	157 000	195 000	16 000	19 900	2 600	3 400
	140	28.25	26	20	2.5	2	147 000	190 000	15 000	19 400	2 400	3 400
	140	35.25	33	28	2.5	2	192 000	254 000	19 600	25 900	2 600	3 400
	140	46	46	35	2.5	2	256 000	385 000	26 200	39 000	2 600	3 400
	170	42.5	39	33	3	2.5	276 000	330 000	28 200	33 500	2 200	3 000
	170	42.5	39	27	3	2.5	235 000	283 000	24 000	28 900	2 000	2 800
	170	42.5	39	27	3	2.5	235 000	283 000	24 000	28 900	2 000	2 800
	170	61.5	58	48	3	2.5	385 000	505 000	39 000	51 500	2 200	3 000
	170	61.5	58	48	3	2.5	365 000	530 000	37 500	54 000	2 200	3 000

Remarks 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

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

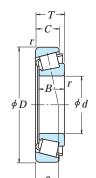
When $F_{\rm r}\!>\!0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of $\emph{e},~Y_1$, and Y_0 are

given in the table below.

Danis Number	ISO355			Abutr	nent ar	nd Fillet (mm)	Dimens	ions	0	0	Eff. Load Centers	Constant	Axial Fact		Mass (kg)
Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.		$r_{ m a}$	(mm) a	e	Y_1	Y_0	арргох.
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
T 7 FC070	7FC	88	79	126	106	133	5	12	2.5	2.5	46.4	0.87	0.69	0.38	2.55
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

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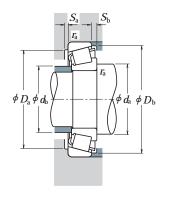
Bore Diameter 85 – 100 mm



		Bound	lary Dimens	ions				Basic Load	3		Limiting	•
			(mm)		Cone	Cup	(1)	•	{kṛ	-	(min	,
d	D	T	B	C	n	r nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
85	120	23	23	18	1.5	1.5	93 500	157 000	9 550	16 000	2 800	3 800
	130 130	29 36	29 36	22 29.5	1.5 1.5	1.5 1.5	143 000	231 000	14 600	23 600	2 600	3 600
	140	41	41	32	2.5		180 000 230 000	305 000 365 000	18 400 23 500	31 000 37 000	2 600 2 400	3 600 3 400
	150 150	30.5 30.5	28 28	24 22	2.5 2.5	2 2 2	184 000 171 000	233 000 226 000	18 700 17 500	23 800 23 000	2 400 2 200	3 200 3 200
	150	38.5	36	30	2.5		210 000	277 000	21 400	28 200	2 200	3 200
	150 180	49 44.5	49 41	37 34	2.5 4	2 2 3	281 000 310 000	415 000 375 000	28 700 31 500	42 500 38 000	2 400 2 000	3 200 2 800
	180 180	44.5	41	28	4	3	261 000	315 000	26 600	32 000	1 900	2 600
	180	63.5	44.5 41 28			3	261 000 410 000	315 000 535 000	26 600 42 000	32 000 54 500	1 900 2 000	2 600 2 800
90	125 140	23	23		1.5	1.5 1.5	97 000 170 000	167 000 273 000	9 850 17 300	17 000 27 800	2 600 2 400	3 600 3 200
	140	39	39	32.5	2	1.5	220 000	360 000	22 400	37 000	2 400	3 200
	150 160	45 32.5	45 30	35 26	2.5 2.5	2	259 000 201 000	405 000 256 000	26 500 20 500	41 500 26 100	2 400 2 200	3 200 3 000
	160	42.5	40	34	2.5	2 2	256 000	350 000	26 100	35 500	2 200	3 000
	190 190	46.5 46.5	43 43	36 30	4	3 3 3	345 000 264 000	425 000 315 000	35 500 26 900	43 000 32 000	1 900 1 800	2 600 2 400
	190 190	46.5 67.5	43 64	30 53	4 4	3	264 000 450 000	315 000 590 000	26 900 46 000	32 000 60 500	1 800 2 000	2 400 2 600
95	130	23	23	18	1.5	1.5	98 000	172 000	10 000	17 500	2 400	3 400
	145 145	32 39	32 39	24 32.5	2	1.5 1.5	173 000 231 000	283 000 390 000	17 600 23 500	28 900 39 500	2 400 2 400	3 200 3 200
	160 170	46 34.5	46 32	38 27	3	3 2.5	283 000 223 000	445 000 286 000	28 800 22 800	45 500 29 200	2 200 2 200	3 000 2 800
	170	45.5	43	37	3	2.5	289 000	400 000	29 500	40 500	2 200	2 800
	200 200	49.5 49.5	45 45	38 36	4	3	370 000 350 000	455 000 435 000	38 000 35 500	46 500 44 000	1 900 1 800	2 600 2 400
	200	49.5	45	32	4	3	310 000	375 000	31 500	38 500	1 700	2 400
	200 200	49.5 71.5	45 67	32 55	4 4	3	310 000 525 000	375 000 710 000	31 500 53 500	38 500 72 500	1 700 1 900	2 400 2 600
100	140 145	25 24	25 22.5	20 17.5	1.5 3	1.5 3	117 000 113 000	205 000 163 000	12 000 11 500	20 900 16 600	2 200 2 200	3 200 3 000
	150	32	32	24	2	1.5	176 000	294 000	17 900	30 000	2 200	3 000
	150 165	39 52	39 52	32.5 40	2 2.5	1.5 2	235 000 315 000	405 000 515 000	24 000 32 500	41 500 52 500	2 200 2 000	3 000 2 800
	180	37	34	29	3	2.5	255 000	330 000	26 000	34 000	2 000	2 600
	180 180	49 63	46 63	39 48	3	2.5 2.5	325 000 410 000	450 000 635 000	33 000 42 000	46 000 65 000	2 000 2 000	2 600 2 600
	215 215	51.5 56.5	47 51	39 35	4 4	3	425 000 385 000	525 000 505 000	43 000 39 000	53 500 51 500	1 700 1 500	2 400 2 200
	215	77.5	73	60	4	3	565 000	755 000	57 500	77 000	1 700	2 400

Remarks 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

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$F_{ m r} > e$
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

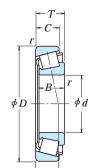
 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}\!>\!0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of $\emph{e},~Y_1$, and Y_0 are

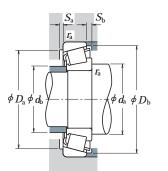
given in the table below.

Dooring Number	ISO355			Abutr	nent ar	nd Fillet (mm)	Dimens	sions	0 0		Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	d _a min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone Cu $r_{\rm a}$ max.	Jb	(mm) <i>a</i>	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.		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.		26.5	0.29	2.1	1.1	1.75
HR 33117 J HR 30217 J 30217 CA	3DE 3EB	100 100 100	94 97 98	130 140 140	122 133 131	135 141 142	7 5 5	9 6.5 8.5	2 2 2 2 2 2		32.7 30.3 36.2	0.41 0.42 0.58	1.5 1.4 1.0	0.81 0.79 0.57	2.51 2.12 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.		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.		55.4	0.83	0.73	0.40	4.88
HR 32317 J	2GD	110	104	166	151	167	5	14.5	3 2.		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.		29.7	0.42	1.4	0.78	1.78
HR 33018 J	2CE	102	99	131	129	135	7	6.5	2 1.		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 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.		58.7	0.83	0.73	0.40	5.52
HR 31318 J	7GB	118	110	176	152	179	6	16.5	3 2.		58.7	0.83	0.73	0.40	5.52
HR 32318 J	2GD	115	109	176	158	177	5	14.5	3 2.		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.		31.2	0.44	1.4	0.75	1.88
HR 33019 J	2CE	107	103	136	133	139	7	6.5	2 1.		28.6	0.28	2.2	1.2	2.3
T 2 ED095	2ED	113	108	146	141	152	6	8	2.5 2.		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 5	38.6	0.35	1.7	0.96	6.92
30319 CA	—	116	119	186	168	188	5	13.5	3 2.		48.6	0.54	1.1	0.61	6.71
HR 30319 DJ	7GB	123	115	186	158	187	6	17.5	3 2.		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 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.		48.6	0.35	1.7	0.96	10.4
HR 32920 J	2CC	111	109	132	132	134	5	5	1.5 1.		24.2	0.33	1.8	1.0	1.18
T 4 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.		32.5	0.46	1.3	0.72	1.95
HR 33020 J	2CE	112	107	141	137	143	7	6.5	2 1.		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.		41.4	0.35	1.7	0.96	8.41
HR 31320 J	7GB	136	125	201	169	202	7	21.5	3 2.		67.7	0.83	0.73	0.40	9.02
HR 32320 J	2GD	125	125	201	178	202	5	17.5	3 2.		53.2	0.83	1.7	0.40	12.7

Bore Diameter 105 – 130 mm



		Bound	ary Dimen	sions				Basic Load I	5		Limiting	•
,	_	_	(mm)	_	Cone	Cup	,	N)	{kg		(mir	,
d	D	T	В	С	n	r nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
105	145	25	25	20	1.5	1.5	119 000	212 000	12 100	21 600	2 200	3 000
	160	35	35	26	2.5	2	204 000	340 000	20 800	34 500	2 000	2 800
	160	43	43	34	2.5	2	256 000	435 000	26 100	44 000	2 000	2 800
	190	39	36	30	3	2.5	280 000	365 000	28 500	37 500	1 900	2 600
	190	53	50	43	3	2.5	360 000	510 000	37 000	52 000	1 900	2 600
	225	53.5	49	41	4	3	455 000	565 000	46 500	57 500	1 600	2 200
	225	58	53	36	4	3	415 000	540 000	42 000	55 000	1 500	2 000
	225	81.5	77	63	4	3	670 000	925 000	68 000	94 500	1 700	2 200
110	150 170 170	25 38 47	25 38 47	20 29 37			123 000 236 000 294 000	224 000 390 000 515 000	12 500 24 000 30 000	22 800 40 000 52 500	2 200 2 000 2 000	2 800 2 600 2 600
	180	56	56	43	2.5	2	365 000	610 000	37 500	62 000	1 900	2 600
	200	41	38	32	3	2.5	315 000	420 000	32 000	43 000	1 800	2 400
	200	56	53	46	3	2.5	400 000	565 000	40 500	57 500	1 800	2 400
	240	54.5	50	42	4	3	485 000	595 000	49 500	60 500	1 500	2 000
	240	63	57	38	4	3	470 000	605 000	48 000	62 000	1 400	1 900
	240	84.5	80	65	4	3	675 000	910 000	68 500	93 000	1 500	2 000
120	165	29	29	23	1.5	1.5	161 000	291 000	16 400	29 700	1 900	2 600
	170	27	25	19.5	3	3	153 000	243 000	51 600	24 800	1 800	2 600
	180	38	38	29	2.5	2	242 000	405 000	24 600	41 000	1 800	2 400
	180	48	48	38	2.5	2	300 000	540 000	30 500	55 000	1 800	2 600
	200	62	62	48	2.5	2	460 000	755 000	46 500	77 000	1 700	2 400
	215	43.5	40	34	3	2.5	335 000	450 000	34 000	46 000	1 600	2 200
	215	61.5	58	50	3	2.5	440 000	635 000	44 500	65 000	1 600	2 200
	260	59.5	55	46	4	3	535 000	655 000	54 500	67 000	1 400	1 900
	260	68	62	42	4	3	560 000	730 000	57 000	74 500	1 300	1 800
	260	90.5	86	69	4	3	770 000	1 060 000	78 500	108 000	1 400	1 900
130	180	32	30	26	2	1.5	167 000	281 000	17 000	28 600	1 800	2 400
	180	32	32	25	2	1.5	200 000	365 000	20 400	37 500	1 800	2 400
	185	29	27	21	3	3	183 000	296 000	18 600	30 000	1 700	2 400
	200	45	45	34	2.5	2	320 000	535 000	32 500	54 500	1 600	2 200
	200	55	55	43	2.5	2	395 000	715 000	40 500	73 000	1 700	2 200
	230	43.75	40	34	4	3	375 000	505 000	38 000	51 500	1 500	2 000
	230	67.75	64	54	4	3	530 000	790 000	54 000	80 500	1 500	2 000
	280	63.75	58	49	5	4	545 000	675 000	56 000	68 500	1 300	1 800
	280	63.75	58	49	5	4	650 000	820 000	66 000	83 500	1 300	1 800
	280 280	72 98.75	66 93	44 78	5 5	4	625 000 830 000	820 000 1 150 000	63 500 84 500	83 500 117 000	1 200 1 300	1 700 1 800



Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	7 _r e	$F_{\rm a}/I$	$F_{\rm r}$ e
X	Y	X	Y
1	0	0.4	Y_1

NSK

Static Equivalent Load

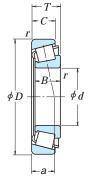
 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}=0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are given in the table below.

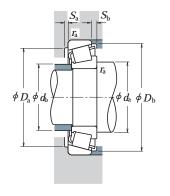
	ISO355			Abutn	nent ar	nd Fillet (mm)	Dimens	ions			Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	i	e Cup $r_{ m a}$ nax.	(mm) a	e	Y_1	Y_0	арргох.
HR 32921 J	2CC	116	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		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
T 4 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 HR 32926 J T 4 CB130	2CC 4CB	142 142 148	141 140 141	171 170 171	168 168 171	175 173 179	6 6 8	6 7 8	2 2 2.5	1.5 1.5 2.5	34.7 31.4 37.5	0.36 0.34 0.47	1.7 1.8 1.3	0.92 0.97 0.70	2.25 2.46 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 32326	7GB —	174 162	159 165	262 262	220 233	261 263	9 8	28 20.5	4	3	87.1 69.2	0.83 0.36	0.73 1.7	0.40 0.92	18.8 26.6

Bore Diameter 140 – 170 mm





							- a - 					
		Bound	lary Dimer (mm)	nsions			,	Basic Load F	0	f)	Limiting :	
d	D	T	В	С		$m{r}$ Cup	$C_{\rm r}$	(N) $C_{0\mathrm{r}}$	$C_{ m r}$	gf $ brace$ $C_{0 m r}$	(min Grease	Oil
140	190	32	32	25	2	1.5	206 000	390 000	21 000	39 500	1 700	2 200
	210	45	45	34	2.5	2	325 000	555 000	33 000	57 000	1 600	2 200
	210	56	56	44	2.5	2	410 000	770 000	42 000	78 500	1 600	2 200
	250	45.75	42	36	4	3	390 000	515 000	40 000	52 500	1 400	1 900
	250	71.75	68	58	4	3	610 000	915 000	62 000	93 500	1 400	1 900
	300	67.75	62	53	5	4	740 000	945 000	75 500	96 500	1 200	1 700
	300 300	77 107.75	70 102	47 85	5 5	4	695 000 985 000	955 000 1 440 000	71 000 101 000	97 500 147 000	1 100 1 200	1 500 1 600
150	210	38	36	31	2.5	2	247 000	440 000	25 200	45 000	1 500	2 000
	210	38	38	30	2.5	2	281 000	520 000	28 600	53 000	1 500	2 000
	225	48	48	36	3	2.5	375 000	650 000	38 000	66 500	1 400	2 000
	225	59	59	46	3	2.5	435 000	805 000	44 000	82 000	1 400	2 000
	270	49	45	38	4	3	485 000	665 000	49 000	67 500	1 300	1 800
	270	77	73	60	4	3	705 000	1 080 000	71 500	110 000	1 300	1 800
	320 320 320 320	72 72 82 114	65 65 75 108	55 55 50 90	5 5 5 5	4 4 4 4	690 000 825 000 790 000 1 120 000	860 000 1 060 000 1 100 000 1 700 000	80 500	87 500 108 000 112 000 174 000	1 100 1 100 1 000 1 100	1 500 1 600 1 400 1 500
160	220	38	38	30	2.5	2	296 000	570 000	30 000	58 000	1 400	1 900
	240	51	51	38	3	2.5	425 000	750 000	43 500	76 500	1 300	1 800
	290	52	48	40	4	3	530 000	730 000	54 000	74 500	1 200	1 600
	290 340 340	84 75 75	80 68 68	67 58 58	4 5 5	3 4 4	795 000 765 000 870 000	1 220 000 960 000 1 110 000	78 000	125 000 98 000 113 000	1 200 1 000 1 100	1 600 1 400 1 400
	340	75	68	48	5	4	675 000	875 000	69 000	89 000	950	1 300
	340	121	114	95	5	4	1 210 000	1 770 000	123 000	181 000	1 000	1 400
170	230	38	36	31	2.5	2.5	258 000	485 000	26 300	49 500	1 300	1 800
	230	38	38	30	2.5	2	294 000	560 000	30 000	57 000	1 400	1 800
	260	57	57	43	3	2.5	505 000	890 000	51 500	90 500	1 200	1 700
	310	57	52	43	5	4	630 000	885 000	64 000	90 000	1 100	1 500
	310	91	86	71	5	4	930 000	1 450 000	94 500	148 000	1 100	1 500
	360	80	72	62	5	4	845 000	1 080 000	86 000	110 000	950	1 300
	360 360 360	80 80 127	72 72 120	62 50 100	5 5 5	4 4 4	960 000 760 000 1 370 000	1 230 000 1 040 000 2 050 000		125 000 106 000 209 000	1 000 900 1 000	1 300 1 200 1 300



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$F_{\rm r} > e$
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}\!>\!0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of $\emph{e},~Y_1$, and Y_0 are

given in the table below.

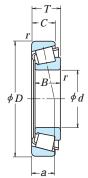
	ISO355			Abutn	nent ar	nd Fillet (mm)	Dimens	sions			Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	d a min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.		$r_{ m a}$ lax.	(mm) a	e	<i>Y</i> ₁	Y_0	approx.
HR 32928 J	2CC	152	150	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 HR 32930 J HR 32030 XJ	2DC 4EC	165 165 168	162 163 164	200 198 213	195 196 202	201 202 216	7 7 8	7 8 12	2 2 2.5	2 2 2	36.7 36.5 49.8	0.33 0.33 0.46	1.8 1.8 1.3	1.0 1.0 0.72	3.8 4.05 6.6
HR 33030 J HR 30230 J HR 32230 J	2EE 2GB 4GD	168 171 171	165 175 171	213 256 256	203 236 228	217 250 254	8 7 8	13 11 17	2.5 2 2.5 2 3 2.5 3 2.5		48.7 51.3 64.7	0.36 0.44 0.44	1.7 1.4 1.4	0.90 0.76 0.76	8.07 11.2 17.8
30330 HR 30330 J HR 31330 J 32330	— 2GB 7GB	177 177 194 182	193 190 187 191	302 302 302 302	275 276 253 262	292 292 300 297	8 8 9 8	17 17 32 24	4 4 4 4	3 3 3 3	61.4 60.0 99.3 81.5	0.36 0.35 0.83 0.37	1.7 1.7 0.73 1.6	0.92 0.96 0.40 0.88	24.2 25 28.5 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 32332	_	196 192	198 202	322 322	270 281	313 319	9 10	27 26	4 4	3	99.4 87.1	0.81 0.37	0.74 1.6	0.41 0.88	27.5 48.3
32934 HR 32934 J HR 32034 XJ	3DC 4EC	185 185 188	183 180 187	220 218 248	216 215 232	223 222 249	7 7 10	7 8 14	2 2 2.5	2 2 2	41.6 41.7 56.6	0.36 0.38 0.44	1.7 1.6 1.4	0.90 0.86 0.74	4.3 4.44 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

B 130 B 131

Bore Diameter 180 - 240 mm









Dynamic Equivalent Load $P = XF_r + YF_a$ $F_{\rm a}/F_{\rm r} \leq e$ $F_{\rm a}/F_{\rm r} > e$ X YYX Y_1 1 0 0.4

Static Equivalent Load $P_0 = 0.5F_r + Y_0 F_a$ When $F_{\rm r} > 0.5 F_{\rm r} + Y_0 F_{\rm a}$, use $P_0 = F_{\rm r}$ The values of e, Y_1 , and Y_0 are given in the table below.

Eff. Load | Constant |

53.9 0.48

96.6 0.37

e

60.4 0.42 1.4 61.8 0.45 1.3

55.3 0.48 1.3 63.4 0.44 1.4 65.6 0.44 1.4

80.5 0.44 1.4 76.1 0.36 1.7

102.7 | 0.37 | 1.6

53.4 0.37 1.6 54.2 0.39 1.5 67.4 0.43 1.4

Centers

(mm)

Axial Load

Factors

 Y_1 Y_0

0.69

0.78 14.3 0.73 17.8

0.88 | 66.8

0.76 35.2 0.92 46

0.88 78.9

0.69 0.75

0.88

0.84

1.3

78.9 0.45 1.3 0.73 29.8 72.5 0.36 1.7 0.92 39.3 113.1 0.81 0.74 0.41 38.5

1.6

Mass

(kg)

approx.

6.56

6.83 14.9 0.76 21.4

9.26

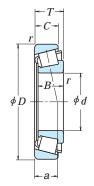
9.65 0.77 18.9

		Bou	ndary Dimer (mm)	nsions			(1	Basic Load R	atings {kg	afl.	Limiting (ISO355			Abutn	nent an	d Fillet ((mm)	Dimens	ions		
<u>d</u>	D	T	В	С		r Cup nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{\scriptscriptstyle m a}$	$d_{ m b}$ max.	1 max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone C $oldsymbol{r_a}$ max.	up
180	250 280 320	45 64 57	45 64 52	34 48 43	2.5 3 5	2 2.5 4	350 000 640 000 650 000	685 000 1 130 000 930 000		69 500 115 000 95 000	1 300 1 200 1 100	1 700 1 600 1 400	HR 32936 J HR 32036 XJ HR 30236 J	4DC 3FD 4GB	195 198 207	192 199 210	240 268 302	227 248 281	267	8 10 9	11 16 14	2 2 2.5 2 4 3	
	320 380 380 380	91 83 83 134	86 75 75 126	71 64 53 106	5 5 5 5	4 4 4 4	960 000 935 000 820 000 1 520 000	1 540 000 1 230 000 1 120 000 2 290 000	95 500	157 000 126 000 114 000 234 000	1 100 900 850 950	1 400 1 300 1 200 1 300	HR 32236 J 30336 30336 D 32336	4GD — — —	207 207 216 212	205 233 229 225	302 362 362 362	270 324 304 310	345 352	10 10 10 10	20 19 30 28	4 3 4 3 4 3 4 3	
190	260 290 340	45 64 60	45 64 55	34 48 46	2.5 3 5	2 2.5 4	365 000 650 000 715 000	715 000 1 170 000 1 020 000		73 000 119 000 104 000	1 200 1 100 1 000	1 600 1 500 1 300	HR 32938 J HR 32038 XJ HR 30238 J	4DC 4FD 4GB	205 208 217	201 209 223	250 278 322	237 258 302		8 10 9	11 16 14	2 2.5 2 4 3	
	340 400 400	97 86 140	92 78 132	75 65 109	5 6 6	4 5 5	1 110 000 1 010 000 1 660 000	1 770 000 1 340 000 2 580 000	113 000 103 000 169 000	136 000	1 000 850 850	1 400 1 200 1 200	HR 32238 J 30338 32338	4GD — —	217 223 229	216 248 243	322 378 378		323 366 375	10 11 11	22 21 31	4 3 5 4 5 4	
200	280 280 310	51 51 70	48 51 70	41 39 53	3 3 3	2.5 2.5 2.5	410 000 480 000 760 000	780 000 935 000 1 370 000	42 000 48 500 77 500	80 000 95 000 139 000	1 100 1 100 1 000	1 500 1 500 1 400	32940 HR 32940 J HR 32040 XJ	— 3EC 4FD	218 218 218	217 216 221	268 268 298		269 271 297	9 9 11	10 12 17	2.5 2 2.5 2 2.5 2	
	360 360 420	64 104 89	58 98 80	48 82 67	5 5 6	4 4 5	795 000 1 210 000 1 030 000	1 120 000 1 920 000 1 390 000	81 000 123 000 105 000		950 950 850	1 300 1 300 1 200	HR 30240 J HR 32240 J 30340	4GB 3GD —	227 227 233	236 230 253	342 342 398	318 305 346	340	10 11 11	16 22 22	4 3 4 3 5 4	
	420 420	89 146	80 138	56 115	6 6	5 5	965 000 1 820 000	1 330 000 2 870 000	98 500 185 000	136 000 292 000	750 800	1 000 1 100	30340 D 32340	_	244 239	253 253	398 398	336 346		11 11	33 31	5 4 5 4	
220	300 340 400	51 76 72	51 76 65	39 57 54	3 4 5	2.5 3 4	490 000 885 000 810 000	990 000 1 610 000 1 150 000	90 500	101 000 164 000 117 000	1 000 950 850	1 400 1 300 1 100	HR 32944 J HR 32044 XJ 30244	3EC 4FD —	238 241 247	235 244 267	288 326 382	278 303 350	326	9 12 11	12 19 18	2.5 2 3 2. 4 3	.5
	400 460 460	114 97 154	108 88 145	90 73 122	5 6 6	4 5 5	1 340 000 1 430 000 2 020 000	2 210 000 1 990 000 3 200 000	137 000 146 000 206 000	203 000	850 750 750	1 100 1 000 1 000	32244 30344 32344	_ _ _	247 253 259	260 283 274	382 438 438	340 390 372	414	12 12 12	24 24 32	4 3 5 4 5 4	
240	320 360 440	51 76 79	51 76 72	39 57 60	3 4 5	2.5 3 4	500 000 920 000 990 000	1 040 000 1 730 000 1 400 000		107 000 177 000 142 000	950 850 750	1 300 1 200 1 000	HR 32948 J HR 32048 XJ 30248	4EC 4FD —	258 261 267	255 262 288	308 346 422		314 346 408	9 12 11	12 19 19	2.5 2 3 2. 4 3	.5
	440 500 500	127 105 165	120 95 155	100 80 132	5 6 6	4 5 5	1 630 000 1 660 000 2 520 000	2 730 000 2 340 000 4 100 000	166 000 169 000 257 000	238 000	750 670 670	1 000 950 900	32248 30348 32348	_ _ _	267 273 279	285 308 301	422 478 478	374 422 410		12 12 12	27 25 33	4 3 5 4 5 4	

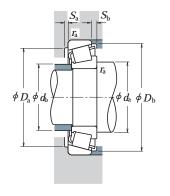
	360 360 420	64 104 89	58 98 80	48 82 67	5 5 6	4 4 5	1 210 000	1 120 000 1 920 000 1 390 000	81 000 114 000 123 000 196 000 105 000 142 000	950 950 850	1 300 1 300 1 200	HR 30240 J HR 32240 J 30340	4GB 3GD		236 230 253	342 342 398	318 305 346	340	10 11 11	16 22 22	4 4 5	3 3 4	69.1 85.1 81.4	0.44 0.41 0.37	1.4 1.5 1.6	0.76 0.81 0.88	25.5 42.6 52.3
	420 420	89 146	80 138	56 115	6 6	5 5	965 000 1 820 000		98 500 136 000 185 000 292 000	750 800	1 000 1 100	30340 D 32340	_	244 239	253 253	398 398	336 346		11 11	33 31	5 5	4 4	122.9 106.7	0.81 0.37	0.74 1.6	0.41 0.88	49.6 90.9
0	300 340 400	51 76 72	51 76 65	39 57 54	3 4 5	2.5 3 4	490 000 885 000 810 000		50 000 101 000 90 500 164 000 82 500 117 000	1 000 950 850	1 400 1 300 1 100	HR 32944 J HR 32044 XJ 30244	3EC 4FD —	238 241 247	235 244 267	288 326 382	278 303 350	326	9 12 11	12 19 18	2.5 3 4	2 2.5 3		0.43 0.43 0.40	1.4 1.4 1.5	0.78 0.77 0.82	10.3 24.4 33.6
	400 460 460	114 97 154	108 88 145	90 73 122	5 6 6	4 5 5	1 340 000 1 430 000 2 020 000	1 990 000	137 000 225 000 146 000 203 000 206 000 325 000	850 750 750	1 100 1 000 1 000	32244 30344 32344	_ _ _	247 253 259	260 283 274	382 438 438	340 390 372	414	12 12 12	24 24 32	4 5 5	3 4 4	85.4	0.40 0.36 0.37	1.5 1.7 1.6	0.82 0.92 0.88	72.4
0	320 360 440	51 76 79	51 76 72	39 57 60	3 4 5	2.5 3 4	500 000 920 000 990 000		51 000 107 000 94 000 177 000 101 000 142 000	950 850 750	1 300 1 200 1 000	HR 32948 J HR 32048 XJ 30248	4EC 4FD —		255 262 288	308 346 422	297 321 384		9 12 11	12 19 19	2.5 3 4	2 2.5 3	65.1 79.1 85.1	0.46 0.46 0.44	1.3 1.3 1.4	0.72 0.72 0.74	26.2
	440 500 500	127 105 165	120 95 155	100 80 132	5 6 6	4 5 5	1 630 000 1 660 000 2 520 000	2 340 000	166 000 278 000 169 000 238 000 257 000 415 000	750 670 670	1 000 950 900	32248 30348 32348	_ _ _	267 273 279	285 308 301	422 478 478	374 422 410	447	12 12 12	27 25 33	4 5 5	3 4 4		0.40 0.36 0.37	1.5 1.7 1.6		78 92.6 145
									'																	'	

B 132 B 133 Bore Diameter 260 – 440 mm





		Boun	dary Dimen (mm)	sions			(1	Basic Load R	atings {kc	ıf)	Limiting :	
d	D	T	В	C		$m{r}$ Cup nin.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
260	360 400 480	63.5 87 89	63.5 87 80	48 65 67	3 5 6	2.5 4 5	730 000 1 160 000 1 190 000	1 450 000 2 160 000 1 700 000	74 500 118 000 121 000		850 800 670	1 100 1 100 900
	480 540 540	137 113 176	130 102 165	106 85 136	6 6 6	5 6 6	1 900 000 1 870 000 2 910 000	3 300 000 2 640 000 4 800 000	194 000 190 000 297 000	269 000	670 630 630	950 850 850
280	380 420 500	63.5 87 89	63.5 87 80	48 65 67	3 5 6	2.5 4 5	765 000 1 180 000 1 240 000	1 580 000 2 240 000 1 900 000	78 000 120 000 127 000		800 710 630	1 100 1 000 850
	500 580	137 187	130 175	106 145	6 6	5 6	1 950 000 3 300 000	3 450 000 5 400 000	199 000 335 000		630 560	850 800
300	420 420 460	76 76 100	72 76 100	62 57 74	4 4 5	3 3 4	895 000 1 010 000 1 440 000	1 820 000 2 100 000 2 700 000	91 000 103 000 147 000		710 710 670	950 950 900
	540 540	96 149	85 140	71 115	6 6	5 5	1 440 000 2 220 000	2 100 000 3 700 000	147 000 226 000		600 600	800 800
320	440 440 480	76 76 100	72 76 100	63 57 74	4 4 5	3 3 4	900 000 1 040 000 1 510 000	1 880 000 2 220 000 2 910 000	92 000 106 000 153 000		970 670 630	900 900 850
	580 580 670	104 159 210	92 150 200	75 125 170	6 6 7.5	5 5 7.5	1 640 000 2 860 000 4 200 000	2 420 000 5 050 000 7 100 000	168 000 292 000 430 000	515 000	530 530 480	750 750 670
340	460 460 520	76 76 112	72 76 106	63 57 92	4 4 6	3 3 5	910 000 1 050 000 1 650 000	1 940 000 2 220 000 3 400 000	93 000 107 000 168 000		630 630 560	850 850 750
360	480 480 540	76 76 112	72 76 106	62 57 92	4 4 6	3 3 5	945 000 1 080 000 1 680 000	2 100 000 2 340 000 3 500 000	96 500 110 000 171 000		600 560 530	800 800 750
380	520	87	82	71	5	4	1 210 000	2 550 000	124 000	260 000	560	750
400	540 600	87 125	82 118	71 100	5 6	4 5	1 250 000 1 960 000	2 700 000 4 050 000	128 000 200 000		530 480	710 670
420	560 620	87 125	82 118	72 100	5 6	4 5	1 300 000 2 000 000	2 810 000 4 200 000	132 000 204 000		500 450	670 630
440	650	130	122	104	6	6	2 230 000	4 600 000	227 000	470 000	430	600



Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

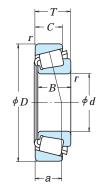
When $F_{\rm r}\!>\!0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of $\emph{e},~Y_1$, and Y_0 are

given in the table below.

Dansing Numbers	ISO355			Abutr	nent ar	nd Fillet (mm)	Dimens	sions	0	0	Eff. Load Centers	Constant		Load tors	Mass (kg)
Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	$D_{ m a}$ min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.		e Cup $r_{ m a}$	(mm) a	e	Y_1	Y_0	арргох.
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 HR 32972 J 32072	4FD —	381 381 393	386 381 402	466 466 518	445 445 480	465 466 514	14 13 5.5	14 19 22	3 3 5	2.5 2.5 4	91.4 96.8 108.6	0.40 0.46 0.38	1.5 1.3 1.6	0.82 0.72 0.86	35.8 36.1 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

B 134 B 135

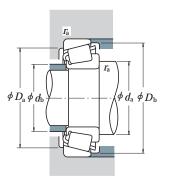
Bore Diameter 12.000 – 22.225 mm



	Boundary Dimensions (mm)							Basic Loa	0		Limiting	
		(m	nm)		Cone	Cup	(N)	{k	gf}	(mii	∩ ⁻¹)
d	D	T	В	C	<i>I</i> mi	,	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
12.000	31.991	10.008	10.785	7.938	0.8	1.3	10 300	8 900	1 050	905	13 000	18 000
12.700	34.988	10.998	10.988	8.730	1.3	1.3	11 700	10 900	1 200	1 110	12 000	16 000
15.000	34.988	10.998	10.988	8.730	0.8	1.3	11 700	10 900	1 200	1 110	12 000	16 000
15.875	34.988 39.992 41.275	10.998 12.014 14.288	10.998 11.153 14.681	8.712 9.525 11.112	1.3 1.3 1.3	1.3 1.3 2.0	13 800 14 900 21 300	13 400 15 700 19 900	1 410 1 520 2 170	1 360 1 600 2 030		15 000 13 000 13 000
	42.862	14.288	14.288	9.525	1.5	1.5	17 300	17 200	1 770	1 750	8 500	12 000
	42.862	16.670	16.670	13.495	1.5	1.5	26 900	26 300	2 750	2 680	9 500	13 000
	44.450	15.494	14.381	11.430	1.5	1.5	23 800	23 900	2 430	2 440	8 500	11 000
	49.225	19.845	21.539	14.288	0.8	1.3	37 500	37 000	3 800	3 800	8 500	11 000
16.000	47.000	21.000	21.000	16.000	1.0	2.0	35 000	36 500	3 600	3 750	9 000	12 000
16.993	39.992	12.014	11.153	9.525	0.8	1.3	14 900	15 700	1 520	1 600	9 500	13 000
17.455	36.525	11.112	11.112	7.938	1.5	1.5	11 600	11 000	1 190	1 120	10 000	14 000
17.462	39.878	13.843	14.605	10.668	1.3	1.3	22 500	22 500	2 290	2 290	10 000	13 000
	47.000	14.381	14.381	11.112	0.8	1.3	23 800	23 900	2 430	2 440	8 500	11 000
19.050	39.992	12.014	11.153	9.525	1.0	1.3	14 900	15 700	1 520	1 600	9 500	13 000
	45.237	15.494	16.637	12.065	1.3	1.3	28 500	28 900	2 910	2 950	9 000	12 000
	47.000	14.381	14.381	11.112	1.3	1.3	23 800	23 900	2 430	2 440	8 500	11 000
	49.225	18.034	19.050	14.288	1.3	1.3	37 500	37 000	3 800	3 800	8 500	11 000
	49.225	19.845	21.539	14.288	1.2	1.3	37 500	37 000	3 800	3 800	8 500	11 000
	49.225	21.209	19.050	17.462	1.3	1.5	37 500	37 000	3 800	3 800	8 500	11 000
	49.225	23.020	21.539	17.462	C1.5	3.5	37 500	37 000	3 800	3 800	8 500	11 000
	53.975	22.225	21.839	15.875	1.5	2.3	40 500	39 500	4 150	4 000	7 500	10 000
19.990	47.000	14.381	14.381	11.112	1.5	1.3	23 800	23 900	2 430	2 440	8 500	11 000
20.000	51.994	15.011	14.260	12.700	1.5	1.3	26 000	27 900	2 650	2 840	7 500	10 000
20.625	49.225	23.020	21.539	17.462	1.5	1.5	37 500	37 000	3 800	3 800	8 500	11 000
20.638	49.225	19.845	19.845	15.875	1.5	1.5	36 000	37 000	3 650	3 750	8 000	11 000
21.430	50.005	17.526	18.288	13.970	1.3	1.3	38 500	40 000	3 950	4 100	8 000	11 000
22.000	45.237 45.975	15.494 15.494	16.637 16.637	12.065 12.065	1.3	1.3	29 200 29 200	33 500 33 500	2 980 2 980	3 400 3 400	8 500 8 500	11 000 11 000
22.225	50.005	13.495	14.260	9.525	1.3	1.0	26 000	27 900	2 650	2 840	7 500	10 000
	50.005	17.526	18.288	13.970	1.3	1.3	38 500	40 000	3 950	4 100	8 000	11 000
	52.388	19.368	20.168	14.288	1.5	1.5	40 500	43 000	4 100	4 400	7 500	10 000
	53.975	19.368	20.168	14.288	1.5	1.5	40 500	43 000	4 100	4 400	7 500	10 000
	56.896	19.368	19.837	15.875	1.3	1.3	38 000	40 500	3 900	4 150	7 100	9 500
	57.150	22.225	22.225	17.462	0.8	1.5	48 000	50 000	4 850	5 100	7 100	9 500



B 137



Dynamic Equivalent Load

P = X	$F_{\rm r}$ + $YF_{\rm a}$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	<i>Y</i> ₁

Static Equivalent Load

given in the table below.

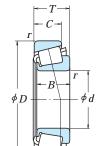
 $P_0=0.5F_{\rm r}+Y_0\,F_{\rm a}$ When $F_{\rm r}>0.5F_{\rm r}+Y_0\,F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are

Bearing	J Numbers	Al	outment	and Fille (mm)			C	Eff. Load Centers	Constant		Load tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle \mathrm{a}}$	$d_{\scriptscriptstyle m b}$	$D_{\rm a}$	$D_{\scriptscriptstyle m b}$	Cone r ma	a	(mm) a	e	Y_1	Y_0	app CONE	orox. 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

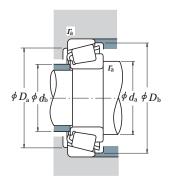
- * The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).
- ** The maximum outside diameter is listed and its tolerance is negative (See Table 8.4.2 on Pages A68 and A69).
- † The tolerances for the bore diameter and overall bearing width differ from the standard (See Table 5 on Page B114).
- * † The tolerance for the bore diameter is 0 to $-20~\mu m$, and for overall bearing width is +356 to 0 μm .

Bore Diameter 22.606 – 28.575 mm



			Dimension	S					oad Ratings		Limiting	
_		,	nm)		Cone	Cup	,	N)		gf}	(mi	,
d	D	T	В	С	<i>1</i> mi		$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
22.606	47.000	15.500	15.500	12.000	1.5	1.0	26 300	30 000	2 680	3 100	8 000	11 000
23.812	50.292	14.224	14.732	10.668	1.5	1.3	27 600	32 000	2 820	3 250	7 100	10 000
	56.896	19.368	19.837	15.875	0.8	1.3	38 000	40 500	3 900	4 150	7 100	9 500
24.000	55.000	25.000	25.000	21.000	2.0	2.0	49 500	55 000	5 050	5 650	7 100	9 500
24.981	51.994	15.011	14.260	12.700	1.5	1.3	26 000	27 900	2 650	2 840	7 500	10 000
	52.001	15.011	14.260	12.700	1.5	2.0	26 000	27 900	2 650	2 840	7 500	10 000
	62.000	16.002	16.566	14.288	1.5	1.5	37 000	39 500	3 750	4 000	6 300	8 500
25.000	50.005	13.495	14.260	9.525	1.5	1.0	26 000	27 900	2 650	2 840	7 500	10 000
	51.994	15.011	14.260	12.700	1.5	1.3	26 000	27 900	2 650	2 840	7 500	10 000
25.400	50.005	13.495	14.260	9.525	3.3	1.0	26 000	27 900	2 650	2 840	7 500	10 000
	50.005	13.495	14.260	9.525	1.0	1.0	26 000	27 900	2 650	2 840	7 500	10 000
	50.292	14.224	14.732	10.668	1.3	1.3	27 600	32 000	2 820	3 250	7 100	10 000
	57.150	17.462	17.462	13.495	1.3	1.5	39 500	45 500	4 050	4 650	6 700	9 000
	57.150	19.431	19.431	14.732	1.5	1.5	42 500	49 000	4 300	5 000	6 700	9 000
	59.530	23.368	23.114	18.288	0.8	1.5	50 000	58 000	5 100	5 900	6 300	9 000
	62.000	19.050	20.638	14.288	0.8	1.3	46 000	53 000	4 700	5 400	6 000	8 000
	63.500	20.638	20.638	15.875	3.5	1.5	46 000	53 000	4 700	5 400	6 000	8 000
	64.292	21.433	21.433	16.670	1.5	1.5	51 000	64 500	5 200	6 600	5 600	8 000
	65.088	22.225	21.463	15.875	1.5	1.5	45 000	47 500	4 600	4 850	5 600	8 000
	68.262	22.225	22.225	17.462	0.8	1.5	55 000	64 000	5 600	6 550	5 600	7 500
	72.233	25.400	25.400	19.842	0.8	2.3	63 500	83 500	6 500	8 500	5 000	7 100
	72.626	24.608	24.257	17.462	2.3	1.5	60 000	58 000	6 100	5 900	5 600	7 500
26.988	50.292	14.224	14.732	10.668	3.5	1.3	27 600	32 000	2 820	3 250	7 100	10 000
	57.150	19.845	19.355	15.875	3.3	1.5	40 000	44 500	4 100	4 500	6 700	9 000
	60.325	19.842	17.462	15.875	3.5	1.5	39 500	45 500	4 050	4 650	6 700	9 000
	62.000	19.050	20.638	14.288	0.8	1.3	46 000	53 000	4 700	5 400	6 000	8 000
28.575	57.150	19.845	19.355	15.875	3.5	1.5	40 000	44 500	4 100	4 500	6 700	9 000
	59.131	15.875	16.764	11.811	spec.	1.3	34 500	41 500	3 550	4 200	6 300	8 500
	62.000	19.050	20.638	14.288	3.5	1.3	46 000	53 000	4 700	5 400	6 000	8 000
	62.000	19.050	20.638	14.288	0.8	1.3	46 000	53 000	4 700	5 400	6 000	8 000
	64.292	21.433	21.433	16.670	1.5	1.5	51 000	64 500	5 200	6 600	5 600	8 000
	68.262	22.225	22.225	17.462	0.8	1.5	55 000	64 000	5 600	6 550	5 600	7 500
	72.626	24.608	24.257	17.462	4.8	1.5	60 000	58 000	6 100	5 900	5 600	7 500
	72.626	24.608	24.257	17.462	1.5	1.5	60 000	58 000	6 100	5 900	5 600	7 500
	73.025	22.225	22.225	17.462	0.8	3.3	54 500	64 500	5 550	6 600	5 300	7 100





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}>$ 0.5 $F_{\rm r}+Y_0\,F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are

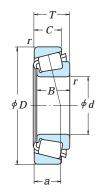
given in the table below.

Bearing Nu	mbers	Ak	outment			sions		Eff. Load	Constant	Axial		Mass	-
				(mm)		Cone	Cup	Centers (mm)		Fac	tors	(kg)	
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{ m b}$	$r_{\rm a}$	r _a max.		e	Y_1	Y_0	approx. CONE CUP	
LM 72849	LM 72810	29	27	40.5	44.5	1.5	1.5 1		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	

† The tolerances for the bore diameter and overall bearing width differ from the standard (See Table 5 on Page B114).

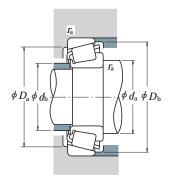
The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

Bore Diameter 29.000 – 32.000 mm



Boundary Dimensions (mm)									sic Loa	ıd Ratinç	,		Limiting	
		,	,		Cone	Cup		(N)				gf}	(mir	,
<i>d</i>	D	T	В	С		$m{r}$ in.	$C_{ m r}$	(C_{0r}		$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
29.000 29.367	50.292 66.421	14.224 23.812	14.732 25.433	10.668 19.050	3.5 3.5	1.3 1.3	26 80 65 00		000 000		2 730 6 600	3 500 7 450	7 100 6 000	9 500 8 000
30.000	62.000 62.000 63.500 72.000	16.002 19.050 20.638 19.000	16.566 20.638 20.638 18.923	14.288 14.288 15.875 15.875	1.5 1.3 1.3 1.5	1.5 1.3 1.3 1.5	37 00 46 00 46 00 52 00	0 53 0 53	500 000 000 000		3 750 4 700 4 700 5 300	4 000 5 400 5 400 5 700	6 300 6 000 6 000 5 600	8 500 8 000 8 000 7 500
30.112	62.000	19.050	20.638	14.288	0.8	1.3	46 00	0 53	000		4 700	5 400	6 000	8 000
30.162	58.738 64.292 68.262	14.684 21.433 22.225	15.080 21.433 22.225	10.716 16.670 17.462	3.5 1.5 2.3	1.0 1.5 1.5	28 80 51 00 55 50	0 64	500 500 500		2 940 5 200 5 650	3 450 6 600 7 200	6 000 5 600 5 300	8 000 8 000 7 500
	69.850 69.850 76.200	23.812 23.812 24.608	25.357 25.357 24.074	19.050 19.050 16.670	2.3 0.8 1.5	1.3 1.3 C3.3	71 00 71 00 67 50	0 84	000 000 500		7 200 7 200 6 850	8 550 8 550 7 100	5 600 5 600 5 000	7 500 7 500 6 700
30.213	62.000 62.000 62.000	19.050 19.050 19.050	20.638 20.638 20.638	14.288 14.288 14.288	3.5 0.8 1.5	1.3 1.3 1.3	46 00 46 00 46 00	0 53	000 000 000		4 700 4 700 4 700	5 400 5 400 5 400	6 000 6 000 6 000	8 000 8 000 8 000
30.955	64.292	21.433	21.433	16.670	1.5	1.5	51 00	0 64	500		5 200	6 600	5 600	8 000
31.750	58.738 59.131 62.000	14.684 15.875 18.161	15.080 16.764 19.050	10.716 11.811 14.288	1.0 spec. spec.	1.0 1.3 1.3	28 80 34 50 46 00	0 41	500 500 000		2 940 3 550 4 700	3 450 4 200 5 400	6 000 6 300 6 000	8 000 8 500 8 000
	62.000 62.000 63.500	19.050 19.050 20.638	20.638 20.638 20.638	14.288 14.288 15.875	0.8 3.5 0.8	1.3 1.3 1.3	46 00 46 00 46 00	0 53	000 000 000		4 700 4 700 4 700	5 400 5 400 5 400	6 000 6 000 6 000	8 000 8 000 8 000
	68.262 68.262 69.012	22.225 22.225 19.845	22.225 22.225 19.583	17.462 17.462 15.875	3.5 1.5 3.5	1.5 1.5 1.3	55 00 55 50 47 00	0 70	000 500 000		5 600 5 650 4 800	6 550 7 200 5 700	5 600 5 300 5 600	7 500 7 500 7 500
	69.012 69.850 69.850	26.982 23.812 23.812	26.721 25.357 25.357	15.875 19.050 19.050	4.3 0.8 3.5	3.3 1.3 1.3	47 00 71 00 71 00	0 84	000 000 000		4 800 7 200 7 200	5 700 8 550 8 550	5 600 5 600 5 600	7 500 7 500 7 500
	72.626 73.025 80.000	30.162 29.370 21.000	29.997 27.783 22.403	23.812 23.020 17.826	0.8 1.3 0.8	3.3 3.3 1.3	79 50 74 00 68 50	0 100	000 000 500		8 100 7 550 6 950	9 200 10 200 7 700	5 300 5 000 4 500	7 500 7 100 6 300
32.000	72.233	25.400	25.400	19.842	3.3	2.3	63 50	0 83	500		6 500	8 500	5 000	7 100





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ When $F_{
m r}\!>\!0.5F_{
m r}+Y_0\,F_{
m a}$, use P_0 = $F_{
m r}$

The values of e, Y_1 , and Y_0 are given in the table below.

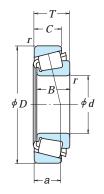
Bearing	y Numbers	Ab	outment	and Fillet (mm)	t Dimen		0	Eff. Load Centers	Constant	Axial Fac		Mass (kg)	
CONE	CUP	$d_{\scriptscriptstyle \mathrm{a}}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{\scriptscriptstyle m b}$	Cone $m{r}_{ m a}$ max	· ·	(mm) a	e	Y_1	Y_0	app CONE	rox. CUP
† 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 diar	meter is I	isted and	d its toler	rance is	negati	ve (S	ee Table	8.4.1	on Page	A68).		

The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).

† The tolerances for the bore diameter and overall bearing width differ from the standard (See Table 5 on Page B114).

B 140 B 141

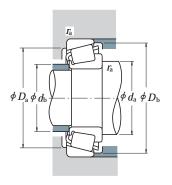
Bore Diameter 33.338 - 35.000 mm



Boundary Dimensions (mm)									nd Ratings		Limiting	Speeds
							(N)	{k	:gf}	(mir	n ⁻¹)
d	D	T	В	С			$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
33.338	66.675	20.638	20.638	15.875	3.5	1.5	46 000	53 500	4 650	5 450	5 600	7 500
	68.262	22.225	22.225	17.462	0.8	1.5	55 500	70 500	5 650	7 200	5 300	7 500
	69.012	19.845	19.583	15.875	3.5	3.3	47 000	56 000	4 800	5 700	5 600	7 500
	69.012	19.845	19.583	15.875	0.8	1.3	47 000	56 000	4 800	5 700	5 600	7 500
	69.850	23.812	25.357	19.050	3.5	1.3	71 000	84 000	7 200	8 550	5 600	7 500
	72.000	19.000	18.923	15.875	3.5	1.5	52 000	56 000	5 300	5 700	5 600	7 500
	72.626	30.162	29.997	23.812	0.8	3.3	79 500	90 000	8 100	9 200	5 300	7 500
	73.025	29.370	27.783	23.020	0.8	3.3	74 000	100 000	7 550	10 200	5 000	7 100
	76.200	29.370	28.575	23.020	3.8	0.8	78 500	106 000	8 000	10 800	4 800	6 700
	76.200	29.370	28.575	23.020	0.8	3.3	78 500	106 000	8 000	10 800	4 800	6 700
	79.375	25.400	24.074	17.462	3.5	1.5	67 500	69 500	6 850	7 100	5 000	6 700
34.925	65.088	18.034	18.288	13.970	spec.	1.3	47 500	57 500	4 850	5 900	5 600	7 500
	65.088	20.320	18.288	16.256	spec.	1.3	47 500	57 500	4 850	5 900	5 600	7 500
	66.675	20.638	20.638	16.670	3.5	2.3	53 000	62 500	5 400	6 400	5 600	7 500
	69.012	19.845	19.583	15.875	3.5	1.3	47 000	56 000	4 800	5 700	5 600	7 500
	69.012	19.845	19.583	15.875	1.5	1.3	47 000	56 000	4 800	5 700	5 600	7 500
	72.233	25.400	25.400	19.842	2.3	2.3	63 500	83 500	6 500	8 500	5 000	7 100
	73.025	22.225	22.225	17.462	0.8	3.3	54 500	64 500	5 550	6 600	5 300	7 100
	73.025	22.225	23.812	17.462	3.5	3.3	63 500	77 000	6 500	7 850	5 300	7 100
	73.025	23.812	24.608	19.050	1.5	0.8	71 000	86 000	7 250	8 750	5 300	7 100
	73.025	23.812	24.608	19.050	3.5	2.3	71 000	86 000	7 250	8 750	5 300	7 100
	76.200	29.370	28.575	23.020	0.8	0.8	78 500	106 000	8 000	10 800	4 800	6 700
	76.200	29.370	28.575	23.020	3.5	0.8	78 500	106 000	8 000	10 800	4 800	6 700
	76.200	29.370	28.575	23.020	3.5	3.3	78 500	106 000	8 000	10 800	4 800	6 700
	76.200	29.370	28.575	23.812	1.5	3.3	80 500	96 500	8 200	9 850	5 000	6 700
	79.375	29.370	29.771	23.812	3.5	3.3	88 000	106 000	8 950	10 800	4 800	6 700
34.976	68.262	15.875	16.520	11.908	1.5	1.5	45 000	53 500	4 600	5 450	5 300	7 100
	72.085	22.385	19.583	18.415	1.3	2.3	47 000	56 000	4 800	5 700	5 600	7 500
	80.000	21.006	20.940	15.875	1.5	1.5	56 500	64 500	5 750	6 600	5 000	6 700
35.000	59.131	15.875	16.764	11.938	spec.	1.3	35 000	47 000	3 550	4 750	6 000	8 000
	59.975	15.875	16.764	11.938	spec.	1.3	35 000	47 000	3 550	4 750	6 000	8 000
	62.000	16.700	17.000	13.600	spec.	1.0	38 000	50 000	3 900	5 100	5 600	8 000
	62.000	16.700	17.000	13.600	spec.	1.5	38 000	50 000	3 900	5 100	5 600	8 000
	65.987	20.638	20.638	16.670	3.5	2.3	53 000	62 500	5 400	6 400	5 600	7 500
	73.025	26.988	26.975	22.225	3.5	0.8	75 500	88 500	7 650	9 050	5 300	7 500



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Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}$	$F_{\rm r} \leq e$	$F_{\rm a}/I$	r > e		
X	Y	X	Y		
1	0	0.4	Y ₁		

Static Equivalent Load

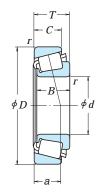
 $P_0 = 0.5F_r + Y_0 F_a$ When $F_{\rm r} > 0.5 F_{\rm r} + Y_0 F_{\rm a}$, use $P_0 = F_{\rm r}$

The values of e, Y_1 , and Y_0 are given in the table below.

Bearing Numbers	А	butment	and Fill (mm				Eff. Load Centers	Constant		Load tors		ass (g)
CONE CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\rm a}$	$D_{\scriptscriptstyle m b}$	Cone C $oldsymbol{r_a}$ max.	Jup	(mm) a	e	Y_1	Y_0	app CONE	orox. CUP
1680 1620 M 88048 M 88010 14130 14274	42.5	38.5 41 38.5	58 58 59	61 65 63	0.8	1.5 1.5 3.3	15.2 19.0 15.3	0.37 0.55 0.38	1.6 1.1 1.6	0.89 0.60 0.86	0.196 0.236 0.207	0.121 0.146 0.132
14131 14276 2585 2523 26131 26283	45	38.5 39 38.5	60 61 62	63 64 65	3.5	1.3 1.3 1.5	15.3 14.5 14.7	0.38 0.27 0.36	1.6 2.2 1.7	0.86 1.2 0.92	0.209 0.263 0.20	0.135 0.169 0.163
3197 3120 HM 88547 HM 88510 HM 89444 HM 89411		40.5 42.5 44.5	61 59 65	67 70 73	0.8	3.3 3.3 0.8	19.6 23.5 23.6	0.33 0.55 0.55	1.8 1.1 1.1	0.99 0.60 0.60	0.348 0.362 0.419	0.225 0.242 0.261
HM 89443 HM 89410 43131 43312		44.5 42	62 67	73 74		3.3 1.5	23.6 23.7	0.55 0.67	1.1 0.90	0.60 0.49	0.421 0.348	0.257 0.22
† LM 48548	46	40 40 40	58 58 58	61 61 62	3.5	1.3 1.3 2.3	14.1 16.4 15.2	0.38 0.38 0.35	1.6 1.6 1.7	0.88 0.88 0.94	0.172 0.172 0.194	0.087 0.108 0.112
14138 A 14276 14137 A 14276 HM 88649 HM 88610	42	40 40 42.5	60 60 60	63 63 69	1.5	1.3 1.3 2.3	15.3 15.1 20.7	0.38 0.38 0.55	1.6 1.6 1.1	0.86 0.86 0.60	0.194 0.196 0.307	0.135 0.135 0.188
02878 02820 2877 2820 25877 25821		42 41.5 40.5	62 63 65	68 68 68	3.5	3.3 3.3 0.8	18.3 16.1 15.7	0.45 0.37 0.29	1.3 1.6 2.1	0.73 0.90 1.1	0.266 0.291 0.306	0.16 0.15 0.167
25878 25820 HM 89446 A HM 89411 HM 89446 HM 89411	47 47.5 53	40.5 44.5 44.5	64 65 65	68 73 73	0.8	2.3 0.8 0.8	15.7 23.6 23.6	0.29 0.55 0.55	2.1 1.1 1.1	1.1 0.60 0.60	0.304 0.403 0.40	0.165 0.261 0.261
HM 89446 HM 89410 31594 31520 3478 3420	46	44.5 43.5 43.5	62 64 67	73 72 74	1.5	3.3 3.3 3.3	23.6 21.6 20.0	0.55 0.40 0.37	1.1 1.5 1.6	0.60 0.82 0.90	0.40 0.404 0.448	0.257 0.235 0.259
19138 19268 14139 14283 28138 28315	41.5	40.5 40 41	61 60 69	65 65 73	1.3 2	1.5 2.3 1.5	14.5 17.7 16.0	0.44 0.38 0.40	1.4 1.6 1.5	0.74 0.87 0.82	0.196 0.198 0.308	0.073 0.21 0.199
*† L 68149	45.5	39 39 40	52 53 55	56 56 59	3.5	1.3 1.3 1	13.2 13.2 14.4	0.42 0.42 0.44	1.4 1.4 1.4	0.79 0.79 0.74	0.117 0.117 0.137	0.056 0.064 0.074
* LM 78349	A 46 46 49	40 39.5 42	54 59 63	59 61 68	3.5 2	1.5 2.3 0.8	14.4 15.2 18.1	0.44 0.35 0.37	1.4 1.7 1.6	0.74 0.94 0.89	0.138 0.193 0.309	0.073 0.103 0.212
Notes * The maximum bore	diameter is	listed an	d its tol	erance i	s negative	e (Se	e Table	8.4.1	on Page	A68)		

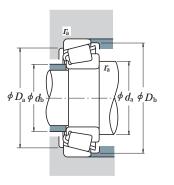
- The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).
- ** The maximum outside diameter is listed and its tolerance is negative (See Table 8.4.2 on Pages A68 and A69).
- † The tolerances for the bore diameter and overall bearing width differ from the standard (See Table 5 on Page B114).
- * † The tolerance for the bore diameter is 0 to $-20~\mu m$, and for overall bearing width is +356 to 0 μm .

Bore Diameter 35.717 – 41.275 mm



			Dimension	S			,	Basic Loa	9	E)	Limiting	
d	D	T	В	C	Cone <i>I</i> mi		$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	gf $ brace$ $C_{0 m r}$	(mir Grease	Oil
35.717	72.233	25.400	25.400	19.842	3.5	2.3	63 500	83 500	6 500	8 500	5 000	7 100
36.487	73.025	23.812	24.608	19.050	1.5	0.8	71 000	86 000	7 250	8 750	5 300	7 100
36.512	76.200	29.370	28.575	23.020	3.5	3.3	78 500	106 000	8 000	10 800	4 800	6 700
	79.375	29.370	29.771	23.812	0.8	3.3	88 000	106 000	8 950	10 800	4 800	6 700
	88.501	25.400	23.698	17.462	2.3	1.5	73 000	81 000	7 450	8 250	4 000	5 600
	93.662	31.750	31.750	26.195	1.5	3.3	110 000	142 000	11 200	14 400	4 000	5 600
38.000	63.000	17.000	17.000	13.500	spec.	1.3	38 500	52 000	3 900	5 300	5 600	7 500
38.100	63.500	12.700	11.908	9.525	1.5	0.8	24 100	30 500	2 460	3 100	5 300	7 100
	65.088	18.034	18.288	13.970	2.3	1.3	42 500	55 000	4 300	5 650	5 300	7 500
	65.088	18.034	18.288	13.970	spec.	1.3	42 500	55 000	4 300	5 650	5 300	7 500
	65.088	19.812	18.288	15.748	2.3	1.3	42 500	55 000	4 300	5 650	5 300	7 500
	68.262	15.875	16.520	11.908	1.5	1.5	45 000	53 500	4 600	5 450	5 300	7 100
	69.012	19.050	19.050	15.083	2.0	2.3	49 000	61 000	4 950	6 250	5 300	7 100
	69.012	19.050	19.050	15.083	3.5	0.8	49 000	61 000	4 950	6 250	5 300	7 100
	72.238	20.638	20.638	15.875	3.5	1.3	48 500	59 500	4 950	6 050	5 300	7 100
	73.025	23.812	25.654	19.050	3.5	0.8	73 500	91 000	7 500	9 300	5 000	6 700
	76.200	23.812	25.654	19.050	3.5	3.3	73 500	91 000	7 500	9 300	5 000	6 700
	76.200	23.812	25.654	19.050	3.5	0.8	73 500	91 000	7 500	9 300	5 000	6 700
	79.375	29.370	29.771	23.812	3.5	3.3	88 000	106 000	8 950	10 800	4 800	6 700
	80.035	24.608	23.698	18.512	0.8	1.5	69 000	84 500	7 000	8 600	4 500	6 300
	82.550	29.370	28.575	23.020	0.8	3.3	87 000	117 000	8 850	11 900	4 500	6 000
	88.501	25.400	23.698	17.462	2.3	1.5	73 000	81 000	7 450	8 250	4 000	5 600
	88.501	26.988	29.083	22.225	3.5	1.5	96 500	109 000	9 800	11 100	4 500	6 000
	95.250	30.958	28.301	20.638	1.5	0.8	87 500	97 000	8 950	9 850	3 600	5 300
39.688	73.025	25.654	22.098	21.336	0.8	2.3	62 500	80 000	6 400	8 150	5 000	6 700
	76.200	23.812	25.654	19.050	3.5	3.3	73 500	91 000	7 500	9 300	5 000	6 700
	80.167	29.370	30.391	23.812	0.8	3.3	92 500	108 000	9 450	11 000	4 800	6 300
40.000	80.000	21.000	22.403	17.826	3.5	1.3	68 500	75 500	6 950	7 700	4 500	6 300
	80.000	21.000	22.403	17.826	0.8	1.3	68 500	75 500	6 950	7 700	4 500	6 300
	88.501	25.400	23.698	17.462	2.3	1.5	73 000	81 000	7 450	8 250	4 000	5 600
41.000	68.000	17.500	18.000	13.500	spec.	1.5	43 500	58 000	4 450	5 950	5 300	7 100
41.275	73.025	16.667	17.462	12.700	3.5	1.5	44 500	54 000	4 550	5 500	4 800	6 700
	73.431	19.558	19.812	14.732	3.5	0.8	54 500	67 000	5 550	6 850	4 800	6 700
	73.431	21.430	19.812	16.604	3.5	0.8	54 500	67 000	5 550	6 850	4 800	6 700





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

Static Equivalent Load

 P_0 = 0.5 $F_{\rm r}$ + Y_0 $F_{\rm a}$ When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + Y_0 $F_{\rm a}$, use P_0 = $F_{\rm r}$

The values of e, Y_1 , and Y_0 are given in the table below.

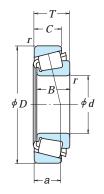
Bearing N	Numbers	Al	outment	and Fille		nsions		Eff. Load Centers	Constant		Load tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle \mathrm{a}}$	$d_{\scriptscriptstyle m b}$	$D_{ m a}$	$D_{ m b}$	Cone r ma	a	(mm) a	e	Y_1	Y_0		orox. CUP
HM 88648	HM 88610	52	43	60	69	3.5	2.3	20.7	0.55	1.1	0.60	0.298	0.188
25880	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

tes * The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).

- ** The maximum outside diameter is listed and its tolerance is negative (See Table 8.4.2 on Pages A68 and A69).
- ▲ The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

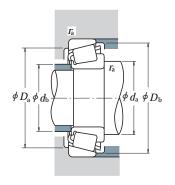
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Bore Diameter 41.275 – 44.450 mm



Boundary Dimensions (mm) Cone								Basic Load			Limiting	
		,	,		Cone	Cup	1)	•		gf}	(mir	,
d	D	T	В	С	<i>1</i> mi		$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
41.275	76.200	18.009	17.384	14.288	1.5	1.5	42 500	51 000	4 350	5 200	4 500	6 300
	76.200	22.225	23.020	17.462	3.5	0.8	66 000	82 000	6 700	8 400	4 800	6 700
	76.200	25.400	23.020	20.638	3.5	2.3	66 000	82 000	6 700	8 400	4 800	6 700
	79.375	23.812	25.400	19.050	3.5	0.8	77 000	98 500	7 850	10 000	4 800	6 300
	80.000	21.000	22.403	17.826	0.8	1.3	68 500	75 500	6 950	7 700	4 500	6 300
	80.000	21.000	22.403	17.826	3.5	1.3	68 500	75 500	6 950	7 700	4 500	6 300
	80.167	25.400	25.400	20.638	3.5	3.3	77 000	98 500	7 850	10 000	4 800	6 300
	82.550	26.543	25.654	20.193	3.5	3.3	78 500	102 000	8 000	10 400	4 300	6 000
	85.725	30.162	30.162	23.812	3.5	3.3	91 000	115 000	9 300	11 700	4 300	6 000
	87.312	30.162	30.886	23.812	0.8	3.3	96 000	120 000	9 800	12 200	4 300	6 000
	88.501	25.400	23.698	17.462	2.3	1.5	73 000	81 000	7 450	8 250	4 000	5 600
	88.900	30.162	29.370	23.020	3.5	3.3	96 500	129 000	9 800	13 200	4 000	5 600
	88.900	30.162	29.370	23.020	0.8	3.3	96 500	129 000	9 800	13 200	4 000	5 600
	90.488	39.688	40.386	33.338	3.5	3.3	139 000	180 000	14 200	18 400	4 300	5 600
	93.662	31.750	31.750	26.195	0.8	3.3	110 000	142 000	11 200	14 400	4 000	5 600
	95.250	30.162	29.370	23.020	3.5	3.3	106 000	143 000	10 800	14 500	3 800	5 300
	98.425	30.958	28.301	20.638	1.5	0.8	87 500	97 000	8 950	9 850	3 600	5 300
42.862	76.992	17.462	17.145	11.908	1.5	1.5	44 000	54 000	4 450	5 500	4 500	6 000
	82.550	19.842	19.837	15.080	2.3	1.5	58 500	69 000	5 950	7 050	4 500	6 300
	82.931	23.812	25.400	19.050	2.3	0.8	76 500	99 000	7 800	10 100	4 500	6 000
	82.931	26.988	25.400	22.225	2.3	2.3	76 500	99 000	7 800	10 100	4 500	6 000
42.875	76.200	25.400	25.400	20.638	3.5	1.5	77 000	98 500	7 850	10 000	4 800	6 300
	80.000	21.000	22.403	17.826	3.5	1.3	68 500	75 500	6 950	7 700	4 500	6 300
	82.931	26.988	25.400	22.225	3.5	2.3	76 500	99 000	7 800	10 100	4 500	6 000
	83.058	23.812	25.400	19.050	3.5	3.3	76 500	99 000	7 800	10 100	4 500	6 000
43.000	74.988	19.368	19.837	14.288	1.5	1.3	52 500	68 000	5 350	6 900	4 800	6 300
44.450	80.962	19.050	17.462	14.288	0.3	1.5	45 000	57 000	4 600	5 800	4 300	6 000
	82.931	23.812	25.400	19.050	3.5	0.8	76 500	99 000	7 800	10 100	4 500	6 000
	83.058	23.812	25.400	19.050	3.5	3.3	76 500	99 000	7 800	10 100	4 500	6 000
	87.312	30.162	30.886	23.812	3.5	3.3	96 000	120 000	9 800	12 200	4 300	6 000
	88.900	30.162	29.370	23.020	3.5	3.3	96 500	129 000	9 800	13 200	4 000	5 600
	93.264	30.162	30.302	23.812	3.5	3.2	103 000	136 000	10 500	13 900	3 800	5 300
	93.662	31.750	31.750	25.400	0.8	3.3	120 000	147 000	12 200	15 000	4 000	5 600
	93.662	31.750	31.750	25.400	3.5	3.3	120 000	147 000	12 200	15 000	4 000	5 600
	93.662	31.750	31.750	26.195	3.5	3.3	110 000	142 000	11 200	14 400	4 000	5 600
	95.250	27.783	29.901	22.225	3.5	2.3	106 000	126 000	10 800	12 900	4 300	5 600





Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$ $F_{\rm a}/F_{\rm r} \leq e$ $F_{\rm a}/F_{\rm r} > e$ X YX

1 0 0.4 Y_1

Static Equivalent Load

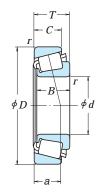
 $P_0 = 0.5F_r + Y_0 F_a$ When $F_{\rm r} > 0.5 F_{\rm r} + Y_0 F_{\rm a}$, use $P_0 = F_{\rm r}$ The values of e, Y_1 , and Y_0 are given in the table below.

Bearin	ng Numbers	Al	outment			nsions		Eff. Load Constant Centers			Load	Ma	
CONE	CUP	$d_{\scriptscriptstyle a}$	d_{b}	(mm) $D_{\rm a}$	$D_{ m b}$	Cone		(mm)			tors Y_0	(k	_
CONE	001	u _a	$u_{\rm b}$	D _a	D_{b}	r _a max		а	e	Y_1	10	appi 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		0.219
M 802048	M 802011	57	51	70	79	3.5	3.3	22.9	0.55	1.1	0.60		0.23
3877	3820	57	50	73	81	3.5	3.3	21.8	0.40	1.5	0.82		0.285
3576	3525	49	48	75	81	0.8	3.3	19.5	0.31	2.0	1.1		0.304
44162	44348	57	51	75	84	2.3	1.5	28.0	0.78	0.77	0.42		0.245
HM 803146	HM 803110	60	53	74	85	3.5	3.3	25.6	0.55	1.1	0.60		0.322
HM 803145	HM 803110	54	53	74	85	0.8	3.3	25.6	0.55	1.1	0.60		0.322
4388	4335	57	51	77	85	3.5	3.3	24.6	0.28	2.1	1.2		0.459
46162	46368	52	51	79	87	0.8	3.3	24.0	0.40	1.5	0.82		0.405
HM 804840	HM 804810	61	54	81	91	3.5	3.3	26.1	0.55	1.1	0.60		0.354
53162	53387	57	53	82	91	1.5	0.8	30.7	0.74	0.81	0.45		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 342 \$ 25577 25577	26823 S 332 25523 25521	55 54 55 55	48.5 47.5 49	69 73 72 72	73 75 77 77	3.5 3.5 3.5 3.5	1.5 1.3 2.3 3.3	18.0 14.5 20.8 17.6	0.32 0.27 0.33 0.33	1.9 2.2 1.8 1.8	1.0 1.2 0.99 0.99		0.136 0.146 0.248 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

* The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).

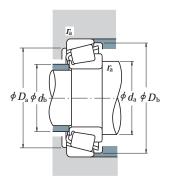
B 147 B 146

Bore Diameter 44.450 – 47.625 mm



	Boundary Dimensions (mm) Cone							ad Ratings	£)	Limiting		
d	D	T	В	С	Cone Cup $m{r}$ min.		$C_{ m r}$	N) $C_{0 m r}$	$C_{ m r}^{\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	gf} $C_{0\mathrm{r}}$	(mir Grease	Oil
44.450	95.250	30.162	29.370	23.020	3.5	3.3	106 000	143 000	10 800	14 500	3 800	5 300
	95.250	30.958	28.301	20.638	3.5	0.8	87 500	97 000	8 950	9 850	3 600	5 300
	95.250	30.958	28.301	20.638	1.3	0.8	87 500	97 000	8 950	9 850	3 600	5 300
	95.250	30.958	28.301	20.638	2.0	0.8	87 500	97 000	8 950	9 850	3 600	5 300
	95.250	30.958	28.301	22.225	1.3	0.8	100 000	122 000	10 200	12 500	3 600	5 000
	95.250	30.958	28.575	22.225	3.5	0.8	100 000	122 000	10 200	12 500	3 600	5 000
	98.425	30.958	28.301	20.638	3.5	0.8	87 500	97 000	8 950	9 850	3 600	5 300
	103.188	43.658	44.475	36.512	1.3	3.3	178 000	238 000	18 100	24 300	3 800	5 000
	104.775	36.512	36.512	28.575	3.5	3.3	139 000	192 000	14 200	19 600	3 400	4 800
	107.950	27.783	29.317	22.225	3.5	0.8	116 000	149 000	11 800	15 200	3 400	4 800
	111.125	30.162	26.909	20.638	3.5	3.3	92 500	110 000	9 450	11 200	3 200	4 300
	114.300	44.450	44.450	34.925	3.5	3.3	172 000	205 000	17 500	20 900	3 600	4 800
44.983	82.931	23.812	25.400	19.050	1.5	0.8	76 500	99 000	7 800	10 100	4 500	6 000
45.000	93.264	20.638	22.225	15.082	0.8	1.3	77 000	93 000	7 900	9 500	3 800	5 300
45.230	79.985	19.842	20.638	15.080	2.0	1.3	62 000	78 500	6 300	8 000	4 500	6 000
45.242	73.431	19.558	19.812	15.748	3.5	0.8	53 500	75 000	5 450	7 650	4 800	6 300
	77.788	19.842	19.842	15.080	3.5	0.8	56 000	71 000	5 700	7 250	4 500	6 300
	77.788	21.430	19.842	16.667	3.5	0.8	56 000	71 000	5 700	7 250	4 500	6 300
45.618	82.931	23.812	25.400	19.050	3.5	0.8	76 500	99 000	7 800	10 100	4 500	6 000
	82.931	26.988	25.400	22.225	3.5	2.3	76 500	99 000	7 800	10 100	4 500	6 000
46.000	75.000	18.000	18.000	14.000	2.3	1.5	51 000	71 500	5 200	7 300	4 500	6 300
46.038	79.375	17.462	17.462	13.495	2.8	1.5	46 000	57 000	4 700	5 800	4 500	6 000
	80.962	19.050	17.462	14.288	0.8	1.5	45 000	57 000	4 600	5 800	4 300	6 000
	85.000	20.638	21.692	17.462	2.3	1.3	71 500	81 500	7 300	8 300	4 300	6 000
	85.000	25.400	25.608	20.638	3.5	1.3	79 500	105 000	8 100	10 700	4 300	6 000
	95.250	27.783	29.901	22.225	3.5	0.8	106 000	126 000	10 800	12 900	4 300	5 600
47.625	88.900	20.638	22.225	16.513	3.5	1.3	73 000	85 000	7 450	8 650	4 000	5 600
	88.900	25.400	25.400	19.050	3.5	3.3	86 000	107 000	8 750	10 900	4 000	5 600
	95.250	30.162	29.370	23.020	3.5	3.3	106 000	143 000	10 800	14 500	3 800	5 300
	101.600	34.925	36.068	26.988	3.5	3.3	137 000	169 000	14 000	17 200	3 800	5 000
	111.125	30.162	26.909	20.638	3.5	3.3	92 500	110 000	9 450	11 200	3 200	4 300
	112.712	30.162	26.909	20.638	3.5	3.3	92 500	110 000	9 450	11 200	3 200	4 300
	117.475	33.338	31.750	23.812	3.5	3.3	137 000	156 000	13 900	15 900	3 200	4 300
	123.825	36.512	32.791	25.400	3.5	3.3	143 000	160 000	14 600	16 400	3 000	4 000





Dynamic Equivalent Load

Static Equivalent Load

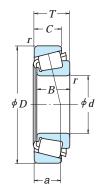
 $P_0=0.5F_r+Y_0F_a$ When $F_r>0.5F_r+Y_0F_a$, use $P_0=F_r$ The values of e, Y_1 , and Y_0 are given in the table below.

Bearing N	lumbers	A	outmen	t and Fille (mm				Eff. Load Centers	Constant	Axial Fac	Load tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{\scriptscriptstyle m b}$	Cone r ma	a	(mm) a	e	Y_1	Y_0	app CONE	orox. 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

* The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).

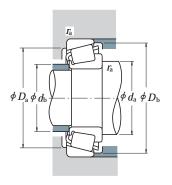
** The maximum outside diameter is listed and its tolerance is negative (See Table 8.4.2 on Pages A68 and A69).

Bore Diameter 48.412 – 52.388 mm



Boundary Dimensions (mm)									d Ratings		Limiting	
,	_	,	,	~				N)		gf}	(mir	,
d	D	T	В	C	<i>I</i> mi		$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
48.412	95.250	30.162	29.370	23.020	3.5	3.3	106 000	143 000	10 800	14 500	3 800	5 300
	95.250	30.162	29.370	23.020	2.3	3.3	106 000	143 000	10 800	14 500	3 800	5 300
49.212	104.775 114.300	36.512 44.450	36.512 44.450	28.575 36.068	3.5 3.5	0.8	139 000 196 000	192 000 243 000	14 200 20 000	19 600 24 800	3 400 3 400	4 800 4 800
50.000	82.000	21.500	21.500	17.000	3.0	0.5	71 000	96 000	7 250	9 800	4 300	5 600
	82.550	21.590	22.225	16.510	0.5	1.3	71 000	96 000	7 250	9 800	4 300	5 600
	88.900	20.638	22.225	16.513	2.3	1.3	73 000	85 000	7 450	8 650	4 000	5 600
	90.000	28.000	28.000	23.000	3.0	2.5	104 000	136 000	10 600	13 900	4 000	5 600
	105.000	37.000	36.000	29.000	3.0	2.5	139 000	192 000	14 200	19 600	3 400	4 800
50.800	80.962	18.258	18.258	14.288	1.5	1.5	53 000	81 000	5 400	8 250	4 300	5 600
	82.550	23.622	22.225	18.542	3.5	0.8	71 000	96 000	7 250	9 800	4 300	5 600
	82.931	21.590	22.225	16.510	3.5	1.3	71 000	96 000	7 250	9 800	4 300	5 600
	85.000	17.462	17.462	13.495	3.5	1.5	48 500	63 000	4 950	6 450	4 300	5 600
	85.725	19.050	18.263	12.700	1.5	1.5	42 500	54 000	4 350	5 500	4 000	5 300
	88.900	20.638	22.225	16.513	3.5	1.3	73 000	85 000	7 450	8 650	4 000	5 600
	88.900	20.638	22.225	16.513	1.5	1.3	73 000	85 000	7 450	8 650	4 000	5 600
	92.075	24.608	25.400	19.845	3.5	0.8	84 500	117 000	8 600	11 900	4 000	5 300
	93.264	30.162	30.302	23.812	0.8	0.8	103 000	136 000	10 500	13 900	3 800	5 300
	93.264	30.162	30.302	23.812	3.5	0.8	103 000	136 000	10 500	13 900	3 800	5 300
	95.250	27.783	28.575	22.225	3.5	2.3	110 000	144 000	11 200	14 700	3 800	5 300
	101.600	31.750	31.750	25.400	3.5	3.3	118 000	150 000	12 100	15 200	3 600	5 000
	101.600	34.925	36.068	26.988	0.8	3.3	137 000	169 000	14 000	17 200	3 800	5 000
	101.600	34.925	36.068	26.988	3.5	3.3	137 000	169 000	14 000	17 200	3 800	5 000
	104.775	36.512	36.512	28.575	3.5	0.8	139 000	192 000	14 200	19 600	3 400	4 800
	104.775	36.512	36.512	28.575	3.5	3.3	139 000	192 000	14 200	19 600	3 400	4 800
	108.966	34.925	36.512	26.988	3.5	3.3	145 000	181 000	14 700	18 500	3 600	4 800
	111.125	30.162	26.909	20.638	3.5	3.3	113 000	152 000	11 500	15 400	3 000	4 300
	111.125	30.162	26.909	20.638	3.5	3.3	92 500	110 000	9 450	11 200	3 200	4 300
	123.825	36.512	32.791	25.400	3.5	3.3	162 000	199 000	16 500	20 300	2 800	4 000
	123.825	36.512	32.791	25.400	3.5	3.3	143 000	160 000	14 600	16 400	3 000	4 000
	127.000	44.450	44.450	34.925	3.5	3.3	199 000	258 000	20 200	26 300	3 000	4 000
	127.000	50.800	52.388	41.275	3.5	3.3	236 000	300 000	24 000	31 000	3 200	4 300
52.388	92.075	24.608	25.400	19.845	3.5	0.8	84 500	117 000	8 600	11 900	4 000	5 300
	100.000	25.000	22.225	21.824	2.3	2.0	77 000	93 000	7 900	9 500	3 800	5 300
	111.125	30.162	26.909	20.638	3.5	3.3	92 500	110 000	9 450	11 200	3 200	4 300





Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e		
X	Y	X	Y		
1	0	0.4	Y ₁		

Static Equivalent Load

given in the table below.

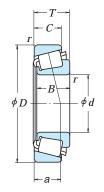
 $P_0=0.5\,F_{\rm r}+Y_0\,F_{\rm a}$ When $F_{\rm r}>0.5\,F_{\rm r}+Y_0\,F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are

Bearing Nu	umbers	A	butmen	t and Fill (mm			Cun	Eff. Load Centers	Constant		Load tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{\scriptscriptstyle m b}$	Cone r a max	a	(mm) a	e	Y_1	Y_0	app CONE	orox. 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		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

* The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).

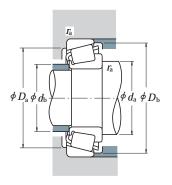
The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

Bore Diameter 53.975 – 58.738 mm



			Dimension	S				Basic Loa	0		Limiting	•
		(m	nm)		Cone	Cup	(N)	{k	gf}	(mir	ı ⁻¹)
d	D	T	В	С	<i>r</i> mir		$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
53.975	104.775	39.688	40.157	33.338	3.5	3.3	148 000	207 000	15 100	21 100	3 600	4 800
	107.950	36.512	36.957	28.575	3.5	3.3	144 000	182 000	14 700	18 500	3 600	4 800
	122.238	33.338	31.750	23.812	3.5	3.3	135 000	156 000	13 800	15 900	3 000	4 000
	123.825	36.512	32.791	25.400	3.5	3.3	143 000	160 000	14 600	16 400	3 000	4 000
	123.825	36.512	32.791	25.400	3.5	3.3	162 000	199 000	16 500	20 300	2 800	4 000
	123.825	38.100	36.678	30.162	3.5	3.3	161 000	221 000	16 400	22 500	3 000	4 000
	127.000	44.450	44.450	34.925	3.5	3.3	199 000	258 000	20 200	26 300	3 000	4 000
	127.000	50.800	52.388	41.275	3.5	3.3	236 000	300 000	24 000	31 000	3 200	4 300
	130.175	36.512	33.338	23.812	3.5	3.3	133 000	154 000	13 600	15 700	2 600	3 600
55.000	90.000	23.000	23.000	18.500	1.5	0.5	79 000	111 000	8 050	11 300	3 800	5 300
	95.000	29.000	29.000	23.500	1.5	2.5	111 000	152 000	11 300	15 500	3 800	5 000
	96.838	21.000	21.946	15.875	2.3	0.8	80 500	100 000	8 200	10 200	3 600	5 000
	110.000	39.000	39.000	32.000	3.0	2.5	177 000	225 000	18 000	23 000	3 400	4 500
	115.000	41.021	41.275	31.496	3.0	3.0	172 000	214 000	17 500	21 800	3 200	4 500
55.562	97.630	24.608	24.608	19.446	3.5	0.8	89 000	129 000	9 100	13 100	3 600	5 000
	122.238	43.658	43.764	36.512	1.3	3.3	198 000	292 000	20 200	29 700	3 000	4 000
	123.825	36.512	32.791	25.400	3.5	3.3	143 000	160 000	14 600	16 400	3 000	4 000
	123.825	36.512	32.791	25.400	3.5	3.3	162 000	199 000	16 500	20 300	2 800	4 000
57.150	96.838	21.000	21.946	15.875	3.5	0.8	80 500	100 000	8 200	10 200	3 600	5 000
	96.838	21.000	21.946	15.875	2.3	0.8	80 500	100 000	8 200	10 200	3 600	5 000
	96.838	25.400	21.946	20.275	3.5	2.3	80 500	100 000	8 200	10 200	3 600	5 000
	98.425	21.000	21.946	17.826	3.5	0.8	80 500	100 000	8 200	10 200	3 600	5 000
	104.775	30.162	29.317	24.605	3.5	3.3	116 000	149 000	11 800	15 200	3 400	4 800
	104.775	30.162	29.317	24.605	2.3	3.3	116 000	149 000	11 800	15 200	3 400	4 800
	104.775	30.162	30.958	23.812	0.8	3.3	130 000	170 000	13 300	17 400	3 400	4 800
	104.775	30.162	30.958	23.812	0.8	0.8	130 000	170 000	13 300	17 400	3 400	4 800
	122.238	33.338	31.750	23.812	3.5	3.3	135 000	156 000	13 800	15 900	3 000	4 000
	123.825	36.512	32.791	25.400	3.5	3.3	162 000	199 000	16 500	20 300	2 800	4 000
	123.825	38.100	36.678	30.162	3.5	3.3	161 000	221 000	16 400	22 500	3 000	4 000
	140.030	36.512	33.236	23.520	3.5	2.3	152 000	183 000	15 500	18 700	2 600	3 600
	144.983	36.000	33.236	23.007	3.5	3.5	152 000	183 000	15 500	18 700	2 600	3 600
	149.225	53.975	54.229	44.450	3.5	3.3	287 000	410 000	29 300	41 500	2 600	3 400
57.531	96.838	21.000	21.946	15.875	3.5	0.8	80 500	100 000	8 200	10 200	3 600	5 000
58.738	112.712	33.338	30.048	26.988	3.5	3.3	120 000	173 000	12 200	17 700	3 200	4 300





Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

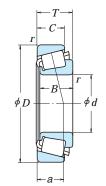
Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 \, F_{\rm a}$ When $F_{\rm r} > 0.5F_{\rm r} + Y_0 \, F_{\rm a}$, use $P_0 = F_{\rm r}$

The values of \emph{e}_{\imath} \emph{Y}_{1} , and \emph{Y}_{0} are given in the table below.

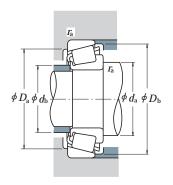
Bearing No	umbers	A	butmen	t and Fill (mm				Eff. Load Centers	Constant	Axial Fac	Load tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\rm a}$	$D_{\scriptscriptstyle m b}$	Cone r a ma	a	(mm) a	e	Y_1	Y_0	app CONE	orox. CUP
4595	4535	70	63	90	99	3.5	3.3	27.4	0.34	1.79	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	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		28.7	0.40	1.5	0.82	0.899	0.541

Bore Diameter 60.000 – 64.963 mm



			Dimension	S				Basic Load	0		Limiting	•
		,	nm)		Cone	Cup	1)	V)	{k	gf}	(mir	,
d	D	T	В	С	<i>T</i> mir		$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
60.000	95.000	24.000	24.000	19.000	5.0	2.5	86 500	125 000	8 800	12 800	3 600	5 000
	104.775	21.433	22.000	15.875	2.3	2.0	83 500	107 000	8 500	10 900	3 400	4 500
	110.000	22.000	21.996	18.824	0.8	1.3	85 500	113 000	8 750	11 500	3 200	4 300
	122.238	33.338	31.750	23.812	3.5	3.3	135 000	156 000	13 800	15 900	3 000	4 000
60.325	100.000	25.400	25.400	19.845	3.5	3.3	91 000	135 000	9 250	13 700	3 400	4 800
	101.600	25.400	25.400	19.845	3.5	3.3	91 000	135 000	9 250	13 700	3 400	4 800
	122.238	38.100	36.678	30.162	2.3	3.3	161 000	221 000	16 400	22 500	3 000	4 000
	122.238	38.100	38.354	29.718	8.0	1.5	188 000	245 000	19 200	25 000	3 000	4 000
	122.238	43.658	43.764	36.512	0.8	3.3	198 000	292 000	20 200	29 700	3 000	4 000
	127.000	44.450	44.450	34.925	3.5	3.3	199 000	258 000	20 200	26 300	3 000	4 000
	130.175	41.275	41.275	31.750	3.5	3.3	195 000	263 000	19 800	26 800	2 800	3 800
	135.755	53.975	56.007	44.450	3.5	3.3	264 000	355 000	27 000	36 000	2 800	3 800
61.912	136.525	46.038	46.038	36.512	3.5	3.3	233 000	370 000	23 800	37 500	2 600	3 400
	146.050	41.275	39.688	25.400	3.5	3.3	193 000	225 000	19 700	22 900	2 400	3 400
	152.400	47.625	46.038	31.750	3.5	3.3	237 000	267 000	24 200	27 300	2 400	3 400
63.500	94.458	19.050	19.050	15.083	1.5	1.5	59 000	100 000	6 050	10 200	3 600	4 800
	104.775	21.433	22.000	15.875	2.0	2.0	83 500	107 000	8 500	10 900	3 400	4 500
	107.950	25.400	25.400	19.050	1.5	3.3	90 000	138 000	9 150	14 100	3 200	4 300
	110.000	22.000	21.996	18.824	3.5	1.3	85 500	113 000	8 750	11 500	3 200	4 300
	110.000	22.000	21.996	18.824	1.5	1.3	85 500	113 000	8 750	11 500	3 200	4 300
	112.712	30.162	30.048	23.812	3.5	3.2	120 000	173 000	12 200	17 700	3 200	4 300
	112.712	30.162	30.162	23.812	3.5	3.3	142 000	202 000	14 500	20 600	3 200	4 300
	112.712	33.338	30.048	26.988	3.5	3.3	120 000	173 000	12 200	17 700	3 200	4 300
	122.238	38.100	38.354	29.718	7.0	3.3	188 000	245 000	19 200	25 000	3 000	4 000
	122.238	38.100	38.354	29.718	7.0	1.5	188 000	245 000	19 200	25 000	3 000	4 000
	122.238	38.100	38.354	29.718	3.5	1.5	188 000	245 000	19 200	25 000	3 000	4 000
	122.238	43.658	43.764	36.512	3.5	3.3	198 000	292 000	20 200	29 700	3 000	4 000
	123.825	38.100	36.678	30.162	3.5	3.3	161 000	221 000	16 400	22 500	3 000	4 000
	127.000	36.512	36.170	28.575	3.5	3.3	166 000	234 000	16 900	23 900	2 800	3 800
	130.175	41.275	41.275	31.750	3.5	3.3	195 000	263 000	19 800	26 800	2 800	3 800
	136.525	36.512	33.236	23.520	2.3	3.3	152 000	183 000	15 500	18 700	2 600	3 600
	136.525	41.275	41.275	31.750	3.5	3.3	195 000	263 000	19 800	26 800	2 800	3 800
	140.030	36.512	33.236	23.520	2.3	2.3	152 000	183 000	15 500	18 700	2 600	3 600
64.963	127.000	36.512	36.170	28.575	3.5	3.3	166 000	234 000	16 900	23 900	2 800	3 800





Dynamic Equivalent Load

Static Equivalent Load

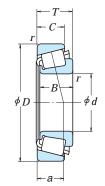
 $P_0=0.5F_{\rm r}+Y_0F_{\rm a}$ When $F_{\rm r}>0.5F_{\rm r}+Y_0F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are given in the table below.

Bearing	Numbers	Al	outmen	t and Fille (mm				Eff. Load Centers	Constant		Load tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle \mathrm{a}}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{\scriptscriptstyle m b}$	Cone $m{r}_{\!a}$	· ·	(mm) a	e	Y_1	Y_0	app CONE	orox. 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 Notes *	563	81	74	112	120	3.5	3.3	28.3	0.36	1.6	0.91	1.41	0.655

* The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).

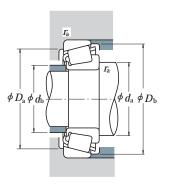
The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

Bore Diameter 65.000 – 69.850 mm



			Dimension	s					nd Ratings		Limiting	
ı	Б	,	•	a	Cone		,	N)		gf}	(mir	,
d	D	T	В	С	<i>I</i> mi		$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
65.000	105.000	24.000	23.000	18.500	3.0	1.0	93 000	126 000	9 500	12 900	3 400	4 500
	110.000	28.000	28.000	22.500	3.0	2.5	120 000	173 000	12 200	17 700	3 200	4 300
	120.000	29.002	29.007	23.444	2.3	3.3	123 000	169 000	12 500	17 200	3 000	4 000
	120.000	39.000	38.500	32.000	3.0	2.5	185 000	249 000	18 800	25 400	3 000	4 000
65.088	135.755	53.975	56.007	44.450	3.5	3.3	264 000	355 000	27 000	36 000	2 800	3 800
	136.525	46.038	46.038	36.512	3.5	3.3	233 000	370 000	23 800	37 500	2 600	3 400
66.675	110.000	22.000	21.996	18.824	0.8	1.3	85 500	113 000	8 750	11 500	3 200	4 300
	110.000	22.000	21.996	18.824	3.5	1.3	85 500	113 000	8 750	11 500	3 200	4 300
	112.712	30.162	30.048	23.812	3.5	3.2	120 000	173 000	12 200	17 700	3 200	4 300
	112.712	30.162	30.048	23.812	5.5	3.2	120 000	173 000	12 200	17 700	3 200	4 300
	112.712	30.162	30.162	23.812	3.5	0.8	142 000	202 000	14 500	20 600	3 200	4 300
	112.712	30.162	30.162	23.812	3.5	3.3	142 000	202 000	14 500	20 600	3 200	4 300
	117.475	30.162	30.162	23.812	3.5	3.3	119 000	179 000	12 200	18 300	3 000	4 000
	122.238	38.100	36.678	30.162	3.5	3.3	161 000	221 000	16 400	22 500	3 000	4 000
	122.238	38.100	38.354	29.718	3.5	1.5	188 000	245 000	19 200	25 000	3 000	4 000
	122.238	38.100	38.354	29.718	3.5	3.3	188 000	245 000	19 200	25 000	3 000	4 000
	123.825	38.100	36.678	30.162	3.5	3.3	161 000	221 000	16 400	22 500	3 000	4 000
	136.525	46.038	46.038	36.512	3.5	3.3	233 000	370 000	23 800	37 500	2 600	3 400
68.262	110.000	22.000	21.996	18.824	2.3	1.3	85 500	113 000	8 750	11 500	3 200	4 300
	120.000	29.795	29.007	24.237	3.5	2.0	123 000	169 000	12 500	17 200	3 000	4 000
	122.238	38.100	36.678	30.162	3.5	3.3	161 000	221 000	16 400	22 500	3 000	4 000
	127.000	36.512	36.170	28.575	3.5	3.3	166 000	234 000	16 900	23 900	2 800	3 800
	136.525	41.275	41.275	31.750	3.5	3.3	229 000	297 000	23 300	30 500	2 600	3 600
	136.525	46.038	46.038	36.512	3.5	3.3	233 000	370 000	23 800	37 500	2 600	3 400
	152.400	47.625	46.038	31.750	3.5	3.3	237 000	267 000	24 200	27 300	2 400	3 400
69.850	112.712	22.225	21.996	15.875	1.5	0.8	85 000	113 000	8 650	11 500	3 000	4 000
	112.712	25.400	25.400	19.050	1.5	3.3	96 000	152 000	9 800	15 500	2 800	4 000
	117.475	30.162	30.162	23.812	3.5	3.3	119 000	179 000	12 200	18 300	3 000	4 000
	120.000	32.545	32.545	26.195	3.5	3.3	152 000	225 000	15 500	22 900	3 000	4 000
	120.650	25.400	25.400	19.050	1.5	3.3	96 000	152 000	9 800	15 500	2 800	4 000
	127.000	36.512	36.170	28.575	3.5	0.8	166 000	234 000	16 900	23 900	2 800	3 800
	130.175	41.275	41.275	31.750	3.5	3.3	195 000	263 000	19 800	26 800	2 800	3 800
	146.050	41.275	39.688	25.400	3.5	3.3	193 000	225 000	19 700	22 900	2 400	3 400
	146.050	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200
	149.225	53.975	54.229	44.450	5.0	3.3	287 000	410 000	29 300	41 500	2 600	3 400
	150.089	44.450	46.672	36.512	3.5	3.3	265 000	370 000	27 000	37 500	2 400	3 200





Dynamic Equivalent Load

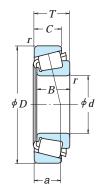
P = X	$F_{\rm r} + Y F_{\rm a}$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	7>
X	Y	X	

Static Equivalent Load

$$\begin{split} P_0 &= 0.5F_{\rm r} + Y_0\,F_{\rm a} \\ \text{When } F_{\rm r} &> 0.5F_{\rm r} + Y_0\,F_{\rm a}, \text{ use } P_0 = F_{\rm r} \end{split}$$
 The values of $e,~Y_1$, and Y_0 are given in the table below.

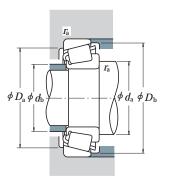
Bearing N	umbers	A	butmen	t and Fill (mm		nsions Cone	C	Eff. Load Centers	Constant		Load tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{\scriptscriptstyle m b}$	Cone $oldsymbol{r_{ m a}}$	1	(mm) a	e	Y_1	Y_0	app CONE	orox. CUP
▲ JLM 710949	▲ 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	2.95	1.63
745 A	742	88	82	134	142	3.5	3.3	32.5	0.33	1.8	1.0	2.82	1.07

Bore Diameter 70.000 – 76.200 mm



			Dimension	S			//	Basic Loa	9	f)	Limiting	
d	D	T	В	С	Cone 1		$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	C_{0r}	(mir Grease	۱¬۱) Oil
					mi	n.	•	•	•			
70.000	110.000	26.000	25.000	20.500	1.0	2.5	98 500	152 000	10 000	15 500	3 000	4 000
	115.000	29.000	29.000	23.000	3.0	2.5	126 000	177 000	12 900	18 100	3 000	4 000
	120.000	29.795	29.007	24.237	2.0	2.0	123 000	169 000	12 500	17 200	3 000	4 000
71.438	117.475	30.162	30.162	23.812	3.5	3.3	119 000	179 000	12 200	18 300	3 000	4 000
	120.000	32.545	32.545	26.195	3.5	3.3	152 000	225 000	15 500	22 900	3 000	4 000
	127.000	36.512	36.170	28.575	6.4	3.3	166 000	234 000	16 900	23 900	2 800	3 800
	127.000	36.512	36.170	28.575	3.5	3.3	166 000	234 000	16 900	23 900	2 800	3 800
	130.175	41.275	41.275	31.750	6.4	3.3	195 000	263 000	19 800	26 800	2 800	3 800
	136.525	41.275	41.275	31.750	3.5	3.3	195 000	263 000	19 800	26 800	2 800	3 800
	136.525	41.275	41.275	31.750	3.5	3.3	229 000	297 000	23 300	30 500	2 600	3 600
	136.525	46.038	46.038	36.512	3.5	3.3	233 000	370 000	23 800	37 500	2 600	3 400
73.025	112.712	25.400	25.400	19.050	3.5	3.3	96 000	152 000	9 800	15 500	2 800	4 000
	117.475	30.162	30.162	23.812	3.5	3.3	119 000	179 000	12 200	18 300	3 000	4 000
	127.000	36.512	36.170	28.575	3.5	3.3	166 000	234 000	16 900	23 900	2 800	3 800
	146.050	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200
	149.225	53.975	54.229	44.450	3.5	3.3	287 000	410 000	29 300	41 500	2 600	3 400
73.817	127.000	36.512	36.170	28.575	0.8	3.3	166 000	234 000	16 900	23 900	2 800	3 800
74.612	150.000	41.275	41.275	31.750	3.5	3.0	207 000	296 000	21 100	30 000	2 400	3 200
75.000	115.000	25.000	25.000	19.000	3.0	2.5	101 000	150 000	10 300	15 300	3 000	4 000
	120.000	31.000	29.500	25.000	3.0	2.5	129 000	198 000	13 100	20 200	2 800	3 800
	145.000	51.000	51.000	42.000	3.0	2.5	283 000	410 000	28 900	41 500	2 600	3 400
76.200	121.442	24.608	23.012	17.462	2.0	2.0	89 000	124 000	9 100	12 600	2 800	3 800
	127.000	30.162	31.000	22.225	3.5	3.3	134 000	195 000	13 700	19 900	2 800	3 800
	127.000	30.162	31.001	22.225	6.4	3.3	134 000	195 000	13 700	19 900	2 800	3 800
	133.350	33.338	33.338	26.195	0.8	3.3	154 000	237 000	15 700	24 200	2 600	3 600
	135.733	44.450	46.101	34.925	3.5	3.3	216 000	340 000	22 000	35 000	2 600	3 600
	136.525	30.162	29.769	22.225	3.5	3.3	130 000	192 000	13 300	19 600	2 600	3 400
	136.525	30.162	29.769	22.225	6.4	3.3	130 000	192 000	13 300	19 600	2 600	3 400
	139.992	36.512	36.098	28.575	3.5	3.3	175 000	260 000	17 800	26 500	2 600	3 400
	149.225	53.975	54.229	44.450	3.5	3.3	287 000	410 000	29 300	41 500	2 600	3 400
	152.400	39.688	36.322	30.162	3.5	3.2	183 000	285 000	18 700	29 100	2 200	3 200
	152.400	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200
	161.925	49.212	46.038	31.750	3.5	3.3	248 000	290 000	25 300	29 600	2 200	3 000
	161.925	53.975	55.100	42.862	3.5	3.3	325 000	480 000	33 000	49 000	2 200	3 000
	161.925	53.975	55.100	42.862	6.4	3.3	325 000	480 000	33 000	49 000	2 200	3 000
	161.925	53.975	55.100	42.862	6.4	0.8	325 000	480 000	33 000	49 000	2 200	3 000





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

Static Equivalent Load

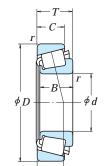
 $P_0 = 0.5F_r + Y_0 F_a$ When $F_{
m r}\!>\!0.5F_{
m r}+Y_0\,F_{
m a}$, use P_0 = $F_{
m r}$ The values of e, Y_1 , and Y_0 are given in the table below.

Bearing Nu	umbers	Al	butment	t and Fill (mm			C	Eff. Load Centers	Constant		Load ctors		ass kg)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{ m b}$	Cone r ma	a '	(mm) a	e	<i>Y</i> ₁	Y_0	app CONE	prox. CUP
▲ JLM 813049	▲ JLM 813010	78	77	98	105	1	2.5	26.2	0.49	1.2	0.68	0.604	
▲ JM 612949	▲ JM 612910	83	77	103	110	3	2.5	26.4	0.43	1.4	0.77	0.800	
484	472	80	78	106	113	2	2	25.1	0.38	1.6	0.86	0.822	
33281	33462	85	79	104	112	3.5	3.3	26.8	0.44	1.4	0.76	0.789	0.655
47490	47420	86	79	107	114	3.5	3.3	26.0	0.36	1.7	0.92	0.983	
567 S	563	92	80	112	120	6.4	3.3	28.3	0.36	1.6	0.91	1.21	
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

The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

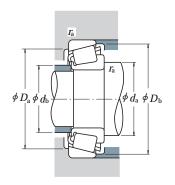
B 158 B 159

Bore Diameter 76.200 – 83.345 mm



	Boundary Dimensions (mm)							Basic Load	0		Limiting Speeds		
,	_	,	,	_	Cone	Cup	`	N)		gf} -	(min	,	
d	D	T	В	С	<i>T</i> mir		$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
76.200	168.275	53.975	56.363	41.275	6.4	3.3	345 000	470 000	35 000	48 000	2 200	3 000	
	168.275	53.975	56.363	41.275	0.8	3.3	345 000	470 000	35 000	48 000	2 200	3 000	
	171.450	49.212	46.038	31.750	3.5	3.3	257 000	310 000	26 200	32 000	2 000	2 800	
	177.800	55.562	50.800	34.925	3.5	3.3	257 000	310 000	26 200	32 000	2 000	2 800	
77.788	121.442	24.608	23.012	17.462	3.5	2.0	89 000	124 000	9 100	12 600	2 800	3 800	
	127.000	30.162	31.000	22.225	3.5	3.3	134 000	195 000	13 700	19 900	2 800	3 800	
	135.733	44.450	46.101	34.925	3.5	3.3	216 000	340 000	22 000	35 000	2 600	3 600	
79.375	146.050	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200	
	150.089	44.450	46.672	36.512	3.5	3.3	265 000	370 000	27 000	37 500	2 400	3 200	
80.000	130.000	35.000	34.000	28.500	3.0	2.5	166 000	251 000	17 000	25 600	2 600	3 600	
80.962	136.525	30.162	29.769	22.225	3.5	3.3	130 000	192 000	13 300	19 600	2 600	3 400	
	139.700	36.512	36.098	28.575	3.5	3.3	175 000	260 000	17 800	26 500	2 600	3 400	
	139.992	36.512	36.098	28.575	3.5	3.3	175 000	260 000	17 800	26 500	2 600	3 400	
82.550	125.412	25.400	25.400	19.845	3.5	1.5	102 000	164 000	10 400	16 700	2 600	3 600	
	133.350	30.162	29.769	22.225	3.5	3.3	130 000	192 000	13 300	19 600	2 600	3 400	
	133.350	33.338	33.338	26.195	3.5	3.3	154 000	237 000	15 700	24 200	2 600	3 600	
	133.350	33.338	33.338	26.195	0.8	3.3	154 000	237 000	15 700	24 200	2 600	3 600	
	133.350	33.338	33.338	26.195	6.8	3.3	154 000	237 000	15 700	24 200	2 600	3 600	
	133.350	39.688	39.688	32.545	6.8	3.3	179 000	310 000	18 300	31 500	2 600	3 600	
	136.525	30.162	29.769	22.225	3.5	3.3	130 000	192 000	13 300	19 600	2 600	3 400	
	139.700	36.512	36.098	28.575	3.5	3.3	175 000	260 000	17 800	26 500	2 600	3 400	
	139.992	36.512	36.098	28.575	3.5	3.3	175 000	260 000	17 800	26 500	2 600	3 400	
	139.992	36.512	36.098	28.575	6.8	3.3	175 000	260 000	17 800	26 500	2 600	3 400	
	146.050	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200	
	150.000	44.455	46.672	35.000	3.5	3.3	265 000	370 000	27 000	37 500	2 400	3 200	
	150.089	44.450	46.672	36.512	3.5	3.3	265 000	370 000	27 000	37 500	2 400	3 200	
	152.400	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200	
	161.925	47.625	48.260	38.100	3.5	3.3	274 000	390 000	28 000	40 000	2 200	3 000	
	161.925	53.975	55.100	42.862	3.5	3.3	325 000	480 000	33 000	49 000	2 200	3 000	
	168.275	47.625	48.260	38.100	3.5	3.3	274 000	390 000	28 000	40 000	2 200	3 000	
	168.275	53.975	56.363	41.275	3.5	3.3	345 000	470 000	35 000	48 000	2 200	3 000	
83.345	125.412	25.400	25.400	19.845	3.5	1.5	102 000	164 000	10 400	16 700	2 600	3 600	
	125.412	25.400	25.400	19.845	0.8	1.5	102 000	164 000	10 400	16 700	2 600	3 600	





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e		
X	Y	X	Y		
1	0	0.4	Y ₁		

Static Equivalent Load

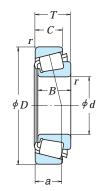
 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}>0.5F_{\rm r}+Y_0\,F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are

given in the table below.

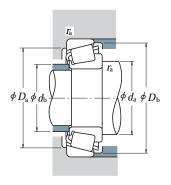
Bearing Nun	nhers	Abutment and Fillet Dimensions							Constant			Mass	
Dodning Null		A	Jan 11011	(mm		Cone	Cun	Centers (mm)	Jonatuill		tors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{ m b}$	r _a	i '	a	e	Y_1	Y_0	app CONE	CUP
843	832	101	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

Bore Diameter 84.138 – 90.488 mm



			Dimension	S				Basic Loa			Limiting Speeds		
		(m	nm)		Cone	Cup	1)	۷)	{k	gf}	(mir	,	
d	D	T	В	С	<i>I</i> mir	• '	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
84.138	136.525	30.162	29.769	22.225	3.5	3.3	130 000	192 000	13 300	19 600	2 600	3 400	
	146.050	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200	
	171.450	49.212	46.038	31.750	3.5	3.3	257 000	310 000	26 200	32 000	2 000	2 800	
85.000	130.000	30.000	29.000	24.000	6.0	2.5	138 000	222 000	14 100	22 700	2 600	3 600	
	130.000	30.000	29.000	24.000	3.0	2.5	138 000	222 000	14 100	22 700	2 600	3 600	
	140.000	39.000	38.000	31.500	3.0	2.5	202 000	305 000	20 600	31 000	2 400	3 400	
	150.000	46.000	46.000	38.000	3.0	2.5	275 000	390 000	28 000	40 000	2 400	3 200	
85.026	150.089	44.450	46.672	36.512	3.5	3.3	265 000	370 000	27 000	37 500	2 400	3 200	
	150.089	44.450	46.672	36.512	5.0	3.3	265 000	370 000	27 000	37 500	2 400	3 200	
85.725	133.350	30.162	29.769	22.225	3.5	3.3	130 000	192 000	13 300	19 600	2 600	3 400	
	136.525	30.162	29.769	22.225	3.5	3.3	130 000	192 000	13 300	19 600	2 600	3 400	
	142.138	42.862	42.862	34.133	4.8	3.3	221 000	360 000	22 500	36 500	2 400	3 400	
	146.050	41.275	41.275	31.750	6.4	3.3	207 000	296 000	21 100	30 000	2 400	3 200	
	146.050	41.275	41.275	31.750	3.5	3.3	207 000	296 000	21 100	30 000	2 400	3 200	
	152.400	39.688	36.322	30.162	3.5	3.2	183 000	285 000	18 700	29 100	2 200	3 200	
	161.925	47.625	48.260	38.100	3.5	3.3	274 000	390 000	28 000	40 000	2 200	3 000	
	168.275	41.275	41.275	30.162	3.5	3.3	223 000	345 000	22 700	35 000	2 000	2 800	
87.312	190.500	57.150	57.531	46.038	8.0	3.3	390 000	520 000	39 500	53 500	1 900	2 600	
88.900	149.225	31.750	28.971	24.608	3.0	3.3	140 000	218 000	14 300	22 300	2 200	3 000	
	152.400	39.688	36.322	30.162	3.5	3.2	183 000	285 000	18 700	29 100	2 200	3 200	
	152.400	39.688	39.688	30.162	6.4	3.3	253 000	365 000	25 800	37 500	2 200	3 200	
	161.925	47.625	48.260	38.100	3.5	3.3	274 000	390 000	28 000	40 000	2 200	3 000	
	161.925	47.625	48.260	38.100	7.0	3.3	274 000	390 000	28 000	40 000	2 200	3 000	
	161.925	53.975	55.100	42.862	3.5	3.3	325 000	480 000	33 000	49 000	2 200	3 000	
	168.275	47.625	48.260	38.100	3.5	3.3	274 000	390 000	28 000	40 000	2 200	3 000	
	168.275	53.975	56.363	41.275	3.5	3.3	345 000	470 000	35 000	48 000	2 200	3 000	
	190.500	57.150	57.531	44.450	8.0	3.3	355 000	500 000	36 000	51 000	1 900	2 600	
	190.500	57.150	57.531	46.038	8.0	3.3	390 000	520 000	39 500	53 500	1 900	2 600	
90.000	145.000	35.000	34.000	27.000	3.0	2.5	190 000	285 000	19 400	29 000	2 400	3 200	
	147.000	40.000	40.000	32.500	7.0	3.5	229 000	345 000	23 400	35 000	2 400	3 200	
	155.000	44.000	44.000	35.500	3.0	2.5	274 000	395 000	28 000	40 000	2 200	3 000	
90.488	161.925	47.625	48.260	38.100	3.5	3.3	274 000	390 000	28 000	40 000	2 200	3 000	





Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}>$ 0.5 $F_{\rm r}+Y_0$ $F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are

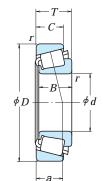
given in the table below.

Bearing Numbers		Abutmen	t and Fil	lat Diman	olono	Eff. Load	Constant	nt Axial Load		Mass		
Bearing Numbers		Abutmen	it and Fil (mn				Centers	CONSIGNI		tors		ass :g)
CONE CUP	a	$d_{ m a}$ $d_{ m b}$	$D_{\scriptscriptstyle m a}$	$D_{\scriptscriptstyle m b}$	i	e Cup r a nax.	(mm) a	e	Y_1	Y_0	app CONE	orox. 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 716649 ▲ JHM 516849 ▲ JH 217249 ▲ JH 217210	104 98 100 101	92 92 94 95	117 117 125 134	125 125 134 142	6 3 3 3	2.5 2.5 2.5 2.5	29.5 29.5 33.3 33.9	0.44 0.44 0.41 0.33	1.4 1.4 1.5 1.8	0.74 0.74 0.81 0.99	0.931 0.943 1.55 2.29	0.461 0.461 0.768 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 <i>I</i>	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 /	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		3.3	42.3	0.33	1.8	0.99	5.41	2.24
▲ JM 718149 *HM 218248 ▲ JHM 318448 ▲ JHM 318440	105 111 106	99 98 100	131 133 140	139 141 148	3 7 3	2.5 3.5 2.5	33.0 30.8 34.1	0.44 0.33 0.34	1.4 1.8 1.7	0.74 0.99 0.96	1.49 1.77 2.32	0.66 0.796 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 8.4.1 on Page A68).

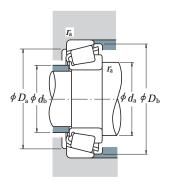
- ** The maximum outside diameter is listed and its tolerance is negative (See Table 8.4.2 on Pages A68 and A69).
- ▲ The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

Bore Diameter 92.075 – 100.012 mm



	Boundary Dimensions (mm)								nd Ratings		Limiting Speeds		
,		,	•		Cone		(1)	*		gf}	(mir	,	
d	D	T	В	С	<i>1</i> mi		$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
92.075	146.050	33.338	34.925	26.195	3.5	3.3	169 000	280 000	17 300	28 500	2 400	3 200	
	148.430	28.575	28.971	21.433	3.5	3.0	140 000	218 000	14 300	22 300	2 200	3 000	
	152.400	39.688	36.322	30.162	3.5	3.2	183 000	285 000	18 700	29 100	2 200	3 200	
	152.400	39.688	36.322	30.162	6.4	3.2	183 000	285 000	18 700	29 100	2 200	3 200	
	168.275	41.275	41.275	30.162	3.5	3.3	223 000	345 000	22 700	35 000	2 000	2 800	
	190.500	57.150	57.531	44.450	8.0	3.3	355 000	500 000	36 000	51 000	1 900	2 600	
93.662	148.430	28.575	28.971	21.433	3.0	3.0	140 000	218 000	14 300	22 300	2 200	3 000	
	149.225	31.750	28.971	24.608	3.0	3.3	140 000	218 000	14 300	22 300	2 200	3 000	
	152.400	39.688	36.322	30.162	3.5	3.2	183 000	285 000	18 700	29 100	2 200	3 200	
95.000	150.000	35.000	34.000	27.000	3.0	2.5	183 000	285 000	18 700	29 100	2 200	3 200	
95.250	146.050	33.338	34.925	26.195	3.5	3.3	169 000	280 000	17 300	28 500	2 400	3 200	
	148.430	28.575	28.971	21.433	3.0	3.0	140 000	218 000	14 300	22 300	2 200	3 000	
	149.225	31.750	28.971	24.608	3.5	3.3	140 000	218 000	14 300	22 300	2 200	3 000	
	152.400	39.688	36.322	30.162	3.5	3.2	183 000	285 000	18 700	29 100	2 200	3 200	
	152.400	39.688	36.322	33.338	3.5	3.3	183 000	285 000	18 700	29 100	2 200	3 200	
	168.275	41.275	41.275	30.162	3.5	3.3	223 000	345 000	22 700	35 000	2 000	2 800	
	171.450	47.625	48.260	38.100	3.5	3.3	282 000	415 000	28 800	42 500	2 000	2 800	
	180.975	47.625	48.006	38.100	3.5	3.3	258 000	375 000	26 300	38 500	2 000	2 600	
	190.500	57.150	57.531	44.450	8.0	3.3	355 000	500 000	36 000	51 000	1 900	2 600	
	190.500	57.150	57.531	46.038	8.0	3.3	390 000	520 000	39 500	53 500	1 900	2 600	
96.838	148.430	28.575	28.971	21.433	3.5	3.0	140 000	218 000	14 300	22 300	2 200	3 000	
	149.225	31.750	28.971	24.606	3.5	3.3	140 000	218 000	14 300	22 300	2 200	3 000	
98.425	161.925	36.512	36.116	26.195	3.5	3.3	191 000	310 000	19 500	31 500	2 000	2 800	
	168.275	41.275	41.275	30.162	3.5	3.3	223 000	345 000	22 700	35 000	2 000	2 800	
	180.975	47.625	48.006	38.100	3.5	3.3	258 000	375 000	26 300	38 500	2 000	2 600	
	190.500	57.150	57.531	44.450	3.5	3.3	355 000	500 000	36 000	51 000	1 900	2 600	
	190.500	57.150	57.531	46.038	3.5	3.3	390 000	520 000	39 500	53 500	1 900	2 600	
99.982	190.500	57.150	57.531	46.038	6.4	3.3	390 000	520 000	39 500	53 500	1 900	2 600	
100.000	150.000	32.000	30.000	26.000	2.3	2.3	146 000	235 000	14 900	24 000	2 200	3 000	
	155.000	36.000	35.000	28.000	3.0	2.5	191 000	325 000	19 500	33 000	2 000	2 800	
	160.000	41.000	40.000	32.000	3.0	2.5	239 000	380 000	24 400	38 500	2 000	2 800	
100.012	157.162	36.512	36.116	26.195	3.5	3.3	191 000	310 000	19 500	31 500	2 000	2 800	





Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$							
X	Y	X	Y						
1	0	0.4	Y ₁						

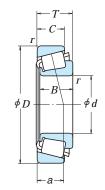
Static Equivalent Load

 $P_0 = 0.5\,F_r + Y_0\,F_a$ When $F_r > 0.5\,F_r + Y_0\,F_a$, use $P_0 = F_r$

The values of e, Y_1 , and Y_0 are given in the table below.

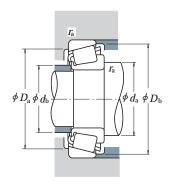
Bearin	ng Numbers	Α	lbutmen	nt and Fil (mn	let Dimer n)			Eff. Load Centers	Constant		l Load ctors	Mass (kg)	
CONE	CUP	$d_{\scriptscriptstyle \mathrm{a}}$	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{ m b}$	1	e Cup $oldsymbol{r_a}$ nax.	(mm) a	e	<i>Y</i> ₁	Y_0	ap CONE	prox. CUP
47890	47820	107	101	131	140	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 <i>A</i>	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 776 864 HH 221440	77675 772 854 HH 221410	117 114 123 125	105 107 108 110	152 161 170 171	159 168 174 179	3.5 3.5 8	3.3 3.3 3.3 3.3	37.8 39.1 41.8 42.3	0.37 0.39 0.33 0.33	1.6 1.6 1.8 1.8	0.90 0.86 0.99 0.99	2.91 3.25 4.57 5.0	1.67 1.99 2.55 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 A	The tolerances are liste	d in Tahl	los 2 2	and 1 or	Dagge P	1112 a	nd D11	1					

Bore Diameter 101.600 – 117.475 mm



			Dimensio mm)	ns			1)		nd Ratings	gf}	Limiting Speeds (min ⁻¹)	
d	D	T	В	С	Cone <i>1</i> mi	, '	$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
101.600	157.162	36.512	36.116	26.195	3.5	3.3	191 000	310 000	19 500	31 500	2 000	2 800
	161.925	36.512	36.116	26.195	3.5	3.3	191 000	310 000	19 500	31 500	2 000	2 800
	168.275	41.275	41.275	30.162	3.5	3.3	223 000	345 000	22 700	35 000	2 000	2 800
	180.975	47.625	48.006	38.100	3.5	3.3	258 000	375 000	26 300	38 500	2 000	2 600
	190.500	57.150	57.531	44.450	8.0	3.3	355 000	500 000	36 000	51 000	1 900	2 600
	190.500	57.150	57.531	46.038	8.0	3.3	390 000	520 000	39 500	53 500	1 900	2 600
	212.725	66.675	66.675	53.975	7.0	3.3	570 000	810 000	58 000	82 500	1 700	2 200
104.775	180.975	47.625	48.006	38.100	7.0	3.3	258 000	375 000	26 300	38 500	2 000	2 600
	180.975	47.625	48.006	38.100	3.5	3.3	258 000	375 000	26 300	38 500	2 000	2 600
	190.500	47.625	49.212	34.925	3.5	3.3	296 000	465 000	30 000	47 000	1 800	2 400
106.362	165.100	36.512	36.512	26.988	3.5	3.3	195 000	320 000	19 800	33 000	2 000	2 600
107.950	158.750	23.020	21.438	15.875	3.5	3.3	102 000	165 000	10 400	16 800	2 000	2 800
	159.987	34.925	34.925	26.988	3.5	3.3	164 000	315 000	16 700	32 000	2 000	2 800
	161.925	34.925	34.925	26.988	3.5	3.3	164 000	280 000	16 800	28 600	2 000	2 800
	165.100	36.512	36.512	26.988	3.5	3.3	195 000	320 000	19 800	33 000	2 000	2 600
	190.500	47.625	49.212	34.925	3.5	3.3	296 000	465 000	30 000	47 000	1 800	2 400
	212.725	66.675	66.675	53.975	8.0	3.3	570 000	810 000	58 000	82 500	1 700	2 200
109.987	159.987	34.925	34.925	26.988	3.5	3.3	164 000	315 000	16 700	32 000	2 000	2 800
	159.987	34.925	34.925	26.988	8.0	3.3	164 000	315 000	16 700	32 000	2 000	2 800
109.992	177.800	41.275	41.275	30.162	3.5	3.3	232 000	375 000	23 700	38 000	1 800	2 600
110.000	165.000	35.000	35.000	26.500	3.0	2.5	195 000	320 000	19 800	33 000	2 000	2 600
	180.000	47.000	46.000	38.000	3.0	2.5	310 000	490 000	31 500	50 000	1 900	2 600
111.125	190.500	47.625	49.212	34.925	3.5	3.3	296 000	465 000	30 000	47 000	1 800	2 400
114.300	152.400	21.433	21.433	16.670	1.5	1.5	89 500	178 000	9 100	18 100	2 000	2 800
	177.800	41.275	41.275	30.162	3.5	3.3	232 000	375 000	23 700	38 000	1 800	2 600
	180.000	34.925	31.750	25.400	3.5	0.8	174 000	254 000	17 800	25 900	1 800	2 400
	190.500	47.625	49.212	34.925	3.5	3.3	296 000	465 000	30 000	47 000	1 800	2 400
	212.725	66.675	66.675	53.975	7.0	3.3	475 000	700 000	48 500	71 500	1 700	2 400
	212.725	66.675	66.675	53.975	7.0	3.3	570 000	810 000	58 000	82 500	1 700	2 200
115.087	190.500	47.625	49.212	34.925	3.5	3.3	296 000	465 000	30 000	47 000	1 800	2 400
117.475	180.975	34.925	31.750	25.400	3.5	3.3	174 000	254 000	17 800	25 900	1 800	2 400





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e		
X	Y	X	Y		
1	0	0.4	Y ₁		

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}>$ 0.5 $F_{\rm r}+Y_0\,F_{\rm a}$, use $P_0=F_{\rm r}$ The values of e, Y_1 , and Y_0 are

given in the table below.

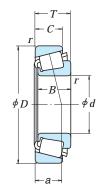
Bearing	Numbers	Α	butmen	t and Fil (mr	let Dimer	sions		Eff. Load Centers	Constant	Axial Fac	Load tors		ass :g)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{ m b}$		Cup a ax.	(mm) a	e	Y_1	Y_0		rox. CUP
52400	52618	117	111	142	152	3.5	3.3	36.1	0.47	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		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 68462 Notes ** T	71750 68712	133 132	126 125	171 163	181 172	3.5 3.5	3.3	40.1 40.0	0.42 0.50	1.4	0.79 0.66	3.31 1.73	1.71

Notes ** The maximum outside diameter is listed and its tolerance is negative (See Table 8.4.2 on Pages A68 and A69).

The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

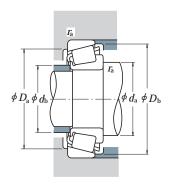
B 166 B 167

Bore Diameter 120.000 – 165.100 mm



	Boundary Dimensions (mm)							Basic Lo	~f)	Limiting Speeds (min ⁻¹)		
d	D	T	В	С	Cone <i>I</i> mi	, '	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
120.000	170.000	25.400	25.400	19.050	3.3	3.3	130 000	219 000	13 200	22 300	1 900	2 600
	174.625	35.720	36.512	27.783	3.5	1.5	212 000	385 000	21 600	39 000	1 900	2 600
120.650	182.562	39.688	38.100	33.338	3.5	3.3	228 000	445 000	23 200	45 000	1 800	2 400
	206.375	47.625	47.625	34.925	3.3	3.3	320 000	530 000	32 500	54 000	1 600	2 200
123.825	182.562	39.688	38.100	33.338	3.5	3.3	228 000	445 000	23 200	45 000	1 800	2 400
125.000	175.000	25.400	25.400	18.288	3.3	3.3	134 000	232 000	13 700	23 600	1 800	2 400
127.000	165.895	18.258	17.462	13.495	1.5	1.5	84 500	149 000	8 650	15 200	1 900	2 600
	182.562	39.688	38.100	33.338	3.5	3.3	228 000	445 000	23 200	45 000	1 800	2 400
	196.850	46.038	46.038	38.100	3.5	3.3	315 000	560 000	32 000	57 500	1 700	2 200
	215.900	47.625	47.625	34.925	3.5	3.3	287 000	495 000	29 300	50 000	1 500	2 000
128.588	206.375	47.625	47.625	34.925	3.3	3.3	320 000	530 000	32 500	54 000	1 600	2 200
130.000	206.375	47.625	47.625	34.925	3.5	3.3	320 000	530 000	32 500	54 000	1 600	2 200
130.175	203.200	46.038	46.038	38.100	3.5	3.3	315 000	560 000	32 000	57 500	1 700	2 200
	206.375	47.625	47.625	34.925	3.5	3.3	320 000	530 000	32 500	54 000	1 600	2 200
133.350	177.008	25.400	26.195	20.638	1.5	1.5	124 000	258 000	12 700	26 300	1 800	2 400
	190.500	39.688	39.688	33.338	3.5	3.3	240 000	485 000	24 500	49 500	1 700	2 200
	196.850	46.038	46.038	38.100	3.5	3.3	315 000	560 000	32 000	57 500	1 700	2 200
	215.900	47.625	47.625	34.925	3.5	3.3	287 000	495 000	29 300	50 000	1 500	2 000
136.525	190.500	39.688	39.688	33.338	3.5	3.3	216 000	440 000	22 000	45 000	1 700	2 200
	217.488	47.625	47.625	34.925	3.5	3.3	287 000	495 000	29 300	50 000	1 500	2 000
139.700	187.325	28.575	29.370	23.020	1.5	1.5	153 000	305 000	15 600	31 500	1 700	2 200
	215.900	47.625	47.625	34.925	3.5	3.3	287 000	495 000	29 300	50 000	1 500	2 000
	254.000	66.675	66.675	47.625	7.0	3.3	515 000	830 000	52 500	84 500	1 300	1 800
142.875	200.025	41.275	39.688	34.130	3.5	3.3	227 000	460 000	23 100	46 500	1 600	2 200
146.050	193.675	28.575	28.575	23.020	1.5	1.5	170 000	355 000	17 300	36 500	1 600	2 200
	236.538	57.150	56.642	44.450	3.5	3.3	455 000	720 000	46 000	73 500	1 400	1 900
	254.000	66.675	66.675	47.625	7.0	3.3	515 000	830 000	52 500	84 500	1 300	1 800
149.225	254.000	66.675	66.675	47.625	7.0	3.3	515 000	830 000	52 500	84 500	1 300	1 800
152.400	254.000	66.675	66.675	47.625	7.0	3.3	515 000	830 000	52 500	84 500	1 300	1 800
158.750	225.425	41.275	39.688	33.338	3.5	3.3	240 000	540 000	24 400	55 000	1 400	1 900
165.100	247.650	47.625	47.625	38.100	3.5	3.3	345 000	705 000	35 500	71 500	1 300	1 700





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y ₁

Static Equivalent Load

 $P_0 = 0.5\,F_r + Y_0\,F_a$ When $F_r > 0.5\,F_r + Y_0\,F_a$, use $P_0 = F_r$

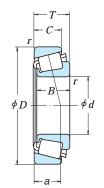
The values of \emph{e}_{\imath} \emph{Y}_{1} , and \emph{Y}_{0} are given in the table below.

Bearing No	umbers	ŀ	Abutmen	t and Fill (mm	let Dimer n)		C	Eff. Load Centers	Constant		Load ctors		ass (g)
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{\scriptscriptstyle m b}$	Cone Cup $m{r}_{ m a}$ max.		(mm) a	e	Y_1	Y_0	app CONE	orox. 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 67780	46720 67720	176 185	169 179	209 229	218 240	3.5 3.5	3.3	44.3 52.4	0.38	1.6 1.4	0.86 0.75	3.69 5.83	1.66 2.33

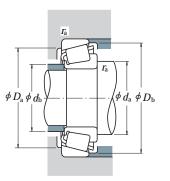
otes * The maximum bore diameter is listed and its tolerance is negative (See Table 8.4.1 on Page A68).

▲ The tolerances are listed in Tables 2, 3 and 4 on Pages B113 and B114.

Bore Diameter 170.000 – 206.375 mm



	Boundary Dimensions (mm)						Basic Load Ratings (N) {kgf}			gf}	Limiting Speeds (min ⁻¹)		
d	D	T	В	С	Cone I mi	Cup r n.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
170.000	230.000	39.000	38.000	31.000	3.0	2.5	278 000	520 000	28 300	53 000	1 300	1 800	
	240.000	46.000	44.500	37.000	3.0	2.5	380 000	720 000	39 000	73 000	1 300	1 800	
174.625	247.650	47.625	47.625	38.100	3.5	3.3	345 000	705 000	35 500	71 500	1 300	1 700	
177.800	227.012	30.162	30.162	23.020	1.5	1.5	181 000	415 000	18 500	42 000	1 300	1 800	
	247.650	47.625	47.625	38.100	3.5	3.3	345 000	705 000	35 500	71 500	1 300	1 700	
	260.350	53.975	53.975	41.275	3.5	3.3	455 000	835 000	46 500	85 000	1 200	1 700	
190.000	260.000	46.000	44.000	36.500	3.0	2.5	370 000	730 000	38 000	74 500	1 100	1 600	
190.500	266.700	47.625	46.833	38.100	3.5	3.3	345 000	720 000	35 000	73 000	1 100	1 500	
200.000	300.000	65.000	62.000	51.000	3.5	2.5	615 000	1 130 000	62 500	116 000	1 000	1 400	
203.200	282.575	46.038	46.038	36.512	3.5	3.3	365 000	800 000	37 500	81 500	1 000	1 400	
206.375	282.575	46.038	46.038	36.512	3.5	3.3	365 000	800 000	37 500	81 500	1 000	1 400	



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}>e$				
X	Y	X	Y			
1	0	0.4	Y ₁			

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Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

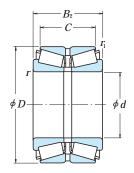
When $F_{\rm r} > 0.5 F_{\rm r} + Y_0 F_{\rm a}$, use $P_0 = F_{\rm r}$ The values of e, Y_1 , and Y_0 are

given in the table below.

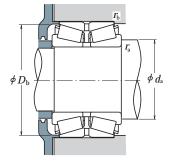
Bearing	Numbers	Α	Abutmen	t and Fil mn)	let Dimer	isions		Eff. Load Centers	Constant		Load tors		ass
CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{ m a}$	$D_{ m b}$	1	Cone Cup $m{r_{ m a}}_{ m max.}$		e	<i>Y</i> ₁	Y_0		g) rox. CUP
▲ JHM 534149	▲ JHM 534110	184	178	217	224	3	2.5	43.2	0.38	1.6	0.86	3.1	1.3
▲ JM 734449	▲ JM 734410	185	180	222	232		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

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Bore Diameter 40 – 90 mm



			Dimensions	5			nd Ratings N)	Limiting Spe	eds (min ⁻¹)
d	D	B_2	C	$m{r}$ min.	$oldsymbol{arGamma}_1$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	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
	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



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$					
X	Y	X	Y				
1	Y ₃	0.67	Y ₂				

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

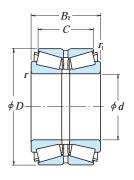
The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

	Abutme	ent and F (m		ensions	Constant	P	xial Load Factors	t	Mass (kg)
Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	$r_{ m b}$ 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

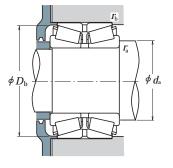
Remarks For other double-row tapered roller bearings not listed above, please contact NSK.

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Bore Diameter 90 – 120 mm



			y Dimension (mm)	ns			ad Ratings (N)	Limiting Spe	eds (min ⁻¹)
d	D	B_2	С	$m{r}$ min.	$oldsymbol{arGamma_1}{ ext{min.}}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	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



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}$	$T_{\rm r} \leq e$	$F_{\rm a}/F_{\rm r} > e$				
X	Y	X	Y			
1	Y ₃	0.67	Y ₂			

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

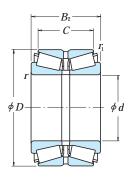
The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Desaile a Niverbore	Abutm	ent and F (m		ensions	Constant	F	xial Load Factors	b	Mass (kg)
Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	$oldsymbol{arGamma}_{a}$ max.	$r_{ m b}$ 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 KBE1901+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

Remarks For other double-row tapered roller bearings not listed above, please contact NSK.

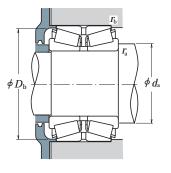


Bore Diameter 125 – 150 mm



		Boundar	y Dimensions	S		Basic Lo	oad Ratings	Limiting Spe	ode (min-1)
			(mm)				(N)	"	, ,
d	D	B_2	С	$m{r}$ min.	$oldsymbol{r_1}{ ext{min.}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	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

Remarks For other double-row tapered roller bearings not listed above, please contact NSK.



Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F_{\rm r}>e$			
X	Y	X	Y		
1	Y ₃	0.67	Y_2		

Static Equivalent Load

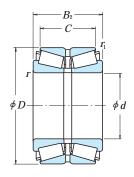
 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

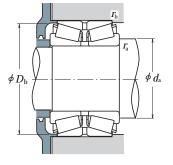
Decides Newsland	Abutme	ent and Fi (m		ensions	Constant	F	xial Load Factors	t	Mass (kg)
Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	$r_{ m b}$ max.	e	Y_2	Y_3	Y_0	approx.
125 KBE 2101+L	146	201	3	1	0.43	2.3	1.6	1.5	14.5
HR130 KBE 42+L	151	220	3	1	0.44	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 HR150 KBE 52X+L HR150 KBE 2701+L HR150 KBE 43+L	171 171 171 177	253 257 257 295	3 3 4	1 1 1 1.5	0.44 0.44 0.44 0.35	2.3 2.3 2.3 2.9	1.6 1.6 1.6 2.0	1.5 1.5 1.5 1.9	

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Bore Diameter 160 – 200 mm



			y Dimensior	ns		Basic Lo	ad Ratings	Limiting Spe	eds (min ⁻¹)
		(mm)				(N)		
d	D	B_2	С	r min.	$oldsymbol{r_1}{ ext{min.}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	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
D							L. I NCV		



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}>e$			
X	Y	X	Y		
1	Y ₃	0.67	Y ₂		

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

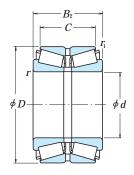
The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Danis a Novebous	Abutme	ent and F (m		ensions	Constant	F	Axial Load Factors	t	Mass (kg)
Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	$r_{ m b}$ max.	e	Y_2	Y_3	Y_0	арргох.
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 160 KBE 42+L HR160 KBE 52X+L 160 KBE 43+L	181 181 181 187	266 275 277 314	3 3 4	1 1 1 1.5	0.32 0.43 0.44 0.36	3.2 2.3 2.3 2.8	2.1 1.6 1.6 1.9	2.1 1.5 1.5 1.8	35.9 28.2 47.3 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

Remarks For other double-row tapered roller bearings not listed above, please contact NSK.

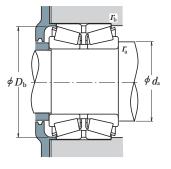
NSK

Bore Diameter 206 – 260 mm



			y Dimensior (mm)	ıs			oad Ratings (N)	Limiting Spe	eds (min ⁻¹)
d	D	B_2	С	$m{r}$ min.	$oldsymbol{r_1}{min.}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	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

Remarks For other double-row tapered roller bearings not listed above, please contact NSK.



Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$			
X	Y	X	Y		
1	Y ₃	0.67	Y ₂		

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Dessire Number	Abutm	ent and Fi (m		ensions	Constant	£	xial Load Factors	t	Mass (kg)
Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	$r_{ m b}$ 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





SPHERICAL ROLLER BEARINGS

SPHERICAL ROLLER BEARINGS

Cylindrical Bores, Tapered Bores Bore Diameter 20 – 150mm B184

Bore Diameter 160 – 560mm B192

Bore Diameter 600 – 1400mm ····· B202



DESIGN, TYPES, AND FEATURES

Shown in the figures, types EA, C, CD, CA, which are designed for high load capacity, are available. Types EA, C and CD have pressed steel cages, and type CA has machined brass cages. 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.

When bearings with a hole for a locking pin to prevent outer ring rotation are required, please inform NSK.



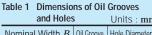
PERMISSIBLE MISALIGNMENT

Table 2 Number of Oil Holes

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.



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 A37 for detailed information.

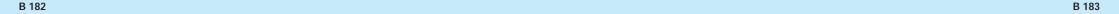


CA

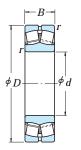
	and Holes	S	Units : mm			
	Width B	Oil Groove	Hole Diameter	Nominal Outer Ring Dia <i>I</i>		Number
over	incl.	Width W	$d_{\scriptscriptstyle extsf{OH}}$			of Holes
18	30	5	2.5	over	incl.	
30	40	6 7	3	_	180	4
40	50	7	4	180	250	6
50	65	8	5	250	315	6
65	80	10	6	315	400	6
80	100	12	8	400	500	
100	120	15	10	500	630	6 8
120 160	160 200	20 25	12 15	630 800	800 1000	8 8 8
200	250	30	20	1000	1250	0
250	315	35	20			
315	400	40	25	1250	1600	8
400	_	40	25	1600	2000	8

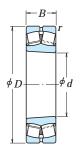
And if the load on spherical roller bearings becomes too small during operation or if the ratio of axial and radial loads is larger than the value of 'e'(listed in the bearing tables), slippage occurs between the rollers and raceways, which may result in smearing. The higher the weight of the rollers 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.



Bore Diameter 20 – 55 mm







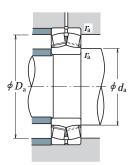
Cylindrical Bore

Tapered Bore

Without an Oil Groove or Holes

Вс	oundary (m	Dimensi nm)	ons	(1	Basic Load N)	Ratings {k	gf}	Limiting (mir	•	Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
20	52	15	1.1	29 300	26 900	2 980	2 740	6 300	8 200	21304CDE4
25	52	18	1	37 500	37 000	3 850	3 800	7 100	9 000	22205CE4
	62	17	1.1	43 000	40 500	4 350	4 150	5 300	6 700	21305CDE4
30	62	20	1	50 000	50 000	5 100	5 100	6 000	7 500	22206CE4
	72	19	1.1	55 000	54 000	5 600	5 500	4 500	6 000	21306CDE4
35	72	23	1.1	69 000	71 000	7 050	7 200	5 300	6 700	22207CE4
	80	21	1.5	71 500	76 000	7 250	7 750	4 000	5 300	21307CDE4
40	80	23	1.1	113 000	99 500	11 500	10 100	6 700	8 500	*22208EAE4
	90	23	1.5	118 000	111 000	12 000	11 300	6 000	7 500	*21308EAE4
	90	33	1.5	170 000	153 000	17 300	15 600	5 300	6 700	*22308EAE4
45	85	23	1.1	118 000	111 000	12 000	11 300	6 000	7 500	*22209EAE4
	100	25	1.5	149 000	144 000	15 200	14 600	5 000	6 300	*21309EAE4
	100	36	1.5	207 000	195 000	21 100	19 900	4 500	5 600	*22309EAE4
50	90	23	1.1	124 000	119 000	12 600	12 100	5 600	7 100	*22210EAE4
	110	27	2	178 000	174 000	18 100	17 800	4 500	5 600	*21310EAE4
	110	40	2	246 000	234 000	25 100	23 900	4 300	5 300	*22310EAE4
55	100	25	1.5	149 000	144 000	15 200	14 600	5 300	6 700	*22211EAE4
	120	29	2	178 000	174 000	18 100	17 800	4 500	5 600	*21311EAE4
	120	43	2	292 000	292 000	29 800	29 800	3 800	4 800	*22311EAE4

Note (1) The suffix K represents bearings with tapered bores (taper 1 : 12).



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}>e$			
X	Y	X	Y		
1	Y ₃	0.67	Y ₂		

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

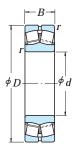
Numbers	А	butment	and Fillet Din (mm)	nensions		Constant		xial Loa Factors		Mass (kg)
Tapered Bore(1)	$d_{ m a}$	max.	$D_{ m a}$ max.	min.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
21304CDKE4	27	28	45	42	1	0.31	3.2	2.1	2.1	0.17
22205CKE4 21305CDKE4	31 32	31 34	46 55	45 51	1	0.35 0.29	2.9 3.4	1.9 2.3	1.9	0.17 0.26
22206CKE4	36	37	56	54	1	0.33	3.1	2.1	2.0	0.27
21306CDKE4	37	40	65	59	1	0.28	3.6	2.4	2.3	0.39
22207CKE4	42	43	65	63	1	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	0.28	3.6	2.4	2.4	0.50
*21308EAKE4	49	54	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	54	78	75	1	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	59	91	86	1.5	0.34	2.9	2.0	1.9	1.34
*22210EAKE4	57	60	83	81	1	0.24	4.3	2.9	2.8	0.61
*21310EAKE4	60	72	100	98	2	0.23	4.4	3.0	2.9	1.21
*22310EAKE4	60	64	100	93	2	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	0.23	4.4	3.0	2.9	1.58
*22311EAKE4	65	73	110	103	2	0.34	2.9	2.0	1.9	2.3

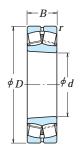
Remarks
1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of Shaft) on Page A84 of the NSK Rolling Bearings catalog, in case of NSKHPS bearings, the conditions are different.

The segmentations are: Light Loads ($\leq 0.05\,C_T$): Normal Loads (0.05 to 0.10 C_T); and Heavy Loads ($> 0.10\,C_T$).

3. For the dimensions of adapters and withdrawal sleeves, refer to Pages B358 – B359, and B366.

Bore Diameter 60 – 85 mm







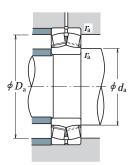
Cylindrical Bore

Tapered Bore

Without an Oil Groove or Holes

Вс	oundary [(m	Dimension)	ons	(1	Basic Load	0	gf}	Limiting (mir		Bearing
d	D	В	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
60	95	26	1.1	98 500	141 000	10 000	14 400	3 600	4 500	23012CE4
	110	28	1.5	178 000	174 000	18 100	17 800	4 800	6 000	*22212EAE4
	130	31	2.1	238 000	244 000	24 200	24 900	3 800	4 800	*21312EAE4
	130	46	2.1	340 000	340 000	34 500	35 000	3 600	4 500	*22312EAE4
65	120	31	1.5	221 000	230 000	22 500	23 500	4 300	5 300	*22213EAE4
	140	33	2.1	264 000	275 000	27 000	28 000	3 600	4 500	*21313EAE4
	140	48	2.1	375 000	380 000	38 000	38 500	3 200	4 000	*22313EAE4
70	125	31	1.5	225 000	232 000	22 900	23 600	4 000	5 300	*22214EAE4
	150	35	2.1	310 000	325 000	32 000	33 500	3 200	4 000	*21314EAE4
	150	51	2.1	425 000	435 000	43 500	44 000	3 000	3 800	*22314EAE4
75	130	31	1.5	238 000	244 000	24 200	24 900	4 000	5 000	*22215EAE4
	160	37	2.1	310 000	325 000	32 000	33 500	3 200	4 000	*21315EAE4
	160	55	2.1	485 000	505 000	49 500	51 500	2 800	3 600	*22315EAE4
80	140	33	2	264 000	275 000	27 000	28 000	3 600	4 500	*22216EAE4
	170	39	2.1	355 000	375 000	36 000	38 000	3 000	3 800	*21316EAE4
	170	58	2.1	540 000	565 000	55 000	58 000	2 600	3 400	*22316EAE4
85	150	36	2	310 000	325 000	32 000	33 500	3 400	4 300	*22217EAE4
	180	41	3	360 000	395 000	37 000	40 000	3 000	4 000	*21317EAE4
	180	60	3	600 000	630 000	61 000	64 000	2 400	3 200	*22317EAE4

Note (1) The suffix K represents bearings with tapered bores (taper 1 : 12).



Dynamic Equivalent Load

$P = XF_r$	+	YF_a
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$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}\!>\!e$					
X	Y	X	Y				
1	Y_3	0.67	Y ₂				

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

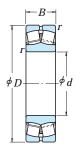
The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

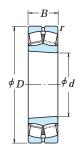
Numbers	ŀ	Abutment	and Fillet Dir (mm)	mensions		Constant		xial Loa Factors		Mass (kg)
Tapered Bore(1)	d_{ϵ} min.	max.	$oldsymbol{D}_{i}$ max.	a min.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
23012CKE4	67	68	88	85	1	0.26	3.9	2.6	2.5	0.68
*22212EAKE4	69	72	101	98	1.5	0.23	4.4	3.0	2.9	1.1
*21312EAKE4	72	87	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	0.33	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

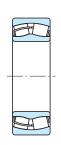
Remarks
1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of Shaft) on Page A84 of the NSK Rolling Bearings catalog, in case of NSKHPS bearings, the conditions are different.

The segmentations are: Light Loads ($\leq 0.05\,C_1$): Normal Loads (0.05 to 0.10 C_1); and Heavy Loads ($> 0.10\,C_1$). 3. For the dimensions of adapters and withdrawal sleeves, refer to Pages B359 – B361, and B366.

Bore Diameter 90 – 110 mm







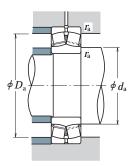
Cylindrical Bore

Tapered Bore

Without an Oil Groove or Holes

				ı						
Во	oundary (m	Dimensio nm)	ins	(Basic Load (N)	3	.gf}	Limiting (mir		Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
90	160	40	2	360 000	395 000	37 000	40 000	3 200	4 000	*22218EAE4
	160	52.4	2	340 000	490 000	34 500	50 000	1 800	2 400	23218CE4
	190	43	3	415 000	450 000	42 000	46 000	2 800	3 600	*21318EAE4
	190	64	3	665 000	705 000	68 000	72 000	2 400	3 000	*22318EAE4
95	170	43	2.1	415 000	450 000	42 000	46 000	3 000	3 800	*22219EAE4
	170	55.6	2.1	370 000	525 000	37 500	53 500	1 700	2 200	23219CAE4
	200	45	3	345 000	435 000	35 000	44 500	1 500	2 000	21319CE4
	200	67	3	735 000	780 000	75 000	79 500	2 200	2 800	*22319EAE4
100	150	37	1.5	212 000	335 000	21 600	34 500	2 200	2 800	23020CDE4
	150	50	1.5	276 000	470 000	28 100	48 000	1 800	2 400	24020CE4
	165	52	2	345 000	530 000	35 500	54 000	1 700	2 200	23120CE4
	165	65	2	345 000	535 000	35 000	55 000	1 700	2 200	24120CAE4
	180	46	2.1	455 000	490 000	46 500	50 000	2 800	3 600	*22220EAE4
	180	60.3	2.1	420 000	605 000	42 500	61 500	1 600	2 200	23220CE4
	215 215	47 73	3	395 000 860 000	485 000 930 000	40 500 88 000	49 500 94 500	1 400 2 000	1 900 2 600	21320CE4 *22320EAE4
110	170	45	2	293 000	465 000	29 900	47 500	2 000	2 400	23022CDE4
	170	60	2	380 000	645 000	38 500	66 000	1 600	2 200	24022CE4
	180	56	2	385 000	630 000	39 500	64 000	1 600	2 000	23122CE4
	180	69	2	460 000	750 000	47 000	76 500	1 600	2 000	24122CE4
	200	53	2.1	605 000	645 000	61 500	66 000	2 600	3 200	*22222EAE4
	200	69.8	2.1	515 000	760 000	52 500	77 500	1 500	1 900	23222CE4
	240	50	3	450 000	545 000	46 000	55 500	1 300	1 700	21322CAE4
	240	80	3	1030 000	1 120 000	105 000	115 000	1 900	2 400	*22322EAE4

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).



Dynamic Equivalent Load

$P = XF_r + Y$	F_{z}
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$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}\!>\!e$					
X	Y	X	Y				
1	Y_3	0.67	Y ₂				

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

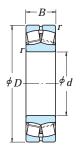
Numbers	,	Abutment	and Fillet Dir (mm)	mensions		Constant		xial Loa Factors		Mass (kg)
Tapered Bore(1)	d	a max.	$oldsymbol{D}_{i}$ max.	a min.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
*22218EAKE4	100	108	150	142	2	0.24	4.3	2.9	2.8	3.3
23218CKE4	100	105	150	138	2	0.32	3.2	2.1	2.1	4.51
*21318EAKE4	104	115	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
*22219EAKE4	107	115	158	152	2	0.24	4.3	2.9	2.8	4.04
23219CAKE4	107	—	158	146	2	0.32	3.1	2.1	2.0	5.33
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
24120CAK30E4 *22220EAKE4 23220CKE4	110 112 112	119 118	155 168 168	143 160 155	2 2 2	0.35 0.24 0.32	2.9 4.3 3.2	1.9 2.9 2.1	1.9 2.8 2.1	5.42 4.84 6.6
21320CKE4	114	133	201	184	2.5	0.21	4.7	3.2	3.1	8.46
*22320EAKE4	114	130	201	184	2.5	0.33	3.0	2.0	2.0	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
23122CKE4	120	127	170	158	2	0.28	3.5	2.4	2.3	5.7
24122CK30E4	120	123	170	154	2	0.36	2.8	1.9	1.8	6.84
*22222EAKE4	122	129	188	178	2	0.25	4.0	2.7	2.6	6.99
23222CKE4	122	130	188	170	2	0.34	3.0	2.0	1.9	9.54
21322CAKE4	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

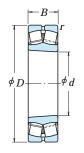
- Remarks
 1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
 2. When making a selection of the recommended fit (Tolerance of Shaft) on Page A84 of the NSK Rolling Bearings catalog, in case of NSKHPS bearings, the conditions are different.
 - The segmentations are: Light Loads ($\leq 0.05\,C_7$): Normal Loads (0.05 to 0.10 C_7); and Heavy Loads ($> 0.10\,C_7$).

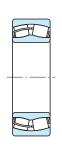
 3. For the dimensions of adapters and withdrawal sleeves, refer to Pages B360 B361, and B366 B367.

Bore Diameter 120 - 150 mm







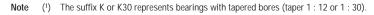


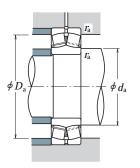
Cylindrical Bore

Tapered Bore

Without an Oil Groove or Holes

Во		Dimensi nm)	ions		Basic Load	0	. 6	Limiting	•	Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	(N) $C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0 m r}$	(mir Grease	Oil	Cylindrical Bore
120	180	46	2	315 000	525 000	32 000	53 500	1 800	2 200	23024CDE4
	180	60	2	395 000	705 000	40 500	72 000	1 500	2 000	24024CE4
	200	62	2	465 000	720 000	47 500	73 500	1 400	1 800	23124CE4
	200	80	2	575 000	950 000	58 500	96 500	1 400	1 800	24124CE4
	215	58	2.1	685 000	765 000	70 000	78 000	2 400	3 000	*22224EAE4
	215	76	2.1	630 000	970 000	64 500	99 000	1 300	1 700	23224CE4
	260	86	3	1190 000	1 320 000	122 000	134 000	1 700	2 200	*22324EAE4
130	200	52	2	400 000	655 000	40 500	67 000	1 700	2 000	23026CDE4
	200	69	2	495 000	865 000	50 500	88 000	1 400	1 800	24026CE4
	210	64	2	505 000	825 000	51 500	84 500	1 300	1 700	23126CE4
	210	80	2	590 000	1 010 000	60 000	103 000	1 300	1 700	24126CE4
	230	64	3	820 000	940 000	83 500	96 000	2 200	2 600	*22226EAE4
	230	80	3	700 000	1 080 000	71 500	110 000	1 200	1 600	23226CE4
	280	93	4	995 000	1 350 000	101 000	137 000	1 300	1 600	22326CE4
140	210	53	2	420 000	715 000	43 000	73 000	1 600	1 900	23028CDE4
	210	69	2	525 000	945 000	53 500	96 500	1 300	1 700	24028CE4
	225	68	2.1	580 000	945 000	59 000	96 500	1 200	1 600	23128CE4
	225	85	2.1	670 000	1 160 000	68 500	118 000	1 200	1 600	24128CE4
	250	68	3	645 000	930 000	65 500	95 000	1 400	1 700	22228CDE4
	250	88	3	835 000	1 300 000	85 000	133 000	1 100	1 500	23228CE4
	300	102	4	1 160 000	1 590 000	118 000	162 000	1 200	1 500	22328CE4
150	225	56	2.1	470 000	815 000	48 000	83 000	1 400	1 800	23030CDE4
	225	75	2.1	590 000	1 090 000	60 500	111 000	1 200	1 500	24030CE4
	250	80	2.1	725 000	1 180 000	74 000	121 000	1 100	1 400	23130CE4
	250	100	2.1	890 000	1 530 000	91 000	156 000	1 100	1 400	24130CE4
	270	73	3	765 000	1 120 000	78 000	114 000	1 300	1 600	22230CDE4
	270	96	3	975 000	1 560 000	99 500	159 000	1 100	1 400	23230CE4
	320	108	4	1 220 000	1 690 000	125 000	172 000	1 100	1 400	22330CAE4





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}\!>\!e$					
X	Y	X	Y				
1	Y_3	0.67	Y ₂				

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Numbers	ļ	Abutment a	and Fillet Din (mm)	nensions		Constant		kial Loa Factors	d	Mass (kg)
Tapered Bore(1)	d_{i} min.	a max.	$D_{ m a}$ max.	min.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
23024CDKE4	130	134	170	163	2	0.22	4.5	3.0	2.9	4.11
24024CK30E4	130	131	170	158	2	0.32	3.2	2.1	2.1	5.33
23124CKE4	130	138	190	175	2	0.29	3.5	2.4	2.3	7.85
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
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
23026CDKE4	140	147	190	180	2	0.23	4.3	2.9	2.8	5.98
24026CK30E4	140	143	190	175	2	0.31	3.2	2.2	2.1	7.84
23126CKE4	140	149	200	184	2	0.28	3.6	2.4	2.4	8.69
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
23226CKE4	144	150	216	196	2.5	0.34	2.9	2.0	1.9	14.3
22326CKE4	148	166	262	236	3	0.34	2.9	2.0	1.9	28.1
23028CDKE4	150	157	200	190	2	0.22	4.5	3.0	2.9	6.49
24028CK30E4	150	154	200	186	2	0.29	3.4	2.3	2.2	8.37
23128CKE4	152	158	213	198	2	0.28	3.6	2.4	2.3	10.5
24128CK30E4	152	156	213	193	2	0.35	2.9	1.9	1.9	13
22228CDKE4	154	167	236	219	2.5	0.25	4.0	2.7	2.6	14.5
23228CKE4	154	163	236	213	2.5	0.35	2.9	1.9	1.9	18.8
22328CKE4	158	177	282	253	3	0.35	2.9	1.9	1.9	35.4
23030CDKE4	162	168	213	203	2	0.22	4.6	3.1	3.0	7.9
24030CK30E4	162	165	213	198	2	0.30	3.4	2.3	2.2	10.5
23130CKE4	162	174	238	218	2	0.30	3.4	2.3	2.2	15.8
24130CK30E4	162	169	238	212	2	0.38	2.6	1.8	1.7	19.8
22230CDKE4	164	179	256	236	2.5	0.26	3.9	2.6	2.5	18.4
23230CKE4	164	176	256	230	2.5	0.35	2.9	1.9	1.9	24.2
22330CAKE4	168	—	302	270	3	0.35	2.9	1.9	1.9	41.5

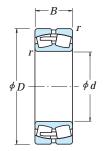
Remarks
1. The bearings denoted by an asterisk (*) are NSKHPS bearings and an oil groove and holes are standard for them.
2. When making a selection of the recommended fit (Tolerance of Shaft) on Page A84 of the NSK Rolling Bearings catalog, in case of NSKHPS bearings, the conditions are different.

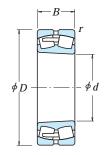
The segmentations are: Light Loads ($\leq 0.05\,C_7$): Normal Loads (0.05 to 0.10 C_7); and Heavy Loads ($> 0.10\,C_7$).

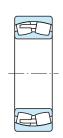
3. For the dimensions of adapters and withdrawal sleeves, refer to Pages B361 – B362, and B367 – B368.

NSK

Bore Diameter 160 – 190 mm







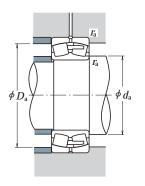
Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

Во		Dimensi nm)	ons	(1	Basic Load N)	3	gf}	Limiting (mir	•	Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
160	220	45	2	360 000	675 000	37 000	69 000	1 400	1 800	23932CAE4
	240	60	2.1	540 000	955 000	55 000	97 500	1 300	1 700	23032CDE4
	240	80	2.1	680 000	1 260 000	69 000	128 000	1 100	1 400	24032CE4
	270	86	2.1	855 000	1 400 000	87 000	143 000	1 000	1 300	23132CE4
	270	109	2.1	1 040 000	1 760 000	106 000	179 000	1 000	1 300	24132CE4
	290	80	3	910 000	1 320 000	93 000	135 000	1 200	1 500	22232CDE4
	290	104	3	1 100 000	1 770 000	112 000	180 000	1 000	1 300	23232CE4
	340	114	4	1 360 000	1 900 000	139 000	193 000	1 100	1 300	22332CAE4
170	230	45	2	350 000	660 000	35 500	67 500	1 400	1 800	23934BCAE4
	260	67	2.1	640 000	1 090 000	65 000	112 000	1 200	1 600	23034CDE4
	260	90	2.1	825 000	1 520 000	84 000	155 000	1 000	1 300	24034CE4
	280	88	2.1	940 000	1 570 000	96 000	160 000	1 000	1 300	23134CE4
	280	109	2.1	1 080 000	1 860 000	110 000	190 000	1 000	1 300	24134CE4
	310	86	4	990 000	1 500 000	101 000	153 000	1 100	1 400	22234CDE4
	310	110	4	1 200 000	1 910 000	122 000	195 000	900	1 200	23234CE4
	360	120	4	1 580 000	2 110 000	161 000	215 000	1 000	1 200	22334CAE4
180	250	52	2	470 000	890 000	48 000	90 500	1 200	1 600	23936CAE4
	280	74	2.1	750 000	1 270 000	76 000	129 000	1 200	1 400	23036CDE4
	280	100	2.1	965 000	1 750 000	98 500	178 000	950	1 200	24036CE4
	300	96	3	1 050 000	1 760 000	108 000	180 000	900	1 200	23136CE4
	300	118	3	1 190 000	2 040 000	121 000	208 000	900	1 200	24136CE4
	320	86	4	1 020 000	1 540 000	104 000	157 000	1 100	1 300	22236CDE4
	320	112	4	1 300 000	2 110 000	133 000	215 000	850	1 100	23236CE4
	380	126	4	1 740 000	2 340 000	177 000	238 000	950	1 200	22336CAE4
190	260	52	2	460 000	875 000	47 000	89 500	1 200	1 500	23938CAE4
	290	75	2.1	775 000	1 350 000	79 000	138 000	1 100	1 400	23038CAE4
	290	100	2.1	975 000	1 840 000	99 500	188 000	900	1 200	24038CE4
	320	104	3	1 190 000	2 020 000	121 000	206 000	850	1 100	23138CE4
	320	128	3	1 370 000	2 330 000	140 000	238 000	850	1 100	24138CE4
	340	92	4	1 140 000	1 730 000	116 000	176 000	1 000	1 200	22238CAE4
	340	120	4	1 440 000	2 350 000	147 000	240 000	800	1 100	23238CE4
	400	132	5	1 890 000	2 590 000	193 000	264 000	900	1 100	22338CAE4

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).



Dynamic Equivalent Load $P = XF_{\rm r} + YF_{\rm a}$

	1 a		
$F_{\rm a}/I$	$F_{\rm r} \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y ₃	0.67	Y ₂

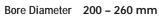
Static Equivalent Load

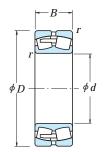
 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

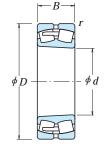
The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

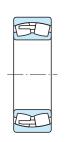
Numbers	,	Abutment	and Fillet Dii (mm)	mensions		Constant		xial Loa Factors		Mass (kg)
Tapered Bore(1)	d min.	a max.	$oldsymbol{D}$ max.	a min.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
23932CAKE4	170		210	203	2	0.18	5.6	3.8	3.7	4.97
23032CDKE4	172	179	228	216	2	0.22	4.5	3.0	2.9	9.66
24032CK30E4	172	177	228	212	2	0.30	3.4	2.3	2.2	12.7
23132CKE4	172	185	258	234	2	0.30	3.4	2.3	2.2	20.3
24132CK30E4	172	179	258	229	2	0.39	2.6	1.7	1.7	25.4
22232CDKE4	174	190	276	255	2.5	0.26	3.8	2.6	2.5	23.1
23232CKE4	174	189	276	245	2.5	0.34	2.9	2.0	1.9	30.5
22332CAKE4	178	—	322	287	3	0.35	2.9	1.9	1.9	49.3
23934BCAKE4	180	—	220	213	2	0.17	5.8	3.9	3.8	5.38
23034CDKE4	182	191	248	233	2	0.23	4.3	2.9	2.8	13
24034CK30E4	182	188	248	228	2	0.31	3.2	2.2	2.1	17.3
23134CKE4	182	194	268	245	2	0.29	3.5	2.3	2.3	21.8
24134CK30E4	182	190	268	239	2	0.37	2.7	1.8	1.8	26.6
22234CDKE4	188	206	292	270	3	0.26	3.8	2.6	2.5	28.8
23234CKE4 22334CAKE4	188 188	201	292 342	261 304	3	0.34 0.35	2.9 2.9	2.0 1.9	1.9 1.9	36.4 57.9
23936CAKE4 23036CDKE4 24036CK30E4	190 192 192	202 200	240 268 268	230 249 245	2 2 2	0.18 0.24 0.32	5.5 4.2 3.1	3.7 2.8 2.1	3.6 2.8 2.0	7.64 17.1 22.7
23136CKE4	194	206	286	260	2.5	0.30	3.4	2.3	2.2	27.5
24136CK30E4	194	202	286	255	2.5	0.37	2.7	1.8	1.8	33.1
22236CDKE4	198	212	302	278	3	0.26	3.9	2.6	2.6	30.2
23236CKE4	198	211	302	274	3	0.33	3.0	2.0	2.0	38.9
22336CAKE4	198	—	362	322	3	0.34	2.9	2.0	1.9	67
23938CAKE4 23038CAKE4 24038CK30E4	200 202 202	 210	250 278 278	240 261 253	2 2 2	0.18 0.24 0.31	5.7 4.2 3.2	3.8 2.8 2.2	3.7 2.8 2.1	8.03 17.6 24
23138CKE4	204	219	306	276	2.5	0.31	3.3	2.2	2.2	34.5
24138CK30E4	204	211	306	269	2.5	0.40	2.5	1.7	1.6	41.5
22238CAKE4	208	—	322	296	3	0.26	3.8	2.6	2.5	35.5
23238CKE4	208	222	322	288	3	0.35	2.9	1.9	1.9	47.6
22338CAKE4	212	—	378	338	4	0.34	2.9	2.0	1.9	77.6

Remarks For the dimensions of adapters and withdrawal sleeves, refer to Pages B362 and B368.









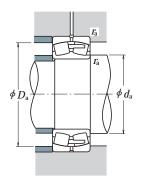
Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

Вс		Dimensi nm)	ions	(1	Basic Load	3	gf}	Limiting (mir		Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
200	280	60	2.1	570 000	1 060 000	58 000	108 000	1 100	1 400	23940CAE4
	310	82	2.1	940 000	1 700 000	96 000	174 000	1 000	1 300	23040CAE4
	310	109	2.1	1 140 000	2 120 000	116 000	216 000	850	1 100	24040CE4
	340	112	3	1 360 000	2 330 000	139 000	238 000	800	1 000	23140CE4
	340	140	3	1 570 000	2 670 000	160 000	272 000	800	1 000	24140CE4
	360	98	4	1 300 000	2 010 000	133 000	204 000	950	1 200	22240CAE4
	360	128	4	1 660 000	2 750 000	169 000	281 000	750	1 000	23240CE4
	420	138	5	2 000 000	2 990 000	204 000	305 000	850	1 000	22340CAE4
220	300	60	2.1	625 000	1 240 000	64 000	126 000	1 000	1 300	23944CAE4
	340	90	3	1 090 000	1 980 000	111 000	202 000	950	1 200	23044CAE4
	340	118	3	1 360 000	2 600 000	138 000	265 000	750	1 000	24044CE4
	370	120	4	1 570 000	2 710 000	160 000	276 000	710	950	23144CE4
	370	150	4	1 800 000	3 200 000	183 000	325 000	710	950	24144CE4
	400	108	4	1 570 000	2 430 000	160 000	247 000	850	1 000	22244CAE4
	400	144	4	2 020 000	3 400 000	206 000	350 000	670	900	23244CE4
	460	145	5	2 350 000	3 400 000	240 000	345 000	750	950	22344CAE4
240	320	60	2.1	635 000	1 300 000	65 000	133 000	950	1 200	23948CAE4
	360	92	3	1 160 000	2 140 000	118 000	218 000	850	1 100	23048CAE4
	360	118	3	1 390 000	2 730 000	141 000	278 000	710	950	24048CE4
	400	128	4	1 790 000	3 100 000	182 000	320 000	670	850	23148CE4
	400	160	4	2 130 000	3 800 000	217 000	385 000	670	850	24148CE4
	440	120	4	1 870 000	2 890 000	191 000	294 000	750	950	22248CAE4
	440	160	4	2 440 000	4 050 000	249 000	415 000	630	800	23248CAE4
	500	155	5	2 600 000	3 800 000	265 000	385 000	670	850	22348CAE4
260	360	75	2.1	930 000	1 870 000	95 000	191 000	850	1 000	23952CAE4
	400	104	4	1 430 000	2 580 000	145 000	263 000	800	950	23052CAE4
	400	140	4	1 810 000	3 500 000	185 000	360 000	630	850	24052CAE4
	440	144	4	2 160 000	3 750 000	221 000	385 000	600	800	23152CAE4
	440	180	4	2 560 000	4 700 000	261 000	480 000	600	800	24152CAE4
	480	130	5	2 180 000	3 400 000	222 000	345 000	670	850	22252CAE4
	480	174	5	2 740 000	4 550 000	279 000	460 000	560	750	23252CAE4
	540	165	6	3 100 000	4 600 000	320 000	470 000	630	800	22352CAE4





Dynamic Equivalent Load $P = XF_r + YF_a$

	-r · a		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y ₂

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

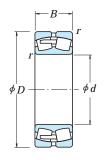
Numbers	,	Abutment	and Fillet Dir (mm)	mensions		Constant		xial Loa Factors		Mass (kg)
Tapered Bore(1)	d min.	a max.	$oldsymbol{D}$ max.	a min.	$m{r_{ m a}}$ max.	e	Y_2	Y_3	Y_0	approx.
23940CAKE4	212	_	268	258	2	0.20	5.1	3.4	3.3	11
23040CAKE4	212	_	298	279	2	0.25	4.0	2.7	2.6	22.6
24040CK30E4	212	223	298	271	2	0.32	3.1	2.1	2.0	30.4
23140CKE4	214	232	326	293	2.5	0.31	3.2	2.2	2.1	42.7
24140CK30E4	214	226	326	290	2.5	0.39	2.6	1.8	1.7	51.3
22240CAKE4	218	—	342	315	3	0.26	3.8	2.6	2.5	42.6
23240CKE4	218	237	342	307	3	0.34	2.9	2.0	1.9	57.1
22340CAKE4	222		398	352	4	0.34	2.9	2.0	1.9	92.6
23944CAKE4 23044CAKE4 24044CK30E4	232 234 234	 244	288 326 326	278 302 296	2 2.5 2.5	0.18 0.24 0.31	5.7 4.1 3.2	3.8 2.8 2.1	3.7 2.7 2.1	12.2 29.7 40.5
23144CKE4	238	254	352	320	3	0.30	3.3	2.2	2.2	53
24144CK30E4	238	248	352	313	3	0.39	2.6	1.7	1.7	66.7
22244CAKE4	238	—	382	348	3	0.27	3.7	2.5	2.4	59
23244CKE4	238	260	382	337	3	0.35	2.9	1.9	1.9	80.4
22344CAKE4	242	—	438	391	4	0.33	3.0	2.0	2.0	116
23948CAKE4	252		308	298	2	0.17	6.0	4.0	3.9	13.3
23048CAKE4	254		346	324	2.5	0.24	4.2	2.8	2.7	32.6
24048CK30E4	254	265	346	317	2.5	0.29	3.4	2.3	2.2	43.4
23148CKE4	258	275	382	347	3	0.30	3.3	2.2	2.2	66.9
24148CK30E4	258	268	382	341	3	0.38	2.7	1.8	1.8	79.5
22248CAKE4	258	—	422	383	3	0.27	3.7	2.5	2.4	80.2
23248CAKE4	258	_	422	372	3	0.37	2.7	1.8	1.8	106
22348CAKE4	262		478	423	4	0.32	3.2	2.1	2.1	147
23952CAKE4	272		348	333	2	0.19	5.4	3.6	3.5	23
23052CAKE4	278		382	356	3	0.25	4.1	2.7	2.7	46.6
24052CAK30E4	278		382	348	3	0.32	3.1	2.1	2.1	62.6
23152CAKE4	278	_	422	380	3	0.32	3.2	2.1	2.1	88.2
24152CAK30E4	278	_	422	371	3	0.39	2.6	1.7	1.7	109
22252CAKE4	282	_	458	418	4	0.27	3.7	2.5	2.5	104
23252CAKE4	282	_	458	406	4	0.37	2.7	1.8	1.8	137
22352CAKE4	288		512	462	5	0.32	3.2	2.1	2.1	180

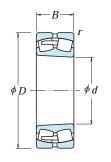
Remarks For the dimensions of adapters and withdrawal sleeves, refer to Pages **B363** and **B369**.

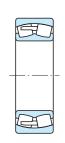
B 195 B 194

Bore Diameter 280 - 340 mm









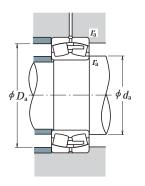
Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

В		Dimens	ions	(Basic Load	9	gf}	Limiting S		Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
280	380	75	2.1	925 000	1 950 000	94 500	199 000	800	950	23956CAE4
	420	106	4	1 540 000	2 950 000	157 000	300 000	710	900	23056CAE4
	420	140	4	1 880 000	3 800 000	191 000	385 000	600	800	24056CAE4
	460	146	5	2 230 000	4 000 000	228 000	410 000	560	750	23156CAE4
	460	180	5	2 640 000	5 000 000	269 000	505 000	560	750	24156CAE4
	500	130	5	2 280 000	3 650 000	233 000	370 000	630	800	22256CAE4
	500	176	5	2 880 000	4 900 000	294 000	500 000	530	670	23256CAE4
	580	175	6	3 500 000	5 150 000	355 000	525 000	560	710	22356CAE4
300	420	90	3	1 230 000	2 490 000	125 000	254 000	710	900	23960CAE4
	460	118	4	1 920 000	3 700 000	196 000	375 000	670	850	23060CAE4
	460	160	4	2 310 000	4 600 000	235 000	470 000	530	710	24060CAE4
	500	160	5	2 670 000	4 800 000	273 000	490 000	500	670	23160CAE4
	500	200	5	3 100 000	5 800 000	315 000	595 000	500	670	24160CAE4
	540	140	5	2 610 000	4 250 000	266 000	430 000	600	750	22260CAE4
	540	192	5	3 400 000	5 900 000	350 000	600 000	480	630	23260CAE4
320	440	90	3	1 300 000	2 750 000	132 000	281 000	670	850	23964CAE4
	480	121	4	1 960 000	3 850 000	200 000	395 000	630	800	23064CAE4
	480	160	4	2 440 000	5 050 000	249 000	515 000	500	670	24064CAE4
	540	176	5	3 050 000	5 500 000	315 000	560 000	480	600	23164CAE4
	540	218	5	3 550 000	6 650 000	360 000	675 000	480	600	24164CAE4
	580	150	5	2 990 000	4 850 000	305 000	495 000	530	670	22264CAE4
	580	208	5	3 900 000	6 900 000	395 000	700 000	450	600	23264CAE4
340	460	90	3	1 330 000	2 840 000	136 000	289 000	630	800	23968CAE4
	520	133	5	2 280 000	4 400 000	232 000	445 000	560	710	23068CAE4
	520	180	5	2 920 000	6 050 000	298 000	615 000	480	600	24068CAE4
	580	190	5	3 600 000	6 600 000	370 000	670 000	430	560	23168CAE4
	580	243	5	4 250 000	7 900 000	430 000	810 000	430	560	24168CAE4
	620	224	6	4 400 000	7 800 000	450 000	795 000	400	530	23268CAE4

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).



Dynamic Equivalent Load $P = XF_r + YF_s$

F = A	$\Gamma_{\rm r}$ + $I \Gamma_{\rm a}$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y ₃	0.67	Y ₂

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

Numbers	Abutme	ent and Fille (mm		ons	Constant	А	xial Loa Factors		Mass (kg)
Tapered Bore(1)	$d_{ m a}$ min.	L max.) a min.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
23956CAKE4	292	368	351	2	0.18	5.7	3.9	3.8	24.5
23056CAKE4	298	402	377	3	0.24	4.2	2.8	2.7	50.5
24056CAK30E4	298	402	369	3	0.31	3.3	2.2	2.2	66.4
23156CAKE4	302	438	400	4	0.30	3.3	2.2	2.2	94.3
24156CAK30E4	302	438	392	4	0.37	2.7	1.8	1.8	115
22256CAKE4	302	478	439	4	0.25	4.0	2.7	2.6	110
23256CAKE4	302	478	425	4	0.35	2.9	1.9	1.9	147
22356CAKE4	308	552	496	5	0.31	3.2	2.1	2.1	221
23960CAKE4	314	406	386	2.5	0.19	5.2	3.5	3.4	38.2
23060CAKE4	318	442	413	3	0.24	4.2	2.8	2.7	70.5
24060CAK30E4	318	442	400	3	0.32	3.1	2.1	2.0	93.6
23160CAKE4	322	478	433	4 4	0.31	3.3	2.2	2.2	125
24160CAK30E4	322	478	423		0.38	2.6	1.8	1.7	152
22260CAKE4	322	518	473	4 4	0.25	4.0	2.7	2.6	139
23260CAKE4	322	518	458		0.35	2.9	1.9	1.9	189
23964CAKE4	334	426	406	2.5	0.18	5.5	3.7	3.6	40.6
23064CAKE4	338	462	432	3	0.24	4.2	2.8	2.8	75.6
24064CAK30E4	338	462	422	3	0.31	3.3	2.2	2.2	99.7
23164CAKE4	342	518	466	4	0.31	3.2	2.1	2.1	162
24164CAK30E4	342	518	456		0.39	2.6	1.7	1.7	196
22264CAKE4	342	558	508	4 4	0.26	3.9	2.6	2.6	174
23264CAKE4	342	558	488		0.36	2.8	1.9	1.8	239
23968CAKE4	354	446	427	2.5	0.18	5.7	3.8	3.7	42.4
23068CAKE4	362	498	465	4	0.24	4.2	2.8	2.8	101
24068CAK30E4	362	498	454	4	0.32	3.2	2.1	2.1	135
23168CAKE4	362	558	499	4	0.31	3.2	2.1	2.1	206
24168CAK30E4	362	558	489	4	0.40	2.5	1.7	1.7	257
23268CAKE4	368	592	521	5	0.36	2.8	1.9	1.8	295

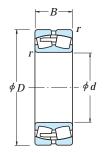
Remarks For the dimensions of adapters and withdrawal sleeves, refer to Pages B363 – B364, and B369 – B370.

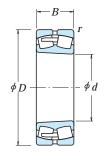
B 196 B 197

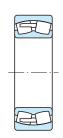
Bore Diameter 360 – 440 mm











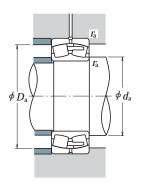
Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

Во		Dimensi nm)	ons		Basic Load	0	-£)	Limiting S		Bearing
d	D	В	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	gf} $C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
360	480	90	3	1 390 000	3 050 000	142 000	315 000	600	750	23972CAE4
	540	134	5	2 390 000	4 700 000	244 000	480 000	530	670	23072CAE4
	540	180	5	2 930 000	6 100 000	299 000	625 000	450	600	24072CAE4
	600	192	5	3 800 000	7 100 000	390 000	725 000	400	530	23172CAE4
	600	243	5	4 200 000	8 000 000	430 000	815 000	400	530	24172CAE4
	650	232	6	4 800 000	8 550 000	490 000	870 000	380	500	23272CAE4
380	520	106	4	1 870 000	4 100 000	190 000	420 000	530	670	23976CAE4
	560	135	5	2 500 000	5 100 000	255 000	520 000	530	630	23076CAE4
	560	180	5	3 050 000	6 600 000	315 000	670 000	430	560	24076CAE4
	620	194	5	4 000 000	7 600 000	405 000	775 000	400	500	23176CAE4
	620	243	5	4 350 000	8 450 000	440 000	865 000	400	500	24176CAE4
	680	240	6	5 150 000	9 200 000	525 000	940 000	360	480	23276CAE4
400	540	106	4	1 890 000	4 250 000	193 000	435 000	530	630	23980CAE4
	600	148	5	2 970 000	5 900 000	305 000	605 000	480	600	23080CAE4
	600	200	5	3 600 000	7 600 000	370 000	775 000	400	500	24080CAE4
	650 650 720	200 250 256	6 6 6		7 900 000 10 100 000 10 400 000	420 000 505 000 590 000		380 380 340	480 480 450	23180CAE4 24180CAE4 23280CAE4
420	560	106	4	1 870 000	4 250 000	191 000	430 000	500	600	23984CAE4
	620	150	5	2 910 000	5 850 000	297 000	595 000	450	560	23084CAE4
	620	200	5	3 750 000	8 100 000	380 000	825 000	380	480	24084CAE4
	700 700 760	224 280 272	6 6 7.5		9 400 000 12 000 000 11 700 000	510 000 610 000 660 000		340 340 320	450 450 430	23184CAE4 24184CAE4 23284CAE4
440	600	118	4	2 190 000	4 800 000	223 000	490 000	450	560	23988CAE4
	650	157	6	3 150 000	6 350 000	320 000	645 000	430	530	23088CAE4
	650	212	6	4 150 000	9 100 000	425 000	930 000	360	450	24088CAE4
	720 720 790	226 280 280	6 6 7.5	6 000 000	10 300 000 12 100 000 12 800 000	540 000 610 000 705 000	1 230 000	320 320 300	430 430 400	23188CAE4 24188CAE4 23288CAE4

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1 : 12 or 1 : 30).



Dynamic Equivalent Load $P = XF_r + YF_a$

	1 4		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y ₃	0.67	Y ₂

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

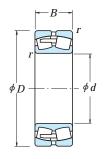
The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

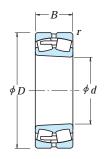
Numbers	Abutme	ent and Fille (mm		ons	Constant		xial Loa Factors		Mass (kg)
Tapered Bore(1)	$d_{ m a}$ min.	$oldsymbol{L}$ max.) a min.	$oldsymbol{arGamma}_{a}$ max.	e	Y_2	Y_3	Y_0	approx.
23972CAKE4	374	466	447	2.5	0.17	6.0	4.1	4.0	44.7
23072CAKE4	382	518	485	4	0.24	4.2	2.8	2.8	106
24072CAK30E4	382	518	476	4	0.32	3.2	2.1	2.1	139
23172CAKE4	382	578	520	4	0.31	3.2	2.2	2.1	217
24172CAK30E4	382	578	507	4	0.40	2.5	1.7	1.7	264
23272CAKE4	388	622	549	5	0.36	2.8	1.9	1.8	342
23976CAKE4	398	502	482	3	0.18	5.5	3.7	3.6	65.4
23076CAKE4	402	538	506	4	0.22	4.5	3.0	3.0	113
24076CAK30E4	402	538	496	4	0.29	3.4	2.3	2.3	148
23176CAKE4	402	598	540	4	0.30	3.3	2.2	2.2	229
24176CAK30E4	402	598	529	4	0.38	2.6	1.8	1.7	275
23276CAKE4	408	652	578	5	0.35	2.9	1.9	1.9	372
23980CAKE4	418	522	501	3	0.18	5.7	3.9	3.8	69.1
23080CAKE4	422	578	540	4	0.23	4.4	3.0	2.9	146
24080CAK30E4	422	578	527	4	0.31	3.3	2.2	2.2	193
23180CAKE4	428	622	569	5	0.29	3.4	2.3	2.3	257
24180CAK30E4	428	622	551	5	0.37	2.7	1.8	1.8	316
23280CAKE4	428	692	610	5	0.36	2.8	1.9	1.9	449
23984CAKE4	438	542	521	3	0.17	6.0	4.0	3.9	71.6
23084CAKE4	442	598	562	4	0.23	4.3	2.9	2.8	151
24084CAK30E4	442	598	549	4	0.31	3.2	2.2	2.1	199
23184CAKE4	448	672	607	5	0.31	3.3	2.2	2.2	341
24184CAK30E4	448	672	598	5	0.38	2.6	1.8	1.7	421
23284CAKE4	456	724	644	6	0.35	2.9	1.9	1.9	534
23988CAKE4	458	582	555	3	0.18	5.7	3.9	3.8	96.3
23088CAKE4	468	622	587	5	0.23	4.3	2.9	2.8	173
24088CAK30E4	468	622	576	5	0.31	3.2	2.1	2.1	237
23188CAKE4	468	692	627	5	0.3	3.3	2.2	2.2	360
24188CAK30E4	468	692	617	5	0.37	2.7	1.8	1.8	433
23288CAKE4	476	754	669	6	0.35	2.9	1.9	1.9	594

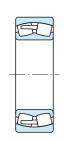
Remarks For the dimensions of adapters and withdrawal sleeves, refer to Pages B364, and B370 – B371.

Bore Diameter 460 - 560 mm









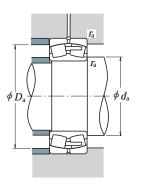
Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

E	Boundary (r	Dimens nm)	ions	(Basic Load	0	(gf)	Limiting Speeds (min ⁻¹)		Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
460	620	118	4	2 220 000	4 950 000	227 000	505 000	430	530	23992CAE4
	680	163	6	3 450 000	7 100 000	355 000	725 000	400	500	23092CAE4
	680	218	6	4 500 000	9 950 000	460 000	1 010 000	340	430	24092CAE4
	760	240	7.5	5 700 000	10 900 000	580 000	1 110 000	300	400	23192CAE4
	760	300	7.5	6 300 000	12 400 000	640 000	1 270 000	300	400	24192CAE4
	830	296	7.5	7 350 000	13 700 000	750 000	1 400 000	280	380	23292CAE4
480	650	128	5	2 580 000	5 850 000	263 000	595 000	400	500	23996CAE4
	700	165	6	3 800 000	7 950 000	385 000	810 000	400	480	23096CAE4
	700	218	6	4 600 000	10 200 000	470 000	1 040 000	320	430	24096CAE4
	790	248	7.5	6 050 000	11 700 000	620 000	1 200 000	300	380	23196CAE4
	790	308	7.5	7 150 000	14 600 000	730 000	1 490 000	300	380	24196CAE4
	870	310	7.5	7 850 000	14 400 000	805 000	1 470 000	260	360	23296CAE4
500	670	128	5	2 460 000	5 550 000	250 000	565 000	400	500	239/500CAE4
	720	167	6	3 750 000	8 100 000	385 000	825 000	380	480	230/500CAE4
	720	218	6	4 450 000	9 900 000	450 000	1 010 000	300	400	240/500CAE4
	830	264	7.5	6 850 000	13 400 000	700 000	1 360 000	280	360	231/500CAE4
	830	325	7.5	8 000 000	16 000 000	815 000	1 630 000	280	360	241/500CAE4
	920	336	7.5	9 000 000	16 600 000	915 000	1 690 000	260	320	232/500CAE4
530	710	136	5	2 930 000	6 800 000	299 000	695 000	360	450	239/530CAE4
	780	185	6	4 400 000	9 200 000	450 000	940 000	340	430	230/530CAE4
	780	250	6	5 400 000	11 800 000	550 000	1 210 000	280	360	240/530CAE4
	870	272	7.5	7 150 000	14 100 000	730 000	1 440 000	260	340	231/530CAE4
	870	335	7.5	8 500 000	17 500 000	870 000	1 790 000	260	340	241/530CAE4
	980	355	9.5	10 100 000	18 800 000	1 030 000	1 920 000	240	300	232/530CAE4
560	750	140	5	3 100 000	7 250 000	320 000	740 000	340	430	239/560CAE4
	820	195	6	5 000 000	10 700 000	510 000	1 090 000	320	400	230/560CAE4
	820	258	6	5 950 000	13 300 000	605 000	1 360 000	260	340	240/560CAE4
	920	280	7.5	7 850 000	15 500 000	800 000	1 580 000	240	320	231/560CAE4
	920	355	7.5	9 400 000	19 600 000	960 000	2 000 000	240	320	241/560CAE4
	1 030	365	9.5	10 900 000	20 500 000	1 110 000	2 090 000	220	280	232/560CAE4





Dynamic Equivalent Load $P = XF_{r} + YF_{a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$		
X	X Y		Y	
1	Y ₃	0.67	Y_2	

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

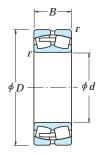
The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

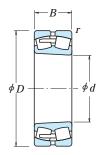
Numbers	Abutme	ent and Fille (mm		ons	Constant	А	xial Loa Factors		Mass (kg)
Tapered Bore(1)	$d_{ m a}$ min.	max.) a min.	$r_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
23992CAKE4	478	602	575	3	0.17	5.9	4.0	3.9	100
23092CAKE4	488	652	615	5	0.22	4.6	3.1	3.0	201
24092CAK30E4	488	652	604	5	0.29	3.4	2.3	2.3	266
23192CAKE4	496	724	661	6	0.31	3.3	2.2	2.2	423
24192CAK30E4	496	724	646	6	0.39	2.6	1.7	1.7	512
23292CAKE4	496	794	702	6	0.36	2.8	1.9	1.8	691
23996CAKE4	502	628	602	4	0.18	5.7	3.8	3.7	121
23096CAKE4	508	672	633	5	0.22	4.6	3.1	3.0	211
24096CAK30E4	508	672	625	5	0.30	3.4	2.3	2.2	270
23196CAKE4	516	754	688	6	0.31	3.3	2.2	2.2	475
24196CAK30E4	516	754	670	6	0.39	2.6	1.7	1.7	567
23296CAKE4	516	834	733	6	0.36	2.8	1.9	1.8	795
239/500CAKE4	522	648	622	4	0.17	6.0	4.0	3.9	124
230/500CAKE4	528	692	655	5	0.21	4.8	3.2	3.1	220
240/500CAK30E4	528	692	643	5	0.30	3.4	2.3	2.2	276
231/500CAKE4	536	794	720	6	0.31	3.2	2.2	2.1	567
241/500CAK30E4	536	794	703	6	0.39	2.6	1.7	1.7	666
232/500CAKE4	536	884	773	6	0.38	2.7	1.8	1.8	969
239/530CAKE4	552	688	659	4	0.17	6.0	4.0	3.9	149
230/530CAKE4	558	752	706	5	0.22	4.6	3.1	3.0	298
240/530CAK30E4	558	752	690	5	0.31	3.3	2.2	2.2	390
231/530CAKE4	566	834	758	6	0.30	3.3	2.2	2.2	628
241/530CAK30E4	566	834	740	6	0.38	2.6	1.8	1.7	773
232/530CAKE4	574	936	824	8	0.38	2.7	1.8	1.7	1 170
239/560CAKE4	582	728	697	4	0.16	6.1	4.1	4.0	172
230/560CAKE4	588	792	742	5	0.22	4.5	3.0	2.9	344
240/560CAK30E4	588	792	729	5	0.30	3.3	2.2	2.2	440
231/560CAKE4	596	884	804	6	0.30	3.4	2.3	2.2	727
241/560CAK30E4	596	884	782	6	0.39	2.6	1.8	1.7	886
232/560CAKE4	604	986	870	8	0.36	2.8	1.9	1.8	1 320

Remarks For the dimensions of adapters and withdrawal sleeves, refer to Pages B365 and B371.

NSK

Bore Diameter 600 – 800 mm



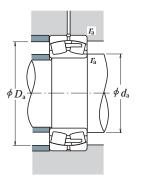


Cylindrical Bore

Tapered Bore

Е	oundary (r	Dimens	ions	(1)	Basic Load	0	gf}	Limiting S	•	Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
600	800	150	5	3 450 000	8 100 000	350 000	830 000	320	400	239/600CAE4
	870	200	6	5 450 000	12 200 000	555 000	1 240 000	300	360	230/600CAE4
	870	272	6	6 600 000	15 100 000	675 000	1 540 000	240	320	240/600CAE4
	980	300	7.5	8 750 000	17 500 000	895 000	1 790 000	220	280	231/600CAE4
	980	375	7.5	10 400 000	21 900 000	1 060 000	2 230 000	220	280	241/600CAE4
	1 090	388	9.5	12 700 000	24 900 000	1 300 000	2 540 000	200	260	232/600CAE4
630	850	165	6	4 000 000	9 350 000	405 000	950 000	300	360	239/630CAE4
	920	212	7.5	5 900 000	12 700 000	600 000	1 300 000	280	340	230/630CAE4
	920	290	7.5	7 550 000	17 700 000	770 000	1 810 000	220	300	240/630CAE4
	1 030	315	7.5	9 600 000	19 400 000	980 000	1 970 000	200	260	231/630CAE4
	1 030	400	7.5	11 300 000	23 900 000	1 160 000	2 440 000	200	260	241/630CAE4
	1 150	412	12	13 400 000	25 600 000	1 370 000	2 610 000	180	240	232/630CAE4
670	900	170	6	4 350 000	10 300 000	445 000	1 050 000	260	340	239/670CAE4
	980	230	7.5	6 850 000	15 000 000	700 000	1 530 000	240	320	230/670CAE4
	980	308	7.5	8 450 000	19 500 000	860 000	1 990 000	200	260	240/670CAE4
	1 090	336	7.5	10 600 000	21 600 000	1 080 000	2 200 000	190	240	231/670CAE4
	1 090	412	7.5	12 400 000	26 500 000	1 270 000	2 700 000	190	240	241/670CAE4
	1 220	438	12	14 900 000	28 700 000	1 520 000	2 920 000	170	220	232/670CAE4
710	950	180	6	4 800 000	11 700 000	490 000	1 200 000	240	300	239/710CAE4
	1 030	236	7.5	7 100 000	15 800 000	725 000	1 610 000	240	280	230/710CAE4
	1 030	315	7.5	8 850 000	20 700 000	905 000	2 110 000	190	240	240/710CAE4
	1 150	438	9.5	13 900 000	30 500 000	1 410 000	3 100 000	170	220	241/710CAE4
	1 280	450	12	15 700 000	30 500 000	1 600 000	3 100 000	160	200	232/710CAE4
750	1 000	185	6	5 250 000	12 800 000	535 000	1 310 000	220	280	239/750CAE4
	1 090	250	7.5	7 750 000	17 200 000	790 000	1 750 000	220	260	230/750CAE4
	1 090	335	7.5	10 100 000	24 000 000	1 030 000	2 450 000	180	220	240/750CAE4
	1 360	475	15	17 700 000	35 500 000	1 800 000	3 600 000	140	190	232/750CAE4
800	1 060	195	6	5 600 000	13 700 000	570 000	1 400 000	220	260	239/800CAE4
	1 150	258	7.5	8 350 000	19 100 000	850 000	1 950 000	200	240	230/800CAE4
	1 150	345	7.5	10 900 000	26 300 000	1 110 000	2 680 000	160	200	240/800CAE4
	1 280	375	9.5	13 800 000	29 200 000	1 410 000	2 970 000	150	190	231/800CAE4
	1 420	488	15	20 300 000	41 000 000	2 070 000	4 150 000	130	170	232/800CAE4





Dynamic Equivalent Load $P = XF_{r} + YF_{o}$

$F = AF_r + IF_a$								
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$						
X	Y	X	Y					
1	Y ₃	0.67	Y ₂					

Static Equivalent Load

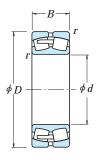
 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

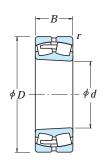
The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

Νι	umbers	Abutm	ent and Fil (mr	let Dimens n)	ions	Constant	nstant Axial Load Factors			Mass (kg)
	Tapered Bore(1)	$d_{ m a}$ min.	max.	$D_{ m a}$ min.	$m{r_a}$ max.	e	Y_2	Y_3	Y_0	approx.
2:	39/600CAKE4	622	778	745	4	0.17	5.9	3.9	3.9	205
	30/600CAKE4	628	842	794	5	0.21	4.8	3.3	3.2	389
	40/600CAK30E4	628	842	772	5	0.30	3.3	2.2	2.2	529
	31/600CAKE4	636	944	856	6	0.30	3.4	2.3	2.2	898
	41/600CAK30E4	636	944	836	6	0.39	2.6	1.8	1.7	1 050
	32/600CAKE4	644	1 046	923	8	0.36	2.8	1.9	1.8	1 590
2	39/630CAKE4	658	822	786	5	0.18	5.6	3.8	3.7	259
	30/630CAKE4	666	884	835	6	0.22	4.7	3.1	3.1	468
	40/630CAK30E4	666	884	815	6	0.30	3.3	2.2	2.2	637
2	31/630CAKE4	666	994	900	6	0.30	3.4	2.3	2.2	1 040
	41/630CAK30E4	666	994	876	6	0.38	2.7	1.8	1.7	1 250
	32/630CAKE4	684	1 096	970	10	0.36	2.8	1.9	1.8	1 850
2	39/670CAKE4 30/670CAKE4 40/670CAK30E4 31/670CAKE4	698 706 706 706	872 944 944 1 054	836 891 868 952	5 6 6	0.17 0.22 0.30 0.30	5.8 4.7 3.3 3.3	3.9 3.1 2.2 2.2	3.8 3.1 2.2 2.2	300 571 773 1 230
	41/670CAK30E4	706	1 054	934	6	0.37	2.7	1.8	1.8	1 440
	32/670CAKE4	724	1 166	1 024	10	0.37	2.7	1.8	1.8	2 210
2	39/710CAKE4	738	922	883	5	0.17	5.8	3.9	3.8	352
	30/710CAKE4	746	994	936	6	0.22	4.6	3.1	3.0	647
	40/710CAK30E4	746	994	916	6	0.29	3.4	2.3	2.2	861
	41/710CAK30E4	754	1 106	981	8	0.38	2.6	1.8	1.7	1 730
	32/710CAKE4	764	1 226	1 080	10	0.36	2.8	1.9	1.8	2 470
	39/750CAKE4	778	972	931	5	0.17	6.0	4.1	4.0	398
	30/750CAKE4	786	1 054	990	6	0.22	4.6	3.1	3.0	768
	40/750CAK30E4	786	1 054	969	6	0.29	3.4	2.3	2.2	1 030
	32/750CAKE4	814	1 296	1 148	12	0.36	2.8	1.9	1.8	2 980
2	39/800CAKE4	828	1 032	987	5	0.17	6.0	4.0	3.9	462
	30/800CAKE4	836	1 114	1 045	6	0.21	4.7	3.2	3.1	870
	40/800CAK30E4	836	1 114	1 029	6	0.27	3.7	2.5	2.5	1 130
	31/800CAKE4	844	1 236	1 127	8	0.28	3.6	2.4	2.3	1870
	32/800CAKE4	864	1 356	1 208	12	0.35	2.8	1.9	1.9	3 250

Bore Diameter 850 – 1400 mm





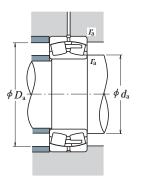


Cylindrical Bore

Tapered Bore

Е	Boundary (r	Dimens nm)	ions	1)	Basic Load N)	3	gf}	Limiting Speeds (min ⁻¹)		Bearing
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore
850	1 120 1 220	200 272	6 7.5	6 100 000 9 300 000	15 200 000 21 400 000	620 000 945 000	1 550 000 2 190 000	190 180	240 220	239/850CAE4 230/850CAE4
	1 220 1 500	365 515	7.5 15	11 600 000 22 300 000	28 300 000 45 500 000	1 180 000 2 270 000	2 890 000 4 650 000	150 120	190 160	240/850CAE4 232/850CAE4
900	1 180 1 280	206 280	6 7.5	6 600 000 9 850 000	16 700 000 22 800 000	670 000 1 000 000	1 700 000 2 330 000	180 160	220 200	239/900CAE4 230/900CAE4
	1 280 1 580	375 515	7.5 15	12 800 000 23 400 000	31 500 000 47 500 000		3 250 000 4 850 000	140 110	180 140	240/900CAE4 232/900CAE4
950	1 250 1 360	224 300	7.5 7.5	7 600 000 11 300 000	19 900 000 26 500 000	775 000 1 160 000	2 030 000 2 710 000	160 150	200 190	239/950CAE4 230/950CAE4
	1 360 1 660	412 530	7.5 15	14 500 000 24 700 000	36 500 000 50 500 000	1 480 000 2 520 000	3 700 000 5 150 000	120 100	160 130	240/950CAE4 232/950CAE4
1 000	1 320 1 420 1 420	236 308 412	7.5 7.5 7.5	8 200 000 11 900 000 15 300 000	21 700 000 28 100 000 38 500 000	835 000 1 210 000 1 560 000	2 210 000 2 860 000 3 950 000	150 140 110	190 170 150	239/1000CAE4 230/1000CAE4 240/1000CAE4
1 060	1 400 1 500 1 500	250 325 438	7.5 9.5 9.5	9 300 000 13 000 000 16 800 000	24 400 000 31 500 000 43 000 000	950 000 1 330 000 1 720 000	2 490 000 3 200 000 4 350 000	130 120 100	170 160 130	239/1060CAE4 230/1060CAE4 240/1060CAE4
1 120	1 580 1 580	345 462	9.5 9.5	15 400 000 18 700 000	38 000 000 49 500 000	1 570 000 1 910 000	3 850 000 5 050 000	110 95	140 120	230/1120CAE4 240/1120CAE4
1 180	1 660	475	9.5	20 200 000	52 500 000	2 060 000	5 350 000	85	110	240/1180CAE4
1 250	1 750	500	9.5	21 000 000	59 500 000	2 140 000	6 050 000	75	100	240/1250CAE4
1 320	1 850	530	12	22 600 000	63 500 000	2 310 000	6 500 000	67	85	240/1320CAE4
1 400	1 950	545	12	24 500 000	65 000 000	2 500 000	6 650 000	60	75	240/1400CAE4





Dynamic Equivalent Load $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r}>e$			
X	X Y		Y		
1	Y ₃	0.67	Y ₂		

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

Numbers	Abutm	Abutment and Fillet Dimensions (mm)			Constant	Axial Load Factors			Mass (kg)
Tapered Bore(1)	$d_{\!\scriptscriptstyle a}$ min.	max.	$D_{ m a}$ min.	$m{r}_{ m a}$ max.	e	Y_2	Y_3	Y_0	approx.
239/850CAKE4 230/850CAKE4	878 886	1 092 1 184	1 046 1 109	5 6	0.16 0.21	6.2 4.8	4.2 3.2	4.1 3.1	523 1 020
240/850CAK30E4 232/850CAKE4	886 914	1 184 1 436	1 093 1 274	6 12	0.28 0.35	3.6 2.8	2.4 1.9	2.4 1.9	1 350 3 890
239/900CAKE4 230/900CAKE4	928 936	1 152 1 244	1 103 1 169	5 6	0.16 0.20	6.4 4.9	4.3 3.3	4.2 3.2	591 1 160
240/900CAK30E4 232/900CAKE4	936 964	1 244 1 516	1 147 1 354	6 12	0.28 0.33	3.6 3.0	2.4 2.0	2.4 2.0	1 520 4 300
239/950CAKE4 230/950CAKE4	986 986	1 214 1 324	1 169 1 241	6	0.16 0.21	6.3 4.8	4.2 3.2	4.1 3.2	732 1 400
240/950CAK30E4 232/950CAKE4	986 1 014	1 324 1 596	1 219 1 428	6 12	0.28 0.32	3.6 3.1	2.4 2.1	2.3 2.1	1 880 4 800
239/1000CAKE4 230/1000CAKE4 240/1000CAK30E4	1 036 1 036 1 036	1 284 1 384 1 384	1 229 1 298 1 275	6 6 6	0.16 0.20 0.27	6.4 4.9 3.7	4.3 3.3 2.5	4.2 3.2 2.4	881 1 560 2 010
239/1060CAKE4 230/1060CAKE4 240/1060CAK30E4	1 096 1 104 1 104	1 364 1 456 1 456	1 302 1 368 1 346	6 8 8	0.16 0.21 0.28	6.1 4.9 3.6	4.1 3.3 2.4	4.0 3.2 2.4	1 030 1 790 2 410
230/1120CAKE4 240/1120CAK30E4	1 164 1 164	1 536 1 536	1 444 1 421	8	0.20 0.27	5.0 3.7	3.4 2.5	3.3 2.5	2 120 2 790
240/1180CAK30E4	1 224	1 616	1 494	8	0.27	3.7	2.5	2.4	3 180
240/1250CAK30E4	1 294	1 706	1 579	8	0.25	4.0	2.7	2.6	3 700
240/1320CAK30E4	1 374	1 796	1 656	10	0.26	3.9	2.6	2.6	4 400
240/1400CAK30E4	1 454	1 896	1 767	10	0.25	4.0	2.7	2.6	4 900





THRUST BEARINGS

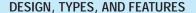
SINGLE-DIRECTION THRUST BALL BEARINGS

With Flat Seat, Aligning Seat, or Aligning Seat Washer	Bore Diameter	10 – 100 mm ······	B210
	Bore Diameter	110 – 360 mm ······	B21
DOLIDLE DIDECTION TUDUCT DALL DEADINGS			

DOUBLE-DIRECTION THRUST BALL BEARINGS

With Flat Seat, Aligning Seat, or Aligning Seat Washer	Bore Diameter	10 – 190 mm ······	B218
THRUST CYLINDRICAL ROLLER BEARINGS	Bore Diameter	35 – 320mm·····	B224
THRUST SPHERICAL ROLLER BEARINGS	Bore Diameter	60 – 500mm·····	B228

Angular Contact Thrust Ball Bearings are described on pages B234 to B243.



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.

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.

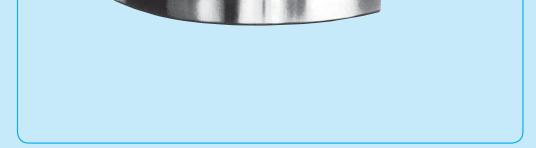
The basic load ratings listed in the bearing tables are based on the standard cage type shown in Table 2. If the type of cage is different for bearings with the same number, the number of balls may vary, in such a case, the load rating will differ from the one listed in the bearing tables.

Table1 Series of Thrust Ball Bearings

	W/Flat Seat	W/Aligning Seat	W/Aligning Seat Washer
	511	_	_
Single-	512	532	532U
Direction	513	533	533U
	514	534	534U
Double-	522	542	542U
Direction	523	543	543U
Direction	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



B 206 B 207





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.

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 BALL BEARINGS	·· Table 8.6 (Pages A72 to A74)
THRUST CYLINDRICAL ROLLER BEARINGS	
According to	o Table 8.2 (Pages A72 to A74)
THRUST SPHERICAL ROLLER BEARINGS	··Table 8.7 (Pages A75)

RECOMMENDED FITS

THRUST BALL BEARINGS	Table	9.3	(Pages	A84)
	Table	9.5	(Pages	A85)
THRUST CYLINDRICAL ROLLER BEARINGS	Table	9.3	(Pages	A84)
	Table	9.5	(Pages	A85)
THRUST SPHERICAL ROLLER BEARINGS	Table	9.3	(Pages	A84)
	Table	9.5	(Pages	A85)

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

PERMISSIBLE MISALIGNMENT

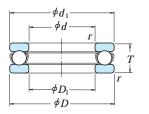
The permissible misalignment of thrust spherical roller bearings varies depending on the size, but it is approximately 0.018 to 0.036 radian (1° to 2°) with average loads.

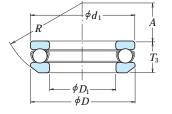
MINIMUM AXIAL LOAD

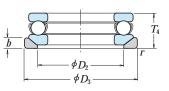
It is necessary to apply some axial load to thrust bearings to prevent slippage between the rolling elements and raceways. For more details, please refer to Page A99.

B 208 B 209





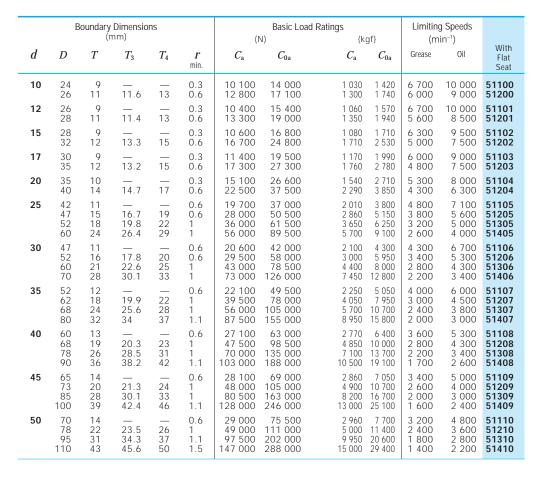


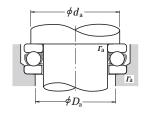


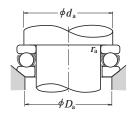
With Flat Seat

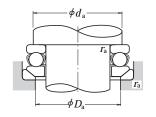
With Aligning Seat

With Aligning Seat Washer





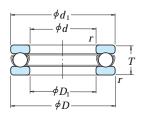


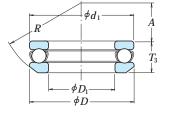


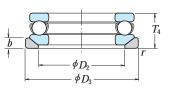
Bearin	g Numbers				Dimens (mm					nent and nsions			Mass(kg) approx.	
Witl Aligni Sea	ng Aligning	$d_{\scriptscriptstyle 1}$	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
5320	 0 53200 U	24 26	11 12	 18	 28	 3.5	— 8.5	 22	18 20	16 16	0.3 0.6	0.019 0.028	 0.029	 0.036
5320	 1 53201 U	26 28	13 14	_ 20	30	 3.5	 11.5	 25	20 22	18 18	0.3 0.6	0.021 0.031	0.031	0.039
5320	 2 53202 U	28 32	16 17	 24	 35	4	 12	 28	23 25	20 22	0.3 0.6	0.023 0.043	 0.048	 0.059
5320	 3 53203 U	30 35	18 19	 26	38	4	 16	 32	25 28	22 24	0.3 0.6	0.025 0.050	 0.055	0.069
5320	 4 53204 U	35 40	21 22	 30	<u>-</u>	- 5	 18	 36	29 32	26 28	0.3 0.6	0.037 0.077	0.080	0.096
5320 5330 5340	5 53305 U	42 47 52 60	26 27 27 27	— 36 38 42	50 55 62	5.5 6 8	 19 21 19	40 45 50	35 38 41 46	32 34 36 39	0.6 0.6 1	0.056 0.111 0.169 0.334	0.123 0.182 0.353	 0.151 0.224 0.426
5320 5330 5340	6 53306 U	47 52 60 70	32 32 32 32	42 45 50	55 62 75	5.5 7 9	— 22 22 20	45 50 56	40 43 48 54	37 39 42 46	0.6 0.6 1	0.064 0.137 0.267 0.519	0.154 0.28 0.535	0.183 0.336 0.666
5320 5330 5340	7 53307 U	52 62 68 80	37 37 37 37	— 48 52 58	 65 72 85		24 24 23	50 56 64	45 51 55 62	42 46 48 53	0.6 1 1 1	0.081 0.21 0.386 0.769	0.231 0.403 0.785	0.292 0.488 0.967
5320 5330 5340	8 53308 U	60 68 78 90	42 42 42 42	55 60 65	72 82 95	— 7 8.5 12	— 28.5 28 26	— 56 64 72	52 57 63 70	48 51 55 60	0.6 1 1 1	0.12 0.27 0.536 1.1	0.289 0.581 1.12	0.355 0.704 1.38
5320 5330 5340	9 53309 U	65 73 85 100	47 47 47 47	 60 65 72	78 90 105	7.5 10 12.5	 26 25 29	56 64 80	57 62 69 78	53 56 61 67	0.6 1 1 1	0.143 0.31 0.672 1.46	0.333 0.702 1.53	0.419 0.888 1.87
5321 5331 5341	0 53310 U	70 78 95 110	52 52 52 52	 62 72 80	82 100 115	— 7.5 11 14	 32.5 28 35	 64 72 90	62 67 77 86	58 61 68 74	0.6 1 1 1.5	0.153 0.378 0.931 1.94	0.404 1.01 1.98	0.504 1.27 2.41

B 210 B 211





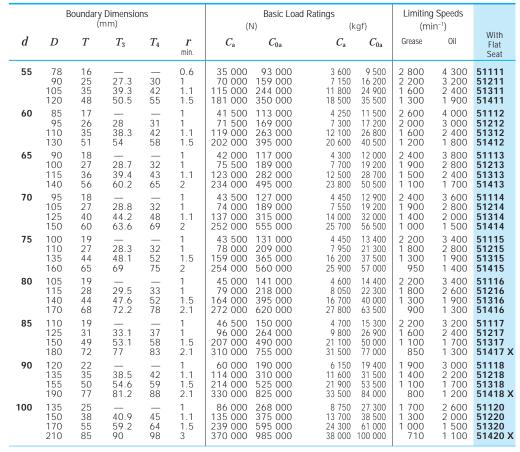


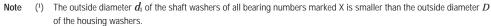


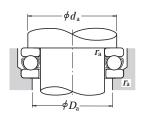
With Flat Seat

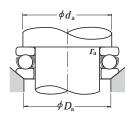
With Aligning Seat

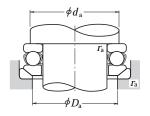
With Aligning Seat Washer





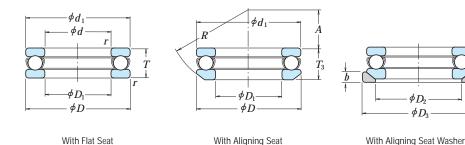


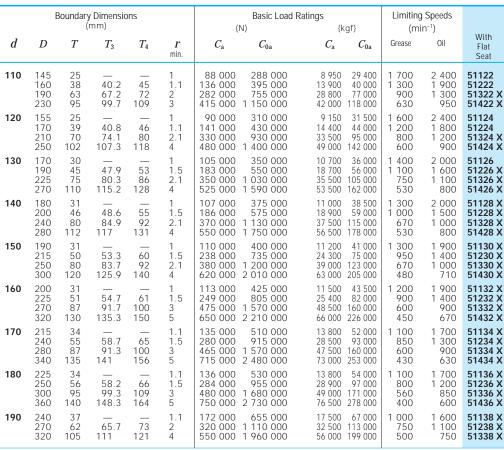




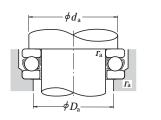
Bearing N	umbers(1)				Dimensi (mm					nent and nsions (Mass(kg) approx.)
With Aligning Seat	With Aligning Seat Washer	d_1	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
53211 53311 53411	53211 U 53311 U 53411 U	78 90 105 120	57 57 57 57	72 80 88	95 110 125	9 11.5 15.5	— 35 30 28	72 80 90	69 76 85 94	64 69 75 81	0.6 1 1 1.5	0.227 0.599 1.31 2.58	0.656 1.45 2.59	0.819 1.78 3.16
53212 53312 53412	53212 U 53312 U 53412 U	85 95 110 130	62 62 62 62	78 85 95	100 115 135	— 9 11.5 16	32.5 41 34	72 90 100	75 81 90 102	70 74 80 88	1 1 1 1.5	0.281 0.673 1.4 3.16	0.731 1.51 3.2	0.897 1.83 3.91
53213 53313 53413	53213 U 53313 U 53413 U	90 100 115 140	67 67 67 68	82 90 100	105 120 145	— 9 12.5 17.5	40 38.5 40	80 90 112	80 86 95 110	75 79 85 95	1 1 1 2	0.324 0.756 1.54 4.1	0.812 1.67 4.22	0.989 2.04 5.13
53214 53314 53414	53214 U 53314 U 53414 U	95 105 125 150	72 72 72 73	88 98 110	110 130 155	— 9 13 19.5	38 43 34	80 100 112	85 91 103 118	80 84 92 102	1 1 1 2	0.346 0.793 2.0 5.05	0.866 2.2 5.12	1.05 2.64 6.21
53215 53315 53415	53215 U 53315 U 53415 U	100 110 135 160	77 77 77 78	92 105 115	115 140 165	9.5 15 21	49 37 42	90 100 125	90 96 111 125	85 89 99 110	1 1 1.5 2	0.389 0.845 2.6 6.15	1.27 2.8 6.23	1.11 3.42 7.58
53216 53316 53416	53216 U 53316 U 53416 U	105 115 140 170	82 82 82 83	98 110 125	120 145 175	10 15 22	46 50 36	90 112 125	95 101 116 133	90 94 104 117	1 1 1.5 2	0.417 0.931 2.74 7.21	1.01 2.94 7.33	1.23 3.55 8.9
53217 53317 53417 X	53217 U 53317 U 53317 XU	110 125 150 177	87 88 88 88	105 115 130	130 155 185	 11 17.5 23	52 43 47	100 112 140	100 109 124 141	95 101 111 124	1 1 1.5 2	0.44 1.22 3.57 8.51	1.35 3.78 8.72	1.63 4.67 10.4
53218 53318 53418 X	53218 U 53318 U 53418 XU	120 135 155 187	92 93 93 93	110 120 140	140 160 195	 13.5 18 25.5	45 40 40	100 112 140	108 117 129 149	102 108 116 131	1 1 1.5 2	0.646 1.69 3.83 10.2	1.89 4.11 10.3	2.38 5.09 12.4
53220 53320 53420 X	53220 U 53320 U 53420 XU	135 150 170 205	102 103 103 103	125 135 155	155 175 220	 14 18 27	— 52 46 50	112 125 160	121 130 142 165	114 120 128 145	1 1 1.5 2.5	0.96 2.25 4.98 14.8	2.49 5.31 15	3.03 6.37 18.1

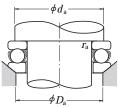


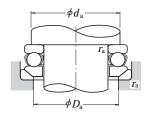




Note (1) The outside diameter d_i of the shaft washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.

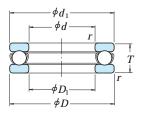


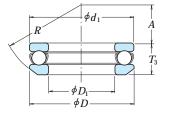


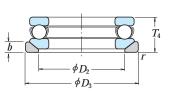


В	Ť	umbers(1)				Dimensi (mm					nent and nsions (Mass(kg) approx.	
F	With Aligning Seat	With Aligning Seat Washer	$d_{\scriptscriptstyle 1}$	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
5		53222 U 53322 XU 53422 XU	145 160 187 225	112 113 113 113	— 135 150 170	— 165 195 240	— 14 20.5 29	 65 51 59	— 125 140 180	131 140 158 181	124 130 142 159	1 1 2 2.5	1.04 2.42 7.19 20		
5		53224 U 53324 XU 53424 XU	155 170 205 245	122 123 123 123	145 165 185	175 220 260	— 15 22 32	— 61 63 70	125 160 200	141 150 173 196	134 140 157 174	1 1 2 3	1.12 2.7 9.7 26.2	2.94 10.1 26.5	3.58 12.4 31.3
5	3326 X	53226 XU 53326 XU 53426 XU	170 187 220 265	132 133 134 134	160 177 200	195 235 280	 17 26 38	67 53 58	140 160 200	154 166 186 212	146 154 169 188	1 1.5 2 3	1.68 3.95 12.1 32.3	4.35 12.7 32.4	5.33 15.8 38.8
5	3328 X	53228 XU 53328 XU 53428 XU	178 197 235 275	142 143 144 144	170 190 206	210 250 290	 17 26 38	87 68 83	160 180 225	164 176 199 222	156 164 181 198	1 1.5 2 3	1.83 4.3 14.2 34.7	 4.74 16.3 34.8	
5	3330 X	53230 XU 53330 XU 53430 XU	188 212 245 295	152 153 154 154	180 200 225	225 260 310	 20.5 26 41	— 79 89.5 69	160 200 225	174 189 209 238	166 176 191 212	1 1.5 2 3	1.95 5.52 15 43.5	 6.09 17.3 43.8	 7.82 20.5 51.9
5	3332 X	53232 XU 53332 XU 53432 XU	198 222 265 315	162 163 164 164	190 215 240	235 280 330	— 21 29 41.5	74 77 84	160 200 250	184 199 225 254	176 186 205 226	1 1.5 2.5 4	2.07 6.04 19.6 52.7	 6.78 22.3 52.9	 8.7 26.7 62
5	3334 X	53234 XU 53334 XU 53434 XU	213 237 275 335	172 173 174 174	200 220 255	250 290 350	— 21.5 29 46	91 105 74	180 225 250	197 212 235 269	188 198 215 241	1 1.5 2.5 4	2.72 7.41 20.3 61.2	8.21 23.2 61.3	
5	3336 X	53236 XU 53336 XU 53436 XU	222 247 295 355	183 183 184 184	210 240 270	260 310 370	— 21.5 32 46.5	 112 91 97	200 225 280	207 222 251 285	198 208 229 255	1 1.5 2.5 4	2.79 7.94 25.9 70.5	— 8.57 29.2 72.1	
		53238 XU 53338 XU	237 267 315	193 194 195	230 255	280 330	 23 33	98 104	200 250	220 238 266	210 222 244	1 2 3	3.6 11.8 36.5	 12.9 38.1	 15.7 44.7









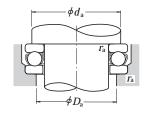
With Flat Seat

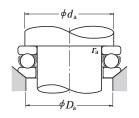
With Aligning Seat

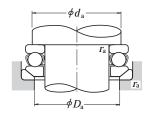
With Aligning Seat Washer

	E		y Dimensio	ons		//	Basic Load R	5	-£)	,	Speeds	
d	D	T	T_3	T_4	r min.	$C_{\rm a}$	N) $C_{0\mathrm{a}}$	$C_{ m a}$	C_{0a}	Grease	in ⁻¹) Oil	With Flat Seat
200	250 280 340	37 62 110	 65.3 118.4	— 74 130	1.1 2 4	173 000 315 000 600 000	675 000 1 110 000 2 220 000		69 000 113 000 227 000	1 000 710 480	1 500 1 100 710	51140 X 51240 X 51340 X
220	270 300	37 63	<u> </u>	 75	1.1 2	179 000 325 000	740 000 1 210 000	18 200 33 500	75 500 123 000	950 670	1 500 1 000	51144 X 51244 X
240	300 340	45 78	— 81.6	— 92	1.5 2.1	229 000 420 000	935 000 1 650 000	23 400 43 000	95 000 168 000	850 560	1 200 850	51148 X 51248 X
260	320 360	45 79	<u> </u>	<u> </u>	1.5 2.1	233 000 435 000	990 000 1 800 000		101 000 184 000	800 560	1 200 850	51152 X 51252 X
280	350 380	53 80	 85	<u> </u>	1.5 2.1	315 000 450 000	1 310 000 1 950 000		134 000 199 000	710 530	1 000 800	51156 X 51256 X
300	380 420	62 95	100.5	 112	2	360 000 540 000	1 560 000 2 410 000		159 000 246 000	600 450	900 670	51160 X 51260 X
320	400 440	63 95	100.5	 112	2 3	365 000 585 000	1 660 000 2 680 000		169 000 273 000	600 450	900 670	51164 X 51264 X
340	420 460	64 96	 100.3	 113	2	375 000 595 000	1 760 000 2 800 000		179 000 285 000	560 430	850 630	51168 X 51268 X
360	440 500	65 110	_ 116.7	_ 130	2 4	385 000 705 000	1 860 000 3 500 000		190 000 355 000	560 380	800 560	51172 X 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.



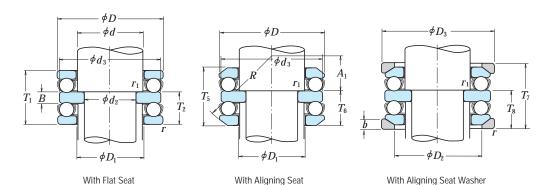


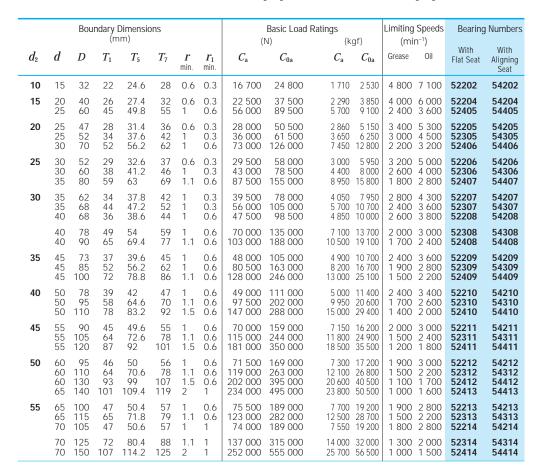


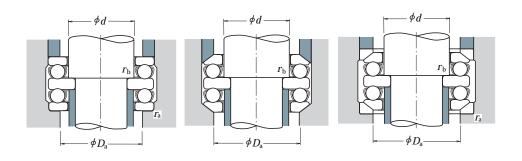
Bearing Nu					Dimensi (mm					nent and nsions (Mass(kg) approx.	
With Aligning Seat	With Aligning Seat Washer	$d_{\scriptscriptstyle 1}$	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{r_{\mathrm{a}}}$ max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
	 53240 XU 53340 XU	247 277 335	203 204 205	 240 270	 290 350	 23 38	— 125 92	— 225 250	230 248 282	220 232 258	1 2 3	3.75 12.3 43.6	 13.4 46.2	— 16.1 54.8
53244 X	 53244 XU	267 297	223 224	 260	310	 25	118	 225	250 268	240 252	1 2	4.09 13.6	 14.9	 18
53248 X	 53248 XU	297 335	243 244	 290	 350	 30	 122	 250	276 299	264 281	1.5 2	6.55 23.7	 25.6	 30.7
53252 X	 53252 XU	317 355	263 264	 305	 370	30	 152	 280	296 319	284 301	1.5 2	7.01 25.1		33.2
53256 X	 53256 XU	347 375	283 284	 325	 390	<u> </u>	143	 280	322 339	308 321	1.5 2	12 27.1	 30.3	- 37
53260 X	 53260 XU	376 415	304 304	 360	430	34	 164	320	348 371	332 349	2 2.5	17.2 43.5	- 47.7	 56.1
53264 X	 53264 XU	396 435	324 325	380	 450	 36	 157	320	368 391	352 369	2 2.5	18.6 45	— 49.9	 59.4
53268 X	 53268 XU	416 455	344 345	 400	 470	 36	 199	 360	388 411	372 389	2 2.5	19.9 47.9	 52.7	<u> </u>
53272 X	 53272 XU	436 495	364 365	 430	_ 510	 43	 172	 360	408 442	392 418	2 3	21.5 68.8	— 76.3	— 90.9

B 216 B 217

Bore Diameter 10 – 55 mm

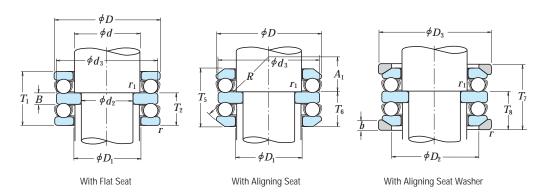






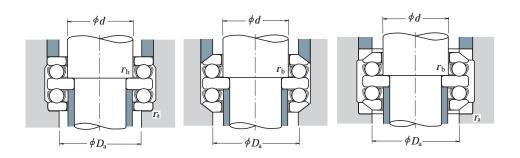
					Di	mensio (mm)	ns						nent an nsions	d Fillet (mm)	ı	Mass(kg approx.)
With Aligning Seat Washer	d_3	D_1	D_2	D_3	T_2	T_6	T_8	В	b	A_1	R	$D_{ m a}$ max.	r _a max.	$r_{ m b}$ max.	With Flat Seat		With Aligning Seat Washer
54202 U	32	17	24	35	13.5	14.8	16.5	5	4	10.5	28	24	0.6	0.3	0.081	0.090	0.113
54204 U 54405 U	40 60	22 27	30 42	42 62	16 28	16.7 30.4	19 33	6 11	5 8	16 15	36 50	30 42	0.6 1	0.3 0.6	0.148 0.641	0.151 0.68	0.185 0.825
54205 U 54305 U 54406 U	47 52 70	27 27 32	36 38 50	50 55 75	17.5 21 32	19.2 22.8 34.1	21.5 25 37	7 8 12	5.5 6 9	16.5 18 16	40 45 56	36 38 50	0.6 1 1	0.3 0.3 0.6	0.213 0.324 0.978	0.236 0.35 1.01	0.293 0.434 1.27
54206 U 54306 U 54407 U	52 60 80	32 32 37	42 45 58	55 62 85	18 23.5 36.5	19.8 25.1 38.5	22 27.5 41.5	7 9 14	5.5 7 10	20 19.5 18.5	45 50 64	42 45 58	0.6 1 1	0.3 0.3 0.6	0.254 0.483 1.43	0.288 0.511 1.47	0.345 0.621 1.83
54207 U 54307 U 54208 U	62 68 68	37 37 42	48 52 55	65 72 72	21 27 22.5	22.9 28.6 23.8	25 31 26.5	8 10 9	7 7.5 7	21 21 25	50 56 56	48 52 55	1 1 1	0.3 0.3 0.6	0.406 0.71 0.543	0.447 0.744 0.581	0.57 0.915 0.713
54308 U 54408 U	78 90	42 42	60 65	82 95	30.5 40	33 42.2	35.5 46	12 15	8.5 12	23.5 22	64 72	60 65	1 1	0.6 0.6	1.04 1.98	1.13 2.02	1.38 2.54
54209 U 54309 U 54409 U	73 85 100	47 47 47	60 65 72	78 90 105	23 32 44.5	24.3 34.1 47.9	27 37 51.5	9 12 17	7.5 10 12.5	23 21 23.5	56 64 80	60 65 72	1 1 1	0.6 0.6 0.6	0.606 1.28 2.71	0.652 1.34 2.85	0.823 1.71 3.53
54210 U 54310 U 54410 U	78 95 110	52 52 52		82 100 115	24 36 48	25.5 39.3 50.6	28 42 55	9 14 18	7.5 11 14	30.5 23 30	64 72 90	62 72 80	1 1 1.5	0.6 0.6 0.6	0.697 1.78 3.51	0.75 1.94 3.59	0.949 2.46 4.45
54211 U 54311 U 54411 U	90 105 120	57 57 57		95 110 125	27.5 39.5 53.5	29.8 43.8 56	32.5 46.5 60.5	10 15 20	9 11.5 15.5	32.5 25.5 22.5	72 80 90	72 80 88	1 1 1.5	0.6 0.6 0.6	1.11 2.43 4.66	1.22 2.7 4.68	1.55 3.35 5.82
54212 U 54312 U 54412 U 54413 U	95 110 130 140	62 62 62 68	85	100 115 135 145	28 39.5 57 62	30 42.8 60 66.2	33 46.5 64 71	10 15 21 23	9 11.5 16 17.5	30.5 36.5 28 34	72 90 100 112	78 85 95 100	1 1 1.5 2	0.6 0.6 0.6 1	1.22 2.59 5.74 7.41	1.33 2.82 5.82 7.66	1.66 3.45 7.24 9.47
54213 U 54313 U 54214 U	100 115 105	67 67 72	90	105 120 110	28.5 40 28.5	30.2 43.4 30.3	33.5 47 33.5	10 15 10	9 12.5 9	38.5 34.5 36.5	80 90 80	82 90 88	1 1 1	0.6 0.6 1	1.34 2.8 1.44	1.45 3.06 1.59	1.81 3.8 1.95
54314 U 54414 U	125 150	72 73	98 110	130 155	44 65.5	48.2 69.1	52 74.5	16 24	13 19.5	39 28.5	100 112	98 110	1	1 1	3.67 8.99	4.07 9.12	4.95 11.3

Bore Diameter 60 – 130 mm



		Bou		Dimensio	ons			(1	Basic Load R	0	gf}	Limiting (mi)	•	Bearing Numbers	(1)
d_2	d	D	T_1	T_5	T_7	$m{r}$ min.	$r_{ m 1}$ min.	C_{a}	C_{0a}	$C_{\rm a}$	C_{0a}	Grease	Oil	With With Flat Seat Alignin Seat	g
60	75 75 75	110 135 160	47 79 115	49.6 87.2 123	57 95 135	1 1.5 2	1 1 1	78 000 159 000 254 000	209 000 365 000 560 000	7 950 16 200 25 900	21 300 37 500 57 000	1 200	2 600 1 800 1 400		
65	80 80 80 85	115 140 170 180	48 79 120 128	51 86.2 128.4 138	58 95 140 150	1 1.5 2.1 2.1	1 1 1 1.1	79 000 164 000 272 000 310 000	218 000 395 000 620 000 755 000	8 050 16 700 27 800 31 500	22 300 40 000 63 500 77 000	1 200 850			x
70	85 85 90	125 150 190	55 87 135	59.2 95.2 143.4	67 105 157	1 1.5 2.1	1 1 1.1	96 000 207 000 330 000	264 000 490 000 825 000	9 800 21 100 33 500	26 900 50 000 84 000	1 100	2 200 1 600 1 100		X
75 80	90 90 100	135 155 210	62 88 150	69 97.2 160	76 106 176	1.1 1.5 3	1 1 1.1	114 000 214 000 370 000	310 000 525 000 985 000	11 600 21 900 38 000	31 500 53 500 100 000	1 100	2 000 1 600 1 000		X
85 90	100 100 110	150 170 230	67 97 166	72.8 105.4 —	81 115 —	1.1 1.5 3	1 1 1.1	135 000 239 000 415 000	375 000 595 000 1 150 000	13 700 24 300 42 000	38 500 61 000 118 000	1 300 950 600	1 900 1 500 900		
95	110 110 120	160 190 250	67 110 177	71.4 118.4 —	81 128 —	1.1 2 4	1 1 1.5	136 000 282 000 515 000	395 000 755 000 1 540 000	13 900 28 800 52 500	40 000 77 000 157 000			52222 54222 52322 X 54322 52424 X —	X
100	120 120 130	170 210 270	68 123 192	71.6 131.2 —	82 143 —	1.1 2.1 4	1.1 1.1 1.5	141 000 330 000 525 000	430 000 930 000 1 590 000	14 400 33 500 53 500	44 000 95 000 162 000			52224 54224 52324 X 54324 52426 X —	X
110	130 130 140	190 225 280	80 130 196	85.8 — —	96 — —	1.5 2.1 4	1.1 1.1 1.5		550 000 1 030 000 1 750 000	18 700 35 500 56 500	56 000 105 000 178 000		1 100	52226 X 54226 52326 X — 52428 X —	X
120	140 140 150	200 240 300	81 140 209	86.2 — —	99 — —	1.5 2.1 4	1.1 1.1 2		575 000 1 130 000 2 010 000	18 900 37 500 63 000		1 000 670 480	1 000	52228 X 54228 52328 X — 52430 X —	X
130	150 150 160	215 250 320	89 140 226	95.6 — —	109 — —	1.5 2.1 5	1.1 1.1 2		735 000 1 200 000 2 210 000	24 300 39 000 66 000	75 000 123 000 226 000	900 630 430	950	52230 X 54230 52330 X — 52432 X —	X

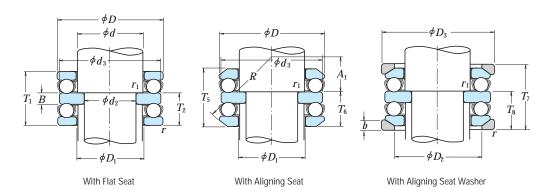
Note (1) The outside diameter d_s of the central washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.



					Di	mensio (mm)	ns						nent an nsions	d Fillet (mm)	1	Mass(kg approx.)
With Aligning Seat Washer	d_3	D_1	D_2	D_3	T_2	T_6	T_8	В	b	A_1	R	$D_{ m a}$ max.	$r_{ m a}$ max.	$r_{ m b}$ max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
54215 U 54315 U 54415 U	110 135 160	77 77 78	105	115 140 165	28.5 48.5 70.5	29.8 52.6 74.5	33.5 56.5 80.5	10 18 26	9.5 15 21	47.5 32.5 36.5	90 100 125	92 105 115	1 1.5 2	1 1 1	1.54 4.74 10.8	1.66 5.14 11	2.06 6.38 13.7
54216 U 54316 U 54416 U 54417 XU	115 140 170 179.5	82 82 83 88	110 125		29 48.5 73.5 78.5	30.5 52.1 77.7 83.5	34 56.5 83.5 89.5	10 18 27 29	10 15 22 23	45 45.5 30.5 40.5	90 112 125 140	98 110 125 130	1 1.5 2 2	1 1 1	1.66 4.99 12.6 15.4	1.78 5.39 12.8 15.8	2.21 6.61 16 19.5
54217 U 54317 U 54418 XU	125 150 189.5	88 88 93	105 115 140		33.5 53 82.5	35.6 57.1 86.7	39.5 62 93.5	12 19 30	11 17.5 25.5	49.5 39 34.5	100 112 140	105 115 140	1 1.5 2	1 1 1	2.26 6.38 17.5	2.45 6.8 18.1	3.02 10.5 22.5
54218 U 54318 U 54420 XU	135 155 209.5	93 93 103	120	140 160 220	38 53.5 91.5	41.5 58.1 96.5	45 62.5 104.5	14 19 33	13.5 18 27	42 36.5 43.5	100 112 160	110 120 155	1 1.5 2.5	1 1 1	3.09 6.79 26.8	3.42 7.33 27.2	4.39 9.29 33.4
54220 U 54320 U —	150 170 229	103 103 113	125 135 —		41 59 101.5	43.9 63.2 —	48 68 —	15 21 37	14 18 —	49 42 —	112 125 —	125 135 159	1 1.5 2.5	1 1 1	4.08 8.82 35.6	4.54 9.47 —	5.64 11.6 —
54222 U 54322 XU —	160 189.5 249	113 113 123	135 150 —	165 195 —	41 67 108.5	43.2 71.2 —	48 76 —	15 24 40	14 20.5 —	62 47 —	125 140 —	135 150 174	1 2 3	1 1 1.5	4.39 12.7 47.6	4.83 13.5 —	5.94 16.6 —
54224 U 54324 XU —	170 209.5 269	123 123 134	145 165 —		41.5 75 117	43.3 79.1 —	48.5 85 —	15 27 42	15 22 —	58.5 58 —	125 160 —	145 165 188	1 2 3	1 1 1.5	4.92 17.6 57.8	5.4 16.4 —	6.68 22.9 —
54226 XU — —	189.5 224 279	133 134 144	160 —	195 — —	49 80 120	51.9 — —	57 — —	18 30 44	17 — —	63 — —	140 —	160 169 198	1.5 2 3	1 1 1.5	7.43 21.5 62.4	8.24 —	10.2 — —
54228 XU — —	199.5 239 299	143 144 153	170 —	210 — —	49.5 85.5 127.5	52.1 — —	58.5 — —	18 31 46	17 —	83.5 — —	160 —	170 181 212	1.5 2 3	1 1 2	8.01 24.8 77.8	8.87 —	11.2 — —
54230 XU — —	214.5 249 319	153 154 164	180 —	225 — —	54.5 85.5 138	57.8 — —	64.5 —	20 31 50	20.5 —	74.5 —	160 —	180 191 226	1.5 2 4	1 1 2	10.4 30.3 93.6	11.5 — —	15 — —

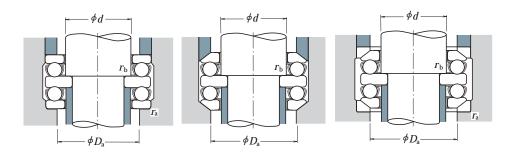
B 220 B 221

Bore Diameter 135 – 190 mm



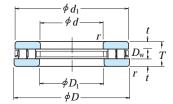
		Bou		Dimensionm)	ons				Basic Load R	atings {kgf}	Limiting Speeds (min ⁻¹)	Bearing Numbers ⁽¹⁾
d_2	d	D	T_1	T_5	T_7	$m{r}$ min.	$r_1 \atop ext{min.}$	C _a	C_{0a}	$C_{\rm a}$ $C_{0 \rm a}$	Grease Oil	With With Flat Seat Aligning Seat
135	170	340	236	_	_	5	2.1	715 000	2 480 000	73 000 253 000	400 600	52434 X —
140	160 160 180	225 270 360	90 153 245	97.4 — —	110 —	1.5 3 5	1.1 1.1 3	249 000 475 000 750 000	805 000 1 570 000 2 730 000	25 400 82 000 48 500 160 000 76 500 278 000	600 900	52232 X 54232 X 52332 X — 52436 X —
150	170 170 180 180	240 280 250 300	97 153 98 165	104.4 — 102.4 —	117 — 118 —	1.5 3 1.5 3	1.1 1.1 2 2	280 000 465 000 284 000 480 000	915 000 1 570 000 955 000 1 680 000	28 500 93 000 47 500 160 000 28 900 97 000 49 000 171 000	560 850 800 1 200	52334 X —
160	190 190	270 320	109 183	116.4	131	2 4	2	320 000 550 000	1 110 000 1 960 000	32 500 113 000 56 000 199 000		52238 X 54238 X 52338 X —
170	200 200	280 340	109 192	115.6 —	133	2	2	315 000 600 000	1 110 000 2 220 000	32 500 113 000 61 500 227 000	710 1 000 450 670	52240 X 54240 X 52340 X —
190	220	300	110	115.2	134	2	2	325 000	1 210 000	33 500 123 000	670 1 000	52244 X 54244 X

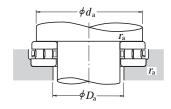
Note (!) The outside diameter d_s of the central washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.



					Di	mensio (mm)	ns						nent an nsions	d Fillet (mm)	ı	Mass(ko approx	
With Aligning Seat Washer	d_3	D_1	D_2	D_3	T_2	T_6	T_8	В	b	A_1	R	$D_{ m a}$ max.	r а тах.	$r_{ m b}$ max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
_	339	174	_	_	143	_	_	50	_	_	_	240	4	2	110	_	_
54232 XU 	224.5 269 359	163 164 184	190 —	235 — —	55 93 148.5	58.7 — —	65 — —	20 33 52	21 — —	70 —	160 —	190 205 254	1.5 2.5 4	1 1 2.5	11.2 35.1 126	12.7 — —	16.5 — —
54234 XU 54236 XU	239.5 279 249 299	173 174 183 184	200 210 —	250 — 260 —	59 93 59.5 101	62.7 — 61.7 —	69 — 69.5 —	21 33 21 37	21.5 — 21.5 —	87 — 108.5 —	180 200 	200 215 210 229	1.5 2.5 1.5 2.5	1 1 2 2.5	13.6 40.8 14.8 46.3	15.2 — 16.1 —	19.8 — 20.6 —
54238 XU —	269 319	194 195	230	280 —	66.5 111.5	70.2 —	77.5 —	24 40	23	93.5 —	200	230 244	2	2	22.1 113	22.2 —	29.8 —
54240 XU —	279 339	204 205	240 —	290 —	66.5 117	69.8 —	78.5 —	24 42	23	120.5 —	225 —	240 258	2	2	23.1 78.4	23.2	30.6
54244 XU	299	224	260	310	67	69.6	79	24	25	114	225	260	2	2	25.2	27.8	34.1

Bore Diameter 35 – 130 mm





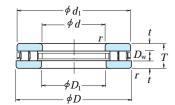
	Boundary D (mr				ad Ratings N)	1	J Speeds in ⁻¹)
d	D	T	r min.	$C_{\rm a}$	$C_{0\mathrm{a}}$	Grease	Oil
35	80	32	1.1	95 500	247 000	1 000	3 000
40	78	22	1	63 000	194 000	1 200	3 600
45	65	14	0.6	33 000	100 000	1 700	5 000
	85	24	1	71 000	233 000	1 100	3 400
50	110	27	1.1	139 000	470 000	900	2 800
	95	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

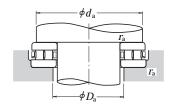
Bearing Numbers			ensions nm)			tment and I ensions (n		Mass (kg)
bearing Numbers	$d_{\scriptscriptstyle 1}$	D_1	$D_{ m w}$	t	d a min.	$D_{ m a}$ max.	$m{r}_{ m a}$ max.	approx.
35 TMP 14	80	37	12	10	71	46	1	0.97
40 TMP 93	78	42	8	7	71	48	1	0.525
45 TMP 11	65	47	6	4	60	49	0.6	0.144
45 TMP 93	85	47	8	8	78	53	1	0.665
50 TMP 74	109	52	11	8	100	61	1	1.52
50 TMP 93	93	52	11		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

Remarks For cylindrical roller thrust bearings not listed adove, please contact NSK.

NSN

Bore Diameter 140 – 320 mm





	Boundary [(m				ad Ratings (N)	١	J Speeds in ⁻¹)
d	D	T	$m{r}$ min.	$C_{\rm a}$	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	380 420	62 95	2 3	795 000 1 390 000	4 000 000 6 250 000	300 220	900 670
320	400 440	63 95	2 3	820 000 1 420 000	4 250 000 6 550 000	300 220	900 670

Bearing Numbers			ensions mm)			tment and I nensions (n		Mass (kg)
bearing numbers	$d_{\scriptscriptstyle 1}$	D_1	$D_{ m w}$	t	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	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 2	6.15
150 TMP 93	250	153	25	17.5	236	165		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 2	4.5
220 TMP 12	297	224	30	16.5	287	232		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

Remarks For cylindrical roller thrust bearings not listed adove, please contact NSK.

B 226 B 227

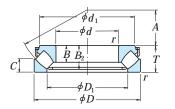
Bore Diameter 60 – 200 mm

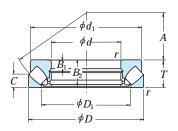


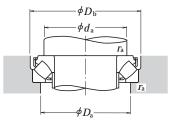
Mass

(kg)

approx.







 d_1

 D_1

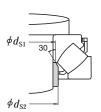
Dimensions (mm)

 B_2

C

A

 B,B_1



Spacer Sleeve Dimensions (mm)

max.

 $d_{
m S1}$ max.

Dynamic Equivalent Load $P=1.2F_{\rm r}+F_{\rm a}$ Static Equivalent Load $P_0=2.8F_{\rm r}+F_{\rm a}$ However, $F_{\rm r}/F_{\rm a}\!\leqq\!0.55$ must be satisfied.

Abutment and Fillet

Dimensions (mm)

 D_{b}

min.

 $r_{\rm a}$

max.

 $d_{a}^{(1)}$ D_{a}

max.

min.

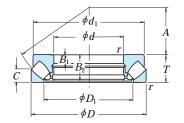
		Dimensior nm)	IS	(Basic Load I N)	•	gf}	Limiting Speeds	Bearing
d	D	T	$m{r}$ min.	C_{a}	$C_{0\mathrm{a}}$	C_{a}	C_{0a}	(min ⁻¹) Oil	Numbers
60	130	42	1.5	330 000	885 000	33 500	90 000	2 600	29412 E
65	140	45	2	405 000	1 100 000	41 500	112 000	2 400	29413 E
70	150	48	2 2	450 000	1 240 000	46 000	126 000	2 400	29414 E
75	160	51		515 000	1 430 000	52 500	146 000	2 200	29415 E
80 85	170 150 180	54 39 58	2.1 1.5 2.1	575 000 330 000 630 000	1 600 000 1 040 000 1 760 000	58 500 34 000 64 500	163 000 106 000 179 000	2 000 2 400 1 900	29416 E 29317 E 29417 E
90	155	39	1.5	350 000	1 080 000	35 500	110 000	2 200	29318 E
	190	60	2.1	695 000	1 950 000	70 500	199 000	1 800	29418 E
100	170	42	1.5	410 000	1 280 000	41 500	131 000	2 000	29320 E
	210	67	3	840 000	2 400 000	86 000	245 000	1 600	29420 E
110	190 230	48 73	2 3	530 000 1 010 000	1 710 000 2 930 000	54 000 103 000	174 000 299 000	1 800 1 500	29322 E 29422 E
120	210	54	2.1	645 000	2 100 000	65 500	214 000	1 600	29324 E
	250	78	4	1 160 000	3 400 000	119 000	350 000	1 400	29424 E
130	225	58	2.1	740 000	2 450 000	75 500	250 000	1 500	29326 E
	270	85	4	1 330 000	3 900 000	135 000	400 000	1 200	29426 E
140	240	60	2.1	840 000	2 810 000	85 500	287 000	1 400	29328 E
	280	85	4	1 370 000	4 200 000	140 000	425 000	1 200	29428 E
150	250	60	2.1	870 000	2 900 000	89 000	296 000	1 400	29330 E
	300	90	4	1 580 000	4 900 000	162 000	500 000	1 100	29430 E
160	270	67	3	1 010 000	3 400 000	103 000	345 000	1 300	29332 E
	320	95	5	1 740 000	5 400 000	178 000	550 000	1 100	29432 E
170	280	67	3	1 050 000	3 500 000	107 000	355 000	1 200	29334 E
	340	103	5	1 680 000	5 800 000	171 000	595 000	1 000	29434
180	300	73	3	1 230 000	4 200 000	125 000	430 000	1 100	29336 E
	360	109	5	1 870 000	6 500 000	190 000	660 000	900	29436
190	320	78	4	1 370 000	4 700 000	140 000	480 000	1 100	29338 E
	380	115	5	2 100 000	7 450 000	215 000	760 000	850	29438
200	280	48	2	540 000	2 310 000	55 000	236 000	1 500	29240
	340	85	4	1 570 000	5 450 000	160 000	555 000	1 000	29340 E
	400	122	5	2 290 000	8 150 000	234 000	835 000	800	29440

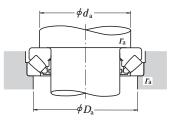
114.5	89	27	38	20	38	67	67	90	108	133	1.5	2.55
121.5	93	29.5	40.5	22	42	72	72	100	115	143	2	3.2
131.5	102	31	43	24	44	78	78	105	125	153	2	3.9
138	107	33.5	46	25	47	83	83	115	132	163		4.65
148	114.5	35	48.5	27	50	89	89	120	140	173	2	5.55
134.5	112	24.5	35.5	19	50	91	91	115	135	153	1.5	2.7
156.5	124	37	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		16.6
203.5	168.5	37	53.5	28	76	141	143	170	195	229	2 3	8.95
235	185	54	74.5	42	81	143	153	195	225	275		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		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		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
266 306.5 365	236 257 280	15 53.5 43	46 75 117	24 41 59	108 116 122	211 —	224 —	235 265 290	255 295 335	346 —	2 3 4	8.55 28.5 69
								•				

Note (1) For heavy load applications, a d_a value should be chosen which is large enough to support the shaft washer rib.

Bore Diameter 220 – 420 mm







Dynamic Equivalent Load $P=1.2F_{\rm r}+F_{\rm a}$ Static Equivalent Load $P_0=2.8F_{\rm r}+F_{\rm a}$ However, $F_{\rm r}/F_{\rm a} {\le} 0.55$ must be satisfied.

		Dimensior nm)	าร		Basic Load (N)	•	.gf}	Limiting Speeds	Bearing
d	D	T	r min.	C_{a}	C_{0a}	C_{a}	C_{0a}	(min ⁻¹) Oil	Numbers
220	300	48	2	560 000	2 500 000	57 000	255 000	1 400	29244
	360	85	4	1 340 000	5 200 000	137 000	530 000	950	29344
	420	122	6	2 350 000	8 650 000	240 000	880 000	800	29444
240	340	60	2.1	800 000	3 450 000	82 000	350 000	1 200	29248
	380	85	4	1 360 000	5 400 000	139 000	550 000	950	29348
	440	122	6	2 420 000	9 100 000	247 000	930 000	750	29448
260	360	60	2.1	855 000	3 850 000	87 500	395 000	1 200	29252
	420	95	5	1 700 000	6 800 000	173 000	695 000	800	29352
	480	132	6	2 820 000	10 700 000	287 000	1 090 000	710	29452
280	380	60	2.1	885 000	4 100 000	90 000	420 000	1 100	29256
	440	95	5	1 830 000	7 650 000	187 000	780 000	800	29356
	520	145	6	3 400 000	13 100 000	345 000	1 330 000	630	29456
	520	145	6	3 950 000	14 900 000	400 000	1 520 000	630	29456 EM
300	420	73	3	1 160 000	5 150 000	118 000	525 000	950	29260
	480	109	5	2 190 000	9 100 000	224 000	925 000	710	29360
	540	145	6	3 500 000	13 700 000	355 000	1 390 000	630	29460
320	440	73	3	1 190 000	5 450 000	122 000	555 000	950	29264
	500	109	5	2 230 000	9 400 000	227 000	960 000	670	29364
	580	155	7.5	3 650 000	14 600 000	370 000	1 490 000	560	29464
340	460	73	3	1 230 000	5 750 000	125 000	590 000	900	29268
	540	122	5	2 640 000	11 200 000	269 000	1 140 000	630	29368
	620	170	7.5	4 400 000	17 400 000	450 000	1 780 000	530	29468
360	500	85	4	1 550 000	7 300 000	158 000	745 000	800	29272
	560	122	5	2 670 000	11 500 000	272 000	1 180 000	600	29372
	640	170	7.5	4 200 000	17 200 000	430 000	1 750 000	500	29472
	640	170	7.5	5 450 000	20 400 000	555 000	2 800 000	500	29472 EM
380	520	85	4	1 620 000	7 800 000	165 000	795 000	800	29276
	600	132	6	3 300 000	14 500 000	335 000	1 480 000	560	29376
	670	175	7.5	4 800 000	19 500 000	490 000	1 990 000	480	29476
400	540	85	4	1 640 000	8 000 000	167 000	815 000	750	29280
	620	132	6	3 250 000	14 500 000	330 000	1 480 000	530	29380
	710	185	7.5	5 400 000	22 100 000	550 000	2 250 000	450	29480
420	580	95	5	2 010 000	9 800 000	205 000	1 000 000	670	29284
	650	140	6	3 500 000	15 700 000	355 000	1 600 000	500	29384
	730	185	7.5	5 650 000	23 500 000	575 000	2 400 000	450	29484

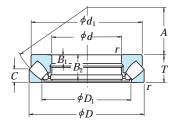
		Dimer (m		ment and ensions (r		Mass (kg)			
$d_{\scriptscriptstyle 1}$	D_1	B_1	B_2	С	A	d _a (1) min.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	approx.
285	254	15	46	24	117	260	275	2	9.2
335	280	29	81	41	125	285	315	3	33
385	308	43	117	58	132	310	355	5	74
325	283	19	57	30	130	285	305	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

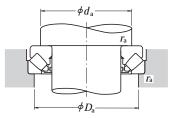
Note (1) For heavy load applications, a d_a value should be chosen which is large enough to support the shaft washer rib.

B 230 B 231

Bore Diameter 440 – 500 mm







Dynamic Equivalent Load $P=1.2F_{\rm r}+F_{\rm a}$ Static Equivalent Load $P_0=2.8F_{\rm r}+F_{\rm a}$ However, $F_{\rm r}/F_{\rm a}\!\leq\!0.55$ must be satisfied.

	,	Dimension nm)	S		Basic Load	d Ratings {kgf}	Limiting Speeds	Bearing
d	D	T	r min.	C_{a}	$C_{0\mathrm{a}}$	C_{a} C_{0a}	(min ⁻¹) Oil	Numbers
440	600 680 780 780	95 145 206 206	5 6 9.5 9.5	2 030 000 3 750 000 6 550 000 8 000 000	10 100 000 16 700 000 27 200 000 31 500 000	207 000	670 480 400 400	29288 29388 29488 29488 EM
460	620 710 800	95 150 206	5 6 9.5	2 060 000 4 100 000 6 750 000	10 300 000 18 400 000 28 600 000	210 000	670 450 380	29292 29392 29492
480	650 730 850	103 150 224	5 6 9.5	2 370 000 4 150 000 7 200 000	12 100 000 19 000 000 31 000 000	241 000	600 450 360	29296 29396 29496
500	670 750 870	103 150 224	5 6 9.5	2 390 000 4 350 000 7 850 000	12 400 000 20 400 000 33 000 000	244 000	600 450 340	292/500 293/500 294/500

Note (1) For heavy load applications, a d_a value should be chosen which is large enough to support the shaft washer rib.

		Dimer (m		ment and ensions (r		Mass (kg)			
$d_{\scriptscriptstyle 1}$	D_1	B_1	B_2	С	A	$d_{\!\scriptscriptstyle m a}^{(^1)}$ min.	$D_{ m a}$ max.	$r_{ m a}$ 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

ANGULAR CONTACT THRUST BALL BEARINGS

DOUBLE-DIRECTION ANGULAR
CONTACT THRUST BALL BEARINGS
ANGULAR CONTACT THRUST

Bore Diameter 35 – 280mm B238

BALL BEARINGS FOR BALL SCREWS Bore Diameter 15 – 60mm B242





DOUBLE-DIRECTION ANGULAR CONTACT THRUST BALL BEARINGS

Double-Direction Angular Contact Thrust Ball Bearings are specially designed high precision bearings for the main spindles of machine tools.

Compared with the Thrust Ball Bearings in the 511 Series, this type contains more balls of smaller diameter and has a contact angle of 60°. Consequently, the influence of centrifugal force is less and they can withstand higher speed and have higher rigidity.

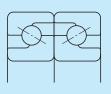
Bearings in Series 20 and 29 have the same inner and outer diameters as the

Bearings in Series 20 and 29 have the same inner and outer diameters as the double-row cylindrical roller bearings in Series NN30 and NN49 respectively, and they are both used for high axial loads.

Their cages are machined brass.

There are the BTR, BAR Series of highly rigid angular contact ball bearings suitable for high speed that can be easily replaced by these double- direction angular contact ball bearings. For more details, please contact NSK.





Bearings of this type were specially designed to support NSK Precision Ball Screws. They are usually used in combinations of more than two bearings and with a preload. Their contact angle is 60°. For more details, please refer to Catalog CAT. No. E1254 SUPER PRECISION BEARINGS.

Their cages are molded polyamide.



TOLERANCES AND RUNNING ACCURACY

DOUBLE-DIRECTION ANGULAR CONTACT THRUST
BALL BEARINGS Table 1

ANGULAR CONTACT THRUST BALL BEARINGS FOR
BALL SCREWS Table 2

The limiting chamfer dimensions of bearings of both types conform to Table 8.9.1

The limiting chamfer dimensions of bearings of both types conform to Table 8.9.1 (Page A78).

Table 1 Tolerances for Double-Direction Angular Contact Thrust Ball Bearings (Class 7 (1))

Table 1. 1 Tolerances for Bearing Bore and Height and Running Accuracy

Units: μm

	ore Diameter d m)	Δ_{dmp}		Δ_{Ts}		$\mathit{K}_{i\mathrm{a}}$ (or K_{ea})	S_d	$S_{i\mathrm{a}}$ (or S_{ea})
over	incl.	high	low	high	low	max.	max.	max.
_	30	0	- 5	0	- 300	5	4	3
30	50	0	- 5	0	- 400	5	4	3
50	80	0	- 8	0	- 500	6	5	5
80	120	0	- 8	0	- 600	6	5	5
120	180	0	-10	0	- 700	8	8	5
180	250	0	-13	0	- 800	8	8	6
250	315	0	-15	0	- 900	10	10	6
315	400	0	-18	0	-1200	10	12	7

Note (1) Class 7 is NSK Standard.

Table 1. 2 Tolerances for Housing Washer

Nominal Outs D (n		Δ	Ds
over	incl.	high	low
30	50	-25	- 41
50	80	-30	- 49
80	120	-36	- 58
120	180	-43	- 68
180	250	-50	- 79
250	315	-56	- 88
315	400	-62	- 98
400	500	-68	-108
500	630	-76	-120

Symbols in the tables are described on Page A59.

Table 2 Tolerances and Running Accuracy of Angular Contact Thrust Ball Bearings for Ball Screws (Class 7A (1))

Table 2. 1 Tolerances and Limits for Shaft and Housing Washer

Units: µm

									OTIRES . µIII
Nominal Bore Diameter d (mm)		Δ_{dmp} Δ_{Bs}		Δ_{Bs} (e	Δ_{Bs} (or Δ_{Cs}) V_{Bs} (or V_{Cs})		K_{ia}	S_d	S_{ia}
over	incl.	high	low	high	low	max.	max.	max.	max.
10	18	0	- 4	0	-120	1.5	2.5	4	2.5
18	30	0	- 5	0	-120	1.5	3	4	2.5
30	50	0	- 6	0	-120	1.5	4	4	2.5
50	80	0	- 7	0	-150	1.5	4	5	2.5

Note (1) Class 7A is NSK Standard.

RECOMMENDED FITS

DOUBLE-DIRECTION ANGULAR CONTACT THRUST BALL BEARINGS

The shaft washer and shaft should be in soft contact with neither interference nor clearance, and the housing washer and housing bore should be loosely fitted. For a bearing arrangement with a double-row cylindrical roller bearing, the tolerances for the outside diameter should be ${\bf f6}$ to produce a loose fit.

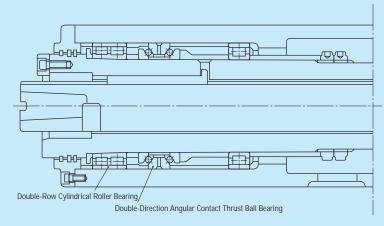
ANGULAR CONTACT THRUST BALL BEARINGS FOR BALL SCREWS

A tolerance of h5 is recommended for shafts and H6 for housing bores.

INTERNAL CLEARANCE AND PRELOAD

In order to produce an appropriate preload on bearings when they are mounted, the following axial internal clearances are recommended.

DOUBLE-ROW ANGULAR CONTACT THRUST	
BALL BEARINGS	Clearance C7
ANGULAR CONTACT THRUST BALL BEARINGS FOR	
BALL SCREWS	Clearance C10



Example of Application of Double-Direction Angular Contact Thrust Ball Bearing (Main Spindle of Machine Tool)

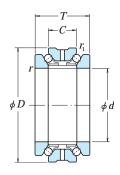
Table 2. 2 Tolerances and Running Accuracy of Housing Washer

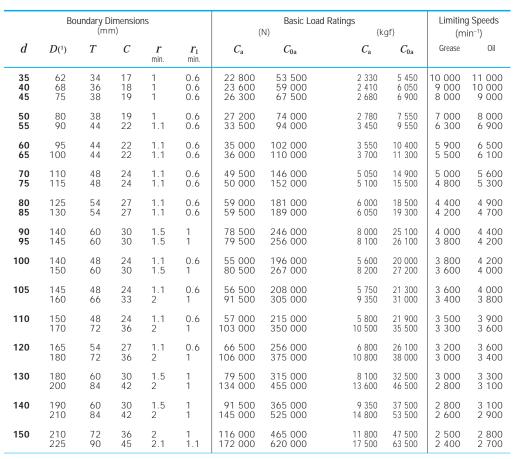
Units : µm

						Offits . µIII		
-	Nominal Outside Diameter D (mm)		Δ	Ds	Kea	$S_{ m ea}$		
	over	incl.	high	low	max.	max.		
	30	50	0	- 6	5	2.5		
	50	80	0	- 7	5	2.5		
	80	120	0	- 8	5	2.5		

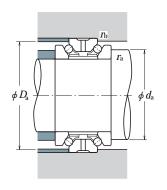
B 236 B 237

Bore Diameter 35 – 150 mm







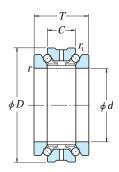


2	Abutm	nent and F (m	illet Dime m)	ensions	Mass (kg)
Bearing Numbers	$d_{\scriptscriptstyle \mathrm{a}}$	$D_{\rm a}$	$m{r}_{ m a}$ max.	$r_{ m b}$ max.	approx.
35 TAC 20X+L	46	58	1	0.6	0.375
40 TAC 20X+L	51	63	1	0.6	0.460
45 TAC 20X+L	57	70	1	0.6	0.580
50 TAC 20X+L	62	75	1	0.6	0.625
55 TAC 20X+L	69	84	1	0.6	0.945
60 TAC 20X+L	74	89	1	0.6	1.000
65 TAC 20X+L	79	94	1	0.6	1.080
70 TAC 20X+L	87	104	1	0.6	1.460
75 TAC 20X+L	92	109	1	0.6	1.550
80 TAC 20X+L	99	117	1	0.6	2.110
85 TAC 20X+L	104	122	1	0.6	2.210
90 TAC 20X+L	110	131	1.5	1	2.930
95 TAC 20X+L	115	136	1.5	1	3.050
100 TAC 29X+L	117	134	1	0.6	1.950
100 TAC 20X+L	120	141	1.5	1	3.200
105 TAC 29X+L	122	139	1	0.6	2.040
105 TAC 20X+L	127	150	2	1	4.100
110 TAC 29X+L	127	144	1	0.6	2.120
110 TAC 20X+L	134	158	2	1	5.150
120 TAC 29X+L	139	157	1	0.6	2.940
120 TAC 20X+L	144	168	2	1	5.500
130 TAC 29X+L	150	170	1.5	1	3.950
130 TAC 20X+L	160	187	2	1	8.200
140 TAC 29D+L	158	182	1.5	1	4.200
140 TAC 20D+L	167	198	2	1	8.750
150 TAC 29D+L	172	200	2	1	6.600
150 TAC 20D+L	178	213	2	1	10.700

Remarks Nominal bearing bore and outside diameters for 20X · 20D and 29X · 29D bearing series are the same as those for the NN30 and NNU49 · NN49 bearing series respectively.

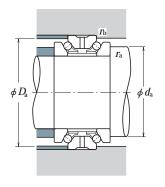


Bore Diameter 160 – 280 mm



	Вс	oundary D (mr		ns		Basic Load Ratings (N) {kgf}			.af}	Limiting Speeds (min ⁻¹)	
d	$D^{(1)}$	T	С	$m{r}$ min.	$r_{\scriptscriptstyle 1}$ min.	C_{a}	C_{0a}	C_{a}	C_{0a}	Grease	Oil
160	220 240	72 96	36 48	2 2.1	1 1.1	118 000 185 000	490 000 680 000	12 100 18 900	50 000 69 500	2 400 2 300	2 700 2 500
170	230 260	72 108	36 54	2 2.1	1 1.1	120 000 218 000	520 000 810 000	12 300 22 200	53 000 82 500	2 300 2 100	2 500 2 400
180	250 280	84 120	42 60	2 2.1	1 1.1	158 000 281 000	655 000 1 020 000	16 100 28 700	67 000 104 000	2 100 2 000	2 400 2 200
190	260 290	84 120	42 60	2 2.1	1 1.1	161 000 285 000	695 000 1 060 000	16 400 29 000	71 000 108 000	2 000 1 900	2 300 2 100
200	280 310	96 132	48 66	2.1 2.1	1.1 1.1	204 000 315 000	855 000 1 180 000	20 800 32 000	87 000 120 000	1 900 1 800	2 100 2 000
220	300	96	48	2.1	1.1	210 000	930 000	21 400	95 000	1 800	2 000
240	320	96	48	2.1	1.1	213 000	980 000	21 700	100 000	1 700	1 800
260	360	120	60	2.1	1.1	315 000	1 390 000	32 000	141 000	1 500	1 700
280	380	120	60	2.1	1.1	320 000	1 470 000	32 500	150 000	1 400	1 600

Note (1) Outside tolerance is f6.

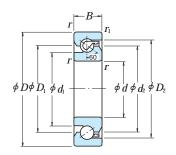


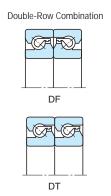
Davidson Namely or	Abutm	Mass (kg)			
Bearing Numbers	$d_{\scriptscriptstyle m a}$	$D_{\rm a}$	$oldsymbol{r_{\mathrm{a}}}{}_{\mathrm{max.}}$	$r_{ m b}$ max.	approx.
160 TAC 29D+L 160 TAC 20D+L	182 191	210 228	2 2	1 1	7.000 13.000
170 TAC 29D+L 170 TAC 20D+L	192 206	219 245	2 2	1 1	7.350 17.700
180 TAC 29D+L 180 TAC 20D+L	207 220	238 264	2 2	1 1	10.700 23.400
190 TAC 29D+L 190 TAC 20D+L	217 230	247 274	2 2	1 1	11.200 24.400
200 TAC 29D+L 200 TAC 20D+L	230 245	267 291	2 2	1 1	15.700 31.500
220 TAC 29D+L	250	287	2	1	17.000
240 TAC 29D+L	270	307	2	1	18.300
260 TAC 29D+L	300	344	2	1	31.500
280 TAC 29D+L	320	364	2	1	33.500

Remarks Nominal bearing bore and outside diameters for 20X · 20D and 29X · 29D bearing series are the same as those for the NN30 and NNU49 · NN49 bearing series respectively.

B 240 B 241

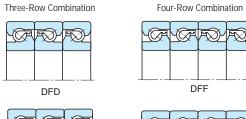
Bore Diameter 15 – 60 mm

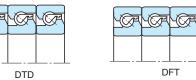




	Boundary Dimensions (mm)					Dimensions (mm)			Limiting Speeds(1) (min-1)		5	Mass (kg)
d	D	В	$m{r}$ min.	$oldsymbol{r_1}{ ext{min.}}$	$d_{\scriptscriptstyle 1}$	d_2	D_1	D_2	Grease	Oil	Bearing Numbers	approx.
15 17 20 25	47 47 47 62	15 15 15 15	1 1 1 1	0.6 0.6 0.6 0.6	27.2 27.2 27.2 37	34 34 34 45	34 34 34 45	39.6 39.6 39.6 50.7	6 000 6 000 6 000 4 500	8 000 8 000 8 000 6 000	15 TAC 47B 17 TAC 47B 20 TAC 47B 25 TAC 62B	0.144 0.144 0.135 0.252
30 35	62 72	15 15	1 1	0.6 0.6	39.5 47	47 55	47 55	53.2 60.7	4 300 3 600	5 600 5 000	30 TAC 62B 35 TAC 72B	0.224 0.31
40	72 90	15 20	1 1	0.6 0.6	49 57	57 68	57 68	62.7 77.2	3 600 3 000	4 800 4 000	40 TAC 72B 40 TAC 90B	0.275 0.674
45 50	75 100 100	15 20 20	1 1 1	0.6 0.6 0.6	54 64 67.5	62 75 79	62 75 79	67.7 84.2 87.7	3 200 2 600 2 600	4 300 3 600 3 400	45 TAC 75B 45 TAC 100B 50 TAC 100B	0.27 0.842 0.778
55 60	100 120 120	20 20 20	1 1 1	0.6 0.6 0.6	67.5 82 82	79 93 93	79 93 93	87.7 102.2 102.2	2 600 2 200 2 200	3 400 3 000 3 000	55 TAC 100B 55 TAC 120B 60 TAC 120B	0.714 1.23 1.16

Note (1) These values apply when the standard preload (C10) is used.





Y	<u> </u>			Dynamic Eq $P_{ m a} = XI$	uivalent Lo F _r + <i>YF</i> _a	oad							
		Rows		Two I	Rows	Three Rows		WS	Four Rows				
		L '	Con	nbination	DF	DT	DI	FD	DTD	DFT	DFF	DFT	
DFF				e=2.17	Axial Load Sustained by	One Row	Two Rows	One Row	Two Rows	Three Rows	One Row	Two Rows	Three Rows
		E /E <	Х	1.9	_	1.43	2.33	_	1.17	2.33	2.53		
上	To Ax			$F_{\rm a}/F_{\rm r} \leq e$	Y	0.55	_	0.77	0.35	_	0.89	0.35	0.26
					Χ	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92

	Basic Load Ratings $C_{ m a}$		Limiting Axial Load				
Sustained by	Sustained by	Sustained by	Sustained by	Sustained by	Sustained by		
one row	two rows	three rows	one row	two rows	three rows		
DF	DT, DFD, DFF	DTD, DFT	DF	DT, DFD, DFF	DTD, DFT		
(N) {kgf}	(N) {kgf}	(N) {kgf}	(N) {kgf}	(N) {kgf}	(N) {kgf}		
21 900 2 240	35 500 3 650	47 500 4 850	26 600 2 710	53 000 5 400	79 500 8 150		
21 900 2 240	35 500 3 650	47 500 4 850	26 600 2 710	53 000 5 400	79 500 8 150		
21 900 2 240	35 500 3 650	47 500 4 850	26 600 2 710	53 000 5 400	79 500 8 150		
28 500 2 910	46 500 4 700	61 500 6 250	40 500 4 150	81 500 8 300	122 000 12 500		
29 200 2 980	47 500 4 850	63 000 6 400	43 000 4 400	86 000 8 800	129 000 13 200		
31 000 3 150	50 500 5 150	67 000 6 850	50 000 5 100	100 000 10 200	150 000 15 300		
31 500 3 250	51 500 5 250	68 500 7 000	52 000 5 300	104 000 10 600	157 000 16 000		
59 000 6 000	95 500 9 750	127 000 13 000	89 500 9 150	179 000 18 300	269 000 27 400		
33 000 3 350	53 500 5 450	71 000 7 250	57 000 5 800	114 000 11 600	170 000 17 400		
61 500 6 300	100 000 10 200	133 000 13 600	99 000 10 100	198 000 20 200	298 000 30 500		
63 000 6 400	102 000 10 400	136 000 13 800	104 000 10 600	208 000 21 200	310 000 32 000		
63 000 6 400	102 000 10 400	136 000 13 800	104 000 10 600	208 000 21 200	310 000 32 000		
67 500 6 850	109 000 11 200	145 000 14 800	123 000 12 600	246 000 25 100	370 000 37 500		
67 500 6 850	109 000 11 200	145 000 14 800	123 000 12 600	246 000 25 100	370 000 37 500		



NEEDLE ROLLER BEARINGS

CAGE & NEEDLE ROLLER ASSEMBLIES Inscribed Circle Diameter 5 – 100mm···· B252

Cage & Needle Roller Assemblies for Connecting Rod Inscribed Circle Diameter 12 – 30mm··· B256

DRAWN CUP NEEDLE ROLLER BEARINGS

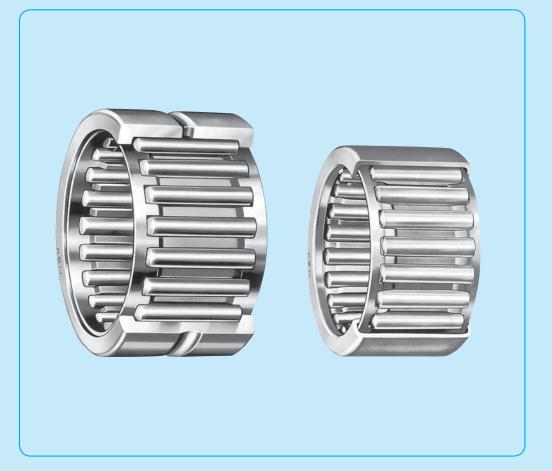
With Cage
Full Complement Type
Inscribed Circle Diameter
Inscribed Cir



For needle roller bearings, there are many designs and types bearings. Catalog

Specified catalog, NSK Needle Roller Bearings CAT.No.E1419 lists bearings shown in Table 1. Representative examples selected from them, are shown in this catalog. (shown with in Table 1) For details, please refer individual specified catalog.

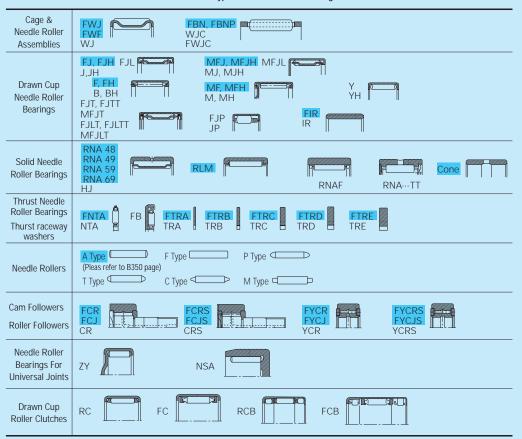
For bearing selection, please contact NSK.



B 244 B 245



Table 1 Types of Needle Roller Bearings



DIMENSIONAL ACCURACY · RUNNING ACCURACY

DRAWN CUP NEEDLE ROLLER BEARINGS

The correct form and dimensional accuracy of outer ring of drawn cup needle roller bearing is achieved only by press fitting into proper housing with appropriate interference. Therefore, roller inscribed circle diameter is measured after press fitted into a standard ring gauge.

The dimension of ring gauge and tolerance of roller inscribed circle diameter are shown in Tables 2 and 3.

Table 2 is applicable to standard drawn cup needle roller bearings (metric series), and Table 3 shows tolerance of roller inscribed circle diameter based on ISO Standards. For bearings assured by ISO Standards, please order by adding symbol of "-1" at the end of bearing number.

Table 2 Inspection Gauge Dimensions (General Metric) of Drawn Cup Needle Roller Bearings.

(FJ, FJH, MFJ, MFJH) F, FH, MF, MFH

	\1,111,1VII,1V	,	Units mm	
Nominal Roller Inscribed	Bore Diameter	Plug Gauge		
Circle Diameter, $F_{ m w}$	of Ring Gauge	GO Gauge	NO-GO Gauge	
4	7. 996	4. 023	4. 048	
5	8. 996	5. 023	5. 048	
6	9. 996	6. 028	6. 053	
7	10. 995	7. 031	7. 056	
8	11. 995	8. 031	8. 056	
9	12. 995	9. 031	9. 056	
10	13. 995	10. 031	10. 056	
12	15. 995	12. 031	12. 056	
FH 12	17. 995	12. 031	12. 056	
13	18. 993	13. 034	13. 059	
14	19. 993	14. 034	14. 059	
15	20. 993	15. 034	15. 059	
16	21. 993	16. 034	16. 059	
17	22. 972	17. 013	17. 038	
18	23. 972	18. 013	18. 038	
20	25. 972	20. 013	20. 038	
22	27. 972	22. 013	22. 038	
25	31. 967	25. 013	25. 038	
28	34. 967	28. 013	28. 038	
30	36. 967	30. 013	30. 038	
35	41. 967	35. 013	35. 043	
40	46. 967	40. 013	40. 043	
45	51. 961	45. 013	45. 043	
50	57. 961	50. 013	50. 043	
55	62. 961	55. 013	55. 043	

Remarks This is the gauge dimension for Inspection of minimum diameter, F_{wmin} , of roller inscribed circle diameter.

Table 3 Ring Gauge of Drawn Cup Needle Roller Bearings and Tolerance of Roller Inscribed Circle Diameter (ISO Standards)

(FJ, FJH, MFJ and MFJH) F, FH, MF and MFH

			Units mm
Nominal Roller Inscribed	Bore Diameter of Ring Gauge	Tolerance for R Circle Diamet	
Circle Diameter, $F_{ m w}$	or King Gauge	min.	max.
4	7. 984	4. 010	4. 028
5	8. 984	5. 010	5. 028
6	9. 984	6. 010	6. 028
7	10. 980	7. 013	7. 031
8	11. 980	8. 013	8. 031
H 8	13. 980	8. 013	8. 031
9	12. 980	9. 013	9. 031
H 9	14. 980	9. 013	9. 031
10	13. 980	10. 013	10. 031
H 10	15. 980	10. 013	10. 031
12	15. 980	12. 016	12. 034
H 12	17. 980	12. 016	12. 034
13	18. 976	13. 016	13. 034
14	19. 976	14. 016	14. 034
15	20. 976	15. 016	15. 034
16	21. 976	16. 016	16. 034
17	22. 976	17. 016	17. 034
18	23. 976	18. 016	18. 034
20	25. 976	20. 020	20. 041
22	27. 976	22. 020	22. 041
25	31. 972	25. 020	25. 041
28	34. 972	28. 020	28. 041
30	36. 972	30. 020	30. 041
35	41. 972	35. 025	35. 050
40	46. 972	40. 025	40. 050
45	51. 967	45. 025	45. 050
50	57. 967	50. 025	50. 050
55	62. 967	55. 030	55. 060

Note (1) When using a cylinder instead of an inner ring, F_{wmin} is the diameter of the cylinder at which the internal clearance is zero in at least one radial direction. (F_{wmin} is the minimum diameter of each inscribed circle diameter where deviation is assumed.)

Remarks To measure the roller inscribed circle diameter, use the following plug gauges:

GO gauge: The same dimensions as the minimum tolerance of the roller inscribed circle diameter $F_{
m wmin}$.

NO-GO gauge: The dimensions should be the maximum tolerance of roller inscribed circle diameter, $F_{
m wmin}$ plus 0.002 mm.

SOLID NEEDLE ROLLER BEARINGS Table 8. 2 (A60-63 pages)

Tolerance of roller inscribed circle diameter for solid needle roller bearings without inner rings are shown in Table 4.

Table 4 Inscribed Circle Diameter for Metric Solid
Needle Roller Bearings

Nee	die Roller Be	earings	Units µm		
Nominal II Circle Dian (mr	neter, $F_{ m w}$	Deviation (F6) of Minimum Diameter, $F_{ m wmin}$, of Roller Inscribed Circle Diameter $F_{ m wmin}$			
over	incl.	high	low		
6	10	+ 22	+13		
10	18	+ 27	+16		
18	30	+ 33	+20		
30	50	+ 41	+25		
50	80	+ 49	+30		
80	120	+ 58	+36		
120	180	+ 68	+43		
180	250	+ 79	+50		
250	315	+ 88	+56		
315	400	+ 98	+62		
400	500	+108	+68		

Note (1) When using a cylinder instead of an inner ring, $F_{\rm wmin}$ is the diameter of the cylinder at which the internal clearance is zero in at least one radial direction. ($F_{\rm wmin}$ is the minimum diameter of each inscribed circle diameter where deviation is assumed.)

CAM FOLLOWERS · ROLLER FOLLOWERS · Table 8. 2 (A60-63 pages)

The tolerance zone class of stud diameter d of cam followers is h7, and the tolerance of assembled width of inner ring of roller followers is shown in bearing table.

These tolerances are applied to the bearings before surface treatment.

Cam Follower Dimensional Tolerences is always applited to the bearing before surface treatment.

RECOMMENDED FITTING AND BEARING INTERNAL CLEARANCE CAGE & NEEDLE ROLLER ASSEMBLIES

Recommended fitting of cage & roller under typical operating condition is shown in Table 5. By combining cage & roller, shaft, and housing, appropriate radial internal clearance is obtained. However, the fitting and the radial internal clearance of cage & roller for connecting rod should be determined by the type of engine, characteristic, and driving condition etc.. For details, please refer to specified catalog.

Table 5 Fitting Tolerances for Shafts and Housing Bores

	Fitting Tolerance				
Operating Conditions	sh	housing bore			
	$F_{\rm w} \leq$ 50 mm	$F_{\rm w}>$ 50 mm	nousing bore		
High Accuracy, Oscillating Motion	js5 (j5)	h5			
Normal	h5	g5	G6		
High Temperature, Large Shaft Deflection	f				
and Mounting Error of Bearings	1				

DRAWN CUP NEEDLE ROLLER BEARINGS

For FJ, FJH, and MFJH types and F, FH, and MFH types, if tolerance of fitting such as shaft:h6, and housing bore:N7 (in case of thick steel housing), are applied under general operating condition, appropriate radial internal clearance is obtained. In case that outer ring rotation, the fitting of shaft: f6, housing bore: R7, and light alloy housing or steel housing of less than 6mm thickness, the housing bore should be smaller than N7 by 0.013-0.025 mm.

SOLID NEEDLE ROLLER BEARINGS

Recommended fitting for solid needle roller bearings with inner rings

Table 9. 2 (Page A84) Table 9. 4 (Page A85)

Internal clearance of solid needle roller bearings with inner rings

Table 9. 14 (Page A91)

However, for needle roller bearing of wider bearing width, and with long needle rollers, bearings with CN clearance are not necessarily common, but large clearance is selected frequently. For the solid needle roller bearing without inner ring, it is possible to select radial internal clearance shown in Table 6 by selecting tolerance class of shaft, which is fitting to the bearing.

Table 6 Fitting Tolerances and Radial Internal clearance of Shafts Assembled with Solid Needle Roller Bearings without Inner Rings

Nominal Roll Circle Diamet			CN	C3	C4
over	incl.				
6	180	k5	g5	f6	e6
180	315	j6	f6	e6	d6
315	490	h6	e6	d6	с6

THRUST NEEDLE ROLLER BEARINGS

Recommended Fitting of Thrust Needle Roller Bearings and Thrust Raceway are shown in Table 7.

Table 7 Recommended Fitting of Thrust Needle Roller Bearings and Thrust Raceway

Units m

Classification	Tumo	Cage or	Tolerance cl	ass or dimension tolerance		
Ciassification	Type	raceway guide	Shaft	Shaft Housing bore D_c (1)+over 1.0		
Thrust Needle Bearing Cage	FNTA	Bore	h8	D _c (1)+over 1.0		
& Needle Roller Assemblies	FINIA	Outside	_	H10		
Thrust Bearing Rings	FTRA to FTRE	Bore	h8	D _c (1)+over 1.0		
Thrust bearing Rings	TINATOTIKE	Outside	_	H10		

Note (1) D_c represents outside diameter of the cage.

Remarks If the cage is guided by outside diameter, to prevent the wear of housing bore, it is necessary to harden the surface at least.

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CAM FOLLOWERS · ROLLER FOLLOWERS

The recommended fittings for the mounting area of cam follower studs are shown in Table 8. Recommended shaft fittings of roller follower are shown in Table 9.

Since cam followers are used with cantilevered mounting, they should be fixed with little clearance of the fitting surface as much as possible.

Since a roller follower is generally used with outer ring rotation, the fitting with shaft is transition or loose fit. In case that heavy loads impose to the roller follower, it is recommended to use the shaft of quench hardening treatment, and with tight fit.

For the details, please refer to specified catalog.

Table 8 Recommended Fitting for Stud Mounting Part of Cam Followers

Туре	Fitting Tolerance of Mounting Hole
FCR, FCRS FCJ, FCJS	JS7 (J7)

Table 9 Recommended Staft Fittings of Roller Followers

Load	Fitting Tolerance of Shaft
Light Load/Normal Load	g6 or h6
Heavy Load	k6

SHAFT AND HOUSING SPECIFICATIONS

The specification of shaft and housing for radial needle roller bearings, which are used under general operating condition, is shown in Table 10.

Table 10 Shaft and housing Specifications of Radial Needle Roller Bearings (Cage & Needle Roller Assemblies/Drawn Cup Bearings/Solid Bearings)

Category	Sh	aft	Housing Bore			
	Raceway Surface	Fitting Surface	Raceway Surface	Fitting Surface		
Out-of-Roundness	IT3	IT3 IT4	IT3	IT4 IT5		
Tolerance	$\frac{\text{IT 3}}{2}$	$\frac{\text{IT3}}{2}$ to $\frac{\text{IT4}}{2}$	2	$\frac{\text{IT}4}{2}$ to $\frac{\text{IT}5}{2}$		
Cylindricity	IT3	IT3 IT3 IT4		$\frac{\text{IT 4}}{2}$ to $\frac{\text{IT 5}}{2}$		
Tolerance	$\frac{\text{IT 3}}{2}$	$\frac{\text{IT 3}}{2}$ to $\frac{\text{IT 4}}{2}$	$\frac{\text{IT 3}}{2}$	$\frac{\text{IT 4}}{2}$ to $\frac{\text{IT 5}}{2}$		
Roughness	0.4	0.8	0.8	1.6		
$R_a(\mu m)$	0.4	0.6	0.6	1.0		
Hardness	HRC58 to 64 Appropriate depth of hardening layer required	_	HRC58 to 64 Appropriate depth of hardening layer required	-		

Remarks 1. For the specification of shaft and housing of cage & needle roller assembly for connecting rod, please refer to specified catalog.

2. These are general recommendation by radius method. For the value of standard tolerance (IT), please refer to Appendix 11 (page C22)

Specifications of Thrust Bearings Raceway Surface are shown in Table 11.

Table 11 Specifications of Thrust Bearings Raceway Surface

S	Squareness A	0.5/1000 incl (mm/mm)	
S	iquareness B	1.0/1000 incl (mm/mm)	
Ī	Roughness R _a (μm)	0.4	_
	Hardness	HRC58 to 64 (HRC60 to 64 is fovorable)	_

LIMITING INCLINATION ANGLES

The limiting inclination angle of radial needle roller bearing under general load condition is 0.001 radian (3.4') approximately. For the detail, please refer to specified catalog.,

PERMISSBLE TRACK LOAD

Table 12 Permissble Load

Hardness

(HRC)

20

25

30

35 40

45

50

55

58

Coefficient of Track

Coefficient

0.4

0.5

0.6

0.8

1.0

1.4

1.9

2.6

3.2

The permissble load of the track is determined by compression strength or hardness. The permissble load of the track shown in the bearing table is value of a track made of steel with a hardness of HRC40. Table 12 indicates the permissible load coefficient of the track for each hardness.

The permissible load of the track for each hardness can be obtained by multiplying the permissible load coefficient of the track corresponding to each hardness

PRE-PACKED GREASE

The cam follower/roller follower with a seal is pre-lubricated with lithium soap-based grease. The range of operating temperature is -10 to $+110\,^{\circ}\text{C}$. For the cam follower/roller follower without seal, please lubricate with suitable lubricant.

MAXIMUM PERMISSIBLE LOAD AND MAXIMUM CLAMP TORQUE OF CAM FOLLOWERS.

The maximum radial Load that the cam follower can carry is determined by the bearing strengh and shear strengh of the stud rather than the Load rating for neele bearings. This value is given in the bearing table as the maximum permissible Load.

Since the stud of the cam follower receives bending stress and tensile stress from the bearing Load, the screw clamp torque should not exceed the value shown in the bearing table.

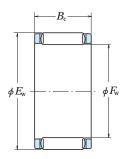
LIMITING SPEED

The limiting speeds of bearings are shown in bearing tables. However, depending on load condition of the bearing, the limiting speeds are necessary to compensate. Also, improvement of lubrication method allows to take higher limiting speed. For the detail, please refer to A37 page.



FWF • FWJ

Inscribed Circle Diameter 5 – 22 mm



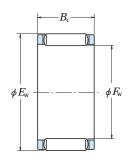
Bound	dary Dimen (mm)	sions		Basic Loa	ad Ratings	{kgf}		Limiting (mi	
$F_{ m W}$	$E_{ m W}$	$B_{ m C}^{^{-0.2}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	C		$C_{0\mathrm{r}}$	Grease	Oil
5 6	8 9 9	8 8 10	2 330 2 200 3 350	1 860 1 780 3 050	2	37 24 40	189 182 310	60 000 48 000 48 000	95 000 75 000 75 000
7	10 10	8 10	2 840 3 650	2 560 3 550	2	90 75	261 360	40 000 40 000	67 000 67 000
8	11 11	10 13	3 950 4 750	4 000 5 150		00 85	410 525	34 000 34 000	56 000 56 000
9	12 12	10 13	3 750 5 100	3 850 5 750		80 20	395 585	30 000 30 000	50 000 50 000
10	13 13 14	10 13 13	3 950 5 400 6 500	4 300 6 350 6 750	5	05 50 60	435 650 690	28 000 28 000 28 000	45 000 45 000 45 000
12	15 15 16	10 13 13	4 350 5 950 7 350	5 100 7 600 8 350	6	45 05 50	520 775 850	22 000 22 000 22 000	36 000 36 000 38 000
14	18 18 20	10 13 17	6 750 8 050 13 400	7 750 9 750 14 600		90 20 70	790 995 1 490	19 000 19 000 20 000	32 000 32 000 32 000
15	19 19 21	10 13 17	7 050 8 400 13 400	8 400 10 500 14 800			855 1 070 1 510	18 000 18 000 19 000	28 000 28 000 30 000
16	20 20 22	10 13 17	7 350 8 800 14 700	9 000 11 300 16 900			920 1 150 1 720	17 000 17 000 17 000	26 000 26 000 28 000
17	21 21 23	10 13 17	7 650 10 200 15 100	9 650 14 000 17 800	7 1 0 1 5		985 1 420 1 810	16 000 16 000 16 000	26 000 26 000 26 000
18	22 22 24	10 13 17	7 900 9 450 17 400	10 300 12 900 21 600		65	1 050 1 310 2 210	15 000 15 000 15 000	24 000 24 000 24 000
20	24 24 26	10 13 17	8 000 9 700 18 000	10 700 13 700 23 200		90	1 090 1 400 2 370	13 000 13 000 14 000	20 000 20 000 22 000
22	26 26 28	10 13 17	8 600 10 300 17 300	12 200 15 300 22 700	8 1 0 1 7	50	1 240 1 560 2 310	12 000 12 000 12 000	19 000 19 000 20 000

Note (*)	These bearings have polyamide cages. The maximum permissible operating temperature for these bearings is 100 °C
	for continued operation and 120 °C for short periods.

Bearing Numbers	Mass (g)
	approx.
* FBNP-588	1.0
* FBNP-698	1.2
* FBNP-6910	1.5
* FBNP-7108	1.3
* FBNP-71010	1.6
* FBNP-81110	1.8
* FBNP-81113	2.6
* FBNP-91210	2.0
* FBNP-91213	2.6
FBN-101310	2.2
FBN-101313	2.9
FWF-101413	4.0
FBN-121510	2.6
FBN-121513	3.4
FWF-121613	4.6
FWF-141810	4.1
FWF-141813	5.3
FWF-142017	11
FWF-151910	4.3
FWF-151913	5.6
FWF-152117	12
FWF-162010	4.6
FWF-162013	6.0
FWF-162217	12
FWF-172110	4.8
FWJ-172113	6.3
FWF-172317	14
FWF-182210	5.1
FWF-182213	6.6
FWJ-182417	14
FWF-202410	5.6
FWF-202413	7.3
FWJ-202617	15
FWF-222610	6.1
FWF-222613	7.9
FWF-222817	16

NSK

FWF • FWJ Inscribed Circle Diameter 25 – 100 mm



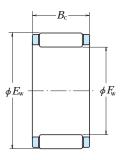
Bound	dary Dimer	nsions		Basic Load	•		Limiting	•
	(mm)	-0.2		(N)	{kgf}		(mir	1 ⁻¹)
$F_{ m W}$	$E_{ m W}$	$B_{ m C}$ $^{-0.55}$	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
25	29 29 31	10 13 17	9 350 11 300 19 200	14 100 18 000 26 800	1 150 1	440 830 740	10 000 10 000 10 000	17 000 17 000 17 000
28	33 33 34	13 17 17	13 700 17 600 19 900	20 400 28 300 29 100	1 800 2	080 890 970	9 500 9 500 9 500	15 000 15 000 15 000
30	35 35 37	13 17 20	14 000 18 700 26 000	21 600 31 500 38 000	1 910 3	200 200 850	8 500 8 500 9 000	14 000 14 000 14 000
32	37 37 39	13 17 20	15 100 18 500 27 300	24 400 31 500 41 000	1 880 3	480 200 200	8 000 8 000 8 500	13 000 13 000 13 000
35	40 40 42	13 17 20	14 900 20 500 30 000	24 600 37 000 47 500	2 090 3	500 750 850	7 500 7 500 7 500	12 000 12 000 12 000
40	45 45 48	17 27 25	21 000 32 000 40 500	40 000 68 000 66 500	3 250 6	050 900 800	6 300 6 300 6 700	10 000 10 000 10 000
45	50 50 53	17 27 25	21 600 34 000 44 000	43 000 77 500 77 000	3 500 7	350 900 850	5 600 5 600 5 600	9 000 9 000 9 500
50	55 55 58	20 27 25	26 900 35 000 48 500	59 000 83 000 90 500	3 600 8	050 450 200	5 000 5 000 5 300	8 000 8 000 8 500
55	61 61 63	20 30 25	31 000 47 000 50 000	64 000 109 000 97 500	4 750 11	500 100 950	4 500 4 500 4 800	7 500 7 500 7 500
60	66 66 68	20 30 25	33 000 50 000 52 000	71 500 122 000 105 000	5 100 12	300 400 700	4 300 4 300 4 300	6 700 6 700 6 700
65 70 75	73 78 83	30 30 30	61 000 63 000 65 000	132 000 140 000 151 000	6 400 14	400 300 400	4 000 3 600 3 400	6 300 6 000 5 600
80 85 90	88 93 98	30 30 30	69 000 71 000 70 000	166 000 176 000 177 000	7 250 17	000 900 000	3 200 3 000 2 800	5 000 4 800 4 500
95 100	103 108	30 30	69 500 75 500	177 000 201 000		100 500	2 600 2 400	4 300 4 000

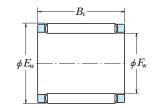
Danis a Novebore	Mass (g)
Bearing Numbers	
	approx.
FWF-252910	6.9
FWF-252913 FWF-253117	8.9 18
FWF-283313	13
FWF-283317 FWF-283417	16 20
FWF-303513	14
FWF-303517A FWF-303720	18 30
FWF-303720 FWF-323713	30 14
FWJ-323717	19
FWF-323920	32
FWF-354013 FWF-354017	16 20
FWJ-354220	34
FWF-404517A FWF-404527	23 36
FWF-404825	56
FWF-455017 FWF-455027	26 41
FWF-455325	62
FWF-505520	37
FWF-505527 FWF-505825	50 77
FWF-556120	53
FWF-556130 FWF-556325	81 85
FWF-606620	57
FWF-606630 FWF-606825	87
FWF-657330	91 120
FWF-707830	125
FWF-758330 FWF-808830	135 145
FWF-859330	150
FWF-909830	160
FWF-9510330 FWF-10010830	175 185

- NSK

Cage & Needle Roller Assemblies for Large Ends of Connecting Rods Inscribed Circle Diameter 12 – 30 mm







Bou	ndary Dimens	ions		Basic Load	Ratings {kgf	F)		Mass (g)
$F_{ m W}$	$E_{ m W}$	$B_{ m C}^{{ m -0.2 \over -0.4}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Bearing Numbers	approx.
12 14	16 19 20	10 10 12	6 100 7 800 8 900	6 500 8 050 8 600	620 795 910	665 820 880	FWF-121610-E FWF-141910-E FWF-142012-E	4.0 6.2 8.3
15	19	9	5 650	6 250	575	640	FWF-15199-E	4.1
	20	10	7 300	7 600	745	775	FWF-152010-E	6.0
	21	10	7 950	7 500	810	765	FWF-152110-E	8.5
16	21	11	8 650	9 600	880	980	FWF-162111-E	7.5
	22	12	9 500	9 600	965	980	FWF-162212-E	9.5
18	23	14	11 800	14 800	1 200	1 510	FWF-182314-E	10
	24	12	10 000	10 600	1 020	1 080	FWF-182412-E	11
20	26	12	12 200	14 100	1 250	1 440	FWF-202612-E	13
	26	17	16 800	21 200	1 710	2 160	FWF-202617-E	17
	28	18	18 100	19 400	1 840	1 970	FWF-202818-E	25
22	28	14	13 900	17 100	1 420	1 740	FWF-222814-E	14
	29	15	16 300	19 000	1 660	1 930	FWF-222915-E	19
	32	16	19 700	19 400	2 010	1 970	FWF-223216-E	31
23 24	31 30 30 31	16 15 17 20	17 600 15 600 17 900 21 600	19 400 20 300 24 300 27 800	1 800 1 590 1 830 2 200	1 980 2 070 2 480 2 840	FWF-233116-E FWF-243015-E FWF-243017-E FWF-243120-E	23 17 19 30
25	32	16	17 700	21 900	1 810	2 230	FWF-253216-E	24
28	35	16	18 400	23 700	1 880	2 410	FWF-283516-E	25
29.75	36.75	16.5	19 600	26 000	1 990	2 650	FWF-293616 Z -E	28
30	37	16	21 900	30 500	2 230	3 100	FWF-303716-E	29
	38	18	25 500	34 000	2 600	3 450	FWF-303818-E	35

Воц	undary Dimens (mm)			Basic Loa	id Ratings {kgf	7)		Mass (g)
$F_{ m W}$	$E_{ m W}$	$B_{ m C}^{^{-0.2}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Bearing Numbers	approx.
9	12	11.5	4 300	4 650	440	475	FBN-91211Z-E	3.5
10	14	12.7	5 900	5 950	605	610	FBN-101412Z-E	5.0
12	15 16 16 16	14.3 13 15.5 16	6 400 7 250 8 500 8 500	8 400 8 200 10 000 10 000	655 740 865 865	855 835 1 020 1 020	FBN-121514Z-E FBN-121613-E FBN-121615Z-E FBN-121616-E	4.8 6.4 7.0 7.5
14	18 18 18 18	12 16.5 18 20	6 950 9 250 10 700 9 550	8 050 11 600 14 000 12 000	710 945 1 090 975	820 1 180 1 430 1 230	FBN-141812-E FBN-141816Z-E FBN-141818-E FBN-141820-E1	6.5 8.5 11.5 13
15	19 21	18 18	11 300 12 900	15 300 13 900	1 150 1 310	1 560 1 420	FBN-151918-E FBN-152118-E	11 13
16	20 20 21	22 23.5 20	13 700 14 900 14 200	20 000 22 300 18 100	1 400 1 520 1 450	2 040 2 280 1 840	FBN-162022-E FBN-162023Z-E FBN-162120-E	14 15 16
17	21	23	14 800	22 500	1 510	2 290	FBN-172123-E	16
18	22 22 22	17 22 23.6	11 500 14 200 15 400	16 500 21 600 24 100	1 170 1 440 1 570	1 680 2 200 2 460	FBN-182217-E FBN-182222-E FBN-182223Z-E	12 15 16
19	23	23.7	16 000	25 800	1 630	2 630	FBN-192323Z-E	17

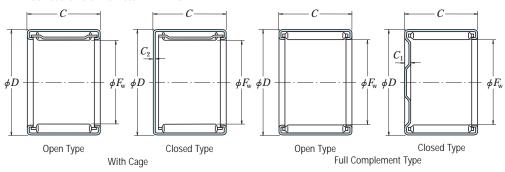
B 256 B 257



FJ · MFJ (With Cage)

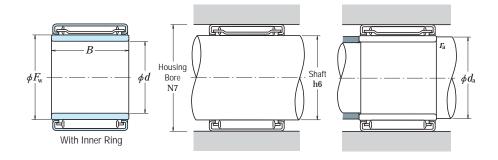
F • MF (Full Complement Type)

Inscribed Circle Diameter 4 – 16 mm



Воц		Dimens	ions	Basic Dynamic L	oad Ratings. {kgf}	Limiting (N)	Loads {kgf}	Limiting (mi			Bearing
F_{W}	D	$C^{-0.25}$	C_1, C_2 max.			$P_{ m ma}$		Grease	Oil	Wit Open	h Cage Closed
4 5 6 7	8 9 10 11	8 9 9	0.8 0.8 0.8 0.8	1 720 1 860 2 320 2 550	175 190 237 260	675 745 985 1 110	69 76 101 113	45 000 43 000 36 000 30 000	75 000 71 000 56 000 48 000	* FJP-48 FJ-59 FJ-69 FJ-79	 MFJ-59 MFJ-69 MFJ-79
8	12	10	0.8	2 840	289	1 270	130	26 000	43 000	FJ-810	MFJ-810
	14	10	1.0	4 300	435	1 770	180	28 000	45 000	FJH-810	MFJH-810
	14	10	1.9	5 550	565	2 980	305	6 300	10 000	—	—
9	13	10	0.8	3 300	335	1 600	163	22 000	36 000	FJ-910	MFJ-910
	15	10	1.0	4 550	465	1 910	194	24 000	40 000	FJH-910	MFJH-910
	15	10	1.8	6 100	625	3 350	340	6 000	10 000	—	—
10	14	10	0.8	3 500	360	1 760	179	20 000	32 000	FJ-1010	MFJ-1010
	16	10	1.0	4 900	500	2 100	214	22 000	34 000	FJH-1010	MFJH-1010
	16	10	1.9	6 650	680	3 700	375	5 600	9 000	—	—
12	16	10	0.8	4 150	420	2 210	225	17 000	26 000	FJ-1210	MFJ-1210
	18	12	1.0	6 450	655	3 050	310	17 000	28 000	FJH-1212	MFJH-1212
	18	12	1.9	9 000	920	5 700	580	4 500	7 500	—	—
13	19	12	1.0	6 950	710	3 400	345	16 000	26 000	FJ-1312	MFJ-1312
	19	12	1.9	9 550	975	6 100	625	4 300	7 100	—	—
14	20 20 20 20	12 12 16 16	1.0 2.2 1.0 2.2	6 500 9 450 9 500 13 300	665 965 970 1 360	3 250 6 350 5 300 9 850	335 645 540 1 000	15 000 3 800 15 000 3 800	24 000 6 000 24 000 6 000	FJ-1412 FJ-1416	MFJ-1412 MFJ-1416
15	21	12	1.0	7 650	780	3 900	400	14 000	22 000	FJ-1512	MFJ-1512
	21	12	1.8	10 300	1 050	6 900	705	3 800	6 000	—	
	21	14	1.8	12 400	1 270	8 800	895	3 800	6 000	—	_
	21	16	1.0	11 000	1 120	6 200	635	14 000	22 000	FJ-1516	MFJ-1516
	21	16	1.8	14 500	1 480	10 700	1 090	3 800	6 000	—	—
16	22 22 22 22	12 12 16 16	1.0 2.2 1.0 2.2	7 100 10 200 10 400 14 400	725 1 040 1 060 1 460	3 750 7 100 6 050 11 100	380 725 620 1 130	12 000 3 400 12 000 3 400	20 000 5 300 20 000 5 300	FJ-1612 FJ-1616 	MFJ-1612 MFJ-1616

Note (*) These bearing have polyamide cages. The maximum permissible operating temperature for these bearings is 100 °C for continued operation and 120 °C for short periods.

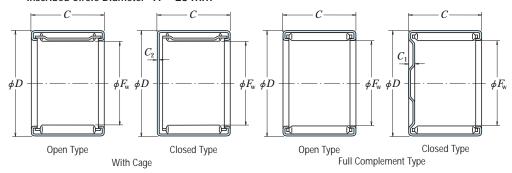


Numbers			ase of in	ner ring is	used			ut Inner Ring a)
Full Compl Open	lement Type Closed	of Inner Ring Dimensions (mm)		Dimensio	and Fillet ons (mm) $ _a$ (max.)	approx. Open Closed		
_ _ _ _	= = =	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	1.3 1.7 2.2 2.3	1.9 2.4 2.7
_ _ FH-810	_ _ MFH-810	_ _ _	_ _	_	_ _ _	=	2.7 5.2 6.0	3.2 5.5 6.3
_ FH-910	_ _ MFH-910	_ = =	_ _	_ _ _	_	_ _ _	3.2 5.7 6.4	3.6 6.1 6.8
_ _ FH-1010	_ _ MFH-1010	FIR-71010 FIR-71010 FIR-71010	7 7 7	10.5 10.5 10.5	9 9 9	0.3 0.3 0.3	3.6 6.1 6.9	4.1 6.6 7.3
_ _ FH-1212	_ _ MFH-1212	FIR-81210 FIR-81212 FIR-81212	8 8 8	10.5 12.5 12.5	10 10 10	0.3 0.3 0.3	4.1 7.7 10	4.5 8.2 11
_ F-1312	MF-1312	FIR-101312 FIR-101312	10 10	12.5 12.5	12 12	0.3 0.3	8.6 11	9.5 12
F-1412 F-1416	MF-1412 MF-1416	FIR-101412 FIR-101412 FIR-101416 FIR-101416	10 10 10 10	12.5 12.5 16.5 16.5	12 12 12 12	0.3 0.3 0.3 0.3	10 12 13 18	11 14 14 19
F-1512 F-1514	MF-1512 MF-1514	FIR-121512 FIR-121512	12 12 —	12.5 12.5 —	14 14 —	0.3 0.3 —	10 12 15	11 14 16
_ F-1516	_ MF-1516	FIR-121516 FIR-121516	12 12	16.5 16.5	14 14	0.3 0.3	13 17	14 18
F-1612 F-1616	MF-1612 MF-1616	FIR-121612 FIR-121612 FIR-121616 FIR-121616	12 12 12 12	12.5 12.5 16.5 16.5	14 14 14 14	0.3 0.3 0.3 0.3	11 14 14 18	12 15 15 20

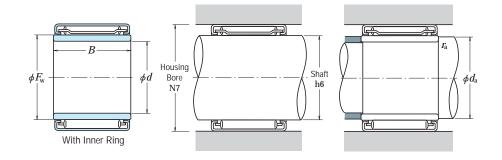


FJ·MFJ (With Cage) F·MF (Full Complement Type)

Inscribed Circle Diameter 17 – 28 mm



Boundary Dimensions (mm)		ions	Basic Dynamic L	.oad Ratings {kgf}	Limiting (N)	Loads {kgf}	Limiting Speeds (min ⁻¹)			Bearing	
F_{W}	D	$C^{-0.25}$	C_1, C_2 max.	$C_{\rm r}$		$P_{ m ma}$		Grease	Oil	With Open	Cage
17	23 23 23 23	12 12 16 16	1.0 1.8 1.0 1.8	8 450 11 300 12 100 15 800	860 1 150 1 230 1 610	4 450 7 750 7 100 12 000	455 790 720 1 220	12 000 3 400 12 000 3 400	19 000 5 600 19 000 5 600	FJ-1712 FJ-1716	MFJ-1712 — MFJ-1716
18	24 24 24 24	12 12 16 16	1.0 2.2 1.0 2.2	7 650 10 900 11 200 15 300	780 1 110 1 140 1 560	4 200 7 900 6 800 12 300	430 805 695 1 250	11 000 3 000 11 000 3 000	18 000 5 000 18 000 5 000	FJ-1812 FJ-1816	MFJ-1812 MFJ-1816
20	26 26 26	12 12 16	1.0 2.2 1.0	8 150 11 500 11 900	835 1 170 1 210	4 650 8 700 7 550	475 885 770	10 000 2 800 10 000	16 000 4 500 16 000	FJ-2012 FJ-2016	MFJ-2012 — MFJ-2016
	26 26 26	16 20 20	2.2 1.0 2.2	16 200 15 300 20 500	1 650 1 560 2 090	13 500 10 500 18 300	1 380 1 070 1 870	2 800 10 000 2 800	4 500 16 000 4 500	FJ-2020	MFJ-2020
22	28 28 28	12 12 16	1.0 2.2 1.0	8 650 12 100 12 600	880 1 230 1 290	5 150 9 500 8 350	525 970 850	9 000 2 400 9 000	14 000 4 000 14 000	FJ-2212 FJ-2216	MFJ-2212 — MFJ-2216
	28 28 28	16 20 20	2.2 1.0 2.2	17 100 16 200 21 600	1 740 1 660 2 200	14 800 11 500 20 000	1 510 1 180 2 040	2 400 9 000 2 400	4 000 14 000 4 000	FJ-2220 —	MFJ-2220
25	32 32 32	16 16 20	1.0 2.5 1.0	15 200 20 200 19 800	1 550 2 060 2 020	9 350 16 200 13 100	955 1 650 1 340	8 000 2 800 8 000	13 000 4 500 13 000	FJ-2516 FJ-2520	MFJ-2516 — MFJ-2520
	32 32 32	20 26 26	2.5 1.0 2.5	25 900 26 200 34 000	2 640 2 670 3 450	22 200 18 800 31 500	2 260 1 920 3 200	2 800 8 000 2 800	4 500 13 000 4 500	FJ-2526	MFJ-2526
28	35 35 35	16 16 20	1.0 2.5 1.0	15 600 21 300 20 500	1 590 2 170 2 090	9 950 17 900 14 200	1 020 1 820 1 450	7 100 2 400 7 100	11 000 4 000 11 000	FJ-2816 FJ-2820	MFJ-2816 MFJ-2820
	35 35 35	20 26 26	2.5 1.0 2.5	27 300 26 900 35 500	2 780 2 750 3 650	24 600 20 200 34 500	2 510 2 060 3 550	2 400 7 100 2 400	4 000 11 000 4 000	FJ-2826 —	MFJ-2826



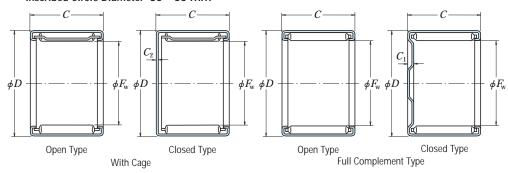
Numbers		In c		Mass Without Inner Ring (g)				
Full Complei	ment Type Closed	Bearing Numbers of Inner Ring	Bou Dimens d	indary ions (mm) <i>B</i>	Dįmensi	at and Fillet ons (mm) r_a (max.)		orox. Closed
F-1712 F-1716	MF-1712 MF-1716	- - - -	_ _ _ _	_ _ _ _	_ _ _	_ _ _ _	10 14 14 18	11 15 16 20
F-1812 F-1816	MF-1812 MF-1816	FIR-151812 FIR-151812 FIR-151816 FIR-151816	15 15 15 15	12.5 12.5 16.5 16.5	17 17 17 17	0.3 0.3 0.3 0.3	12 14 16 19	14 16 18 22
F-2012	MF-2012	FIR-172012 FIR-172012 FIR-172016	17 17 17	12.5 12.5 16.5	19 19 19	0.3 0.3 0.3	13 17 17	15 19 19
F-2016 F-2020	MF-2016 MF-2020	FIR-172016 FIR-172020 FIR-172020	17 17 17	16.5 20.5 20.5	19 19 19	0.3 0.3 0.3	22 22 28	25 24 30
F-2212	MF-2212	FIR-172212 FIR-172212 FIR-172216	17 17 17	12.5 12.5 16.5	19 19 19	0.3 0.3 0.3	14 18 19	17 21 22
F-2216 F-2220	MF-2216 — MF-2220	FIR-172216 FIR-172220 FIR-172220	17 17 17	16.5 20.5 20.5	19 19 19	0.3 0.3 0.3	24 23 30	27 26 33
F-2516	MF-2516	FIR-202516 FIR-202516 FIR-202520	20 20 20	16.5 16.5 20.5	22 22 22	0.3 0.3 0.3	24 31 31	27 35 34
F-2520 F-2526	MF-2520 — MF-2526	FIR-202520 FIR-202526 FIR-202526	20 20 20	20.5 26.5 26.5	22 22 22	0.3 0.3 0.3	40 40 52	43 43 55
F-2816	MF-2816	FIR-222816 FIR-222816 FIR-222820	22 22 22	16.5 16.5 20.5	24 24 24	0.3 0.3 0.3	27 35 34	31 40 38
F-2820 F-2826	MF-2820 MF-2826	FIR-222820 FIR-222826 FIR-222826	22 22 22	20.5 26.5 26.5	24 24 24	0.3 0.3 0.3	44 45 57	48 49 62

B 260 B 261

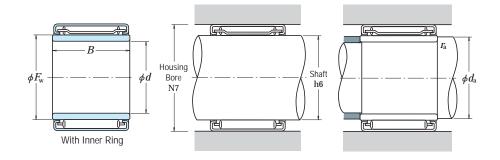


FJ·MFJ (With Cage) F·MF (Full Complement Type)

Inscribed Circle Diameter 30 – 55 mm



				1							
Воц		Dimens	sions	Basic Dynamic I	Load Ratings {kgf}	Limiting (N)	Loads {kgf}	Limiting (mi)			Bearing
$F_{ m W}$	D	'n	C_1, C_2	1 ' '		$P_{ m ma}$		`	,	With	Cage
1.M	D	C	max.	C ₁	•	1 ma	ix	Grease	Oil	Open	Closed
30	37	16	1.0	15 600	1 590	10 100	1 030	6 700	10 000	FJ-3016L	MFJ-3016
	37 37	16 20	2.5 1.0	22 100 19 400	2 250 1 970	18 900 13 300	1 930 1 360	2 400 6 700	3 800 10 000	FJ-3020	MFJ-3020
	37	20	2.5	28 400	2 900	26 200	2 670	2 400	3 800		
	37	26	1.0	26 000	2 660	19 500	1 990	6 700	10 000	FJ-3026	MFJ-3026
	37	26	2.5	37 000	3 800	37 000	3 750	2 400	3 800	_	_
35	42 42	16 16	1.0 2.5	18 100 24 000	1 850 2 450	12 800 22 000	1 300 2 240	5 600 2 000	9 000 3 400	FJ-3516	MFJ-3516
	42	20	1.0	23 600	2 410	17 900	1 830	5 600	9 000	FJ-3520	MFJ-3520
	42	20	2.5	31 000	3 150	30 000	3 100	2 000	3 400	_	_
	42 42	26 26	1.0 2.5	31 500 40 000	3 200 4 100	25 800 42 500	2 630 4 350	5 600 2 000	9 000 3 400	FJ-3526	MFJ-3526
40	47 47	16 16	1.0 2.5	18 600 25 700	1 890 2 620	13 600 24 900	1 390 2 540	4 800 1 800	7 500 3 000	FJ-4016 —	MFJ-4016
	47	20	1.0	23 500	2 400	18 500	1 890	4 800	7 500	FJ-4020	MFJ-4020
	47	20	2.5	32 500	3 350	34 000	3 450	1 800	3 000		
	47	26	1.0	31 500	3 200	26 900	2 740	4 800	7 500	FJ-4026	MFJ-4026
45	52 52	16 16	1.0 2.5	19 900 27 300	2 030 2 790	15 400 27 800	1 570 2 840	4 300 1 600	6 700 2 600	FJ-4516	MFJ-4516
	52 52	20 20	1.0 2.5	25 500 35 000	2 600 3 550	21 200 38 500	2 160 3 900	4 300 1 600	6 700 2 600	FJ-4520	MFJ-4520
	52	20	2.5	35 000	3 330	38 500	3 900	1 600	2 600	_	_
50	58 58	20 20	1.1 2.8	28 900 39 500	2 940 4 050	23 100 41 500	2 350 4 250	3 800 1 700	6 300 2 800	FJ-5020L	MFJ-5020
	58 58	24 24	1.1	36 000 48 000	3 700 4 900	30 500 53 000	3 150 5 400	3 800 1 700	6 300 2 800	FJ-5024	MFJ-5024
										_	_
55	63 63	20 20	1.1 2.8	30 000 41 500	3 100 4 250	25 100 45 500	2 560 4 650	3 400 1 600	5 600 2 400	FJ-5520	MFJ-5520
	63	24 24	1.1	37 500 50 500	3 850 5 150	33 500 58 000	3 400 5 950	3 400 1 600	5 600 2 400	FJ-5524	MFJ-5524
	50		0		2 .00	000	2 700	. 000	00		

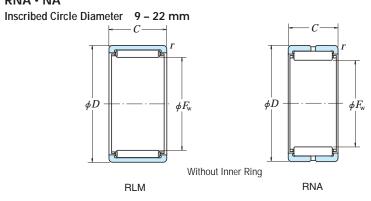


Numbers		In c	ase of in	ner ring is i	used			out Inner Ring (g)
Full Compl Open	ement Type Closed	Bearing Numbers of Inner Ring		indary ions (mm) B	Dimens	nt and Fillet ions (mm) r_a (max.)		orox. Closed
F-3016	MF-3016	 FIR-253020	_ _ 25	_ 20.5	_ _ 27	_ 0.3	26 35 35	31 40 39
F-3020 F-3026	MF-3020 MF-3026	FIR-253020 FIR-253026 FIR-253026	25 25 25	20.5 26.5 26.5	27 27 27	0.3 0.3 0.3	46 46 61	51 50 66
F-3516	MF-3516	_ _ FIR-303520	_ _ 30	_ 20.5	_ 34	_ _ 0.6	32 53 41	38 60 45
F-3520 F-3526	MF-3520 MF-3526	FIR-303520 FIR-303526 FIR-303526	30 30 30	20.5 26.5 26.5	34 34 34	0.6 0.6 0.6	42 54 70	49 58 76
F-4016	MF-4016	_ _ FIR-354020	_ _ 35	_ 20.5	_ _ 39	_ _ 0.6	34 48 46	43 56 51
F-4020 —	MF-4020 —	FIR-354020 FIR-354026	35 35	20.5 26.5	39 39	0.6 0.6	60 60	69 65
F-4516 F-4520	MF-4516 MF-4520	 FIR-404520 FIR-404520	- 40 40	 20.5 20.5	44 44	 0.6 0.6	39 53 53 67	50 64 59 78
F-5020 F-5024	MF-5024	FIR-455020 — — —	45 — — —	20.5 	49 — — —	0.6 _ _ _	56 81 69 98	71 95 84 110
F-5520 F-5524	MF-5520 MF-5524	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	60 88 72 105	79 105 90 125

B 262 B 263

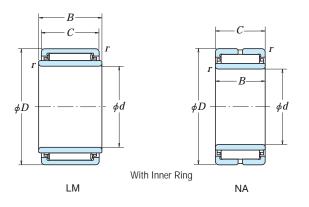


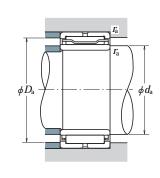
RLM • LM RNA • NA



Вог	undary D (mi		ons	(1	Basic Load	Ratings {kg	nf)	١ ،	g Speeds in ⁻¹)	Bearing
F_{W}	D	С	$m{r}$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Without Inner Ring
9	16	12	0.3	6 150	5 400	625	550	24 000	40 000	RLM 912
	16	16	0.3	7 900	7 450	805	760	24 000	40 000	RLM 916
10	17 17	10 15	0.3	5 350 8 050	4 650 7 800	545 820	470 795	22 000 22 000	36 000 36 000	RLM 101710 RLM 101715
12	17	12	0.3	6 150	7 650	625	780	18 000	30 000	RLM 1212
	19	12	0.3	7 300	7 150	745	730	18 000	30 000	RLM 121912
14	22 22 22	13 16 20	0.3 0.3 0.3	9 150 12 100 15 500	9 950 12 700 17 500	930 1 230 1 580	1 010 1 300 1 790	20 000 15 000 15 000	32 000 24 000 24 000	RLM 1416 RLM 1420
15	20	15	0.3	8 100	11 700	825	1 190	14 000	24 000	RLM 1515
	20	20	0.3	11 100	17 400	1 130	1 770	14 000	24 000	RLM 1520
	22	15	0.3	9 900	11 100	1 010	1 140	14 000	24 000	RLM 152215
16	24 24 24 24	13 16 20 22	0.3 0.3 0.3 0.3	10 100 12 900 16 500 17 900	11 700 14 200 19 500 24 500	1 030 1 310 1 680 1 830	1 190 1 450 1 990 2 500	17 000 13 000 13 000 17 000	28 000 22 000 22 000 28 000	RLM 1616 RLM 1620
17	22	10	0.3	5 850	7 950	595	810	13 000	20 000	RLM 1710
	24	25	0.5	18 200	25 300	1 850	2 580	13 000	20 000	RLM 172425
18	25	15	0.5	11 500	14 300	1 170	1 450	12 000	20 000	RLM 1815
	25	20	0.5	15 800	21 500	1 610	2 190	12 000	20 000	RLM 1820
20	27	10	0.5	7 950	9 150	810	930	11 000	18 000	RLM 2010
	27	15	0.5	11 900	15 400	1 220	1 570	11 000	18 000	RLM 2015
	27	20	0.5	16 400	23 200	1 670	2 370	11 000	18 000	RLM 2020
	27	25	0.5	19 800	29 500	2 010	3 000	11 000	18 000	RLM 2025
	28 28 28	13 18 23	0.3 0.3 0.3	10 800 15 700 19 300	13 600 21 900 28 600	1 100 1 600 1 960	1 390 2 240 2 920	13 000 13 000 13 000	22 000 22 000 22 000	
22	29	20	0.5	17 700	26 400	1 810	2 690	10 000	16 000	RLM 2220
	29	25	0.5	21 300	33 500	2 170	3 400	10 000	16 000	RLM 2225
	30 30 30 30	13 18 20 23	0.3 0.3 0.5 0.3	11 600 16 800 20 000 20 700	15 400 24 800 27 200 32 500	1 190 1 720 2 030 2 110	1 570 2 530 2 780 3 300	12 000 12 000 10 000 12 000	20 000 20 000 16 000 20 000	 RLM 223020

Remarks If a full complement roller bearing is required, please contact NSK.



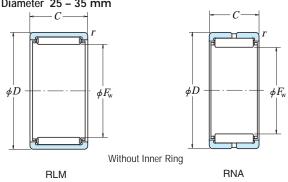


Numbers			Dimensions nm)	Abutment	and Fillet Di	mensions	Mass (kg)		
Without Inner Ring	With Inner Ring	d	В	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	appr Without Inner Ring		
=	LM 91612-1 —	6 —	12 —	8 —	14 14	0.3 0.3	0.009 0.011	0.013	
=	_	_	_	_ _	15 15	0.3 0.3	0.008 0.012	_	
_	LM 1212 LM 121912	8 8	12.2 12.2	10 10	15 17	0.3 0.3	0.007 0.011	0.013 0.017	
RNA 4900 	NA 4900 LM 1416 LM 1420	10 10 10	13 16.2 20.2	12 12 12	20 20 20	0.3 0.3 0.3	0.016 0.019 0.024	0.024 0.028 0.036	
	LM 1515 LM 1520 LM 152215	10 10 10	15.2 20.2 15.2	12 12 12	18 18 20	0.3 0.3 0.3	0.011 0.015 0.016	0.022 0.03 0.027	
RNA 4901 — RNA 6901	NA 4901 LM 1616 LM 1620 NA 6901	12 12 12 12	13 16.2 20.2 22	14 14 14 14	22 22 22 22	0.3 0.3 0.3 0.3	0.018 0.021 0.027 0.03	0.027 0.032 0.041 0.045	
=	LM 1710 LM 172425	12 12	10.2 25.2	14 16	20 20	0.3 0.5	0.008 0.03	0.017 0.052	
_	LM 1815 LM 1820	15 15	15.2 20.2	19 19	21 21	0.5 0.5	0.019 0.025	0.028 0.037	
_ _ _	LM 2010 LM 2015 LM 2020 LM 2025	15 15 15 15	10.2 15.2 20.2 25.2	19 19 19 19	23 23 23 23	0.5 0.5 0.5 0.5	0.014 0.021 0.028 0.035	0.025 0.037 0.049 0.061	
RNA 4902 RNA 5902 RNA 6902	NA 4902 NA 5902 NA 6902	15 15 15	13 18 23	17 17 17	26 26 26	0.3 0.3 0.3	0.021 0.032 0.039	0.035 0.051 0.064	
=	LM 2220 LM 2225	17 17	20.2 25.2	21 21	25 25	0.5 0.5	0.03 0.038	0.054 0.068	
RNA 4903 RNA 5903 RNA 6903	NA 4903 NA 5903 LM 223020 NA 6903	17 17 17 17	13 18 20.2 23	19 19 21 19	28 28 26 28	0.3 0.3 0.5 0.3	0.023 0.034 0.035 0.041	0.038 0.055 0.06 0.068	



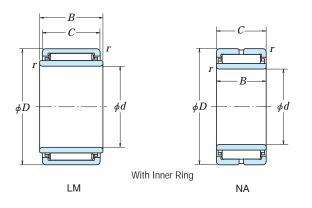
RLM • LM RNA • NA

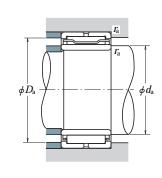
Inscribed Circle Diameter 25 – 35 mm



Вог	Boundary Dimensions (mm)		ons		Basic Load	Ratings {kc	vf)	`	J Speeds in-1)	Bearing
F_{W}	D	C	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Without Inner Ring
25	32	12	0.5	10 300	13 700	1 050	1 400	8 500	14 000	RLM 2512
	32	20	0.5	18 800	29 700	1 920	3 050	8 500	14 000	RLM 2520
	32	25	0.5	22 700	37 500	2 310	3 850	8 500	14 000	RLM 2525
	37	17	0.3	19 700	22 900	2 010	2 340	11 000	18 000	_
	37	23	0.3	27 800	35 500	2 830	3 650	11 000	18 000	_
	37	30	0.3	36 500	50 500	3 700	5 150	11 000	18 000	_
28	35	20	0.5	19 900	33 000	2 030	3 350	7 500	12 000	RLM 2820
	35	25	0.5	23 900	42 000	2 440	4 250	7 500	12 000	RLM 2825
	37	30	0.5	34 000	52 500	3 450	5 350	7 500	12 000	RLM 283730
	39 39 39	17 23 30	0.3 0.3 0.3	22 400 28 300 37 000	30 500 41 500 58 500	2 290 2 890 3 800	3 150 4 200 6 000	9 500 9 500 9 500	15 000 15 000 15 000	
30	37	25	0.5	24 500	44 000	2 490	4 500	7 100	12 000	RLM 3025
	40	20	0.5	25 000	36 000	2 550	3 650	7 100	12 000	RLM 304020
	40	30	0.5	35 000	56 000	3 600	5 700	7 100	12 000	RLM 304030
	42	17	0.3	21 400	26 800	2 180	2 740	9 000	14 000	_
	42	23	0.3	30 000	41 500	3 100	4 250	9 000	14 000	_
	42	30	0.3	39 500	59 000	4 050	6 050	9 000	14 000	_
32	42	20	0.5	25 800	38 000	2 630	3 900	6 700	11 000	RLM 3220
	42	30	0.5	36 500	59 000	3 700	6 050	6 700	11 000	RLM 3230
	45	17	0.3	22 200	28 700	2 270	2 930	8 500	13 000	_
	45	23	0.3	31 500	44 500	3 200	4 550	8 500	13 000	_
	45	30	0.3	41 000	63 500	4 200	6 450	8 500	13 000	_
35	42	20	0.5	22 300	41 000	2 270	4 200	6 300	10 000	RLM 3520
	42	30	0.5	31 000	63 500	3 200	6 450	6 300	10 000	RLM 3530
	45	20	0.5	27 500	42 500	2 800	4 350	6 300	10 000	RLM 354520
	45	25	0.5	33 000	54 500	3 400	5 550	6 300	10 000	RLM 354525
	45	30	0.5	38 500	66 000	3 950	6 750	6 300	10 000	RLM 354530
	47 47 47	17 23 30	0.3 0.3 0.3	23 900 33 500 44 000	32 500 50 500 71 500	2 430 3 450 4 500	3 300 5 150 7 300	7 500 7 500 7 500	12 000 12 000 12 000	

Remarks If a full complement roller bearing is required, please contact NSK.



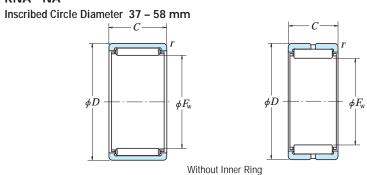


Numbers	I		Dimensions nm)	Abutment	and Fillet Dir (mm)	mensions	Ma: (kg	
Without Inner Ring	With Inner Ring	d	В	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	appr Without Inner Ring	
_	LM 2512	20	12.2	24	28	0.5	0.02	0.036
_	LM 2520	20	20.2	24	28	0.5	0.034	0.061
_	LM 2525	20	25.2	24	28	0.5	0.042	0.076
RNA 4904	NA 4904	20	17	22	35	0.3	0.055	0.077
RNA 5904	NA 5904	20	23	22	35	0.3	0.089	0.12
RNA 6904	NA 6904	20	30	22	35	0.3	0.098	0.14
=	LM 2820	22	20.2	26	31	0.5	0.038	0.062
	LM 2825	22	25.2	26	31	0.5	0.047	0.092
	LM 283730	22	30.2	26	33	0.5	0.075	0.13
RNA 49/22	NA 49/22	22	17	24	37	0.3	0.056	0.086
RNA 59/22	NA 59/22	22	23	24	37	0.3	0.091	0.135
RNA 69/22	NA 69/22	22	30	24	37	0.3	0.096	0.15
=	LM 3025	25	25.2	29	33	0.5	0.05	0.092
	LM 304020	25	20.2	29	36	0.5	0.06	0.093
	LM 304030	25	30.2	29	36	0.5	0.09	0.14
RNA 4905	NA 4905	25	17	27	40	0.3	0.063	0.091
RNA 5905	NA 5905	25	23	27	40	0.3	0.10	0.14
RNA 6905	NA 6905	25	30	27	40	0.3	0.11	0.16
_	LM 3220	28	20.2	32	38	0.5	0.064	0.09
	LM 3230	28	30.2	32	38	0.5	0.096	0.14
RNA 49/28	NA 49/28	28	17	30	43	0.3	0.076	0.099
RNA 59/28	NA 59/28	28	23	30	43	0.3	0.11	0.145
RNA 69/28	NA 69/28	28	30	30	43	0.3	0.13	0.175
Ξ	LM 3520	30	20.2	34	38	0.5	0.046	0.085
	LM 3530	30	30.2	34	38	0.5	0.07	0.13
=	LM 354520	30	20.2	34	41	0.5	0.069	0.11
	LM 354525	30	25.2	34	41	0.5	0.086	0.135
	LM 354530	30	30.2	34	41	0.5	0.10	0.16
RNA 4906	NA 4906	30	17	32	45	0.3	0.072	0.105
RNA 5906	NA 5906	30	23	32	45	0.3	0.11	0.15
RNA 6906	NA 6906	30	30	32	45	0.3	0.13	0.19

B 266 B 267



RLM • LM RNA • NA



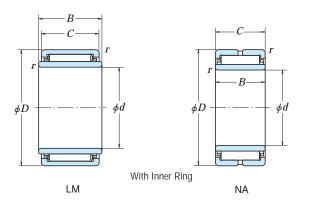
RLM

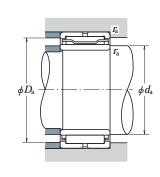
Вог	undary D		ons		Basic Load	3		١ ٠	Speeds	Bearing
$F_{ m W}$	(mr	m) C	r	$C_{ m r}$	(N) $C_{0\mathrm{r}}$	$C_{ m r}$	gf} $C_{0\mathrm{r}}$	(mi Grease	n ⁻¹) Oil	Without Inner Ring
37	47 47	20 30	min. 0.6 0.6	28 200 39 500	45 000 69 500	2 880 4 050	4 550 7 100	6 000 6 000	9 500 9 500	RLM 3720 RLM 3730
38	48	20	0.6	29 000	47 000	2 960	4 800	5 600	9 000	RLM 3820
	48	30	0.6	41 000	73 000	4 150	7 450	5 600	9 000	RLM 3830
40	50	20	0.6	29 700	49 000	3 050	5 000	5 300	9 000	RLM 4020
	50	30	0.6	42 000	76 500	4 250	7 800	5 300	9 000	RLM 4030
	52	20	0.6	29 900	45 000	3 050	4 600	6 700	10 000	_
	52	27	0.6	40 500	66 000	4 100	6 750	6 700	10 000	_
	52	36	0.6	56 000	101 000	5 700	10 300	6 700	10 000	_
42	55 55 55	20 27 36	0.6 0.6 0.6	30 500 41 500 57 500	47 500 69 500 106 000	3 100 4 200 5 850	4 800 7 100 10 900	6 300 6 300 6 300	10 000 10 000 10 000	=
45	55	20	0.6	31 000	53 500	3 150	5 500	4 800	8 000	RLM 4520
	55	30	0.6	43 500	83 500	4 450	8 500	4 800	8 000	RLM 4530
48	62 62 62	22 30 40	0.6 0.6 0.6	39 000 54 500 72 000	61 500 95 000 137 000	3 950 5 550 7 350	6 300 9 700 13 900	5 600 5 600 5 600	9 000 9 000 9 000	
50	62	20	0.6	35 500	60 500	3 600	6 150	4 300	7 100	RLM 506220
	62	25	0.6	43 000	77 500	4 400	7 900	4 300	7 100	RLM 506225
52	68	22	0.6	41 000	67 500	4 150	6 900	5 000	8 000	_
	68	30	0.6	57 000	104 000	5 800	10 600	5 000	8 000	_
	68	40	0.6	76 000	149 000	7 750	15 200	5 000	8 000	_
55	65	30	0.6	49 000	104 000	5 000	10 600	4 000	6 300	RLM 5530
	67	20	0.6	38 000	68 000	3 850	6 900	4 000	6 300	RLM 556720
58	72 72 72	22 30 40	0.6 0.6 0.6	42 500 59 500 79 000	73 500 113 000 163 000	4 350 6 050 8 050	7 500 11 500 16 600	4 500 4 500 4 500	7 100 7 100 7 100	Ξ

RNA

72 40 0.6 79 000 163 000 8 050 16

Remarks If a full complement roller bearing is required, please contact NSK.



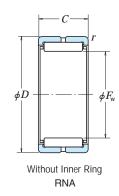


Numbers			Dimensions nm)	Abutment	and Fillet Di (mm)	mensions	Ma (kạ	
Without Inner Ring	With Inner Ring	d	В	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	appr Without Inner Ring	OX. With Inner Rin
=	LM 3720	32	20.3	36	43	0.6	0.072	0.115
	LM 3730	32	30.3	36	43	0.6	0.11	0.17
_	LM 3820	32	20.3	36	44	0.6	0.074	0.125
	LM 3830	32	30.3	36	44	0.6	0.11	0.195
=	LM 4020	35	20.3	39	46	0.6	0.078	0.125
	LM 4030	35	30.3	39	46	0.6	0.12	0.19
RNA 49/32	NA 49/32	32	20	36	48	0.6	0.092	0.16
RNA 59/32	NA 59/32	32	27	36	48	0.6	0.15	0.24
RNA 69/32	NA 69/32	32	36	36	48	0.6	0.17	0.29
RNA 4907	NA 4907	35	20	39	51	0.6	0.11	0.17
RNA 5907	NA 5907	35	27	39	51	0.6	0.175	0.25
RNA 6907	NA 6907	35	36	39	51	0.6	0.20	0.315
_	LM 4520	40	20.3	44	51	0.6	0.086	0.14
	LM 4530	40	30.3	44	51	0.6	0.13	0.21
RNA 4908	NA 4908	40	22	44	58	0.6	0.15	0.24
RNA 5908	NA 5908	40	30	44	58	0.6	0.23	0.355
RNA 6908	NA 6908	40	40	44	58	0.6	0.265	0.435
=	LM 506220	42	20.3	46	58	0.6	0.12	0.21
	LM 506225	42	25.3	46	58	0.6	0.155	0.265
RNA 4909	NA 4909	45	22	49	64	0.6	0.19	0.28
RNA 5909	NA 5909	45	30	49	64	0.6	0.27	0.39
RNA 6909	NA 6909	45	40	49	64	0.6	0.335	0.495
=	LM 5530	45	30.3	49	61	0.6	0.16	0.34
	LM 556720	45	20.3	49	63	0.6	0.13	0.25
RNA 4910	NA 4910	50	22	54	68	0.6	0.18	0.295
RNA 5910	NA 5910	50	30	54	68	0.6	0.25	0.405
RNA 6910	NA 6910	50	40	54	68	0.6	0.32	0.53



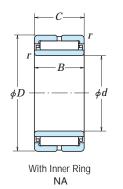
RNA · NA

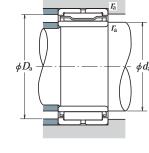
Inscribed Circle Diameter 63 – 120 mm



Вс	oundary D		ons		Basic Loa	0	gf}	Limiting (mir	•	Bearing
$F_{ m W}$	D	C	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Without Inner Ring
63	80	25	1	53 500	87 500	5 450	8 950	4 000	6 700	RNA 4911
	80	34	1	73 500	133 000	7 500	13 600	4 000	6 700	RNA 5911
	80	45	1	93 500	181 000	9 550	18 500	4 000	6 700	RNA 6911
68	85	25	1	56 000	95 500	5 700	9 750	3 800	6 300	RNA 4912
	85	34	1	77 500	145 000	7 900	14 800	3 800	6 300	RNA 5912
	85	45	1	98 000	197 000	10 000	20 100	3 800	6 300	RNA 6912
72	90	25	1	58 500	103 000	5 950	10 500	3 600	5 600	RNA 4913
	90	34	1	81 000	157 000	8 250	16 000	3 600	5 600	RNA 5913
	90	45	1	103 000	213 000	10 500	21 800	3 600	5 600	RNA 6913
80	100	30	1	80 500	143 000	8 200	14 600	3 200	5 300	RNA 4914
	100	40	1	107 000	206 000	10 900	21 000	3 200	5 300	RNA 5914
	100	54	1	143 000	298 000	14 500	30 500	3 200	5 300	RNA 6914
85	105	30	1	84 000	155 000	8 600	15 800	3 000	5 000	RNA 4915
	105	40	1	112 000	222 000	11 400	22 700	3 000	5 000	RNA 5915
	105	54	1	149 000	325 000	15 200	33 000	3 000	5 000	RNA 6915
90	110	30	1	87 500	166 000	8 950	17 000	2 800	4 500	RNA 4916
	110	40	1	116 000	239 000	11 900	24 400	2 800	4 500	RNA 5916
	110	54	1	157 000	350 000	16 000	36 000	2 800	4 500	RNA 6916
100	120	35	1.1	104 000	214 000	10 600	21 800	2 600	4 000	RNA 4917
	120	46	1.1	138 000	310 000	14 100	31 500	2 600	4 000	RNA 5917
	120	63	1.1	174 000	415 000	17 800	42 500	2 600	4 000	RNA 6917
105	125	35	1.1	108 000	228 000	11 000	23 300	2 400	4 000	RNA 4918
	125	46	1.1	143 000	330 000	14 600	33 500	2 400	4 000	RNA 5918
	125	63	1.1	181 000	445 000	18 400	45 000	2 400	4 000	RNA 6918
110	130	35	1.1	111 000	242 000	11 400	24 700	2 200	3 800	RNA 4919
	130	46	1.1	148 000	350 000	15 100	35 500	2 200	3 800	RNA 5919
	130	63	1.1	187 000	470 000	19 100	48 000	2 200	3 800	RNA 6919
115 120	140 140 140	40 54 30	1.1 1.1 1	144 000 193 000 99 500	295 000 430 000 214 000	14 700 19 700 10 100	30 000 43 500 21 900	2 200 2 200 2 000	3 600 3 600 3 400	RNA 4920 RNA 5920 RNA 4822







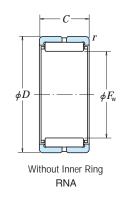
Numbers		Dimensions nm)	Abutment	and Fillet Din (mm)	nensions	Ma: (kg	
With Inner Ring	d	В	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	appr Without Inner Ring	ox. With Inner Ring
NA 4911	55	25	60	75	1	0.26	0.40
NA 5911	55	34	60	75	1	0.37	0.56
NA 6911	55	45	60	75	1	0.475	0.73
NA 4912	60	25	65	80	1	0.28	0.435
NA 5912	60	34	65	80	1	0.415	0.625
NA 6912	60	45	65	80	1	0.485	0.76
NA 4913	65	25	70	85	1	0.32	0.465
NA 5913	65	34	70	85	1	0.48	0.675
NA 6913	65	45	70	85	1	0.53	0.79
NA 4914	70	30	75	95	1	0.47	0.74
NA 5914	70	40	75	95	1	0.69	1.05
NA 6914	70	54	75	95	1	0.89	1.4
NA 4915	75	30	80	100	1	0.5	0.79
NA 5915	75	40	80	100	1	0.735	1.1
NA 6915	75	54	80	100	1	0.96	1.5
NA 4916	80	30	85	105	1	0.53	0.835
NA 5916	80	40	85	105	1	0.75	1.15
NA 6916	80	54	85	105	1	0.99	1.55
NA 4917	85	35	91.5	113.5	1	0.68	1.25
NA 5917	85	46	91.5	113.5	1	0.99	1.75
NA 6917	85	63	91.5	113.5	1	1.2	2.25
NA 4918	90	35	96.5	118.5	1	0.72	1.35
NA 5918	90	46	96.5	118.5	1	1.05	1.85
NA 6918	90	63	96.5	118.5	1	1.35	2.45
NA 4919	95	35	101.5	123.5	1	0.74	1.4
NA 5919	95	46	101.5	123.5	1	1.15	2.0
NA 6919	95	63	101.5	123.5	1	1.5	2.65
NA 4920	100	40	106.5	133.5	1	1.15	1.95
NA 5920	100	54	106.5	133.5	1	1.8	2.85
NA 4822	110	30	115	135	1	0.67	1.1

B 270 B 271



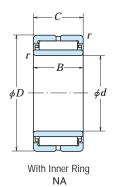
RNA · NA

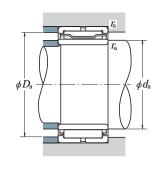
Inscribed Circle Diameter 125 – 390 mm



Вс	undary D (mi		ons		Basic Load R N)	5	kgf}	Limiting (mir	•	Bearing
$F_{ m W}$	D	C	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Without Inner Ring
125	150	40	1.1	149 000	315 000	15 200	32 500	2 000	3 200	RNA 4922
	150	54	1.1	200 000	460 000	20 300	47 000	2 000	3 200	RNA 5922
130	150	30	1	105 000	238 000	10 700	24 300	1 900	3 200	RNA 4824
135	165	45	1.1	192 000	395 000	19 600	40 500	1 900	3 000	RNA 4924
	165	60	1.1	253 000	565 000	25 800	58 000	1 900	3 000	RNA 5924
145	165	35	1.1	127 000	315 000	12 900	32 000	1 700	2 800	RNA 4826
150	180	50	1.5	228 000	515 000	23 200	52 500	1 700	2 800	RNA 4926
	180	67	1.5	299 000	725 000	30 500	74 000	1 700	2 800	RNA 5926
155	175	35	1.1	133 000	340 000	13 600	35 000	1 600	2 600	RNA 4828
160	190	50	1.5	235 000	545 000	24 000	55 500	1 600	2 600	RNA 4928
	190	67	1.5	310 000	775 000	31 500	79 000	1 600	2 600	RNA 5928
165	190	40	1.1	180 000	440 000	18 300	45 000	1 500	2 400	RNA 4830
175	200	40	1.1	184 000	465 000	18 700	47 000	1 400	2 200	RNA 4832
185	215	45	1.1	224 000	540 000	22 900	55 000	1 400	2 200	RNA 4834
195	225	45	1.1	230 000	570 000	23 500	58 000	1 300	2 000	RNA 4836
210	240	50	1.5	268 000	705 000	27 300	72 000	1 200	1 900	RNA 4838
220	250	50	1.5	274 000	740 000	27 900	75 500	1 100	1 800	RNA 4840
240	270	50	1.5	286 000	805 000	29 100	82 000	1 000	1 700	RNA 4844
265	300	60	2	375 000	1 070 000	38 500	109 000	950	1 500	RNA 4848
285	320	60	2	395 000	1 160 000	40 000	118 000	900	1 400	RNA 4852
305	350	69	2	510 000	1 390 000	52 000	142 000	800	1 300	RNA 4856
330	380	80	2.1	660 000	1 810 000	67 500	185 000	750	1 200	RNA 4860
350	400	80	2.1	675 000	1 900 000	69 000	194 000	710	1 100	RNA 4864
370	420	80	2.1	690 000	1 990 000	70 500	203 000	670	1 100	RNA 4868
390	440	80	2.1	705 000	2 080 000	72 000	212 000	630	1 000	RNA 4872

Remarks If a full complement roller bearing is required, please contact NSK.





Numbers		Dimensions nm)	Abutment	and Fillet Dir (mm)	mensions	Ma (kự	
With Inner Ring	d	В	$d_{ m a}$ min.	$D_{ m a}$ max.	$r_{ m a}$ max.	appr Without Inner Ring	
NA 4922	110	40	116.5	143.5	1	1.25	2.1
NA 5922	110	54	116.5	143.5	1	1.95	3.05
NA 4824	120	30	125	145	1	0.71	1.15
NA 4924	120	45	126.5	158.5	1	1.9	2.9
NA 5924	120	60	126.5	158.5	1	2.7	4.05
NA 4826	130	35	136.5	158.5	1	0.92	1.8
NA 4926	130	50	138	172	1.5	2.3	4.0
NA 5926	130	67	138	172	1.5	3.3	5.55
NA 4828	140	35	146.5	168.5	1	0.98	1.9
NA 4928	140	50	148	182	1.5	2.45	4.25
NA 5928	140	67	148	182	1.5	3.55	6.0
NA 4830	150	40	156.5	183.5	1	1.6	2.75
NA 4832	160	40	166.5	193.5	1	1.75	2.95
NA 4834	170	45	176.5	208.5	1	2.55	4.0
NA 4836	180	45	186.5	218.5	1	2.65	4.2
NA 4838	190	50	198	232	1.5	3.2	5.6
NA 4840	200	50	208	242	1.5	3.35	5.9
NA 4844	220	50	228	262	1.5	3.65	6.45
NA 4848	240	60	249	291	2	5.45	10
NA 4852	260	60	269	311	2	5.9	11
NA 4856	280	69	289	341	2	9.5	15.5
NA 4860	300	80	311	369	2	13	22
NA 4864	320	80	331	389	2	13.5	23.5
NA 4868	340	80	351	409	2	14	24.5
NA 4872	360	80	371	429	2	15	26

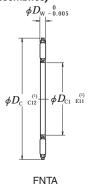


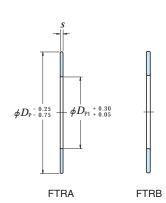
FNTA (Thrust Cage & Needle Roller Assemblies)

Thrust raceway washers FTRA (s=1.0) FTRB (s=1.5) FTRC (s=2.0)

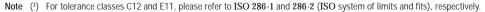
FTRD (s=2.5) FTRE (s=3.0)

Bore Diameter 10 – 100 mm

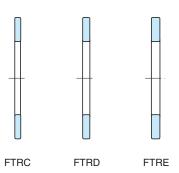


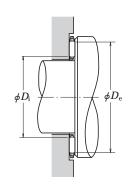


	ry Dimensions (mm)		(Basic Load	3	gf}	Limiting Speeds (min ⁻¹)		
D_{c1} , D_{p1}	$D_{\rm c}$, $D_{\rm p}$	D_{W}	C_{a}	C_{0a}	$C_{\rm a}$	C_{0a}	Oil	Bearing Numbers	$s=1.0^{\pm0.05}$
10	24	2	7 750	23 000	790	2 350	17 000	FNTA-1024	*FTRA-1024
12	26	2	8 350	26 300	855	2 680	16 000	FNTA-1226	FTRA-1226
15	28	2	7 950	25 800	810	2 630	15 000	FNTA-1528	FTRA-1528
16	29	2	8 200	27 100	835	2 770	14 000	FNTA-1629	FTRA-1629
17	30	2	8 400	28 400	855	2 900	14 000	FNTA-1730	FTRA-1730
18	31	2	8 600	29 700	875	3 050	13 000	FNTA-1831	FTRA-1831
20	35	2	11 900	47 000	1 220	4 800	12 000	FNTA-2035	FTRA-2035
25	42	2	14 800	66 000	1 510	6 750	9 500	FNTA-2542	FTRA-2542
30	47	2	16 500	79 000	1 680	8 100	8 500	FNTA-3047	FTRA-3047
35	52	2	17 300	88 000	1 770	8 950	8 000	FNTA-3552	FTRA-3552
40	60	3	26 900	122 000	2 740	12 400	6 700	FNTA-4060	FTRA-4060
45	65	3	28 700	137 000	2 930	14 000	6 300	FNTA-4565	FTRA-4565
50	70	3	30 500	152 000	3 100	15 500	5 600	FNTA-5070	FTRA-5070
55	78	3	37 000	201 000	3 750	20 500	5 300	FNTA-5578	FTRA-5578
60	85	3	43 000	252 000	4 400	25 700	4 800	FNTA-6085	FTRA-6085
65	90	3	45 500	274 000	4 600	28 000	4 500	FNTA-6590	FTRA-6590
70	95	4	59 000	320 000	6 000	33 000	4 300	FNTA-7095	FTRA-7095
75	100	4	60 000	335 000	6 150	34 500	4 000	FNTA-75100	FTRA-75100
80 85 90 100	105 110 120 135	4 4 4	63 000 64 500 80 000 98 500	365 000 380 000 515 000 695 000	6 450 6 550 8 150 10 000	37 500 39 000 52 500 71 000	3 800 3 600 3 400 3 000	FNTA-80105 FNTA-85110 FNTA-90120 FNTA-100135	FTRA-80105 FTRA-85110 FTRA-90120 FTRA-100135



^(*) The tolerance of this bearing bore diameter is +0.025 to +0.175mm and outside diameter tolerance is





Bearing Numbers	of Matching Bearing F	Rings		Roller Conta		Ma (g	
$S=1.5^{\ \ 0}_{\ \ -0.08}$	$s=2.0^{-0.08}$	$S=2.5^{+0.08}$	$s=3.0^{-0.08}$	Outside Diameter $D_{ m e}$ min.		appr FNTA	
FTRB-1024	FTRC-1024	<u> </u>	—	22.0	11.5	2.3	2.9
FTRB-1226	FTRC-1226		—	24.0	13.5	3.4	3.3
FTRB-1528	FTRC-1528		FTRE-1528	26.0	16.5	3.5	3.5
FTRB-1629	FTRC-1629	FTRD-1629	FTRE-1629	27.0	17.5	3.7	3.6
FTRB-1730	FTRC-1730	FTRD-1730	FTRE-1730	28.0	18.5	3.8	3.8
FTRB-1831	FTRC-1831	FTRD-1831	FTRE-1831	29.0	19.5	4	3.9
FTRB-2035	FTRC-2035	FTRD-2035	FTRE-2035	33.0	21.5	5.4	5.1
FTRB-2542	FTRC-2542	FTRD-2542	FTRE-2542	40.0	26.5	7.7	7
FTRB-3047	FTRC-3047	FTRD-3047	FTRE-3047	45.0	31.5	8.9	7.9
FTRB-3552	FTRC-3552	FTRD-3552	FTRE-3552	50.5	36.5	9.7	9.1
FTRB-4060	FTRC-4060	FTRD-4060	FTRE-4060	57.0	42.0	18	12
FTRB-4565	FTRC-4565	FTRD-4565	FTRE-4565	62.0	47.0	20	13
FTRB-5070	FTRC-5070	FTRD-5070	FTRE-5070	67.0	51.5	22	15
FTRB-5578	FTRC-5578	FTRD-5578	FTRE-5578	75.0	57.0	29	19
FTRB-6085	FTRC-6085	FTRD-6085	FTRE-6085	82.0	61.5	35	22
FTRB-6590	FTRC-6590	FTRD-6590	FTRE-6590	87.5	66.5	38	24
FTRB-7095	FTRC-7095	FTRD-7095	FTRE-7095	92.5	71.5	52	25
FTRB-75100	FTRC-75100	FTRD-75100	FTRE-75100	97.5	76.5	54	27
FTRB-80105	FTRC-80105	FTRD-80105	FTRE-80105	102.5	81.5	58	28
FTRB-85110	FTRC-85110	FTRD-85110	FTRE-85110	107.5	86.5	63	30
FTRB-90120	FTRC-90120	FTRD-90120	FTRE-90120	117.5	91.5	80	38
FTRB-100135	FTRC-100135	FTRD-100135	FTRE-100135	132.5	101.5	105	50

B 275 B 274

^{-0.040} to -0.370mm

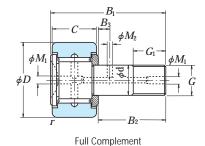
FCR (Full Complement)

FCRS Full Complement, Sealed With Thrust Washer

FCJ (With Cage)

FCJS Sealed, with Cage and Thrust Washer

Outside Diameter 16 – 90 mm



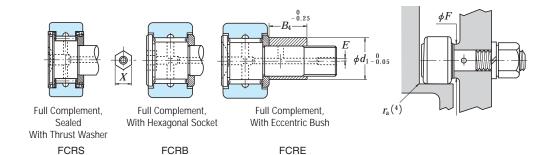
FCR

Bound	ary Dime (mm)	ensions			Di	mensions (mm)					Bearing	Numbers
D	С	d	Screw <i>G</i>	G_1	B_1	B_2	B_3	M_2	M_1	$m{r}$ min.	FCR FCJ	FCRS FCJS
16	11 11	6 6	M 6×1 M 6×1	8 8	28 28	16 16	_	_	4(1) 4(1)	0.3 0.3	FCR-16 FCJ-16	FCRS-16 FCJS-16
19	11 11	8	M 8×1.25 M 8×1.25	10 10	32 32	20 20	=	_	4(1) 4(1)	0.3 0.3	FCR-19 FCJ-19	FCRS-19 FCJS-19
22	12 12	10 10	M10×1.25 M10×1.25	12 12	36 36	23 23	=	_	4(1) 4(1)	0.3 0.3	FCR-22 FCJ-22	FCRS-22 FCJS-22
26	12 12	10 10	M10×1.25 M10×1.25	12 12	36 36	23 23	=	=	4(1) 4(1)	0.3 0.3	FCR-26 FCJ-26	FCRS-26 FCJS-26
30	14 14	12 12	M12×1.5 M12×1.5	13 13	40 40	25 25	6 6	3	6 6	0.6 0.6	FCR-30 FCJ-30	FCRS-30 FCJS-30
32	14 14	12 12	M12×1.5 M12×1.5	13 13	40 40	25 25	6 6	3	6 6	0.6 0.6	FCR-32 FCJ-32	FCRS-32 FCJS-32
35	18 18	16 16	M16×1.5 M16×1.5	17 17	52 52	32.5 32.5	8	3	6 6	0.6 0.6	FCR-35 FCJ-35	FCRS-35 FCJS-35
40	20 20	18 18	M18×1.5 M18×1.5	19 19	58 58	36.5 36.5	8	3	6 6	1 1	FCR-40 FCJ-40	FCRS-40 FCJS-40
47	24 24	20 20	M20×1.5 M20×1.5	21 21	66 66	40.5 40.5	9 9	4 4	8	1 1	FCR-47 FCJ-47	FCRS-47 FCJS-47
52	24 24	20 20	M20×1.5 M20×1.5	21 21	66 66	40.5 40.5	9 9	4 4	8	1 1	FCR-52 FCJ-52	FCRS-52 FCJS-52
62	29 29	24 24	M24×1.5 M24×1.5	25 25	80 80	49.5 49.5	11 11	4 4	8	1 1	FCR-62 FCJ-62	FCRS-62 FCJS-62
72	29 29	24 24	M24×1.5 M24×1.5	25 25	80 80	49.5 49.5	11 11	4 4	8	1 1	FCR-72 FCJ-72	FCRS-72 FCJS-72
80	35 35	30 30	M30×1.5 M30×1.5	32 32	100 100	63 63	15 15	4 4	8	1 1	FCR-80 FCJ-80	FCRS-80 FCJS-80
85	35 35	30 30	M30×1.5 M30×1.5	32 32	100 100	63 63	15 15	4 4	8	1 1	FCR-85 FCJ-85	FCRS-85 FCJS-85
90	35 35	30 30	M30×1.5 M30×1.5	32 32	100 100	63 63	15 15	4 4	8	1 1	FCR-90 FCJ-90	FCRS-90 FCJS-90

Notes (1) Only the head of the stud has on oil hole.

(2) Applicable to FCRB only.

Remarks Standard grease is packed in sealed cam followers, but not in cam followers without seals.



Basic Dynamic L	oad Ratings {kgf}	Limiting I (N)	{kgf}	Limiting Tra	ck Loads {kgf}	Mass (kg)	Dimensions of Hexagonal Socket (2) (width	Eccentric E	(mm)	.,	Shoulder Dimensions (mm)	Tightening (N·cm) {I	
$C_{\rm r}$		$P_{ m max}$	х			approx.	across flats) (mm) X	B_4	$d_{\scriptscriptstyle 1}$	Ε	F (min.)	(max.)	(max.)
5 800	590	2 360	240	3 350	340	0.020	4	8	9	0.5	11	226	23
2 830	288	2 360	240	3 350	340	0.018	4	8	9	0.5	11	226	23
6 600	670	4 200	425	4 150	425	0.031	4 4	10	11	0.5	13	550	56
3 450	355	4 200	425	4 150	425	0.030		10	11	0.5	13	550	56
8 550	875	6 550	665	5 300	540	0.047	5	11	13	0.5	15	1 060	108
4 350	445	6 550	665	5 300	540	0.045	5	11	13	0.5	15	1 060	108
8 550	875	6 550	665	6 000	610	0.060	5	11	13	0.5	15	1 060	108
4 350	445	6 550	665	6 000	610	0.058	5	11	13	0.5	15	1 060	108
12 500	1 280	9 250	945	7 800	795	0.088	6	12	17	1	20	1 450	148
7 200	735	9 250	945	7 800	795	0.086	6	12	17	1	20	1 450	148
12 500	1 280	9 250	945	8 050	820	0.099	6	12	17	1	20	1 450	148
7 200	735	9 250	945	8 050	820	0.096	6	12	17	1	20	1 450	148
18 600	1 900	17 000	1 740	11 800	1 200	0.17	10	15.5	22	1	24	4 000	410
9 700	990	17 000	1 740	11 800	1 200	0.165	10	15.5	22	1	24	4 000	410
20 500	2 090	21 700	2 220	14 300	1 460	0.25	10	17.5	24	1	26	5 950	605
10 300	1 050	21 700	2 220	14 300	1 460	0.24	10	17.5	24	1	26	5 950	605
28 200	2 880	26 400	2 690	20 800	2 120	0.39	12	19.5	27	1	31	8 450	860
19 200	1 950	26 400	2 690	20 800	2 120	0.38	12	19.5	27	1	31	8 450	860
28 200	2 880	26 400	2 690	22 900	2 340	0.47	12	19.5	27	1	31	8 450	860
19 200	1 950	26 400	2 690	22 900	2 340	0.455	12	19.5	27	1	31	8 450	860
40 000	4 100	38 500	3 950	34 000	3 450	0.80	14	24.5	34	1	45	15 200	1 550
24 900	2 540	38 500	3 950	34 000	3 450	0.79	14	24.5	34	1	45	15 200	1 550
40 000	4 100	38 500	3 950	38 000	3 860	1.05	14	24.5	34	1	45	15 200	1 550
24 900	2 540	38 500	3 950	38 000	3 860	1.05	14	24.5	34	1	45	15 200	1 550
60 500	6 200	61 000	6 200	52 000	5 300	1.55	17	31	40	1.5	52	30 500	3 120
39 000	4 000	61 000	6 200	52 000	5 300	1.55	17	31	40	1.5	52	30 500	3 120
60 500	6 200	61 000	6 200	55 500	5 650	1.75	17	31	40	1.5	52	30 500	3 120
39 000	4 000	61 000	6 200	55 500	5 650	1.75	17	31	40	1.5	52	30 500	3 120
60 500	6 200	61 000	6 200	59 000	6 000	1.95	17	31	40	1.5	52	30 500	3 120
39 000	4 000	61 000	6 200	59 000	6 000	1.95	17	31	40	1.5	52	30 500	3 120

Notes (3) Applicable to FCRE only.

(4) Should not be greater than r (min).



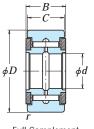
FYCR (Full Complement)

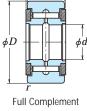
Full Complement, Sealed with Thrust Washer **FYCRS**

FYCJ (With Cage)

Sealed, with Cage and Thrust Washer **FYCJS**

Bore Diameter 5 – 50 mm





FYCR



	Boun	dary Dim (mm)	ensions			Basic Load	3	gf}	Limiting Tra	nck Loads {kgf}
d	D	C	$B^{0 \atop -0.38}$	<i>r</i> min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	(14)	(kgi)
5	16	11	12	0.3	5 800	8 000	590	815	3 350	340
	16	11	12	0.3	2 830	2 620	288	267	3 350	340
6	19	11	12	0.3	6 550	9 900	665	1 010	4 150	425
	19	11	12	0.3	3 450	3 600	355	365	4 150	425
8	24	14	15	0.3	10 100	15 000	1 030	1 530	6 500	665
	24	14	15	0.3	5 700	6 000	580	610	6 500	665
10	30	14	15	0.6	11 700	18 500	1 190	1 890	7 800	795
	30	14	15	0.6	6 950	8 200	705	835	7 800	795
12	32	14	15	0.6	12 600	21 000	1 280	2 140	8 050	820
	32	14	15	0.6	7 650	9 650	780	985	8 050	820
15	35	18	19	0.6	18 700	29 300	1 910	2 990	11 800	1 200
	35	18	19	0.6	12 200	14 100	1 250	1 440	11 800	1 200
17	40	20	21	0.6	21 100	35 000	2 160	3 600	14 300	1 460
	40	20	21	0.6	13 700	16 700	1 390	1 700	14 300	1 460
20	47	24	25	1	28 900	50 000	2 940	5 100	20 800	2 120
	47	24	25	1	18 200	22 600	1 850	2 310	20 800	2 120
25	52	24	25	1	32 500	60 000	3 300	6 100	22 900	2 340
	52	24	25	1	22 200	31 000	2 270	3 150	22 900	2 340
30	62	28	29	1	47 500	96 000	4 800	9 800	33 000	3 350
	62	28	29	1	31 500	47 000	3 200	4 800	33 000	3 350
35	72	28	29	1	49 500	106 000	5 050	10 800	36 500	3 700
	72	28	29	1	33 000	52 500	3 400	5 350	36 500	3 700
40	80	30	32	1	54 500	126 000	5 600	12 800	43 500	4 450
	80	30	32	1	38 500	67 500	3 950	6 900	43 500	4 450
45	85	30	32	1	57 500	139 000	5 850	14 100	46 500	4 750
	85	30	32	1	40 000	73 000	4 100	7 450	46 500	4 750
50	90	30	32	1	60 500	152 000	6 150	15 500	49 500	5 050
	90	30	32	1	41 500	78 000	4 200	7 950	49 500	5 050

pplement, Sealed hrust Washer		φ
Limiting Track Loads	Rearing Numbers	Ma

50	90	30	32	1	60 500	152 000	6 150	15 500	49 500	5 050
	90	30	32	1	41 500	78 000	4 200	7 950	49 500	5 050
Rema	ırks Sta	ndard grea	ise is pack	ked in seale	d cam followe	ers, but not in ca	ım followers with	out seals.		

Bearing I	FYCRS	Mass (kg)	Shoulder Dimensions (mm) F
FYCJ	FYCJS	approx.	min.
FYCR-5	FYCRS-5	0.016	10
FYCJ-5	FYCJS-5	0.014	10
FYCR-6	FYCRS-6	0.022	12
FYCJ-6	FYCJS-6	0.020	12
FYCR-8	FYCRS-8	0.044	14
FYCJ-8	FYCJS-8	0.042	14
FYCR-10	FYCRS-10	0.069	17
FYCJ-10	FYCJS-10	0.067	17
FYCR-12	FYCRS-12	0.076	19
FYCJ-12	FYCJS-12	0.074	19
FYCR-15	FYCRS-15	0.105	23
FYCJ-15	FYCJS-15	0.097	23
FYCR-17	FYCRS-17	0.145	25
FYCJ-17	FYCJS-17	0.14	25
FYCR-20	FYCRS-20	0.255	29
FYCJ-20	FYCJS-20	0.245	29
FYCR-25	FYCRS-25	0.285	34
FYCJ-25	FYCJS-25	0.275	34
FYCR-30	FYCRS-30	0.48	51
FYCJ-30	FYCJS-30	0.47	51
FYCR-35	FYCRS-35	0.64	58
FYCJ-35	FYCJS-35	0.635	58
FYCR-40	FYCRS-40	0.88	66
FYCJ-40	FYCJS-40	0.865	66
FYCR-45	FYCRS-45	0.93	72
FYCJ-45	FYCJS-45	0.91	72
FYCR-50	FYCRS-50	0.995	76
FYCJ-50	FYCJS-50	0.965	76

B 278 B 279



BALL BEARING UNITS

SET SCREW TYPE PILLOW BLOCKS CAST HOUSING

UCP2 Shaft Diameter 12 – 90mm B286

1/2 – 3 1/2 inch

SET SCREW TYPE FLANGED UNITS CAST HOUSING

UCF2 Shaft Diameter 12 – 90mm B292

1/2 – 3 1/2 inch

1/2 – 3 1/2 inch

B 280 B 281

1. CONSTRUCTION

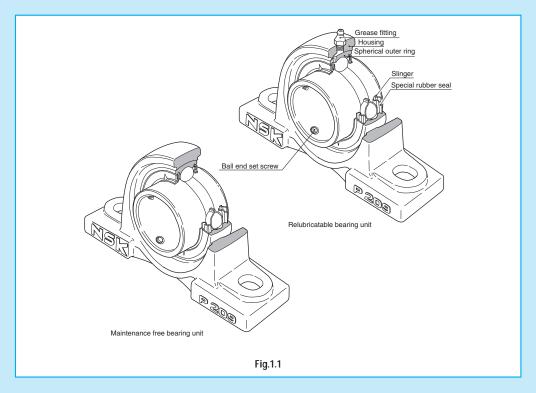
The NSK bearing unit is a combination of a radial ball bearing, seal, and a housing of high-grade cast iron or pressed steel, which comes in various shapes.

The outer surface of the bearing and the internal surface of the housing are spherical, so that the unit is self-aligning.

The inside construction of the ball bearing for the unit is such that steel balls and retainers of the same type as in series 62 and 63 of the deep groove ball bearing are used. A duplex seal consisting of a combination of an oil-proof synthetic rubber seal and a slinger is provided on both sides.

Depending on the type, the following methods of fitting to the shaft are employed:

- The inner ring is fastened onto the shaft in two places by set screws.
- (2) The inner ring has a tapered bore and is fitted to the shaft by means of an adapter.
- (3) In the eccentric locking collar system the inns ring is fastened to the shaft by means of eccentrics grooves provided at the side of the inner ring and on the collar.



2. DESIGN FEATURES AND ADVANTAGES

2.1 MAINTENANCE FREE TYPE

The NSK Maintenance free bearing unit contains a high-grade lithium-based grease, good for use over a long period, which is ideally suited to sealed-type bearing. Also provided is an excellent sealing device, which prevents any leakage of grease or penetration of dust and water from outside.

It is designed so that the rotation of the shaft causes the sealed-in grease to circulate through the inside space, effectively providing maximum lubrication. The lubrication effect is maintained over a long period with no need for replenishment of grease.

To summarize the advantages of the NSK maintenance free bearing unit:

- (1) As an adequate amount of good quality grease is sealed in at the time of manufacture, there is no need for replenishment. This means savings in terms of time and maintenance costs.
- (2) Since there is no need for any regreasing facilities, such as piping, a more compact design is possible.
- (3) The sealed-in design eliminates the possibility of grease leakage, which could lead to stained products.

2.2 RELUBRICATABLE TYPE

The NSK relubricatable type bearing unit has an advantage over other similar, units being so designed as to permit regreasing even in the case of misalignment of 2° to the right or left. The hole through which the grease fitting is mounted usually causes structural weakening of the housing.

However, as a result of extensive testing, in the NSK bearing unit the hole is positioned so as to minimize this adverse effect. In addition, the regreasing groove has been designed to minimize weakening of the housing.

While the NSK maintenance free type bearing unit is satisfactory for use under normal operating conditions in-doors, in the following circumstances it is necessary to use the relubricatable type bearing unit:

- (1) Cases where the temperature of the bearing rises above 100°C, 212°F:
 - *-Normal temperature of up to 130°C, 266°F heat-resistant bearing units.
- (2) Cases where there is excessive dust, but space does not permit using a bearing unit with a cover.
- (3) Cases where the bearing unit is constantly exposed to splashes of water or any other liquid, but space does not permit using a bearing unit with a cover.
- (4) Cases in which the humidity is very high, and the machine in which the bearing unit is used is run only intermittently.

- (5) Cases involving a heavy load of which the Cr/Pr value is about 10 or below, and the speed is 10 min⁻¹ or below, or the movement is oscillatory.
- (6) Cases where the number of revolutions is relatively high and the noise problem has to be considered; for example, when the bearing is used with the fan of an air conditioner.

2.3 SPECIAL SEALING FEATURE

2.3.1 STANDARD BEARING UNITS

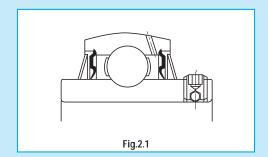
The sealing device of the ball bearing for the NSK bearing unit is a combination of a heat-resistant and oil-proof synthetic rubber seal and a slinger of an exclusive design.

The seal, which is fixed in the outer ring, is steel-reinforced, and its lip, in contact with the inner ring, is designed to minimize frictional torque.

The slinger is fixed to the inner ring of the bearing with which it rotates. There is a small clearance between its periphery and the outer ring.

There are triangular protrusions on the outside face of the slinger and, as the bearing rotates, these protrusions on the slinger create a flow of air outward from the bearing. In this way, the slinger acts as a fan which-keeps dust and water away from the bearing.

These two types of seals on both sides of the bearing prevent grease leakage, and foreign matter is prevented from entering the bearing from outside.





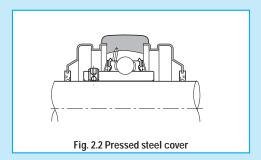
2.3.2 BEARING UNITS WITH COVERS

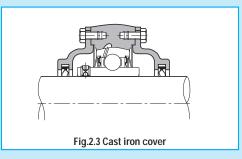
The NSK bearing unit with a cover consists of a standard bearing unit and an outside covering for extra protection against dust. Special consideration has been given to its design with respect to dust-

Sealing devices are provided in both the bearing and the housing, so that units of this type operate satisfactorily even in such adverse environments as flour mills, steel mills, foundries, galvanizing plants and chemical plants, where excessive dust is produced and/or liquids are used. They are also eminently suitable for outdoor environments where dust and rain are inevitable, and in heavy industrial machinery such as construction and transportation equipment.

The rubber seal of the cover contacts with the shaft by its two lips, as shown in Fig. 2.2 and 2.3. By filling the groove between the two lips with grease, an excellent sealing effect is obtained and, at the same time, the contacting portions of the lips are lubricated. Furthermore, the groove is so designed that when the shaft is inclined the rubber seal can move in the radial direction.

When bearing units are exposed to splashes of water rather than to dust, a drain hole (5 to 8 mm, 0.2 to 0.3 inches in diameter) is provided at the bottom of the cover, and grease should be applied to the side of the bearing itself instead of into the cover.





2.4 SECURE FITTING

Fastening the bearing to the shaft is effected by tightening the ball-end set screw, situated on the inner ring. This is a unique feature which prevents loosening, even if the bearing is subject to intense vibrations and shocks.

2.5 SELF-ALIGNING

With the NSK bearing unit, the outer surface of the ball bearing and the inner surface of the housing are spherical, thus this bearing unit has self-aligning characteristic. Any misalignment of axis that arise from poor workmanship on the shaft or errors in fitting will be properly adjusted.

2.6 HIGHER RATED LOAD CAPACITY

The bearing used in the unit is of the same internal construction as those in bearing series 62 and 63, and is capable of accommodating axial load as well as radial load, or composite load. The rated load capacity or this bearing is considerably higher than that of the corresponding self-aligning ball bearings used for standard plummer blocks

2.7 LIGHT WEIGHT YET STRONG HOUSING

Housings for NSK bearing units come in various shapes. They consist of either high-grade cast iron, one-piece casting, or of precision finished pressed steel, the latter being lighter in weight. In either case, they are practically designed to combine lightness with maximum strength.

2.8 EASY MOUNTING

The NSK bearing unit is an integrated unit consisting of a bearing and a housing.

As the bearing is prelubricated at manufacture with the correct amount of high-grade lithium base, it can be mounted on the shaft just as it is. It is sufficient to carry out a short test run after mounting.

2.9 ACCURATE FITTING OF THE HOUSING

In order to simplify the fitting of the pillow block and flange type bearing units, the housings are provided with a seat for a dowel pin, which may be utilized as needed.

2.10 BEARING REPLACEABILITY

The bearing used in the NSK bearing unit is replaceable. In the event of bearing failure, a new bearing can be fitted to the existing housing.

RECOMMENDED TOROUES FOR TIGTENING SET SCREWS

Table 3.1 Recommended torques for tightening set screws

A) Metric series, applied to metric bore size.

	ion of the pplicable υ		Designation of set screws	Tightening torques N·m (max.)
UC201 to UC205	_	_	M 5×0.8 × 7	3.9
UC206	_	UC305 to UC306	M 6×0.75× 8	4.9
UC207	UCX05	_	M 6×0.75× 8	5.8
UC208 to UC210	_	_	M 8×1 ×10	7.8
UC211	UCX06 to UCX08	UC307	M 8×1 ×10	9.8
UC212	UCX09	_	M10×1.25×12	16.6
UC213 to UC215	_	UC308 to UC309	M10×1.25×12	19.6
UC216	UCX10	_	M10×1.25×12	22.5
_	UCX11 to UCX12	_	M10×1.25×12	24.5
UC217 to UC218	UCX13 to UCX15	UC310 to UC314	M12×1.5 ×13	29.4
_	UCX16 to UCX17	_	M12×1.5 ×13	34.3
-	UCX18	UC315 to UC316	M14×1.5 ×15	34.3
	UCX20	UC317 to UC319	M16×1.5 ×18	53.9
_	_	UC320 to UC324	M18×1.5 ×20	58.8
_	_	UC326 to UC328	M20×1.5 ×25	78.4

B) Inch series, applied to inch	bore size.
Designation of the bearings	Designati

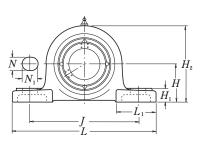
Designation of the bearings for the unit to which torques given are applicable			Designation of set screws	Tightening torques lbf-inch (max
UC201 to UC205	_	_	No.10 -32UNF	34
UC206	_	UC305 to UC306	¹ /4 -28UNF	43
UC207	UCX05	_	1/4 -28UNF	52
UC208 to UC210	_	_	⁵ /16 -24UNF	69
UC211	UCX06 to UCX08	UC307	⁵ /16 -24UNF	86
UC212	UCX09	_	³ /8 -24UNF	147
UC213 to UC215	_	UC308 to UC309	³ /8 -24UNF	173
UC216	UCX10	_	³ /8 -24UNF	199
_	UCX11 to UCX12	_	³ /8 -24UNF	216
UC217 to UC218	UCX13 to UCX15	UC310 to UC314	¹ /2 -20UNF	260
_	UCX16 to UCX17	_	¹ / ₂ -20UNF	303
_	UCX18	UC315 to UC316	9/16 -18UNF	303
_	UCX20	UC317 to UC318	⁵ /8 -18UNF	477
_	_	UC320	⁵ /8 -18UNF	520

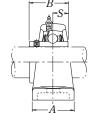
Designation of the bearings of applicable units	Designation of set screws	Tightening torques N·m (max.)
AS201 to 205	M5×0.8 × 7	3.4
AS206	M6×0.75× 8	4.4
AS207	M6×0.75× 8	4.9
AS208	M8×1 ×10	6.8

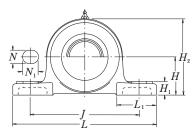
Designation of the bearings for the unit to which torques given are applicable	Designation of set screws	Tightening torques lbf-inch (max.)
AS201 to 205	No 10-32UNF	30
AS206	¹ /4 -28UNF	39
AS207	1/4 -28UNF	43
AS208	5/16-24UNF	60

B 284 B 285

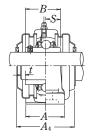
Pillow blocks units cast housing Set screw type

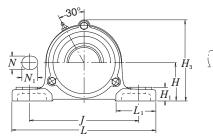


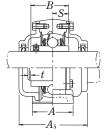




Pressed steel dust cover type
Open end Z-UCP...D1
Closed end ZM-UCP...D1







Cast dust cover type
Open end C-UCP...D1
Closed end CM-UCP...D1

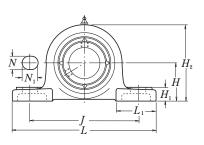
Shaft dia.	Unit number(1)					Nomin	al dime	ensions					Bolt size	Bearing number
						n	nm inc	:h						
mm inch		Н	L	J	Α	N	N_1	H_1	H_2	L_1	В	S	mm inch	
12 1/2	UCP201D1 UCP201-008D1	30.2 1 ³ / ₁₆	127 5	95 3 ³ / ₄	38 1 ¹ / ₂	13 1/2	16 5/8	14 9/16	62 2 ⁷ / ₁₆	42 1 ²¹ / ₃₂	31 1.2205	12.7 0.500	M10 3/8	UC201D1 UC201-008D1
15	UCP202D1	30.2	127	95	38	13	16	14	62	42	31	12.7	M10	UC202D1
9/16 5/8	UCP202-009D1 UCP202-010D1	1 3/16	5	33/4	11/2	1/2	5/8	9/16	27/16	121/32	1.2205	0.500	3/8	UC202-009D1 UC202-010D1
17	UCP203D1	30.2	127	95	38	13	16	14	62	42	31	12.7	M10	UC203D1
11/16	UCP203-011D1	1 ³ /16	5	33/4	1 ¹ / ₂	1/2	5/8	9/16	2 ⁷ /16	121/32	1.2205	0.500	3/8	UC203-011D1
20 3/4	UCP204D1 UCP204-012D1	33.3 1 ⁵ / ₁₆	127 5	95 3 ³ / ₄	38 1 ¹ / ₂	13 1/2	16 5/8	14 9/16	65 2 ⁹ /16	42 1 ²¹ / ₃₂	31 1.2205	12.7 0.500	M10 3/8	UC204D1 UC204-012D1
25	UCP205D1	36.5	140	105	38	13	16	15	71	42	34.1	14.3	M10	UC205D1
7/8	UCP205-013D1 UCP205-014D1 UCP205-015D1 UCP205-100D1	1 ⁷ /16	5 ¹ / ₂	4 ¹ /8	1 ¹ / ₂	1/2	5/8	19/32	2 ²⁵ /32	1 ²¹ / ₃₂	1.3425	0.563	3/8	UC205-013D1 UC205-014D1 UC205-015D1 UC205-100D1
30	UCP206D1	42.9	165	121	48	17	20	17	83	54	38.1	15.9	M14	UC206D1
1 ¹ / ₁₆ 1 ¹ / ₈ 1 ³ / ₁₆ 1 ¹ / ₄	UCP206-101D1 UCP206-102D1 UCP206-103D1 UCP206-104D1	1 ¹¹ /16	6 ¹ / ₂	43/4	1 ⁷ /8	21/32	25/32	21/32	3 9/32	21/8	1.5000	0.626	1/2	UC206-101D1 UC206-102D1 UC206-103D1 UC206-104D1
35	UCP207D1	47.6	167	127	48	17	20	18	93	54	42.9	17.5	M14	UC207D1
13/8	UCP207-104D1 UCP207-105D1 UCP207-106D1 UCP207-107D1	1 ⁷ /8	6 9/16	5	1 ⁷ /8	21/32	25/32	23/32	3 ²¹ / ₃₂	2 ¹ /8	1.6890	0.689	1/2	UC207-104D1 UC207-105D1 UC207-106D1 UC207-107D1
40	UCP208D1	49.2	184	137	54	17	20	18	98	52	49.2	19	M14	UC208D1
1 ¹ / ₂ 1 ⁹ / ₁₆	UCP208-108D1 UCP208-109D1	1 15/16	71/4	513/32	21/8	21/32	25/32	23/32	3 27/32	21/16	1.9370	0.748	1/2	UC208-108D1 UC208-109D1

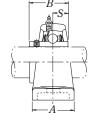
Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".

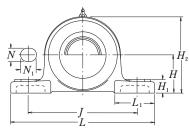
Housing number	Unit number (1) pressed steel dust cover type	Unit number (1) cast dust cover type		Nominal di	mensions	3	N	lass of un	it
	31		4	mm 4		4		kg lb	
			t max.	A_4	H_3	A_5	UCP	Z(ZM)	C(CM)
P203D1 P203D1	Z(ZM)-UCP201D1 Z(ZM)-UCP201-008D1	C(CM)-UCP201D1 C(CM)-UCP201-008D1	2 5/64	45 1 ²⁵ / ₃₂	67 2 ⁵ /8	62 2 ⁷ /16	0.7 1.5	0.7 1.5	1.0 2.2
P203D1	Z(ZM)-UCP202D1	C(CM)-UCP202D1	2	45	67	62	0.7	0.7	1.0
P203D1 P203D1	Z(ZM)-UCP202-009D1 Z(ZM)-UCP202-010D1	C(CM)-UCP202-009D1 C(CM)-UCP202-010D1	5/64	125/32	2 5/8	27/16	1.5	1.5	2.2
P203D1 P203D1	Z(ZM)-UCP203D1 Z(ZM)-UCP203-011D1	C(CM)-UCP203D1 C(CM)-UCP203-011D1	2 5/64	45 1 ²⁵ /32	67 2 5/8	62 2 ⁷ / ₁₆	0.7 1.5	0.7 1.5	1.0 2.2
P204D1	Z(ZM)-UCP204D1	C(CM)-UCP204D1	2	45	70	62	0.7	0.7	0.9
P204D1	Z(ZM)-UCP204-012D1	C(CM)-UCP204-012D1	5/64	1 ²⁵ / ₃₂	23/4	27/16	1.5	1.5	2.0
P205D1	Z(ZM)-UCP205D1	C(CM)-UCP205D1	2	48	76	70	0.8	0.9	1.1
P205D1 P205D1	Z(ZM)-UCP205-013D1 Z(ZM)-UCP205-014D1	C(CM)-UCP205-013D1 C(CM)-UCP205-014D1	<u>.</u>			- 0 -			
P205D1	Z(ZM)-UCP205-015D1	C(CM)-UCP205-015D1	5/64	1 ²⁹ /32	3	23/4	1.8	2.0	2.4
P205D1	Z(ZM)-UCP205-100D1	C(CM)-UCP205-100D1							
P206D1 P206D1	Z(ZM)-UCP206D1 Z(ZM)-UCP206-101D1	C(CM)-UCP206D1 C(CM)-UCP206-101D1	2	53	88	75	1.4	1.4	1.7
P206D1	Z(ZM)-UCP206-101D1	C(CM)-UCP206-101D1	5/64	2 3/32	3 15/32	215/16	3.1	3.1	3.7
P206D1 P206D1	Z(ZM)-UCP206-103D1	C(CM)-UCP206-103D1							
		_			0.0			4.7	
P207D1 P207D1	Z(ZM)-UCP207D1 Z(ZM)-UCP207-104D1	C(CM)-UCP207D1 C(CM)-UCP207-104D1	3	60	99	80	1.6	1.7	2.0
P207D1	Z(ZM)-UCP207-105D1	C(CM)-UCP207-105D1	1/8	2 3/8	3 29/32	3 5/32	3.5	3.7	4.4
P207D1 P207D1	Z(ZM)-UCP207-106D1	C(CM)-UCP207-106D1							
	7/714) 110000004	0(014) 110000004	2	/ 0	105	00	1.0	0.1	0.7
P208D1 P208D1	Z(ZM)-UCP208D1 Z(ZM)-UCP208-108D1	C(CM)-UCP208D1 C(CM)-UCP208-108D1	3	69	105	90	1.9	2.1	2.7
P208D1	Z(ZM)-UCP208-109D1	C(CM)-UCP208-109D1	1/8	2 23/32	4 1/8	3 17/32	4.2	4.6	6.0

B 286 B 287

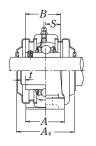
Pillow blocks units cast housing Set screw type

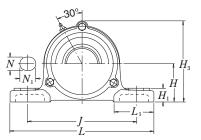


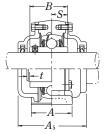




Pressed steel dust cover type
Open end Z-UCP...D1
Closed end ZM-UCP...D1







Cast dust cover type
Open end C-UCP...D1
Closed end CM-UCP...D1

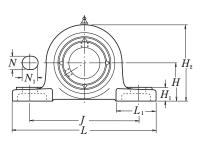
Shaft dia.	Unit number(1)					Nomin	al dime	ensions					Bolt size	Bearing number
						n	nm inc	h						
mm inch		Н	L	J	A	N	N_{1}	H_1	H_2	L_1	В	S	mm inch	
45	UCP209D1	54	190	146	54	17	20	20	106	60	49.2	19	M14	UC209D1
1 ⁵ /8 1 ¹¹ / ₁₆ 1 ³ / ₄	UCP209-110D1 UCP209-111D1 UCP209-112D1	21/8	7 15/32	53/4	21/8	21/32	25/32	25/32	43/16	2 3/8	1.9370	0.748	1/2	UC209-110D1 UC209-111D1 UC209-112D1
50	UCP210D1	57.2	206	159	60	20	23	21	114	65	51.6	19	M16	UC210D1
17/8	UCP210-113D1 UCP210-114D1 UCP210-115D1 UCP210-200D1	21/4	81/8	61/4	2 ³ /8	25/32	29/32	13/16	41/2	2 ⁹ /16	2.0315	0.748	5/8	UC210-113D1 UC210-114D1 UC210-115D1 UC210-200D1
55	UCP211D1	63.5	219	171	60	20	23	23	126	65	55.6	22.2	M16	UC211D1
2 21/16 21/8 23/16	UCP211-200D1 UCP211-201D1 UCP211-202D1 UCP211-203D1	2 ¹ /2	8 5/8	6 ²³ /32	2 ³ /8	25/32	29/32	29/32	4 ³¹ / ₃₂	2 9/16	2.1890	0.874	5/8	UC211-200D1 UC211-201D1 UC211-202D1 UC211-203D1
60	UCP212D1	69.8	241	184	70	20	23	25	138	70	65.1	25.4	M16	UC212D1
21/4 25/16 23/8 27/16	UCP212-204D1 UCP212-205D1 UCP212-206D1 UCP212-207D1	23/4	9 1/2	7 1/4	23/4	25/32	29/32	31/32	5 ⁷ /16	23/4	2.5630	1.000	5/8	UC212-204D1 UC212-205D1 UC212-206D1 UC212-207D1
65	UCP213D1	76.2	265	203	70	25	28	27	151	77	65.1	25.4	M20	UC213D1
2 ¹ / ₂ 2 ⁹ / ₁₆	UCP213-208D1 UCP213-209D1	3	10 ⁷ /16	8	2 ³ /4	31/32	13/32	1 ¹ /16	5 ¹⁵ / ₁₆	31/32	2.5630	1.000	3/4	UC213-208D1 UC213-209D1
70	UCP214D1	79.4	266	210	72	25	28	27	157	77	74.6	30.2	M20	UC214D1
2 ⁵ /8 2 ¹¹ / ₁₆ 2 ³ / ₄	UCP214-210D1 UCP214-211D1 UCP214-212D1	31/8	1015/32	89/32	2 27/32	31/32	13/32	11/16	6 3/16	31/32	2.9370	1.189	3/4	UC214-210D1 UC214-211D1 UC214-212D1

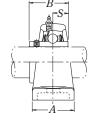
Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".

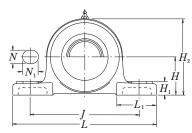
Housing number	Unit number (1) pressed steel dust cover type	Unit number (1) cast dust cover type		Nominal di	imensions	5	N	lass of un	it
			,	mm 4		4		kg lb	
			t max.	A_4	H_3	A_5	UCP	Z(ZM)	C(CM)
P209D1 P209D1	Z(ZM)-UCP209D1 Z(ZM)-UCP209-110D1	C(CM)-UCP209D1 C(CM)-UCP209-110D1	3	69	113	95	2.2	2.4	3.1
P209D1 P209D1	Z(ZM)-UCP209-110D1 Z(ZM)-UCP209-111D1	C(CM)-UCP209-111D1	1/8	2 23/32	4 7/16	33/4	4.9	5.3	6.8
P209D1	Z(ZM)-UCP209-112D1	C(CM)-UCP209-112D1							
P210D1	Z(ZM)-UCP210D1	C(CM)-UCP210D1	3	76	119	100	2.7	2.8	3.6
P210D1 P210D1	Z(ZM)-UCP210-113D1 Z(ZM)-UCP210-114D1	C(CM)-UCP210-113D1 C(CM)-UCP210-114D1	1/8	3	411/16	315/16	6.0	6.2	7.9
P210D1	Z(ZM)-UCP210-115D1	C(CM)-UCP210-115D1							
P210D1	_	C(CM)-UCP210-200D1							
P211D1	Z(ZM)-UCP211D1	C(CM)-UCP211D1	4	77	130	100	3.5	3.5	4.4
P211D1 P211D1	Z(ZM)-UCP211-200D1 Z(ZM)-UCP211-201D1	C(CM)-UCP211-200D1 C(CM)-UCP211-201D1	E /	01/	E1/-	315/16		7.7	0.7
P211D1	Z(ZM)-UCP211-202D1	C(CM)-UCP211-202D1	5/32	3 1/32	5 ¹ / ₈	315/16	7.7	7.7	9.7
P211D1	Z(ZM)-UCP211-203D1	C(CM)-UCP211-203D1							
P212D1	Z(ZM)-UCP212D1	C(CM)-UCP212D1	4	89	143	115	4.7	5.0	6.0
P212D1 P212D1	Z(ZM)-UCP212-204D1 Z(ZM)-UCP212-205D1	C(CM)-UCP212-204D1 C(CM)-UCP212-205D1	5/32	31/2	5 5/8	4 17/32	10	11	13
P212D1	Z(ZM)-UCP212-206D1	C(CM)-UCP212-206D1	3/32	31/2	29/8	417/32	10		13
P212D1	_	C(CM)-UCP212-207D1							
P213D1	Z(ZM)-UCP213D1	C(CM)-UCP213D1	4	91	155	120	5.6	5.8	7.2
P213D1 P213D1	Z(ZM)-UCP213-208D1 Z(ZM)-UCP213-209D1	C(CM)-UCP213-208D1 C(CM)-UCP213-209D1	5/32	319/32	6 ³ / ₃₂	423/32	12	13	16
P214D1		C(CM)-UCP214D1	4		162	135	6.5		8.3
P214D1 P214D1	_	C(CM)-UCP214-210D1	4	_	102	133	0.5	_	0.3
P214D1	_	C(CM)-UCP214-211D1	5/32	_	63/8	5 5/16	14	_	18
P214D1		C(CM)-UCP214-212D1							



Pillow blocks units cast housing Set screw type



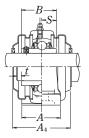


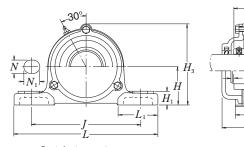


Pressed steel dust cover type
Open end Z-UCP...D1
Closed end ZM-UCP...D1

Shaft dia.	Unit number(1)					Nomin	al dime	nsions					Bolt size	Bearing number
mm						n	nm inc	h					mm	
inch		Н	L	J	A	N	N_1	H_1	H_2	L_1	В	S	inch	
75 2 ¹³ / ₁₆	UCP215D1 UCP215-213D1	82.6	275	217	74	25	28	28	163	80	77.8	33.3	M20	UC215D1 UC215-213D1
27/8	UCP215-214D1 UCP215-215D1 UCP215-300D1	31/4	10 ¹³ /16	817/32	2 29/32	31/32	13/32	13/32	613/32	3 5/32	3.0630	1.311	3/4	UC215-214D1 UC215-215D1 UC215-300D1
80	UCP216D1	88.9	292	232	78	25	28	30	175	85	82.6	33.3	M20	UC216D1
3 ¹ / ₁₆ 3 ¹ / ₈ 3 ³ / ₁₆	UCP216-301D1 UCP216-302D1 UCP216-303D1	31/2	11 ¹ /2	9 1/8	3 ¹ /16	31/32	1 ³ /32	1 ³ /16	6 ⁷ /8	3 ¹¹ / ₃₂	3.2520	1.311	3/4	UC216-301D1 UC216-302D1 UC216-303D1
85	UCP217D1	95.2	310	247	83	25	28	32	187	85	85.7	34.1	M20	UC217D1
	UCP217-304D1 UCP217-305D1 UCP217-307D1	33/4	12 ⁷ /32	923/32	3 9/32	31/32	1 ³ /32	11/4	7 3/8	311/32	3.3740	1.343	3/4	UC217-304D1 UC217-305D1 UC217-307D1
90 3 ¹ / ₂	UCP218D1 UCP218-308D1	101.6 4	327 12 ⁷ /8	262 10 ⁵ /16	88 3 ¹⁵ / ₃₂	27 1 ¹ /16	30 1 ³ / ₁₆	33 1 ⁵ / ₁₆	200 7 ⁷ /8	90 3 ¹⁷ / ₃₂	96 3.7795	39.7 1.563	M22 7/8	UC218D1 UC218-308D1

Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".



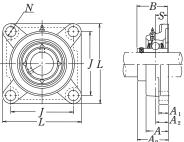


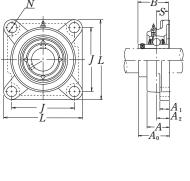
Cast dust cover type
Open end C-UCP...D1
Closed end CM-UCP...D1

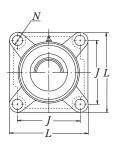
Housing number	Unit number (1) pressed steel dust cover type	Unit number (1) cast dust cover type	١	Nominal d	limensions	i	Ν	lass of un	it
	cover type		t		inch	4		kg lb	
			max.	A_4	H_3	A_5	UCP	Z(ZM)	C(CM)
P215D1	_	C(CM)-UCP215D1	4	_	168	135	7.2	_	9.3
P215D1 P215D1 P215D1 P215D1	_	C(CM)-UCP215-213D1 C(CM)-UCP215-214D1 C(CM)-UCP215-215D1 C(CM)-UCP215-300D1	5/32	_	6 5/8	5 5/16	16	_	21
P216D1	_	C(CM)-UCP216D1	4	_	181	145	8.7	_	11
P216D1 P216D1 P216D1	_	C(CM)-UCP216-301D1 C(CM)-UCP216-302D1 C(CM)-UCP216-303D1	5/32	_	7 ¹ /8	5 ²³ / ₃₂	19	_	24
P217D1	_	C(CM)-UCP217D1	5	_	191	155	11	_	13
P217D1 P217D1 P217D1	_	C(CM)-UCP217-304D1 C(CM)-UCP217-305D1 C(CM)-UCP217-307D1	13/64	_	7 17/32	6 ³ /32	24	_	29
P218D1 P218D1		C(CM)-UCP218D1 C(CM)-UCP218-308D1	5 13/64	_	204 8 ¹ / ₃₂	165 6 ¹ / ₂	13 29		16 35

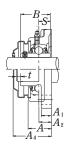
B 290 B 291

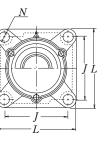
Square flanged units cast housing Set screw type

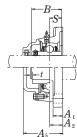












Pressed steel dust cover type
Open end Z-UCF...D1
Closed end ZM-UCF...D1

Cast dust cover type
Open end C-UCF...D1
Closed end CM-UCF...D1

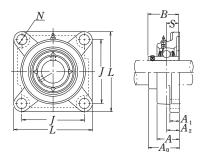
Shaft dia.	Unit number(1)				No	minal dim	ensions				Bolt size	Bearing number		Housing number
mm inch		L	J	A_2	A_1	mm in A	ich N	A_0	В	S	mm			
12 1/2	UCF201D1 UCF201-008D1	86 3 ³ /8	64 2 ³³ / ₆₄	15 19/32	11 7/16	25.5 1	12 15/32	33.3 1 ⁵ / ₁₆	31 1.2205	12.7 0.500	M10 3/8	UC201D1 UC201-008D1	•	F204D1 F204D1
15 9/16 5/8	UCF202D1 UCF202-009D1 UCF202-010D1	86 3 ³ /8	64 2 ³³ / ₆₄	15 19/ ₃₂	11 7/16	25.5 1	12 15/32	33.3 1 ⁵ / ₁₆	31 1.2205	12.7 0.500	M10 3/8	UC202D1 UC202-009D1 UC202-010D1		F204D1 F204D1 F204D1
17 11/ ₁₆	UCF203D1 UCF203-011D1	86 3 ³ /8	64 2 ³³ / ₆₄	15 19/ ₃₂	11 7/16	25.5 1	12 15/ ₃₂	33.3 1 ⁵ / ₁₆	31 1.2205	12.7 0.500	M10 3/8	UC203D1 UC203-011D1		F204D1 F204D1
20 3/4	UCF204D1 UCF204-012D1	86 3 ³ /8	64 2 ³³ / ₆₄	15 19/32	11 7/ ₁₆	25.5 1	12 15/32	33.3 1 ⁵ / ₁₆	31 1.2205	12.7 0.500	M10 3/8	UC204D1 UC204-012D1		F204D1 F204D1
7/8	UCF205D1 UCF205-013D1 UCF205-014D1 UCF205-015D1 UCF205-100D1	95 3 ³ / ₄	70 2 ³ / ₄	16 5/8	13	27 1 ¹ / ₁₆	12 15/ ₃₂	35.8 1 ¹³ / ₃₂	34.1 1.3425	14.3 0.563	M10	UC205D1 UC205-013D1 UC205-014D1 UC205-015D1 UC205-100D1		F205D1 F205D1 F205D1 F205D1 F205D1
30 11/16 11/8 13/16 11/4	UCF206D1 UCF206-101D1 UCF206-102D1 UCF206-103D1 UCF206-104D1	108 4 ¹ / ₄	83 3 ¹⁷ / ₆₄	18 ⁴⁵ / ₆₄	13	31 1 ⁷ / ₃₂	12 15/ ₃₂	40.2 1 ³⁷ / ₆₄	38.1 1.5000	15.9 0.626	M10	UC206D1 UC206-101D1 UC206-102D1 UC206-103D1 UC206-104D1		F206D1 F206D1 F206D1 F206D1 F206D1
13/8	UCF207D1 UCF207-104D1 UCF207-105D1 UCF207-106D1 UCF207-107D1	117 4 ¹⁹ / ₃₂	92 3 ⁵ /8	19 3/4	15 19/ ₃₂	34 1 ¹¹ / ₃₂	14 35/64	44.4 1 ³ / ₄	42.9 1.6890	17.5 0.689	M12	UC207D1 UC207-104D1 UC207-105D1 UC207-106D1 UC207-107D1		F207D1 F207D1 F207D1 F207D1 F207D1
40 1 ¹ / ₂ 1 ⁹ / ₁₆	UCF208D1 UCF208-108D1 UCF208-109D1	130 5 ¹ /8	102 4 ¹ / ₆₄	21 53/64	15 19/ ₃₂	36 1 ¹³ / ₃₂	16 5/8	51.2 2 ¹ / ₆₄	49.2 1.9370	19 0.748	M14	UC208D1 UC208-108D1 UC208-109D1		F208D1 F208D1 F208D1

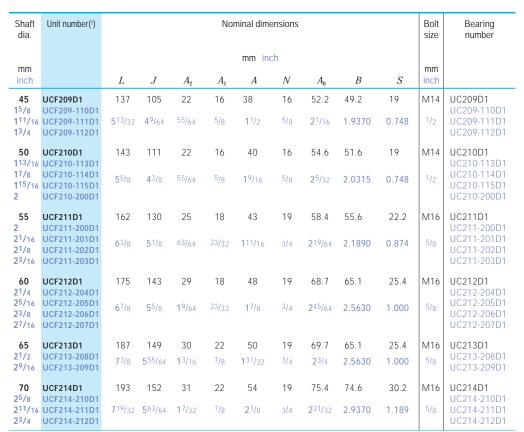
Mata	/ ₁ \	These numbers indicate reliablished by the office of the first time is needed along order without suffice "D1"
wote	(1)	These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".

Housing number	Unit number (1) pressed steel dust cover type	Unit number (¹) cast dust cover type	Nom	inal dimen	sions	N	lass of un	it
	cover type		t	mm inch			kg lb	
			max.	A_4	A_5	UCP	Z(ZM)	C(CM)
F204D1 F204D1	Z(ZM)-UCF201D1 Z(ZM)-UCF201-008D1	C(CM)-UCF201D1 C(CM)-UCF201-008D1	2 5/64	38 1 ¹ / ₂	46 1 ¹³ / ₁₆	0.6 1.3	0.6 1.3	0.8 1.8
F204D1 F204D1 F204D1	Z(ZM)-UCF202D1 Z(ZM)-UCF202-009D1 Z(ZM)-UCF202-010D1	C(CM)-UCF202D1 C(CM)-UCF202-009D1 C(CM)-UCF202-010D1	2 5/64	38 1 ¹ / ₂	46 1 ¹³ / ₁₆	0.6 1.3	0.6	0.8
F204D1 F204D1	Z(ZM)-UCF203D1 Z(ZM)-UCF203-011D1	C(CM)-UCF203D1 C(CM)-UCF203-011D1	2 5/64	38 1 ¹ / ₂	46 1 ¹³ / ₁₆	0.6 1.3	0.6 1.3	0.8 1.8
F204D1 F204D1	Z(ZM)-UCF204D1 Z(ZM)-UCF204-012D1	C(CM)-UCF204D1 C(CM)-UCF204-012D1	2 5/64	38 1 ¹ / ₂	46 1 ¹³ / ₁₆	0.6 1.3	0.6 1.3	0.7 1.5
F205D1 F205D1	Z(ZM)-UCF205D1 Z(ZM)-UCF205-013D1	C(CM)-UCF205D1 C(CM)-UCF205-013D1	2	40	51	0.8	0.8	0.9
F205D1 F205D1 F205D1	Z(ZM)-UCF205-014D1 Z(ZM)-UCF205-015D1 Z(ZM)-UCF205-100D1	C(CM)-UCF205-014D1 C(CM)-UCF205-015D1 C(CM)-UCF205-100D1	5/64	1 ¹⁹ /32	2	1.8	1.8	2.0
F206D1 F206D1	Z(ZM)-UCF206D1 Z(ZM)-UCF206-101D1	C(CM)-UCF206D1 C(CM)-UCF206-101D1	2	45	56	1.1	1.1	1.3
F206D1 F206D1 F206D1	Z(ZM)-UCF206-102D1 Z(ZM)-UCF206-103D1 —	C(CM)-UCF206-102D1 C(CM)-UCF206-103D1 C(CM)-UCF206-104D1	5/64	13/4	2 ⁷ /32	2.4	2.4	2.9
F207D1 F207D1	Z(ZM)-UCF207D1 Z(ZM)-UCF207-104D1	C(CM)-UCF207D1 C(CM)-UCF207-104D1	3	49	59	1.5	1.5	1.8
F207D1 F207D1 F207D1	Z(ZM)-UCF207-105D1 Z(ZM)-UCF207-106D1	C(CM)-UCF207-105D1 C(CM)-UCF207-106D1 C(CM)-UCF207-107D1	1/8	1 ¹⁵ /16	2 ⁵ /16	3.3	3.3	4.0
F208D1	Z(ZM)-UCF208D1	C(CM)-UCF208D1	3	56	66	1.7	1.8	2.2
F208D1 F208D1	Z(ZM)-UCF208-108D1 Z(ZM)-UCF208-109D1	C(CM)-UCF208-108D1 C(CM)-UCF208-109D1	1/8	2 3/16	2 ¹⁹ /32	3.7	4.0	4.9

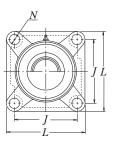
B 292 B 293

Square flanged units cast housing Set screw type

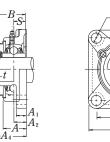




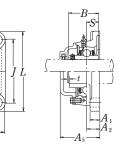
Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".





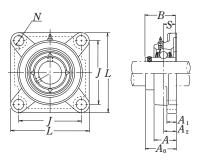


Cast dust cover type
Open end C-UCF...D1
Closed end CM-UCF...D1



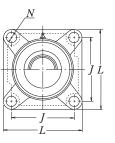
Housing number	Unit number (¹) pressed steel dust cover type	Unit number (1) cast dust cover type	Nomi	nal dimen	sions	N	lass of uni	t
				mm inch			kg lb	
			t max.	A_4	A_5	UCF	Z(ZM)	C(CM)
F209D1	Z(ZM)-UCF209D1	C(CM)-UCF209D1	3	57	70	2.1	2.2	2.6
F209D1 F209D1 F209D1	Z(ZM)-UCF209-110D1 Z(ZM)-UCF209-111D1 Z(ZM)-UCF209-112D1	C(CM)-UCF209-110D1 C(CM)-UCF209-111D1 C(CM)-UCF209-112D1	1/8	21/4	23/4	4.6	4.9	5.7
F210D1 F210D1	Z(ZM)-UCF210D1 Z(ZM)-UCF210-113D1	C(CM)-UCF210D1 C(CM)-UCF210-113D1	3	60	72	2.5	2.5	3.0
F210D1 F210D1 F210D1 F210D1	Z(ZM)-UCF210-113D1 Z(ZM)-UCF210-115D1 —	C(CM)-UCF210-113D1 C(CM)-UCF210-114D1 C(CM)-UCF210-115D1 C(CM)-UCF210-200D1	1/8	2 ³ /8	2 ²⁷ / ₃₂	5.5	5.5	6.6
F211D1	Z(ZM)-UCF211D1	C(CM)-UCF211D1	4	64	75	3.3	3.4	4.0
F211D1 F211D1 F211D1 F211D1	Z(ZM)-UCF211-200D1 Z(ZM)-UCF211-201D1 Z(ZM)-UCF211-202D1 Z(ZM)-UCF211-203D1	C(CM)-UCF211-200D1 C(CM)-UCF211-201D1 C(CM)-UCF211-202D1 C(CM)-UCF211-203D1	5/32	2 1/2	215/16	7.3	7.5	8.8
F212D1	Z(ZM)-UCF212D1	C(CM)-UCF212D1	4	74	86	3.9	4.1	4.8
F212D1 F212D1 F212D1 F212D1	Z(ZM)-UCF212-204D1 Z(ZM)-UCF212-205D1 Z(ZM)-UCF212-206D1 —	C(CM)-UCF212-204D1 C(CM)-UCF212-205D1 C(CM)-UCF212-206D1 C(CM)-UCF212-207D1	5/32	2 ²⁹ /32	33/8	8.6	9.0	11
F213D1	Z(ZM)-UCF213D1	C(CM)-UCF213D1	4	76	90	5.5	5.6	6.4
F213D1 F213D1	Z(ZM)-UCF213-208D1 Z(ZM)-UCF213-209D1	C(CM)-UCF213-208D1 C(CM)-UCF213-209D1	5/32	3	317/32	12	12	14
F214D1 F214D1	_	C(CM)-UCF214D1 C(CM)-UCF214-210D1	4	_	98	6.3	_	7.4
F214D1 F214D1 F214D1	_	C(CM)-UCF214-211D1 C(CM)-UCF214-212D1	5/32	_	3 27/32	14	_	16

Square flanged units cast housing Set screw type

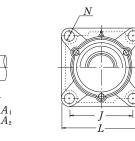


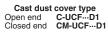
Shaft dia.	Unit number(1)				Noi	minal dime	ensions				Bolt size	Bearing number
						mm inc	ch					
inch		L	J	A_2	A_1	A	N	A_0	В	S	mm inch	
75 2 ¹³ / ₁₆	UCF215D1 UCF215-213D1	200	159	34	22	56	19	78.5	77.8	33.3	M16	UC215D1 UC215-213D1
27/8	UCF215-213D1 UCF215-214D1 UCF215-215D1 UCF215-300D1	7 ⁷ /8	6 ¹⁷ /64	1 ¹¹ /32	7/8	2 ⁷ /32	3/4	3 3/32	3.0630	1.311	5/8	UC215-213D1 UC215-214D1 UC215-215D1 UC215-300D1
80 31/16	UCF216D1 UCF216-301D1	208	165	34	22	58	23	83.3	82.6	33.3	M20	UC216D1 UC216-301D1
3 ¹ / ₈ 3 ³ / ₁₆	UCF216-302D1 UCF216-303D1	83/16	61/2	1 ¹¹ / ₃₂	7/8	2 9/32	29/32	3 9/32	3.2520	1.311	3/4	UC216-303D1 UC216-303D1
85	UCF217D1	220	175	36	24	63	23	87.6	85.7	34.1	M20	UC217D1
3 ¹ / ₄ 3 ⁵ / ₁₆ 3 ⁷ / ₁₆	UCF217-304D1 UCF217-305D1 UCF217-307D1	821/32	6 ⁵⁷ /64	127/64	15/16	2 ¹⁵ / ₃₂	29/32	329/64	3.3740	1.343	3/4	UC217-304D1 UC217-305D1 UC217-307D1
90 3 ¹ / ₂	UCF218D1 UCF218-308D1	235 9 ¹ / ₄	187 7 ²³ / ₆₄	40 1 ³⁷ /64	24 15/ ₁₆	68 2 ¹¹ / ₁₆	23 29/32	96.3 3 ⁵¹ / ₆₄	96 3.7795	39.7 1.563	M20 3/4	UC218D1 UC218-308D1

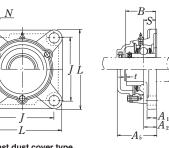
Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".







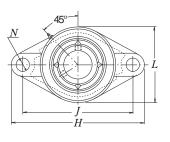


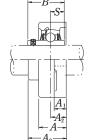


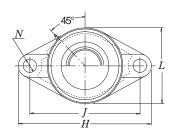
Housing number	Unit number (1) pressed steel dust cover type	Unit number (¹) cast dust cover type	Nomir	nal dimer	nsions	N	lass of uni	t
	cover type		r t	nm inch $A_{\scriptscriptstyle 4}$	A_5		kg lb	
			max.	214	2 15	UCF	Z(ZM)	C(CM)
F215D1	_	C(CM)-UCF215D1	4	_	102	6.6	_	7.9
F215D1 F215D1 F215D1 F215D1	_	C(CM)-UCF215-213D1 C(CM)-UCF215-214D1 C(CM)-UCF215-215D1 C(CM)-UCF215-300D1	5/32	_	4 1/32	15	_	17
F216D1	_	C(CM)-UCF216D1	4	_	106	7.9	_	9.3
F216D1 F216D1 F216D1	_	C(CM)-UCF216-301D1 C(CM)-UCF216-302D1 C(CM)-UCF216-303D1	5/32	_	4 ³ /16	17	_	21
F217D1	_	C(CM)-UCF217D1	5	_	114	9.8	_	12
F217D1 F217D1 F217D1	_	C(CM)-UCF217-304D1 C(CM)-UCF217-305D1 C(CM)-UCF217-307D1	13/64	_	4 1/2	22	_	26
F218D1 F218D1	<u>-</u> -	C(CM)-UCF218D1 C(CM)-UCF218-308D1	5 13/64	<u>-</u>	122 4 ¹³ / ₁₆	12 26	_ _	13 29

B 296 B 297

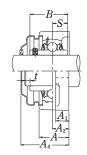
Rhombus flanged units cast housing Set screw type

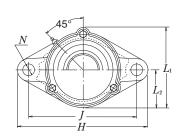


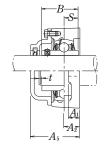




Pressed steel dust cover type
Open end Z-UCFL...D1
Closed end ZM-UCFL...D1







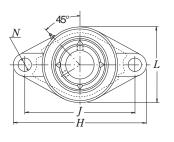
Cast dust cover type
Open end C-UCFL...D1
Closed end CM-UCFL...D1

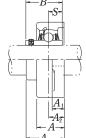
Shaft dia.	Unit number(1)	Nominal dimensions											Bearing number
mm inch		Н	J	A_2	A_1	mm	inch N	L	A_0	В	S	mm inch	
12 1/2	UCFL201D1 UCFL201-008D1	113 4 ⁷ / ₁₆	90 3 ³⁵ /64	15 19/32	11 7/16	25.5 1	12 15/32	60 2 ³ /8	33.3 1 ⁵ / ₁₆	31 1.2205	12.7 0.500	M10 3/8	UC201D1 UC201-008D1
15 9/16 5/8	UCFL202D1 UCFL202-009D1 UCFL202-010D1	113 4 ⁷ / ₁₆	90 3 ³⁵ / ₆₄	15 19/ ₃₂	11 7/ ₁₆	25.5 1	12 15/32	60 2 ³ /8	33.3 15/16	31 1.2205	12.7 0.500	M10 3/8	UC202D1 UC202-009D1 UC202-010D1
17 11/ ₁₆	UCFL203D1 UCFL203-011D1	113 4 ⁷ / ₁₆	90 3 ³⁵ / ₆₄	15 19/32	11 7/16	25.5 1	12 15/ ₃₂	60 2 ³ /8	33.3 1 ⁵ / ₁₆	31 1.2205	12.7 0.500	M10 3/8	UC203D1 UC203-011D1
20 3/4	UCFL204D1 UCFL204-012D1	113 4 ⁷ / ₁₆	90 3 ³⁵ / ₆₄	15 19/32	11 7/16	25.5 1	12 15/32	60 2 ³ /8	33.3 15/16	31 1.2205	12.7 0.500	M10 3/8	UC204D1 UC204-012D1
25 13/16 7/8 15/16	UCFL205D1 UCFL205-013D1 UCFL205-014D1 UCFL205-015D1 UCFL205-100D1	130 5 ¹ / ₈	99 3 ⁵⁷ / ₆₄	16 5/8	13	27 1 ¹ / ₁₆	16 5/8	68 2 ¹¹ / ₁₆	35.8 1 ¹³ / ₃₂	34.1 1.3425	14.3 0.563	M14	UC205D1 UC205-013D1 UC205-014D1 UC205-015D1 UC205-100D1
30 1 ¹ / ₁₆ 1 ¹ / ₈ 1 ³ / ₁₆ 1 ¹ / ₄	UCFL206D1 UCFL206-101D1 UCFL206-102D1 UCFL206-103D1 UCFL206-104D1	148 5 ¹³ / ₁₆	117 4 ³⁹ /64	18 45/64	13	31 1 ⁷ / ₃₂	16 5/8	80 3 ⁵ / ₃₂	40.2 1 ³⁷ /64	38.1 1.5000	15.9 0.626	M14	UC206D1 UC206-101D1 UC206-102D1 UC206-103D1 UC206-104D1
35 1 ¹ / ₄ 1 ⁵ / ₁₆ 1 ³ / ₈ 1 ⁷ / ₁₆	UCFL207D1 UCFL207-104D1 UCFL207-105D1 UCFL207-106D1 UCFL207-107D1	161 6 ¹¹ / ₃₂	130 5 ¹ /8	19 3/ ₄	15 19/32	34 1 ¹¹ / ₃₂	16 5/8	90 3 ¹⁷ / ₃₂	44.4 1 ³ / ₄	42.9 1.6890	17.5 0.689	M14	UC207D1 UC207-104D1 UC207-105D1 UC207-106D1 UC207-107D1
40 1 ¹ / ₂ 1 ⁹ / ₁₆	UCFL208D1 UCFL208-108D1 UCFL208-109D1	175 6 ⁷ /8	144 5 ⁴³ / ₆₄	21 53/64	15 19/32	36 1 ¹³ / ₃₂	16 5/8	100 3 ¹⁵ / ₁₆	51.2 2 ¹ / ₆₄	49. <u>2</u> 1.9370	19 0.748	M14	UC208D1 UC208-108D1 UC208-109D1

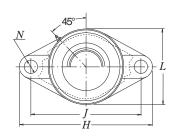
Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".

Housing number	Unit number (1) pressed steel dust cover type	Unit number (1) cast dust cover type		Nomir	nal dimer	nsions		Mass of unit			
	cover type				nm inch				kg lb		
			t max.	A_4	A_5	L_1	L_2	UCFL	Z(ZM)	C(CM)	
FL204D1 FL204D1	Z(ZM)-UCFL201D1 Z(ZM)-UCFL201-008D1	C(CM)-UCFL201D1 C(CM)-UCFL201-008D1	2 5/64	38 1 ¹ / ₂	46 1 ¹³ / ₁₆	67 2 ⁵ /8	30 1 ³ / ₁₆	0.5 1.1	0.5 1.1	0.6 1.3	
FL204D1 FL204D1 FL204D1	Z(ZM)-UCFL202D1 Z(ZM)-UCFL202-009D1 Z(ZM)-UCFL202-010D1	C(CM)-UCFL202D1 C(CM)-UCFL202-009D1 C(CM)-UCFL202-010D1	2 5/64	38 11/2	46 1 ¹³ / ₁₆	67 2 5/8	30 13/16	0.5 1.1	0.5 1.1	0.6	
FL204D1 FL204D1	Z(ZM)-UCFL203D1 Z(ZM)-UCFL203-011D1	C(CM)-UCFL203D1 C(CM)-UCFL203-011D1	2 5/64	38 1 ¹ / ₂	46 1 ¹³ / ₁₆	67 2 ⁵ /8	30 1 ³ / ₁₆	0.5 1.1	0.5 1.1	0.6 1.3	
FL204D1 FL204D1	Z(ZM)-UCFL204D1 Z(ZM)-UCFL204-012D1	C(CM)-UCFL204D1 C(CM)-UCFL204-012D1	2 5/64	38 11/2	46 1 ¹³ / ₁₆	67 2 5/8	30 1 ³ / ₁₆	0.4 0.9	0.4	0.6 1.3	
FL205D1 FL205D1	Z(ZM)-UCFL205D1 Z(ZM)-UCFL205-013D1	C(CM)-UCFL205D1 C(CM)-UCFL205-013D1	2	40	51	74	34	0.6	0.6	0.8	
FL205D1 FL205D1 FL205D1	Z(ZM)-UCFL205-014D1 Z(ZM)-UCFL205-015D1 Z(ZM)-UCFL205-100D1	C(CM)-UCFL205-014D1 C(CM)-UCFL205-015D1 C(CM)-UCFL205-100D1	5/64	1 ¹⁹ /32	2	2 ²⁹ /32	111/32	1.3	1.3	1.8	
FL206D1 FL206D1	Z(ZM)-UCFL206D1	C(CM)-UCFL206D1	2	45	56	85	40	0.9	0.9	1.2	
FL206D1 FL206D1 FL206D1 FL206D1	Z(ZM)-UCFL206-101D1 Z(ZM)-UCFL206-102D1 Z(ZM)-UCFL206-103D1	C(CM)-UCFL206-101D1 C(CM)-UCFL206-102D1 C(CM)-UCFL206-103D1	5/64	13/4	2 ⁷ /32	311/32	1 9/16	2.0	2.0	2.6	
FL207D1	Z(ZM)-UCFL207D1	C(CM)-UCFL207D1	3	49	59	97	45	1.2	1.2	1.4	
FL207D1 FL207D1 FL207D1 FL207D1	Z(ZM)-UCFL207-104D1 Z(ZM)-UCFL207-105D1 Z(ZM)-UCFL207-106D1	C(CM)-UCFL207-104D1 C(CM)-UCFL207-105D1 C(CM)-UCFL207-106D1	1/8	1 ¹⁵ /16	2 ⁵ /16	3 ¹³ / ₁₆	1 ²⁵ /32	2.6	2.6	3.1	
FL208D1	Z(ZM)-UCFL208D1	C(CM)-UCFL208D1	3	56	66	106	50	1.5	1.5	1.9	
FL208D1 FL208D1	Z(ZM)-UCFL208-108D1 Z(ZM)-UCFL208-109D1	C(CM)-UCFL208-108D1 C(CM)-UCFL208-109D1	1/8	2 ³ /16	2 ¹⁹ /32	43/16	131/32	3.3	3.3	4.2	

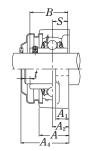
Rhombus flanged units cast housing Set screw type

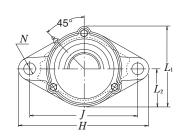


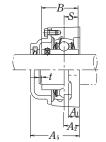




Pressed steel dust cover type
Open end Z-UCFL...D1
Closed end ZM-UCFL...D1







Cast dust cover type
Open end C-UCFL...D1
Closed end CM-UCFL...D1

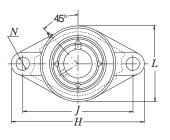
Shaft dia.	Unit number(1)				N	ominal d	limensi	ons				Bolt size	Bearing number
						mm	inch						
mm inch		Н	J	A_2	A_1	A	N	L	A_0	В	S	mm inch	
45	UCFL209D1	188	148	22	16	38	19	108	52.2	49.2	19	M16	UC209D1
1 ⁵ /8 1 ¹¹ / ₁₆ 1 ³ / ₄	UCFL209-110D1 UCFL209-111D1 UCFL209-112D1	7 13/32	5 ⁵³ /64	55/64	5/8	1 ¹ / ₂	3/4	41/4	2 ¹ /16	1.9370	0.748	5/8	UC209-110D1 UC209-111D1 UC209-112D1
50 113/16	UCFL210D1 UCFL210-113D1	197	157	22	16	40	19	115	54.6	51.6	19	M16	UC210D1 UC210-113D1
17/8	UCFL210-113D1 UCFL210-114D1 UCFL210-115D1 UCFL210-200D1	7 3/4	6 ³ /16	55/64	5/8	1 9/16	3/4	417/32	2 5/32	2.0315	0.748	5/8	UC210-113D1 UC210-114D1 UC210-115D1 UC210-200D1
55	UCFL211D1	224	184	25	18	43	19	130	58.4	55.6	22.2	M16	UC211D1
2 2 ¹ / ₁₆ 2 ¹ / ₈ 2 ³ / ₁₆	UCFL211-200D1 UCFL211-201D1 UCFL211-202D1 UCFL211-203D1	813/16	71/4	63/64	23/32	1 11/16	3/4	51/8	2 19/64	2.1890	0.874	5/8	UC211-200D1 UC211-201D1 UC211-202D1 UC211-203D1
60	UCFL212D1	250	202	29	18	48	23	140	68.7	65.1	25.4	M20	UC212D1
2 ¹ / ₄ 2 ⁵ / ₁₆ 2 ³ / ₈ 2 ⁷ / ₁₆	UCFL212-204D1 UCFL212-205D1 UCFL212-206D1 UCFL212-207D1	9 27/32	7 61/64	1 ⁹ /64	23/32	1 7/8	29/32	51/2	2 ⁴⁵ /64	2.5630	1.000	3/4	UC212-204D1 UC212-205D1 UC212-206D1 UC212-207D1
65	UCFL213D1	258	210	30	22	50	23	155	69.7	65.1	25.4	M20	UC213D1
2 ¹ / ₂ 2 ⁹ / ₁₆	UCFL213-208D1 UCFL213-209D1	10 ⁵ /32	817/64	1 ³ /16	7/8	131/32	29/32	6 ³ / ₃₂	2 ³ /4	2.5630	1.000	3/4	UC213-208D1 UC213-209D1
70	UCFL214D1	265	216	31	22	54	23	160	75.4	74.6	30.2	M20	UC214D1
2 ⁵ / ₈ 2 ¹¹ / ₁₆ 2 ³ / ₄	UCFL214-210D1 UCFL214-211D1 UCFL214-212D1	10 ⁷ /16	81/2	17/32	7/8	21/8	29/32	6 ⁵ /16	2 ³¹ / ₃₂	2.9370	1.189	3/4	UC214-210D1 UC214-211D1 UC214-212D1

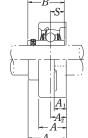
Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".

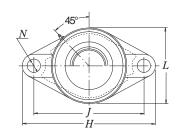
Housing number	Unit number (1) pressed steel dust cover type	Unit number (1) cast dust cover type		Nomin	ıal dimer	nsions		Mass of unit		
	22.2.3/62				nm inch				kg lb	
			t max.	A_4	A_5	L_1	L_2	UCFL	Z(ZM)	C(CM)
FL209D1 FL209D1	Z(ZM)-UCFL209D1 Z(ZM)-UCFL209-110D1	C(CM)-UCFL209D1 C(CM)-UCFL209-110D1	3	57	70	113	54	1.8	1.9	2.3
FL209D1 FL209D1 FL209D1	Z(ZM)-UCFL209-111D1 Z(ZM)-UCFL209-112D1	C(CM)-UCFL209-111D1 C(CM)-UCFL209-112D1	1/8	21/4	23/4	47/16	21/8	4.0	4.2	5.1
FL210D1 FL210D1	Z(ZM)-UCFL210D1 Z(ZM)-UCFL210-113D1	C(CM)-UCFL210D1 C(CM)-UCFL210-113D1	3	60	72	120	58	2.0	2.1	2.7
FL210D1 FL210D1 FL210D1	Z(ZM)-UCFL210-114D1 Z(ZM)-UCFL210-115D1 —	C(CM)-UCFL210-114D1 C(CM)-UCFL210-115D1 C(CM)-UCFL210-200D1	1/8	2 ³ /8	2 ²⁷ / ₃₂	4 ²³ / ₃₂	2 9/32	4.4	4.6	6.0
FL211D1 FL211D1	Z(ZM)-UCFL211D1 Z(ZM)-UCFL211-200D1	C(CM)-UCFL211D1 C(CM)-UCFL211-200D1	4	64	75	133	65	2.9	3.0	3.4
FL211D1 FL211D1 FL211D1	Z(ZM)-UCFL211-201D1 Z(ZM)-UCFL211-202D1 Z(ZM)-UCFL211-203D1	C(CM)-UCFL211-201D1 C(CM)-UCFL211-202D1 C(CM)-UCFL211-203D1	5/32	2 1/2	215/16	51/4	2 9/16	6.4	6.6	7.5
FL212D1 FL212D1	Z(ZM)-UCFL212D1 Z(ZM)-UCFL212-204D1	C(CM)-UCFL212D1 C(CM)-UCFL212-204D1	4	74	86	144	70	3.8	4.0	4.6
FL212D1 FL212D1 FL212D1	Z(ZM)-UCFL212-205D1 Z(ZM)-UCFL212-206D1	C(CM)-UCFL212-205D1 C(CM)-UCFL212-206D1 C(CM)-UCFL212-207D1	5/32	2 ²⁹ /32	33/8	521/32	23/4	8.4	8.9	10
FL213D1	Z(ZM)-UCFL213D1	C(CM)-UCFL213D1	4	76	90	157	78	4.8	4.9	5.8
FL213D1 FL213D1	Z(ZM)-UCFL213-208D1 Z(ZM)-UCFL213-209D1	C(CM)-UCFL213-208D1 C(CM)-UCFL213-209D1	5/32	3	317/32	6 ³ /16	31/16	11	11	15
FL214D1 FL214D1	_	C(CM)-UCFL214D1 C(CM)-UCFL214-210D1	4	_	98	164	80	5.4	_	7.7
FL214D1 FL214D1	_	C(CM)-UCFL214-211D1 C(CM)-UCFL214-212D1	5/32	_	327/32	6 ¹⁵ /32	3 5/32	12	_	17



Rhombus flanged units cast housing Set screw type



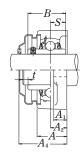


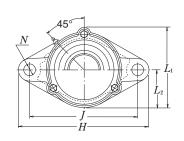


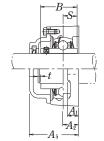
Pressed steel dust cover type
Open end Z-UCFL...D1
Closed end ZM-UCFL...D1

Shaft dia.	Unit number(1)					Bolt size	Bearing number						
m.m.						mm	inch					ma ma	
inch		Н	J	A_2	A_1	A	N	L	A_0	В	S	mm inch	
75	UCFL215D1	275	225	34	22	56	23	165	78.5	77.8	33.3	M20	UC215D1
2 ¹³ / ₁₆ 2 ⁷ / ₈ 2 ¹⁵ / ₁₆ 3	UCFL215-214D1	10 ¹³ / ₁₆	855/64	1 ¹¹ /32	7/8	2 ⁷ / ₃₂	29/32	61/2	3 ³ / ₃₂	3.0630	1.311	3/4	UC215-213D1 UC215-214D1 UC215-215D1 UC215-300D1
80 3 ¹ / ₁₆	UCFL216D1 UCFL216-301D1	290	233	34	22	58	25	180	83.3	82.6	33.3	M22	UC216D1 UC216-301D1
3 ¹ / ₈ 3 ³ / ₁₆	UCFL216-303D1 UCFL216-303D1	11 ¹³ /32	911/64	111/32	7/8	2 9/32	63/64	7 3/32	3 9/32	3.2520	1.311	7/8	UC216-303D1 UC216-303D1
85 3 ¹ / ₄	UCFL217D1	305	248	36	24	63	25	190	87.6	85.7	34.1	M22	UC217D1
3 ⁵ /16 3 ⁷ /16	UCFL217-304D1 UCFL217-305D1 UCFL217-307D1	12	949/64	127/64	15/16	2 ¹⁵ / ₃₂	63/64	7 15/32	3 ²⁹ /64	3.3740	1.343	7/8	UC217-304D1 UC217-305D1 UC217-307D1
90 3 ¹ / ₂	UCFL218D1 UCFL218-308D1	320 12 ¹⁹ /32	265 10 ⁷ /16	40 1 ³⁷ /64	24 15/16	68 2 ¹¹ / ₁₆	25 ⁶³ / ₆₄	205 8 ¹ / ₁₆	96.3 3 ⁵¹ / ₆₄	96 3.7795	39.7 1.563	M22 7/8	UC218D1 UC218-308D1

Note (1) These numbers indicate relubricatable type. If maintenance free type is needed, please order without suffix "D1".







Cast dust cover type
Open end C-UCFL...D1
Closed end CM-UCFL...D1

Housing number	Unit number (1) pressed steel dust	Unit number (¹) cast dust cover type		Nomi	nal dimer	nsions		Mass of unit			
	cover type		t	$A_{\scriptscriptstyle 4}$	mm inch A_5	L_1	L_2		kg lb		
			max.	4	* *5	21		UCFL	Z(ZM)	C(CM)	
FL215D1	_	C(CM)-UCFL215D1	4	_	102	169	82	6.0	_	7.1	
FL215D1 FL215D1 FL215D1 FL215D1	_	C(CM)-UCFL215-213D1 C(CM)-UCFL215-214D1 C(CM)-UCFL215-215D1 C(CM)-UCFL215-300D1	5/32	_	4 ¹ / ₃₂	6 ²¹ /32	3 ⁷ / ₃₂	13	_	16	
FL216D1	_	C(CM)-UCFL216D1	4	_	106	183	90	7.4	_	8.6	
FL216D1 FL216D1 FL216D1	_	C(CM)-UCFL216-301D1 C(CM)-UCFL216-302D1 C(CM)-UCFL216-303D1	5/32	-	4 ³ /16	7 7/32	3 17/32	16	_	19	
FL217D1 FL217D1	_	C(CM)-UCFL217D1 C(CM)-UCFL217-304D1	5	_	114	192	95	8.8	_	10	
FL217D1 FL217D1 FL217D1	_	C(CM)-UCFL217-305D1 C(CM)-UCFL217-307D1	13/64	_	41/2	7 9/16	33/4	19	_	22	
FL218D1 FL218D1		C(CM)-UCFL218D1 C(CM)-UCFL218-308D1	5 13/64	_	122 4 ¹³ / ₁₆	205 8 ¹ / ₁₆	102 4 ¹ / ₃₂	11 24	<u>-</u>	13 29	

PLUMMER BLOCKS

STANDARD TYPE PLUMMER BLOCKS	B306
LARGE PLUMMER BLOCKS	B312
DUSTPROOF PLUMMER BLOCKS	B316
STEPPED-SHAFT TYPE PLUMMER	
BLOCKS	B318

DESIGN, TYPES AND FEATURES

There are numerous types and sizes of plummer blocks. In this catalog, only the types marked by are shown.

SN 5B

SN 6B SN 30B

SN 31B

SN 2B

SN 3B SN 2BC

SN 3BC

SD 30S SD 31S SD 5

SD 6

SD 2

SD 3

SD 2C

SD 3C

 $V \cdot C$



These are the most common type. Models SN30 and SN31 are for medium

For types SN2C and SN3C, the bore diameters on the two sides are different.



Dustproof plummer blocks have a combination of oil seals, labyrinth seals, and oil groove seals, therefore, they are suitable

for environments with much dust and other foreign matter.



SD32TS

SN 5

SN 6

SN 30

SN 31

SN 2

SN 3

SN₂C

SG 5

SD31TS

These are provided with labyrinth seals, so they are suitable for high speed applications.



These have the same dimensions as those of types SN5 and SN6. To increase the bearing box strength, no material is removed from the top or bottom of the base, so mounting holes can be drilled anywhere.



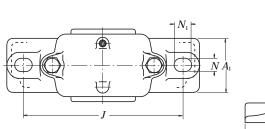
These are large and made for heavy loads. The standard ones have double seals and four mounting bolt holes. For types SD2C and SD3C, the bore diameters on the two sides are different.

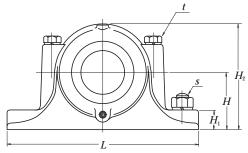


Single-piece plummer blocks (integrated type roller bearing unit)have higher rigidity and precision than split type plummer blocks.

B 304 B 305

SN 5, SN 6 Types Shaft Diameter 20 – 55 mm



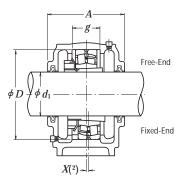


Shaft Diameter (mm)	Plummer Block							Dimens (mr							Mass (kg)
d_1	Bearing Box Numbers (1)	$_{ m H8}^{D}$	<i>H</i> h13	J	N	N_1	\boldsymbol{A}	L	A_1	H_1	H_2	g H13	t nominal	S nominal	approx.
20	SN 505	52	40	130	15	20	67	165	46	22	75	25	M 8	M 12	1.1
	SN 605	62	50	150	15	20	80	185	52	22	90	34	M 8	M 12	1.6
25	SN 506	62	50	150	15	20	77	185	52	22	90	30	M 8	M 12	1.7
	SN 606	72	50	150	15	20	82	185	52	22	95	37	M 10	M 12	1.8
30	SN 507	72	50	150	15	20	82	185	52	22	95	33	M 10	M 12	1.9
	SN 607	80	60	170	15	20	90	205	60	25	110	41	M 10	M 12	2.6
35	SN 508	80	60	170	15	20	85	205	60	25	110	33	M 10	M 12	2.6
	SN 608	90	60	170	15	20	95	205	60	25	115	43	M 10	M 12	2.9
40	SN 509	85	60	170	15	20	85	205	60	25	112	31	M 10	M 12	2.8
	SN 609	100	70	210	18	23	105	255	70	28	130	46	M 12	M 16	4.1
45	SN 510	90	60	170	15	20	90	205	60	25	115	33	M 10	M 12	3.0
	SN 610	110	70	210	18	23	115	255	70	30	135	50	M 12	M 16	4.7
50	SN 511	100	70	210	18	23	95	255	70	28	130	33	M 12	M 16	4.5
	SN 611	120	80	230	18	23	120	275	80	30	150	53	M 12	M 16	5.8
55	SN 512	110	70	210	18	23	105	255	70	30	135	38	M 12	M 16	5.0
	SN 612	130	80	230	18	23	125	280	80	30	155	56	M 12	M 16	6.5



To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+adapter+locating ring".

Remarks Threads for plugs are R 1/8.



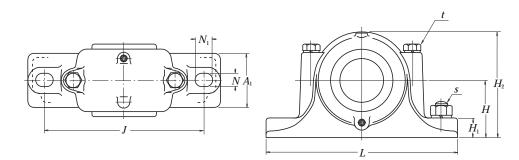


		Ар	plicable Parts				Oil Seals (3)
Self-Aligni Numbers	ng Ball Bearing Basic Dynamic Load Ratings $C_{ m r}$ (N)		r Bearing sic Dynamic Load Ratings $C_{ m r}$ (N)	Adapter Numbers	Locating Rings Nominal (Outside XWidth)	Q'ty	Scuis ()
1205 K 2205 K 1305 K 2305 K	12 200 12 400 18 200 24 900	 22205 CKE4 21305 CDKE4 	37 500 43 000 —	H 205X H 305X H 305X H 2305X	SR 52× 5 SR 52× 7 SR 62× 8.5 SR 62×10	2 1 2 1	GS 5 GS 5
1206 K 2206 K 1306 K 2306 K	15 800 15 300 21 400 32 000	 22206 CKE4 21306 CDKE4 	 50 000 55 000 	H 206X H 306X H 306X H 2306X	SR 62× 7 SR 62×10 SR 72× 9 SR 72×10	2 1 2 1	GS 6 GS 6
1207 K 2207 K 1307 K 2307 K	15 900 21 700 25 300 40 000	22207 CKE4 21307 CDKE4 	 69 000 71 500 	H 207X H 307X H 307X H 2307X	SR 72× 8 SR 72×10 SR 80×10 SR 80×10	2 1 2 1	GS 7 GS 7
1208 K 2208 K 1308 K 2308 K	19 300 22 400 29 800 45 500	22208 EAKE4 21308 EAKE4 22308 EAKE4	90 500 94 500 136 000	H 208X H 308X H 308X H 2308X	SR 80× 7.5 SR 80×10 SR 90×10 SR 90×10	2 1 2 1	GS 8 GS 8
1209 K 2209 K 1309 K 2309 K	22 000 23 300 38 500 55 000	22209 EAKE4 21309 EAKE4 22309 EAKE4	94 500 119 000 166 000	H 209X H 309X H 309X H 2309X	SR 85× 6 SR 85× 8 SR 100×10.5 SR 100×10	2 1 2 1	GS 9 GS 9
1210 K 2210 K 1310 K 2310 K	22 800 23 400 43 500 65 000	22210 EAKE4 21310 EAKE4 22310 EAKE4	99 000 142 000 197 000	H 210X H 310X H 310X H 2310X	SR 90× 6.5 SR 90×10 SR 110×11.5 SR 110×10	2 1 2 1	GS10 GS10
1211 K 2211 K 1311 K 2311 K	26 900 26 700 51 500 76 500	 22211 EAKE4 21311 EAKE4 22311 EAKE4		H 211X H 311X H 311X H 2311X	SR 100× 6 SR 100× 8 SR 120×12 SR 120×10	2 1 2 1	GS11 GS11
1212 K 2212 K 1312 K 2312 K	30 500 34 000 57 500 88 500	 22212 EAKE4 21312 EAKE4 22312 EAKE4	 142 000 190 000 271 000	H 212X H 312X H 312X H 2312X	SR 110× 8 SR 110×10 SR 130×12.5 SR 130×10	2 1 2 1	GS12 GS12

Notes (2) The X dimension indicates the offset of the bearing center from the center of the plummer block bearing box. When one locating ring is used, it is 1/2 of the locating ring width, and when two rings are used, it becomes 0.

(3) Applicable to the ZF Type with the same number.

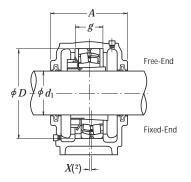
SN 31, SN 5, SN 6 Types Shaft Diameter 60 – 100 mm



Shaft Diameter (mm)	Plummer Block							Dimens (mr							Mass (kg)
d_1	Bearing Box Numbers (1)	$_{ m H8}^{D}$	<i>H</i> h13	J	N	N_1	A	L	A_1	H_1	H_2	g H13	t nominal	S nominal	approx.
60	SN 513	120	80	230	18	23	110	275	80	30	150	43	M 12	M 16	5.6
	SN 613	140	95	260	22	27	130	315	90	32	175	58	M 16	M 20	8.7
65	SN 515	130	80	230	18	23	115	280	80	30	155	41	M 12	M 16	7.0
	SN 615	160	100	290	22	27	140	345	100	35	195	65	M 16	M 20	11.3
70	SN 516	140	95	260	22	27	120	315	90	32	175	43	M 16	M 20	9.0
	SN 616	170	112	290	22	27	145	345	100	35	212	68	M 16	M 20	12.6
75	SN 517	150	95	260	22	27	125	320	90	32	185	46	M 16	M 20	10
	SN 617	180	112	320	26	32	155	380	110	40	218	70	M 20	M 24	15
80	SN 518	160	100	290	22	27	145	345	100	35	195	62.4	M 16	M 20	13
	SN 618	190	112	320	26	32	160	380	110	40	225	74	M 20	M 24	19
85	SN 519	170	112	290	22	27	140	345	100	35	210	53	M 16	M 20	15
	SN 619	200	125	350	26	32	170	410	120	45	245	77	M 20	M 24	22
90	SN 520	180	112	320	26	32	160	380	110	40	218	70.3	M 20	M 24	18.5
	SN 620	215	140	350	26	32	175	410	120	45	270	83	M 20	M 24	25
100	SN 3122 SN 522	180 200	112 125	320 350	26 26	32 32	155 175	380 410	110 120	40 45	218 240	66 80	M 20 M 20	M 24 M 24	18 20
	SN 622	240	150	390	28	36	190	450	130	50	300	90	M 24	M 24	32



To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+adapter+locating ring".





	Арр	olicable Parts				Oil Seals (3)
Self-Aligning Ball Bearing Numbers Basic Dynamic Loa Ratings C_{r} (N)		Bearing ic Dynamic Load latings $C_{ m r}$ (N)	Adapter Numbers	$\begin{array}{c} \text{Locating Rings} \\ \text{Nominal } \begin{pmatrix} \text{Outside} \\ \text{Dia.} \end{pmatrix} \times \text{Width} \end{pmatrix}$	Q'ty	Seals (*)
1213 K 31 000 2213 K 43 500 1313 K 62 500 2313 K 97 000	 22213 EAKE4 21313 EAKE4 22313 EAKE4	 177 000 212 000 300 000	H 213X H 313X H 313X H 2313X	SR 120×10 SR 120×12 SR 140×12.5 SR 140×10	2 1 2 1	GS13 GS13
1215 K 39 000 2215 K 44 500 1315 K 80 000 2315 K 125 000	 22215 EAKE4 21315 EAKE4 22315 EAKE4		H 215X H 315X H 315X H 2315X	SR 130× 8 SR 130×10 SR 160×14 SR 160×10	2 1 2 1	GS15 GS15
1216 K 40 000 2216 K 49 000 1316 K 89 000 2316 K 130 000	 22216 EAKE4 21316 EAKE4 22316 EAKE4	212 000 284 000 435 000	H 216X H 316X H 316X H 2316X	SR 140× 8.5 SR 140×10 SR 170×14.5 SR 170×10	2 1 2 1	GS16 GS16
1217 K 49 500 2217 K 58 500 1317 K 98 500 2317 K 142 000	 22217 EAKE4 21317 EAKE4 22317 EAKE4	250 000 289 000 480 000	H 217X H 317X H 317X H 2317X	SR 150× 9 SR 150×10 SR 180×14.5 SR 180×10	2 1 2 1	GS17 GS17
1218 K 57 500 2218 K 70 500 — — — — — — — — — — — — — — — — — — —	22218 EAKE4 23218 CKE4 21318 EAKE4 22318 EAKE4	289 000 340 000 330 000 535 000	H 218X H 318X H 2318X H 318X H 2318X	SR 160×16.2 SR 160×11.2 SR 160×10 SR 190×15.5 SR 190×10	2 2 1 2 1	GS18 GS18
1219 K 64 000 2219 K 84 000 1319 K 129 000 2319 K 161 000	 22219 EAKE4 21319 CKE4 22319 EAKE4	330 000 345 000 590 000	H 219X H 319X H 319X H 2319X	SR 170×10.5 SR 170×10 SR 200×16 SR 200×10	2 1 2 1	GS19 GS19
1220 K 69 500 2220 K 94 500 — — — — — — — — — — — — — — — — — — —	 22220 EAKE4 23220 CKE4 21320 CKE4 22320 EAKE4	365 000 420 000 395 000 690 000	H 220X H 320X H 2320X H 320X H 2320X	SR 180×18.1 SR 180×12.1 SR 180×10 SR 215×18 SR 215×10	2 2 1 2	GS 20 GS 20
1222 K 87 000 2222 K 122 000	23122 CKE4 22222 EAKE4 23222 CKE4	385 000 	H 3122X H 222X H 322X H 2322X	SR 219×10 SR 180×10 SR 200×21 SR 200×13.5 SR 200×10	1 2 2 1 2	GS22 GS22
1322 K 161 000 2322 K 211 000	21322 CAKE4 22322 EAKE4	450 000 825 000	H 322X H 2322X	SR 240×20 SR 240×10	2 1	GS22

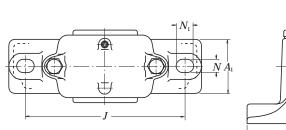
Notes (2) The X dimension indicates the offset of the bearing center from the center of the plummer block bearing box. When one locating ring is used, it is 1/2 of the locating ring width, and when two rings are used, it becomes 0.

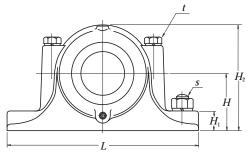
Remarks 1. The threads for plugs are R 1/8 for SN 616 and SN 519 or under and R 1/4 for SN 617, SN 520, SN 3122, and over.

^{2.} SN 620 and SN 622 are provided with eye bolts.

⁽³⁾ Applicable to the ZF Type with the same number.

SN 30, SN 31, SN 5, SN 6 Types Shaft Diameter 110 – 140 mm





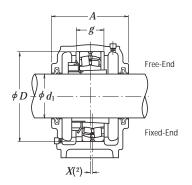
Shaft Diameter (mm)	Plummer Block							Dimens (mr							Mass (kg)
d_1	Bearing Box Numbers (1)	$D_{ m H8}$	<i>H</i> h13	J	N	N_1	A	L	A_1	H_1	H_2	g H13	t nominal	S nominal	approx.
110	SN 3024	180	112	320	26	32	150	380	110	40	218	56	M 20	M 24	16
	SN 3124	200	125	350	26	32	165	410	120	45	245	72	M 20	M 24	20
	SN 524	215	140	350	26	32	185	410	120	45	270	86	M 20	M 24	24.5
	SN 624	260	160	450	33	42	200	530	160	60	320	96	M 24	M 30	48
115	SN 3026	200	125	350	26	32	160	410	120	45	240	62	M 20	M 24	19
	SN 3126	210	140	350	26	32	170	410	120	45	270	74	M 20	M 24	26
	SN 526	230	150	380	28	36	190	445	130	50	290	90	M 24	M 24	30
	SN 626	280	170	470	33	42	210	550	160	60	340	103	M 24	M 30	56
125	SN 3028	210	140	350	26	32	170	410	120	45	270	63	M 20	M 24	25
	SN 3128 SN 528	225 250	150	380 420	28 33	36 42	180 205	445	130	50	290	78 98	M 24 M 24	M 24	32
	3N 328	250	150	420	33	42	205	500	150	50	305	98	IVI Z4	M 30	38
	SN 628	300	180	520	35	45	235	610	170	65	365	112	M 30	M 30	72
135	SN 3030	225	150	380	28	36	175	445	130	50	290	66	M 24	M 24	29
	SN 3130	250	150	420	33	42	200	500	150	50	305	90	M 24	M 30	38
	SN 530	270	160	450	33	42	220	530	160	60	325	106	M 24	M 30	46
	011 / 00	000	400	F / O	0.5		0.45		400		0.05	440			
	SN 630	320	190	560	35	45	245	650	180	65	385	118	M 30	M 30	98
140	SN 3032	240	150	390	28	36	190	450	130	50	300	70	M 24	M 24	32
	SN 3132	270	160	450	33	42	215	530	160	60	325	96	M 24	M 30	48
	SN 532	290	170	470	33	42	235	550	160	60	345	114	M 24	M 30	50
	SN 632	340	200	580	42	50	255	680	190	70	405	124	M 30	M 36	115



To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+adapter+locating ring".

Remarks 1. The threads for plugs are R 1/4.

2. The bearing boxes for SN 524, SN 624, SN 3126, SN 3028, and over are provided with eye bolts.



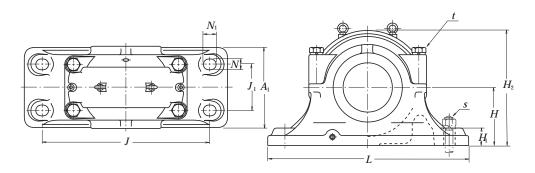


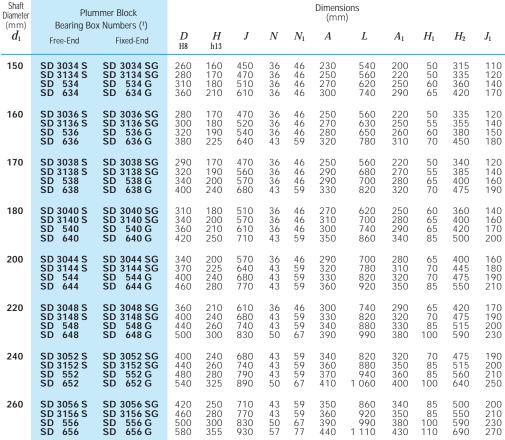
		А	pplicable Parts				Oil Seals (3)
	ng Ball Bearing Basic Dynamic Load	Spherical Roll Numbers B	er Bearing asic Dynamic Load	Adapter Numbers	$\begin{array}{c} \text{Locating Rings} \\ \text{Nominal } \begin{pmatrix} \text{Outside} \\ \text{Dia.} \end{pmatrix} \times \text{Width} \end{pmatrix}$	Q'ty	Jedis ()
Numbers	Ratings $C_{\rm r}$ (N)	Numbers	Ratings $C_{\rm r}$ (N)	Numbers	Norminal (Dia. XWIGIN)	Q ty	
_	_	23024 CDKE4	315 000	H 3024	SR 180×10	1	GS24
_	_	23124 CKE4	465 000	H 3124	SR 200×10	1	GS 24
_	_	22224 EAKE4 23224 CKE4	550 000 630 000	H 3124 H 2324	SR 215×14 SR 215×10	2 1	GS 24
_	_	22324 EAKE4	955 000	H 2324	SR 260×10	1	GS 24
_	_	23026 CDKE4		H 3026	SR 200×10	1	GS 26
_	_	23126 CKE4	505 000	H 3126	SR 210×10	1	GS26
_	_	22226 EAKE4 23226 CKE4	655 000 700 000	H 3126 H 2326	SR 230×13 SR 230×10	2 1	GS26
_	_	22326 CKE4	995 000	H 2326	SR 280×10	1	GS 26
_	_	23028 CDKE4		H 3028	SR 210×10	1	GS 28
_	_	23128 CKE4	580 000	H 3128	SR 225×10	1	GS 28
_	_	22228 CDKE4 23228 CKE4	645 000 835 000	H 3128 H 2328	SR 250×15 SR 250×10	2 1	GS 28
_	_	22328 CKE4	1 160 000	H 2328	SR 300×10	1	GS 28
_	_	23030 CDKE4		H 3030	SR 225×10	1	GS 30
_	_	23130 CKE4	725 000	H 3130	SR 250×10	1	GS 30
_	_	22230 CDKE4 23230 CKE4	765 000 975 000	H 3130 H 2330	SR 270×16.5 SR 270×10	2 1	GS 30
_	_	22330 CAKE4	1 220 000	H 2330	SR 320×10	1	GS 30
_	_	23032 CDKE4	540 000	H 3032	SR 240×10	1	GS 32
_	_	23132 CKE4	855 000	H 3132	SR 270×10	1	GS 32
_	_	22232 CDKE4 23232 CKE4	910 000 1 100 000	H 3132 H 2332	SR 290×17 SR 290×10	2 1	GS 32
_	_	22332 CAKE4	1 360 000	H 2332	SR 340×10	1	GS 32

Notes (2) The X dimension indicates the offset of the bearing center from the center of the plummer block bearing box. When one locating ring is used, it is 1/2 of the locating ring width, and when two rings are used, it becomes 0.

(3) Applicable to the ZF Type with the same number.

SD 30 S, SD 31 S, SD 5, SD 6 Types Shaft Diameter 150 – 260 mm

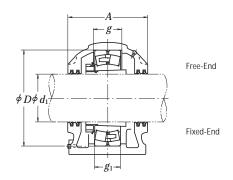






To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+adapter".

Remarks 1. The threads for oil replenishing hole plugs are R 1/4 and those for drain plugs are R 3/8.

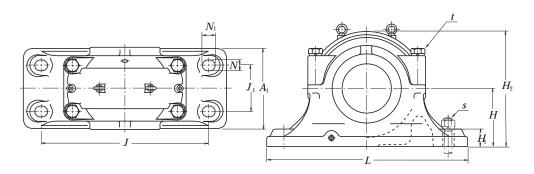


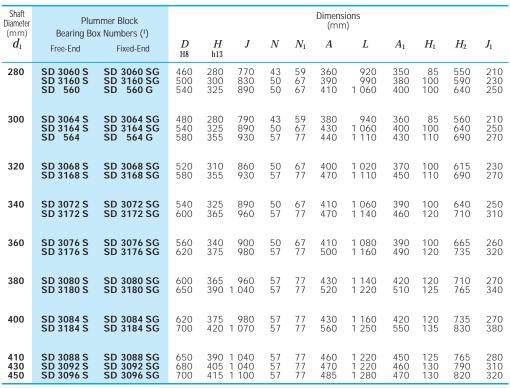
				Mass (kg)	Applicable Parts	Oil Seals (2)
g H13	g 1 H13	t nominal	S nominal	approx.	Spherical Roller Bearing Adapter Numbers Basic Dynamic Load Ratings $C_{ m r}$ (N)	(,
77	67	M 24	M 30	70	23034 CDKE4 640 000 H 3034	GS 34
98	88	M 24	M 30	75	23134 CKE4 940 000 H 3134	GS 34
96	86	M 24	M 30	100	22234 CDKE4 990 000 H 3134	GS 34
130	120	M 30	M 30	160	22334 CAKE4 1 580 000 H 2334	GS 34
84	74	M 24	M 30	79	23036 CDKE4 750 000 H 3036	GS 36
106	96	M 24	M 30	94	23136 CKE4 1 050 000 H 3136	GS 36
96	86	M 24	M 30	110	22236 CDKE4 1 020 000 H 3136	GS 36
136	126	M 30	M 36	195	22336 CAKE4 1 740 000 H 2336	GS 36
85	75	M 24	M 30	87	23038 CAKE4 775 000 H 3038	GS 38
114	104	M 24	M 30	110	23138 CKE4 1 190 000 H 3138	GS 38
102	92	M 30	M 30	130	22238 CAKE4 1 140 000 H 3138	GS 38
142	132	M 30	M 36	210	22338 CAKE4 1 890 000 H 2338	GS 38
92	82	M 24	M 30	100	23040 CAKE4 940 000 H 3040	GS 40
122	112	M 30	M 30	130	23140 CKE4 1 360 000 H 3140	GS 40
108	98	M 30	M 30	155	22240 CAKE4 1 300 000 H 3140	GS 40
148	138	M 36	M 36	240	22340 CAKE4 2 000 000 H 2340	GS 40
100	90	M 30	M 30	130	23044 CAKE4 1 090 000 H 3044	GS 44
130	120	M 30	M 36	180	23144 CKE4 1 570 000 H 3144	GS 44
118	108	M 30	M 36	205	22244 CAKE4 1 570 000 H 3144	GS 44
155	145	M 36	M 36	315	22344 CAKE4 2 350 000 H 2344	GS 44
102	92	M 30	M 30	160	23048 CAKE4 1 160 000 H 3048	GS 48
138	128	M 30	M 36	210	23148 CKE4 1 790 000 H 3148	GS 48
130	120	M 36	M 36	240	22248 CAKE4 1 870 000 H 3148	GS 48
165	155	M 36	M 42	405	22348 CAKE4 2 600 000 H 2348	GS 48
114	104	M 30	M 36	210	23052 CAKE4 1 430 000 H 3052	GS 52
154	144	M 36	M 36	240	23152 CAKE4 2 160 000 H 3152	GS 52
140	130	M 36	M 36	315	22252 CAKE4 2 180 000 H 3152	GS 52
175	165	M 36	M 42	480	22352 CAKE4 3 100 000 H 2352	GS 52
116	106	M 36	M 36	240	23056 CAKE4 1 540 000 H 3056	GS 56
156	146	M 36	M 36	315	23156 CAKE4 2 230 000 H 3156	GS 56
140	130	M 36	M 42	390	22256 CAKE4 2 280 000 H 3156	GS 56
185	175	M 42	M 48	610	22356 CAKE4 3 500 000 H 2356	GS 56

Note (2) Applicable to the ZF Type with the same number.

^{2.} The plummer block bearing boxes listed above are provided with eye bolts.

SD 30 S, SD 31 S, SD 5 Types Shaft Diameter 280 – 450 mm

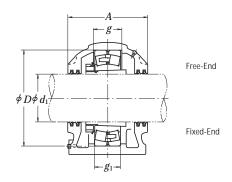






To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+adapter".

Remarks 1. The threads for oil replenishing hole plugs are R 1/4 and those for drain plugs are R 3/8.

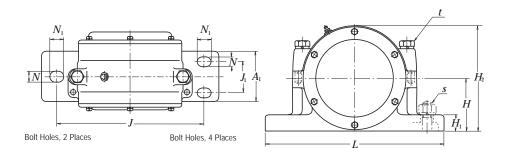


				Mass (kg)	Applicable Parts Spherical Roller Bearing Adapter	Oil Seals (²)
g H13	g_1 H13	t nominal	S nominal	approx.	Numbers $egin{array}{lll} {\sf Basic Dynamic Load} \\ {\sf Ratings } & {\it C_{\rm r}} \ ({\sf N}) \\ \end{array}$ Numbers	
128	118	M 36	M 36	300	23060 CAKE4 1 920 000 H 3060	GS 60
170	160	M 36	M 42	405	23160 CAKE4 2 670 000 H 3160	GS 60
150	140	M 36	M 42	465	22260 CAKE4 2 610 000 H 3160	GS 60
131	121	M 36	M 36	320	23064 CAKE4 1 960 000 H 3064	GS 64
186	176	M 36	M 42	480	23164 CAKE4 3 050 000 H 3164	GS 64
160	150	M 42	M 48	595	22264 CAKE4 2 990 000 H 3164	GS 64
143	133	M 36	M 42	410	23068 CAKE4 2 280 000 H 3068	GS 68
200	190	M 42	M 48	650	23168 CAKE4 3 600 000 H 3168	GS 68
144	134	M 36	M 42	465	23072 CAKE4 2 390 000 H 3072	GS 72
202	192	M 42	M 48	700	23172 CAKE4 3 800 000 H 3172	GS 72
145	135	M 36	M 42	480	23076 CAKE4 2 500 000 H 3076	GS 76
204	194	M 42	M 48	940	23176 CAKE4 4 000 000 H 3176	GS 76
158	148	M 42	M 48	690	23080 CAKE4 2 970 000 H 3080	GS 80
210	200	M 42	M 48	1 040	23180 CAKE4 4 150 000 H 3180	GS 80
160	150	M 42	M 48	770	23084 CAKE4 2 910 000 H 3084	GS 84
234	224	M 48	M 48	1 150	23184 CAKE4 5 000 000 H 3184	GS 84
167	157	M 42	M 48	870	23088 CAKE4 3 150 000 H 3088	GS 88
173	163	M 48	M 48	940	23092 CAKE4 3 450 000 H 3092	GS 92
175	165	M 48	M 48	1 040	23096 CAKE4 3 800 000 H 3096	GS 96

Note (2) Applicable to the ZF Type with the same number.

^{2.} The plummer block bearing boxes listed above are provided with eye bolts.

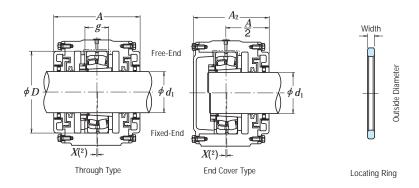
SG 5, SG 5-0 Types Shaft Diameter 50 – 180 mm



Shaft Diameter (mm)		ner Block ing Box							nension (mm)	S					
d_1	Num Through Type	bers (1) End Cover Type	$_{ m H8}^{D}$	H h13	J	N	N_1	A	L	A_1	H_1	H_2	J_1	A_2	g H13
50	SG 511	SG 511-0	100	70	210	18	23	125	255	70	23	137	_	112.5	29
55	SG 512	SG 512-0	110	80	230	18	23	145	290	80	25	160	_	135	32
60	SG 513	SG 513-0	120	83	230	18	23	130	290	70	25	155	_	115	36
65	SG 515	SG 515-0	130	90	230	18	23	135	290	80	25	168	_	120	36
70	SG 516	SG 516-0	140	95	270	22	27	165	340	120	30	180	70	155	38
75	SG 517	SG 517-0	150	100	280	22	27	170	350	120	30	190	70	160	41
80	SG 518	SG 518-0	160	100	290	22	27	180	360	120	35	200	70	170	45
90	SG 520	SG 520-0	180	125	340	22	27	200	410	130	35	240	70	185	51
100	SG 522	SG 522-0	200	140	380	22	27	210	460	130	40	265	70	190	58
110	SG 524	SG 524-0	215	140	380	22	27	230	460	130	45	275	80	200	63
115	SG 526	SG 526-0	230	150	410	26	32	240	490	160	45	295	80	220	69
125	SG 528	SG 528-0	250	160	435	26	32	245	520	160	50	310	80	220	73
135	SG 530	SG 530-0	270	160	465	26	32	265	550	170	50	330	100	240	78
140	SG 532	SG 532-0	290	170	490	26	32	285	580	170	50	350	100	250	85
150	SG 534	SG 534-0	310	180	550	33	42	300	640	180	55	380	100	265	91
160	SG 536	SG 536-0	320	190	600	33	42	325	690	190	55	400	110	285	91
170	SG 538	SG 538-0	340	200	620	42	52	340	730	200	60	420	120	295	97
180	SG 540	SG 540-0	360	210	635	42	52	350	750	210	60	445	130	310	103



To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+adapter+locating ring".



			ass		Applic	able	Parts			Oil
		app	(g) orox.	Spherical I	Roller Bearing	A	dapter	Locating Rir	ng	Seals (3)
t nominal	S nominal	Through Type	End Cover Type	Numbers	Basic Dynamic Load Ratings $C_{ m r}$ (N)	Nu	mbers	Nominal (Outside Dia.×Width)	Q'ty	
M 12	M 16	8.5	7.5	22211 EAK	E4 119 000	Н	311 X	SR 100×4	1	GS 11
M 16	M 16	15	14	22212 EAK	E4 142 000	Н	312 X	SR 110×4	1	GS 12
M 16	M 16	9.5	8.5	22213 EAK	E4 177 000	Н	313 X	SR 120×5	1	GS 13
M 16	M 16	12.5	11	22215 EAK	E4 190 000	Н	315 X	SR 130×5	1	GS 15
M 20	M 20	18.5	17	22216 EAK	E4 212 000	Н	316 X	SR 140×5	1	GS 16
M 20	M 20	21	20	22217 EAK	E4 250 000	Н	317 X	SR 150×5	1	GS 17
M 20	M 20	25	23	22218 EAK	E4 289 000	Н	318 X	SR 160×5	1	GS 18
M 20	M 20	37	34	22220 EAK	E4 365 000	Н	320 X	SR 180×5	1	GS 20
M 20	M 20	50	45	22222 EAK	E4 485 000	Н	322 X	SR 200×5	1	GS 22
M 20	M 20	59	53	22224 EAK	E4 550 000	Н:	3124	SR 215×5	1	GS 24
M 24	M 24	67	62	22226 EAK	E4 655 000	Н	3126	SR 230×5	1	GS 26
M 24	M 24	73	68	22228 CDK	E4 645 000	Н	3128	SR 250×5	1	GS 28
M 24	M 24	90	80	22230 CDK	E4 765 000	Н	3130	SR 270×5	1	GS 30
M 24	M 24	105	92	22232 CDK	E4 910 000	Н	3132	SR 290×5	1	GS 32
M 30	M 30	130	115	22234 CDK	E4 990 000	Н	3134	SR 310×5	1	GS 34
M 30	M 30	155	135	22236 CDK	E4 1 020 000	Н:	3136	SR 320×5	1	GS 36
M 36	M 36	175	155	22238 CAK	E4 1 140 000	Н	3138	SR 340×5	1	GS 38
M 36	M 36	210	180	22240 CAK	E4 1 300 000	Н	3140	SR 360×5	1	GS 40
		1								

Notes (2) The X dimension indicates the offset of the bearing center from the center of plummer block bearing box, and it is 1/2 of the locating ring width.

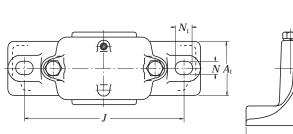
B 316 B 317

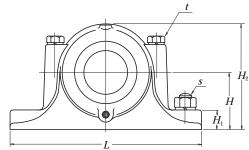
Remarks 1. The threads for grease nipples are R 1/8 for SG518 and under, and R 1/4 for SG520 and over.

^{2.} Bearing boxes larger than SG520 are provided with eye bolts.

⁽³⁾ Applicable to the ZF Type with the same number.

SN 2 C, SN 3 C Types Shaft Diameter 25 – 55 mm



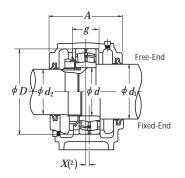


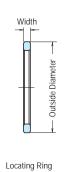
Shaft Diameter (mm)	Plummer Block								Dimens (mm							
d	Bearing Box Numbers (1)	d_1	d_2	$_{ m H8}^{D}$	<i>H</i> h13	J	N	N_1	A	L	A_1	H_1	H_2	g H13	t nominal	S nominal
25	SN 205 C	30	20	52	40	130	15	20	67	165	46	22	75	25	M 8	M 12
	SN 305 C	30	20	62	50	150	15	20	80	185	52	22	90	34	M 8	M 12
30	SN 206 C	35	25	62	50	150	15	20	77	185	52	22	90	30	M 8	M 12
	SN 306 C	35	25	72	50	150	15	20	82	185	52	22	95	37	M 10	M 12
35	SN 207 C	45	30	72	50	150	15	20	82	185	52	22	95	33	M 10	M 12
	SN 307 C	45	30	80	60	170	15	20	90	205	60	25	110	41	M 10	M 12
40	SN 208 C	50	35	80	60	170	15	20	85	205	60	25	110	33	M 10	M 12
	SN 308 C	50	35	90	60	170	15	20	95	205	60	25	115	43	M 10	M 12
45	SN 209 C	55	40	85	60	170	15	20	85	205	60	25	112	31	M 10	M 12
	SN 309 C	55	40	100	70	210	18	23	105	255	70	28	130	46	M 12	M 16
50	SN 210 C	60	45	90	60	170	15	20	90	205	60	25	115	33	M 10	M 12
	SN 310 C	60	45	110	70	210	18	23	115	255	70	30	135	50	M 12	M 16
55	SN 211 C	65	50	100	70	210	18	23	95	255	70	28	130	33	M 12	M 16
	SN 311 C	65	50	120	80	230	18	23	120	275	80	30	150	53	M 12	M 16



To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+nut+Lock-washer+locating ring".

Remarks The threads for plugs are R 1/8.



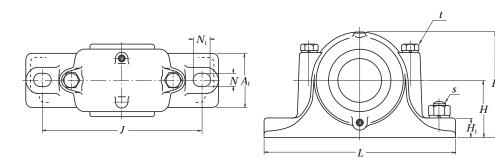


Mass				Applicable	e Parts				Oil Se	als (3)
(kg)		ng Ball Bearing	Spherical Rolle	r Bearing	Nut	Lock-washer	Locating Ring			
approx.	Numbers	B. D. L. R. (4) $C_{ m r}$ (N)	Numbers	B. D. L. R. (4) <i>C</i> _r (N)	Numbers	Numbers	Nominal (Outside Dia.×Width)	Q'ty	Side d_1	Side d_2
1.1	1205 2205	12 200 12 400	 22205 CE4	 37 500	AN 05 AN 05	AW 05X AW 05X	SR 52 × 5 SR 52 × 7	2 1	GS 7	GS 5
1.6	1305 2305	18 200 24 900	21305 CDE4 —	43 000 —	AN 05 AN 05	AW 05X AW 05X	SR 62 × 8.5 SR 62 × 10	2 1	GS 7	GS 5
1.7	1206 2206	15 800 15 300	 22206 CE4	 50 000	AN 06 AN 06	AW 06X AW 06X	SR 62 × 7 SR 62 × 10	2	GS 8	GS 6
1.8	1306 2306	21 400 32 000	21306 CDE4 —	55 000 —	AN 06 AN 06	AW 06X AW 06X	SR 72 × 9 SR 72 × 10	2 1	GS 8	GS 6
1.9	1207 2207	15 900 21 700	 22207 CE4	 69 000	AN 07 AN 07	AW 07X AW 07X	SR 72 × 8 SR 72 × 10	2 1	GS 10	GS 7
2.6	1307 2307	25 300 40 000	21307 CDE4 —	71 500 —	AN 07 AN 07	AW 07X AW 07X	SR 80×10 SR 80×10	2 1	GS 10	GS 7
2.6	1208 2208	19 300 22 400	 22208 EAE4	_ 90 500	AN 08 AN 08	AW 08X AW 08X	SR 80 × 7.5 SR 80 × 10	2	GS 11	GS 8
2.9	1308 2308	29 800 45 500	21308 EAE4 22308 EAE4	94 500 136 000		AW 08X AW 08X	SR 90×10 SR 90×10	2 1	GS 11	GS 8
2.8	1209 2209	22 000 23 300	 22209 EAE4	 94 500	AN 09 AN 09	AW 09X AW 09X	SR 85 × 6 SR 85 × 8	2	GS 12	GS 9
4.1	1309 2309	38 500 55 000	21309 EAE4 22309 EAE4	119 000 166 000		AW 09X AW 09X	SR 100 × 10.5 SR 100 × 10	2 1	GS 12	GS 9
3.0	1210 2210	22 800 23 400	 22210 EAE4	_ 99 000	AN 10 AN 10	AW 10X AW 10X	SR 90 × 6.5 SR 90 × 10	2	GS 13	GS 10
4.7	1310 2310	43 500 65 000	21310 EAE4 22310 EAE4	142 000 197 000		AW 10X AW 10X	SR 110 × 11.5 SR 110 × 10	2 1	GS 13	GS 10
4.5	1211 2211	26 900 26 700	 22211 EAE4	_ 119 000	AN 11 AN 11	AW 11X AW 11X	SR 100 × 6 SR 100 × 8	2	GS 15	GS 11
5.8	1311 2311	51 500 76 500	21311 EAE4 22311 EAE4	142 000 234 000		AW 11X AW 11X	SR 120 × 12 SR 120 × 10	2 1	GS 15	GS 11

Notes (2) The X dimension indicates the offset of the bearing center from the center of the plummer block bearing box. When one locating ring is used, it is 1/2 of the locating ring width, and when two rings are used, it becomes 0.

⁽³⁾ Applicable to the ZF Type with the same number. (4) B. D. L. R.: Basic Dynamic Load Ratings

SN 2 C, SN 3 C Types Shaft Diameter 60 – 90 mm

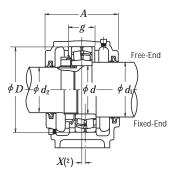


Shaft Diameter (mm)	Plummer Block								Dimensi (mm							
d	Bearing Box Numbers (1)	$d_{\scriptscriptstyle 1}$	d_2	$_{ m H8}^{D}$	<i>H</i> h13	J	N	N_1	A	L	A_1	H_1	H_2	g H13	t nominal	S nominal
60	SN 212 C	70	55	110	70	210	18	23	105	255	70	30	135	38	M 12	M 16
	SN 312 C	70	55	130	80	230	18	23	125	280	80	30	155	56	M 12	M 16
65	SN 213 C	75	60	120	80	230	18	23	110	275	80	30	150	43	M 12	M 16
	SN 313 C	75	60	140	95	260	22	27	130	315	90	32	175	58	M 16	M 20
70	SN 214 C	80	65	125	80	230	18	23	115	275	80	30	155	44	M 12	M 16
	SN 314 C	80	65	150	95	260	22	27	130	320	90	32	185	61	M 16	M 20
75	SN 215 C	85	70	130	80	230	18	23	115	280	80	30	155	41	M 12	M 16
	SN 315 C	85	70	160	100	290	22	27	140	345	100	35	195	65	M 16	M 20
80	SN 216 C	90	75	140	95	260	22	27	120	315	90	32	175	43	M 16	M 20
	SN 316 C	90	75	170	112	290	22	27	145	345	100	35	212	68	M 16	M 20
85	SN 217 C	95	80	150	95	260	22	27	125	320	90	32	185	46	M 16	M 20
	SN 317 C	95	80	180	112	320	26	32	155	380	110	40	218	70	M 20	M 24
90	SN 218 C	100	85	160	100	290	22	27	145	345	100	35	195	62.4	M 16	M 20
	SN 318 C	105	85	190	112	320	26	32	160	380	110	40	225	74	M 20	M 24



To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+nut+Lock-washer+locating ring".

Remarks The threads for plugs are R 1/8 for SN316C, SN218C, and under and R 1/4 for SN317C and over.





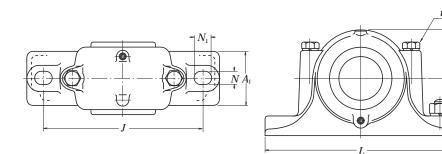
Locating	Ring
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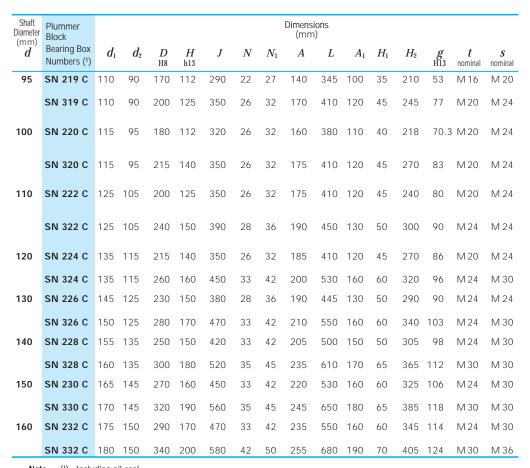
Mass				Applicable	e Parts				Oil Se	als (³)
(kg) approx.	Self-Aligni Numbers	ng Ball Bearing B. D. L. R. (4) $C_{ m r}$ (N)	Spherical Rolle Numbers	r Bearing B. D. L. R. (4) $C_{ m r}$ (N)	Nut Numbers	Lock-washer Numbers	Locating Ring Nominal (Outside Dia.×Width)	Q'ty	Side $d_{\scriptscriptstyle 1}$	Side d_2
5.0	1212 2212	30 500 34 000	 22212 EAE4	_ 142 000	AN 12 AN 12	AW 12X AW 12X	SR 110 × 8 SR 110 × 10	2	GS 16	GS 12
6.5	1312 2312	57 500 88 500	21312 EAE4 22312 EAE4	190 000 271 000	AN 12 AN 12	AW 12X AW 12X	SR 130 × 12.5 SR 130 × 10	2 1	GS 16	GS 12
5.6	1213 2213	31 000 43 500	 22213 EAE4	 177 000	AN 13 AN 13	AW 13X AW 13X	SR 120 × 10 SR 120 × 12	2	GS 17	GS 13
8.7	1313 2313	62 500 97 000	21313 EAE4 22313 EAE4	212 000 300 000		AW 13X AW 13X	SR 140 × 12.5 SR 140 × 10	2 1	GS 17	GS 13
6.2	1214 2214	35 000 44 000	 22214 EAE4	_ 180 000	AN 14 AN 14	AW 14X AW 14X	SR 125 × 10 SR 125 × 13	2	GS 18	GS 15
10	1314 2314	65 000 111 000	21314 EAE4 22314 EAE4	250 000 340 000	AN 14 AN 14	AW 14X AW 14X	SR 150 × 13 SR 150 × 10	2 1	GS 18	GS 15
7.0	1215 2215	39 000 44 500	 22215 EAE4	_ 190 000	AN 15 AN 15	AW 15X AW 15X	SR 130 × 8 SR 130 × 10	2	GS 19	GS 16
11.3	1315 2315	80 000 125 000	21315 EAE4 22315 EAE4	250 000 390 000	AN 15 AN 15	AW 15X AW 15X	SR 160 × 14 SR 160 × 10	2 1	GS 19	GS 16
9.0	1216 2216	40 000 49 000	 22216 EAE4	 212 000	AN 16 AN 16	AW 16X AW 16X	SR 140 × 8.5 SR 140 × 10	2	GS 20	GS 17
12.6	1316 2316	89 000 130 000	21316 EAE4 22316 EAE4	284 000 435 000		AW 16X AW 16X	SR 170 × 14.5 SR 170 × 10	2 1	GS 20	GS 17
10	1217 2217	49 500 58 500	 22217 EAE4	 250 000	AN 17 AN 17	AW 17X AW 17X	SR 150 × 9 SR 150 × 10	2	GS 21	GS 18
15	1317 2317	98 500 142 000	21317 EAE4 22317 EAE4	289 000 480 000	AN 17 AN 17	AW 17X AW 17X	SR 180 × 14.5 SR 180 × 10	2 1	GS 21	GS 18
13	1218 2218 —	57 500 70 500 —	 22218 EAE4 23218 CE4	 289 000 340 000	AN 18 AN 18 AN 18	AW 18X AW 18X AW 18X	SR 160 × 16.2 SR 160 × 11.2 SR 160 × 10	2 2 1	GS 22	GS 19
19	1318 2318	117 000 154 000	21318 EAE4 22318 EAE4	330 000 535 000		AW 18X AW 18X	SR 190 × 15.5 SR 190 × 10	2 1	GS 23	GS 19

Notes (2) The X dimension indicates the offset of the bearing center from the center of the plummer block bearing box. When one locating ring is used, it is 1/2 of the locating ring width, and when two rings are used, it becomes 0.

(3) Applicable to the ZF Type with the same number. (4) B. D. L. R.: Basic Dynamic Load Ratings

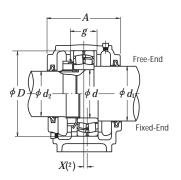
SN 2 C, SN 3 C Types Shaft Diameter 95 – 160 mm



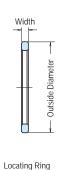




To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+nut+Lock-washer+locating ring".



 \dot{H}_1



Mass				Applicable	e Parts				Oil Se	als (³)
(kg)	Self-Aligni	ng Ball Bearing	g Spherical Rol	ler Bearing	Nut	Lock-washer	Locating Ring			
approx.	Numbers	B. D. L. R. (4) <i>C</i> _r (N)	Numbers	B. D. L. R. (4) $C_{ m r}$ (N)	Numbers	Numbers	Nominal (Outside Dia.×Width)	Q'ty	Side d_1	Side d ₂
15	1219 2219	64 000 84 000	 22219 EAE4	 330 000	AN 19 AN 19	AW 19X AW 19X	SR 170 × 10.5 SR 170 × 10	2 1	GS 24	GS 20
22	1319 2319		21319 CE4 22319 EAE4	345 000 590 000		AW 19X AW 19X	SR 200 × 16 SR 200 × 10	2	GS 24	GS 20
18.5	1220 2220 —	69 500 94 500 —	 22220 EAE4 23220 CE4	 365 000 420 000		AW 20X AW 20X AW 20X	SR 180 × 18.1 SR 180 × 12.1 SR 180 × 10	2 2 1	GS 26	GS 21
25	1320 2320		21320 CE4 22320 EAE4	395 000 690 000		AW 20X AW 20X	SR 215 × 18 SR 215 × 10	2 1	GS 26	GS 21
20	1222 2222 —	87 000 122 000 —	 22222 EAE4 23222 CE4	— 485 000 515 000		AW 22X AW 22X AW 22X	SR 200 × 21 SR 200 × 13.5 SR 200 × 10	2 2 1	GS 28	GS 23
32	1322 2322		21322 CAE4 22322 EAE4	395 000 825 000		AW 22X AW 22X	SR 240 × 20 SR 240 × 10	2 1	GS 28	GS 23
24.5	_	_	22224 EAE4 23224 CE4	550 000 630 000		AW 24 AW 24	SR 215 × 14 SR 215 × 10	2	GS 30	GS 26
48	_	_	22324 EAE4	955 000	AN 24	AW 24	SR 260×10	1	GS 30	GS 26
30	_		22226 EAE4 23226 CE4	655 000 700 000		AW 26 AW 26	SR 230 × 13 SR 230 × 10	2	GS 33	GS 28
56	_	_	22326 CE4	995 000	AN 26	AW 26	SR 280×10	1	GS 34	GS 28
38	_		22228 CDE4 23228 CE4	645 000 835 000		AW 28 AW 28	SR 250 × 15 SR 250 × 10	2	GS 35	GS 30
72	_	_	22328 CE4	1 160 000	AN 28	AW 28	SR 300 × 10	1	GS 36	GS 30
46	_		22230 CDE4 23230 CE4	765 000 975 000		AW 30 AW 30	SR 270 × 16.5 SR 270 × 10	2	GS 37	GS 33
98	_	_	22330 CAE4	1 220 000	AN 30	AW 30	SR 320 × 10	1	GS 38	GS 33
50	_	_	22232 CDE4 23232 CE4	910 000 1 100 000		AW 32 AW 32	SR 290 × 17 SR 290 × 10	2	GS 39	GS 34
115	_	_	22332 CAE4	1 360 000	AN 32	AW 32	SR 340 × 10	1	GS 40	GS 34

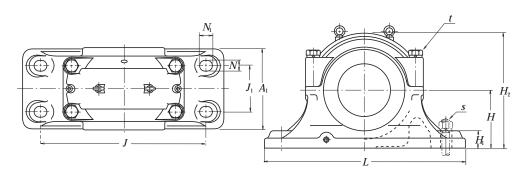
Notes (2) The X dimension indicates the offset of the bearing center from the center of the plummer block bearing box. When one locating ring is used, it is 1/2 of the locating ring width, and when two rings are used, it becomes 0.

Remarks 1. The threads for plugs are R 1/8 for SN219C, and R 1/4 for SN319C and SN220C and over.

^{2.} Bearing boxes larger than SN320C and SN224C are provided with eye bolts.

⁽³⁾ Applicable to the ZF Type with the same number. (4) B. D. L. R.: Basic Dynamic Load Ratings

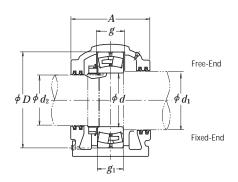
SD 2 C, SD 3 C Types Shaft Diameter 170 – 320 mm



Shaft Diameter (mm)		ner Block ing Box						D	imensi (mm						
d	Num Free-End	bers (¹) Fixed-End	d_1	d_2	$_{ m H8}^{D}$	<i>H</i> h13	J	N	N_1	A	L	A_1	H_1	H_2	J_1
170	SD 234 C	SD 234 CG	190	160	310	180	510	36	46	270	620	250	60	360	140
	SD 334 C	SD 334 CG	190	160	360	210	610	36	46	300	740	290	65	420	170
180	SD 236 C	SD 236 CG	200	170	320	190	540	36	46	280	650	260	60	380	150
100		SD 336 CG	200	170	380	225	640	43	59	320	780	310	70	450	180
190	SD 238 C	SD 238 CG	210	180	340	200	570	36	46	290	700	280	65	400	160
	SD 338 C	SD 338 CG	210	180	400	240	680	43	59	330	820	320	70	475	190
200	SD 240 C	SD 240 CG	220	190	360	210	610	36	46	300	740	290	65	420	170
	SD 340 C	SD 340 CG	220	190	420	250	710	43	59	350	860	340	85	500	200
220	SD 244 C	SD 244 CG	240	210	400	240	680	43	59	330	820	320	70	475	190
220	SD 344 C	SD 344 CG	240	210	460	280	770	43	59	360	920	350	85	550	210
			2.10	210	100	200	,,,	10	0,	500			00		210
240	SD 248 C	SD 248 CG	260	230	440	260	740	43	59	340	880	330	85	515	200
	SD 348 C	SD 348 CG	260	230	500	300	830	50	67	390	990	380	100	590	230
260	SD 252 C	SD 252 CG	280	250	480	280	790	43	59	370	940	360	85	560	210
	SD 352 C	SD 352 CG	280	250	540	325	890	50	67	410	1 060	400	100	640	250
200	CD 25/ C	CD 25/ 00	200	2/0	F00	200	020	F.O.	/ 7	200	000	380	100	F00	220
280		SD 256 CG	300	260	500	300	830	50	67	390	990		100	590	230
	SD 356 C	SD 356 CG	300	260	580	355	930	57	77	440	1 110	430	110	690	270
300	SD 260 C	SD 260 CG	320	280	540	325	890	50	67	410	1 060	400	100	640	250
320	SD 264 C	SD 264 CG	340	300	580	355	930	57	77	440	1 110	430	110	690	270



To place an order for a complete unit, please specify, "Plummer block bearing box+bearing+nut+Lock-washer or stopper".



				Mass		Applicable P		Oil Se	als (²)	
		4		(kg)	Spherical Ro	oller Bearing	Nut	Lock-washer or Stopper	CLI. I	CLL I
g H13	g 1 H13	t nominal	S nominal	approx.	Numbers	Basic Dynamic Load Ratings $C_{ m r}$ (N)	Numbers	Numbers	Side d ₁	Side d_2
96	86	M 24	M 30	100	22234 CDE	990 000	AN 34	AW 34	GS 42	GS 36
130	120	M 30	M 30	160	22334 CAE	1 580 000	AN 34	AW 34	GS 42	GS 36
96	86	M 24	M 30	110	22236 CDE	1 020 000	AN 36	AW 36	GS 44	GS 38
136	126	M 30	M 36	195	22336 CAE	1 740 000	AN 36	AW 36	GS 44	GS 38
102	92	M 30	M 30	130	22238 CAE	1 140 000	AN 38	AW 38	GS 46	GS 40
142	132	M 30	M 36	210	22338 CAE	1 1 890 000	AN 38	AW 38	GS 46	GS 40
108	98	M 30	M 30	155	22240 CAE	1 300 000	AN 40	AW 40	GS 48	GS 42
148	138	M 36	M 36	240	22340 CAE	2 000 000	AN 40	AW 40	GS 48	GS 42
118	108	M 30	M 36	205	22244 CAE	1 570 000	AN 44	AL 44	GS 52	GS 46
155	145	M 36	M 36	315	22344 CAE	1 2 350 000	AN 44	AL 44	GS 52	GS 46
130	120	M 36	M 36	240	22248 CAE	1 870 000	AN 48	AL 44	GS 56	GS 50
165	155	M 36	M 42	405	22348 CAE	1 2 600 000	AN 48	AL 44	GS 56	GS 50
140	130	M 36	M 36	315	22252 CAE	2 180 000	AN 52	AL 52	GS 60	GS 54
175	165	M 36	M 42	480	22352 CAE	3 100 000	AN 52	AL 52	GS 60	GS 54
140	130	M 36	M 42	390	22256 CAE	2 280 000	AN 56	AL 52	GS 64	GS 56
185	175	M 42	M 48	610	22356 CAE	3 500 000	AN 56	AL 52	GS 64	GS 56
150	140	M 36	M 42	465	22260 CAE	2 610 000	AN 60	AL 60	GS 68	GS 60
160	150	M 42	M 48	595	22264 CAE	1 2 990 000	AN 64	AL 64	GS 72	GS 64

Note (2) Applicable to the ZF Type with the same number.

Remarks 1. The threads for oil replenishing hole plugs are R 1/4 and those for drain plugs are R 3/8.

^{2.} The plummer block bearing boxes listed above are provided with eye bolts.



CYLINDRICAL ROLLER BEARINGS FOR SHEAVES

CYLINDRICAL ROLLER BEARINGS FOR SHEAVES

Open Type	Bore Diameter 50 – 560mm ·····	B328
Prelubricated Type	Bore Diameter 40 – 400mm ·····	B332

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

Bearin	g Type	Fixed-End	Free-End
Open Type	Without Snap Ring	RS-48E4 RS-49E4	RSF-48E4 RSF-49E4
Shielded Type	Without Snap Ring With Snap Ring	RS-50 RS-50NR	_

Table 3 Units : μm

	minal		Clear	ances	
	e Dia. mm)	C	N	C	3
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
					_

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.

TOLERANCES AND RUNNING ACCURACY...... Table 8.2 (Pages A60 to A63)

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 2.

Table 2 Fits and Internal Clearances for Cylindrical Roller Bearings for Sheaves

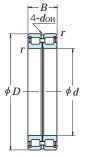
0	perating Conditions	Fitting between Inner Ring and Shaft	Fitting between Outer Ring and Housing Bore	Recommended Internal Clearance	
Outer Ring Rotation	Thin walled housings and heavy loads	g6 or h6	P7	C3	
	Normal to heavy loads	g6 or h6	N7	C3	
	Light or fluctuating loads	g6 or h6	M7	CN	

The fits listed in Tables 9.2 (Page A84) and 9.4 (Page A85) apply when they are used with inner ring rotation in general applications, and the internal clearance should conform to Table 3.

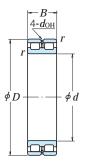
B 326 B 327

RS-48 · RS-49 Types RSF-48 · RSF-49 Types

Bore Diameter 50 – 220 mm



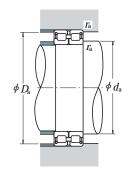




Free-End Bearing RSF

	Boundary [Dimensions m)	S	(Basic Loa		gf}	Limiting Speeds (min ⁻¹)	
d	D	В	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
50	72	22	0.6	48 000	75 500	4 900	7 700	2 000	4 000
60	85	25	1	68 500	118 000	6 950	12 000	1 600	3 200
65	90	25	1	70 500	125 000	7 150	12 700	1 600	3 200
70	100	30	1	102 000	168 000	10 400	17 200	1 400	2 800
80	110	30	1	109 000	191 000	11 100	19 500	1 300	2 600
90	125	35	1.1	147 000	268 000	15 000	27 400	1 100	2 200
100	125	25	1	87 500	189 000	8 900	19 300	1 100	2 200
	140	40	1.1	194 000	400 000	19 800	41 000	1 000	2 000
105	130	25	1	89 000	196 000	9 100	19 900	1 000	2 000
	145	40	1.1	199 000	420 000	20 300	43 000	950	1 900
110	140	30	1	114 000	260 000	11 700	26 500	950	1 900
	150	40	1.1	202 000	430 000	20 600	44 000	900	1 800
120	150	30	1	119 000	283 000	12 200	28 900	900	1 800
	165	45	1.1	226 000	480 000	23 100	49 000	800	1 600
130	165	35	1.1	162 000	390 000	16 500	39 500	800	1 600
	180	50	1.5	262 000	555 000	26 700	56 500	750	1 500
140	175	35	1.1	167 000	415 000	17 000	42 500	750	1 500
	190	50	1.5	272 000	595 000	27 700	60 500	710	1 400
150	190	40	1.1	235 000	575 000	23 900	58 500	670	1 400
	210	60	2	390 000	865 000	40 000	88 500	670	1 300
160	200	40	1.1	243 000	615 000	24 800	63 000	630	1 300
	220	60	2	410 000	930 000	41 500	95 000	600	1 200
170	215	45	1.1	265 000	650 000	27 000	66 500	600	1 200
	230	60	2	415 000	975 000	42 500	99 500	600	1 200
180	225	45	1.1	272 000	685 000	27 800	70 000	560	1 100
	250	69	2	495 000	1 130 000	50 500	115 000	530	1 100
190	240	50	1.5	315 000	785 000	32 000	80 000	530	1 100
	260	69	2	510 000	1 180 000	52 000	120 000	500	1 000
200	250	50	1.5	320 000	825 000	33 000	84 000	500	1 000
	280	80	2.1	665 000	1 500 000	68 000	153 000	480	950
220	270	50	1.5	340 000	905 000	34 500	92 500	450	900
	300	80	2.1	695 000	1 620 000	70 500	165 000	430	850

Remarks Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.



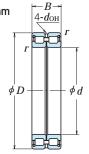
Bearing N	lumbers ⁽¹⁾		nsions im)		butment and Dimensions (n	nm)	Mass (kg)
Fixed-End Bearing	Free-End Bearing	$d_{ m OH}^{(2)}$	Axial Disp.(3)	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{max}.$	approx.
RS-4910E4	RSF-4910E4	2.5	1.5	54	68	0.6	0.30
RS-4912E4	RSF-4912E4	2.5	1.5	65	80	1	0.46
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		116.5	143.5	1	2.15
RS-4824E4	RSF-4824E4	3	2	125	145	1	1.28
RS-4924E4	RSF-4924E4	4		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.

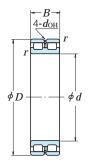
- (2) d_{OH} represents the oil hole diameter in the outer ring.
- (3) Permissible axial displacement for free-end bearings.

RS-48 · RS-49 Types RSF-48 · RSF-49 Types

Bore Diameter 240 – 560 mm



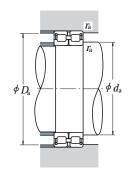




Free-End Bearing RSF

	Bound	lary Dimensi (mm)	ons		Basic Lo N)	ad Ratings	(gf)	Limiting Speeds (min ⁻¹)		
	d I) B	$m{r}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
24	40 30 32		2 2.1	495 000 725 000	1 340 000 1 770 000	50 500 74 000	137 000 181 000	430 400	850 800	
20	60 32 36		2 2.1	515 000 1 050 000	1 450 000 2 530 000	52 500 107 000	148 000 258 000	380 360	750 710	
28	35 35		2 2.1	610 000 1 090 000	1 690 000 2 720 000	62 500 111 000	173 000 277 000	340 340	710 670	
30	38 42		2.1 3	805 000 1 460 000	2 160 000 3 400 000	82 000 149 000	220 000 350 000	320 300	630 600	
32	20 40 44		2.1 3	835 000 1 500 000	2 310 000 3 600 000	85 000 153 000	236 000 365 000	300 280	600 560	
34	40 42 46		2.1 3	855 000 1 560 000	2 430 000 3 900 000	87 500 159 000	248 000 395 000	280 260	560 530	
36	60 44 48		2.1 3	885 000 1 600 000	2 580 000 4 050 000	90 000 163 000	264 000 415 000	260 260	530 500	
38	30 48 52		2.1 4	1 260 000 2 040 000	3 600 000 5 200 000	128 000 209 000	365 000 530 000	240 240	500 450	
40	50 50 54		2.1 4	1 290 000 2 100 000	3 750 000 5 450 000	132 000 214 000	385 000 555 000	240 220	480 450	
42	20 52 56		2.1 4	1 320 000 2 150 000	3 950 000 5 700 000	135 000 219 000	405 000 580 000	220 200	450 430	
44	40 54 60		2.1 4	1 350 000 2 840 000	4 150 000 7 350 000	138 000 289 000	420 000 750 000	200 190	430 380	
46	50 58 62		3 4	1 730 000 2 870 000	5 150 000 7 500 000	177 000 293 000	525 000 765 000	190 190	380 380	
48	80 60 65		3 5	1 760 000 3 200 000	5 300 000 8 500 000	180 000 325 000	545 000 865 000	190 180	380 360	
50	00 62 67		3 5	1 810 000 3 300 000	5 600 000 8 900 000	184 000 335 000	570 000 910 000	180 170	360 340	
	30 71 60 75		5 5	3 400 000 3 800 000	9 200 000 10 100 000	350 000 385 000	935 000 1 030 000	160 150	320 300	

Remarks Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.

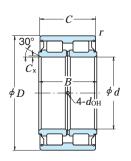


Bearing N	Numbers ⁽¹⁾		nsions ım)		Abutment and Dimensions (r	nm)	Mass (kg)
Fixed-End Bearing	Free-End Bearing	$d_{ m OH}^{(2)}$	Axial Disp. ⁽³)	$oldsymbol{d_{\mathrm{a}}}{}_{min.}$	$D_{ m a}$ max.	$oldsymbol{r_{\mathrm{a}}}{max}.$	арргох.
RS-4848E4	RSF-4848E4	5	3.5	249	291	2 2	10.3
RS-4948E4	RSF-4948E4	7	5	251	309		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 3	49.5
RS-4984E4	RSF-4984E4	11	8	436	544		98.5
RS-4888E4	RSF-4888E4	8	6	451	529	2 3	51.5
RS-4988E4	RSF-4988E4	11	8	456	584		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

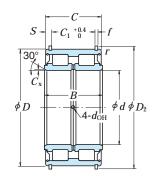
Notes (1) The suffix E4 indicates that the outer ring is provided with oil holes and oil groove.

- (2) d_{OH} represents the oil hole diameter in the outer ring.
- (3) Permissible axial displacement for free-end bearings.

RS-50 Type (Prelubricated) Bore Diameter 40 – 400 mm







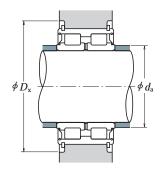
With Locating Ring

	E	Boundary [(m	Dimensior m)	ns		(Basic Load I		(gf)	Limiting Speeds
d	D	В	С	$C_{\rm x}^{(1)}$ min.	r min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$	(min ⁻¹) Grease
40	68	38	37	0.4	0.6	79 500	116 000	8 100	11 800	2 400
45	75	40	39	0.4	0.6	95 500	144 000	9 750	14 700	2 200
50	80	40	39	0.4	0.6	100 000	158 000	10 200	16 100	2 000
55	90	46	45	0.6	0.6	118 000	193 000	12 100	19 700	1 800
60	95	46	45	0.6	0.6	123 000	208 000	12 600	21 200	1 700
65	100	46	45	0.6	0.6	128 000	224 000	13 100	22 800	1 600
70	110	54	53	0.6	0.6	171 000	285 000	17 500	29 000	1 400
75	115	54	53	0.6	0.6	179 000	305 000	18 200	31 500	1 400
80	125	60	59	0.6	0.6	251 000	430 000	25 600	43 500	1 200
85	130	60	59	0.6	0.6	256 000	445 000	26 200	45 500	1 200
90	140	67	66	1	0.6	305 000	540 000	31 000	55 000	1 100
95	145	67	66	1	0.6	310 000	565 000	32 000	57 500	1 100
100	150	67	66	1	0.6	320 000	585 000	32 500	59 500	1 000
110	170	80	79	1.1	1	385 000	695 000	39 000	71 000	900
120	180	80	79	1.1	1	400 000	750 000	40 500	76 500	850
130	200	95	94	1.1	1	535 000	1 000 000	54 500	102 000	750
140	210	95	94	1.1	1	550 000	1 040 000	56 000	106 000	710
150	225	100	99	1.3	1	620 000	1 210 000	63 500	124 000	670
160	240	109	108	1.3	1.1	695 000	1 370 000	71 000	140 000	630
170	260	122	121	1.3	1.1	860 000	1 680 000	88 000	171 000	600
180	280	136	135	1.3	1.1	980 000	1 910 000	100 000	195 000	530
190	290	136	135	1.3	1.1	1 120 000	2 230 000	114 000	227 000	500
200	310	150	149	1.3	1.1	1 310 000	2 650 000	133 000	270 000	480
220	340	160	159	1.5	1.1	1 510 000	3 100 000	154 000	320 000	430
240	360	160	159	1.5	1.1	1 570 000	3 350 000	160 000	340 000	400
260	400	190	189	2	1.5	2 130 000	4 500 000	217 000	460 000	360
280	420	190	189	2	1.5	2 170 000	4 700 000	221 000	480 000	340
300	460	218	216	2	1.5	2 670 000	5 850 000	272 000	600 000	300
320	480	218	216	2	1.5	2 720 000	6 100 000	277 000	620 000	300
340	520	243	241	2.1	2	3 350 000	7 550 000	345 000	770 000	260
360	540	243	241	2.1	2	3 450 000	7 850 000	350 000	800 000	260
380	560	243	241	2.1	2	3 550 000	8 400 000	365 000	855 000	240
400	600	272	270	2.1	2	4 250 000	9 950 000	435 000	1 010 000	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 I	Numbers			ing Ring ions (mm)		Oil Holes (mm)	Abutment and Fillet Dimensions (mm)		Mass (kg)
Without Locating Ring	With Locating Ring	C_1	S	D_2	f	$d_{ m OH}$	$d_{ m a}$ min.	$D_{ m x}$ 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-5064 RS-5068	RS-5060NR — —	178 — —	19 — —	476 — —	7 	8 8 10	310 330 352	512 — —	130 135 185
RS-5072 RS-5076 RS-5080	_ _ _	=	_ _ _	_ _ _	=	10 10 10	372 392 412	_ _ _	192 196 280

Remarks 3. Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.

 For shield with outside diameter larger than 180mm, the above figure is different actual shape. For detail drawing, please contact NSK.





ROLL-NECK BEARINGS

FOUR-ROW **TAPERED ROLLER BEARINGS**

FOUR-ROW CYLINDRICAL ROLLER BEARINGS Bore Diameter 100 – 939.800mm ····· B338

Bore Diameter 100 – 920mm ----- B340

DESIGN, TYPES, AND FEATURES

Four-row tapered roller bearings and four-row cylindrical roller bearings used for rolling-mill roll necks are easy to service and check, and are designed to have the highest load rating possible for the limited space around roll necks. Also, they are designed for high speed to satisfy the demand for fast rolling. In addition to the open type (KV) four-row tapered roller bearings listed in this catalog, sealed-clean type four-row tapered roller bearings are also available. Please refer to "Large-Size Rolling Bearings" catalog (CAT. No. E125) or "Extra-Capacity Sealed-CleanTM Roll Neck Bearings" catalog (CAT. No. E1225) for more detailed information.

TOLERANCES AND RUNNING ACCURACY

METRIC DESIGN FOUR-ROW TAPERED ROLLER BEARINGSTable 8.3 (Pages A64 to A67)	
INCH DESIGN FOUR-ROW TAPERED ROLLER BEARINGSTable 8.4 (Pages A68 to A69)	
FOUR-ROW CYLINDRICAL ROLLER BEARINGSTable 8.2 (Pages A60 to A63) (Not applicable to combined width)	

RECOMMENDED FITS

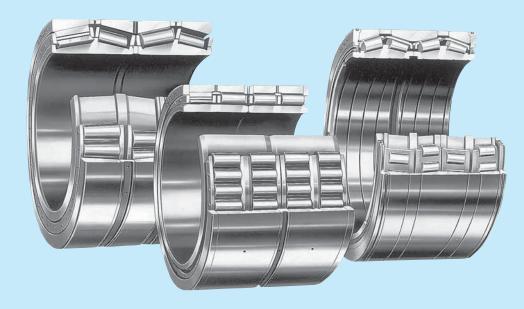
FOUR-ROW TAPERED ROLLER BEARINGS (CYLINDRICAL BORES)

Tables 1 and 2 apply to metric series bearings and Tables 3 and 4 to inch design.

Table 1 Fits of Metric Design Four-Row Tapered Roller Bearings with Roll Necks

Units: µm

Nomina Diam $oldsymbol{d}$ (n	eter	Single Plane Mean Bore Dia. Deviation Δd_{mp}		Tolerance		Clearance		Wear Limits
over	incl.	high	low	high	low	min.	max.	Ref.
80	120	0	- 20	- 120	- 150	100	150	300
120	180	0	- 25	- 150	- 175	125	175	350
180	250	0	- 30	- 175	- 200	145	200	400
250	315	0	- 35	- 210	- 250	175	250	500
315	400	0	- 40	- 240	- 300	200	300	600
400	500	0	- 45	- 245	- 300	200	300	600
500	630	0	- 50	- 250	- 300	200	300	600
630	800	0	- 75	- 325	- 400	250	400	800



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Table 2 Fits of Metric Design Four-Row Tapered Roller Bearings with Chock

Units: µm

Nominal Outside Diameter D (mm)		Outside D	lane Mean ia. Deviation <i>D</i> mp	Tolerai Chock Dian		Clea	rance	Wear Limits of Chock
over	incl.	high	low	high	low	min.	max.	Ref.
120 150 180 250 315 400	150 180 250 315 400 500	0 0 0 0	- 18 - 25 - 30 - 35 - 40 - 45	+ 57 +100 +120 +115 +110 +105	+25 +50 +50 +50 +50 +50	25 50 50 50 50 50	75 125 150 150 150 150	150 250 300 300 300 300 300
500 630 800	630 800 1 000	0 0 0	5075100	+100 +150 +150	+50 +75 +75	50 75 75	150 225 250	300 450 500

Table 3 Fits of Inch Design Four-Row Tapered Roller Bearings with Roll Necks

Units: µm

Nominal Bore Diameter d					Bore Diameter Deviation Δd_s		Tolerance for Roll Neck Diameter		rance	Wear Limits of
ove (mm)	r 1/25.4	incl (mm)	. 1/25.4	high	low	high	low	min.	max.	Roll Neck Ref.
152.400 203.200 304.800 609.600 914.400	6.0000 8.0000 12.0000 24.0000 36.0000	203.200 304.800 609.600 914.400	8.0000 12.0000 24.0000 36.0000	+ 25 + 25 + 51 + 76 +102	0 0 0 0	- 150 - 175 - 200 - 250 - 300	- 175 - 200 - 250 - 325 - 400	175 200 250	200 225 301 401 502	400 450 600 800 1 000

Table 4 Fits of Inch Design Four-Row Tapered Roller Bearings with Chocks

Units: µm

Nominal Outside Diameter D					Outside Dia. Deviation ⊿Ds		Tolerance for Chock Bore Diameter		rance	Wear Limits of
over (mm)	r 1/25.4	incl. (mm)	1/25.4	high	low	high	low	min.	max.	Chock Ref.
— 304.800 609.600	— 12.0000 24.0000	304.800 609.600 914.400	12.0000 24.0000 36.0000	+ 25 + 51 + 76	0	+ 75 +150 +225	+ 50 +100 +150		75 150 225	150 300 450
914.400 1 219.200	36.0000 48.0000	1 219.200 1 524.000	48.0000 60.0000	+102 +127	0	+300 +375	+200 +250		300 375	600 750

FOUR-ROW CYLINDRICAL ROLLER BEARINGS (CYLINDRICAL BORES)

When they are used on backup rolls of four stage rolling mills, the tolerances for roll neck diameters are shown in Table 5. For the fitting between the bearing and chock bore, we recommend G7.

For the fitting of four-row cylindrical roller bearings on the roll necks of other rolling mills, Table 9.2 (Page A84) and Table 9.4 (Page A85) usually apply.

Table 5 Recommended Backup Roll Neck Tolerances

Units: µm

	Nominal Bor	re Diameter !	Tolerances for Roll Neck Diameter			
	over	incl.	high	low		
_	280	355	+0.165	+0.13		
	355	400	+0.19	+0.15		
	400	450	+0.22	+0.17		
	450	500	+0.25	+0.19		
	500	560	+0.28	+0.21		
	560	630	+0.32	+0.25		
	630	710	+0.35	+0.27		
	710	800	+0.39	+0.31		
	800	900	+0.44	+0.35		
	900	1 000	+0.48	+0.39		

INTERNAL CLEARANCES

FOUR-ROW TAPERED ROLLER BEARINGS

The radial internal clearances in four-row tapered roller bearings (cylindrical bores) used on rolling mill roll necks with a loose fit are C2 or often smaller than C2. The NSK standard clearances for four-row tapered roller bearings for roll necks are shown in Table 6. Depending on the operating conditions, special radial clearance selection may become necessary, please contact NSK in such a case.

The internal clearance in four-row tapered roller bearings is peadjusted for individual bearing sets, therefore it is necessary to use each part of a given set by observing mating marks when assembling them.

FOUR-ROW CYLINDRICAL ROLLER BEARINGS

Please contact NSK regarding internal clearance.

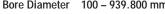
Table 6 Standard Radial Internal Clearances in Four-Row Tapered Roller Bearings (Cylindrical Bores)

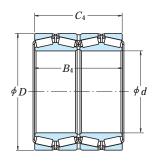
Units: µm

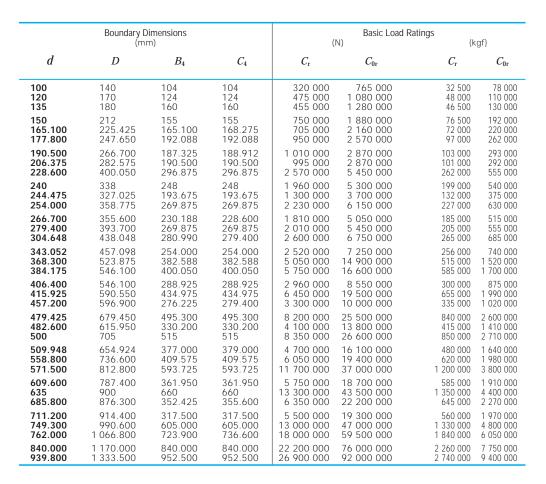
Nominal Bo		Radial Internal Clearance			
over	over incl.		max.		
80	120	25	45		
120	180	30	50		
180	250	40	60		
250	315	50	70		
315	400	60	80		
400	500	70	90		
500	630	80	100		
630	800	100	120		
800	1 000	120	140		

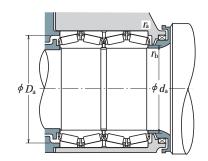
B 336 B 337

Bore Diameter 100 - 939.800 mm









	Abutı	ment and Fill (mn		ons	Mass (kg)	5.6
Bearing Numbers	$d_{\scriptscriptstyle m a}$	D_{a}	$r_{ m a}$ max.	$\emph{\textbf{r}}_{ m b}$ max.	арргох.	Reference Numbers
100 KV 895 120 KV 895 135 KV 1802	109 131 145	130 158 169	2 2 1.5	1.5 2 2	4.9 8.5 11.1	_
150 KV 895	162	196	2	2	17	—
*165 KV 2252	178	209	3.3	0.8	20.2	46791D -720-721D
*177 KV 2452	192	228	3.3	1.5	27.9	67791D -720-721D
*190 KV 2651	204	246	3.3	1.5	32.8	67885D -820-820D
*206 KV 2854	218	261	3.3	0.8	35.2	67986D -920-921D
*228 KV 4051	264	367	3.3	3.3	152	EE 529091D -157-158XD
240 KV 895	257	315	2.5	2.5	68.5	
*244 KV 3251	260	306	3.3	1.5	44.6	LM 247748D -710-710D
*254 KV 3551	272	335	3.3	1.5	85.6	M 249748DW -710-710D
*266 KV 3552	281	335	3.3	1.5	60.6	LM 451349D -310-310D
*279 KV 3951	302	363	6.4	1.5	100	EE 135111D -155-156XD
*304 KV 4353	329	407	4.8	3.3	133	M 757448DW -410-410D
*343 KV 4555	362	430	3.3	1.5	114	LM 761649DW -610-610D
*368 KV 5251	396	487	6.4	3.3	274	HM 265049D -010-010D
*384 KV 5452	417	510	6.4	3.3	309	HM 266449D -410-410D
*406 KV 5455	430	512	6.4	1.5	186	LM 767749DW -710-710D
*415 KV 5951	451	550	6.4	3.3	395	M 268749D -710-710D
*457 KV 5952	487	566	3.3	1.5	201	L 770849DW -810-810D
*479 KV 6751	520	635	6.4	3.3	595	M 272749DW -710-710D
*482 KV 6152	508	582	6.4	3.3	242	LM 272249DW -210-210D
500 KV 895	544	657	5	5	654	—
*509 KV 6551 *558 KV 7352 *571 KV 8151	536 588 622	619 697 755	6.4 6.4 6.4	1.5 3.3 3.3	312 457 1 020	LM 377449DW -410-410D M 278749DW -710-710D
*609 KV 7851 A	644	745	6.4	3.3	454	EE 649241DW -310-311D
635 KV 9001	695	840	5	4	1 380	—
*685 KV 8751	730	833	6.4	3.3	543	EE 655271DW -345-346D
*711 KV 9151	770	870	6.4	3.3	549	EE 755281DW -360-361D
*749 KV 9951	804	940	6.4	3.3	1 310	LM 283649DW -610-610D
*762 KV 1051	828	996	12.7	5	2 100	—
*840 KV 1151	910	1 095	7	7	2 900	
*939 KV 1351	1 035	1 245	12.7	4.8	4 380	LM 287849DW -810-810D

(*) Bearings marked * are inch design.

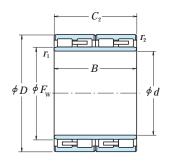
Remarks 1. For four-row tapered roller bearings not listed above, please contact NSK.

2. Four-row tapered roller bearings are designed for specific applications, when using them, please contact NSK.

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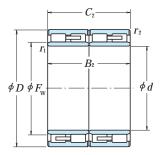


Figure 1

Figure 2

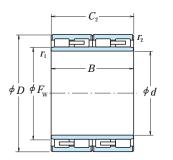
		Воц	undary D (mr	imensions n)			1)	Basic Load Rat N)	ings {kg	gf}
d	D	B, B ₂	C_2	$F_{ m w}$	$r_1 \atop ext{min.}$	r_{2} min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$
100	140	104	104	111	1.5	1.1	345 000	820 000	35 000	84 000
145	225	156	156	169	2	2	835 000	1 820 000	85 000	185 000
150	220 230	150 156	150 156	168 174	2 2	2 2	770 000 825 000	1 700 000 1 810 000	78 500 84 500	174 000 185 000
160	230 230	130 168	130 168	178 180	2 2	2 2	665 000 895 000	1 340 000 2 200 000	68 000 91 500	136 000 225 000
170	250	168	168	192	2.1	2.1	1 040 000	2 320 000	106 000	237 000
	255	180	180	193	2.1	2.1	1 130 000	2 500 000	115 000	255 000
180	250	156	156	200	2	2	880 000	2 230 000	89 500	227 000
	260	168	168	202	2.1	2.1	990 000	2 300 000	101 000	235 000
190	260	168	168	212	2	2	980 000	2 600 000	100 000	265 000
	270	200	200	212	2.1	2.1	1 260 000	3 100 000	128 000	315 000
200	280	200	200	224	2.1	2.1	1 210 000	3 200 000	123 000	325 000
	290	192	192	226	2.1	2.1	1 220 000	3 000 000	124 000	305 000
220	310	192	192	247	2.1	2.1	1 320 000	3 450 000	134 000	350 000
	310	225	225	245	2.1	2.1	1 500 000	3 900 000	153 000	395 000
	320	210	210	248	2.1	2.1	1 530 000	3 650 000	156 000	375 000
230	330	206	206	260	2.1	2.1	1 510 000	3 900 000	154 000	395 000
	340	260	260	261	3	3	2 050 000	5 100 000	209 000	520 000
240	330	220	220	270	3	3	1 520 000	4 400 000	155 000	445 000
250	350	220	220	278	3	3	1 660 000	4 200 000	169 000	430 000
260	370	220	220	292	3	3	1 760 000	4 450 000	179 000	455 000
	380	280	280	294	3	3	2 420 000	6 250 000	247 000	635 000
270	380	230	230	298	2.1	2.1	2 000 000	5 050 000	204 000	515 000
280	390	220	220	312	3	3	1 820 000	4 800 000	186 000	490 000
300	400 420	300 240	300 240	328 332	2 3	2 3	2 330 000 2 280 000	6 900 000 5 750 000	238 000 233 000	700 000 585 000
310	430	240	240	344.5	3	3	2 240 000	5 950 000	228 000	605 000
320	450	240	240	355	3	3	2 320 000	5 750 000	237 000	585 000
330	460	340	340	365	4	4	3 050 000	8 650 000	310 000	880 000

Bearing Numbers	Mass (kg)	Figures	Reference Bearing Numbers
100 RV 1401	4	2	_
145 RV 2201	23		313924A
150 RV 2201	20	1	
150 RV 2302	23	1	313891A
160 RV 2301	16	1	_
160 RV 2302	22	1	
170 RV 2501	27	1	_
170 RV 2503	31	1	
180 RV 2501	23	1	
180 RV 2601	29	1	313812
190 RV 2601	26	1	
190 RV 2701	36	1	314199В
200 RV 2801	38	1	
200 RV 2901	42	1	313811
220 RV 3101	46	1	_
220 RV 3102	52	1	_
220 RV 3201	56	1	_
230 RV 3301	58	1	313824
230 RV 3401	81	1	—
240 RV 3301	57	1	313921
250 RV 3501	64	1	—
260 RV 3701	76	1	313823
260 RV 3801	107	1	—
270 RV 3801	83	1	
280 RV 3901	80	1	313822
300 RV 4021	103	2	_
300 RV 4201	101	1	_
310 RV 4301	107	1	_
320 RV 4502	116	1	_
330 RV 4601	174	1	_

Remarks 1. For four-row cylindrical roller bearings not listed above, please contact NSK.

^{2.} Four-row cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.





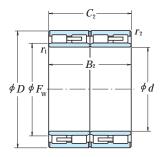
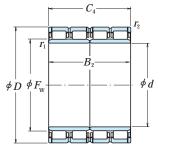


Figure 1

Figure 2



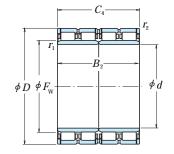


Figure 3

Figure 4

		Во		imensions	Basic Load Ratings					
			(mr	n)			(N) {kgf}			
d	D	B, B ₂	C_2	$F_{ m w}$	$r_1 \atop ext{min.}$	$r_{ m 2}$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	$C_{ m r}$	$C_{0\mathrm{r}}$
370 380 390	540 540 550	400 400 400	400 400 400	415 424 434	4 5 5	4 5 5	4 500 000 4 300 000 4 400 000	12 000 000 12 000 000 12 400 000	440 000	1 230 000 1 220 000 1 260 000
400 430 440	560 591 620	410 420 450	410 420 450	445 476 490	5 4 4	2 4 4	5 600 000 4 450 000 6 350 000	16 500 000 13 400 000 19 000 000	455 000	1 680 000 1 370 000 1 940 000
450 460 480	630 670 680	450 500 500	450 500 500	500 522 534	4 6 5	4 6 5	5 950 000 7 650 000 7 700 000	17 500 000 22 700 000 23 100 000	780 000	1 780 000 2 320 000 2 360 000
500	690 700 720	510 515 530	510 515 530	552 554 560	5 5 6	5 5 6	7 750 000 7 800 000 8 550 000	24 600 000 23 800 000 25 300 000	800 000	2 500 000 2 430 000 2 580 000
520 530 570	735 780 815	535 570 594	535 570 594	574.5 601 628	5 6 6	5 6 6	8 900 000 10 100 000 11 700 000	26 300 000 29 200 000 33 500 000	910 000 1 030 000 1 190 000	
610 650 690	870 920 980	660 690 715	660 690 715	680 723 767.5	6 7.5 7.5	6 7.5 7.5	13 200 000 14 200 000 15 300 000	41 500 000 45 000 000 48 000 000	1 340 000 1 450 000 1 560 000	4 600 000
700	930 980	620 700	620 700	763 774	6	6 6	11 100 000 15 300 000	38 000 000 49 000 000	1 130 000 1 560 000	
725 760 800	1 000 1 080 1 080	700 805 750	700 790 750	796 845 880	6 6 6	6 6 6	15 600 000 19 000 000 16 000 000	51 000 000 61 000 000 56 500 000	1 590 000 1 940 000 1 630 000	6 200 000
820	1 160 1 100	840 745	840 720	911 892	7.5 6	7.5 3	21 900 000 16 900 000	71 500 000 58 500 000	2 230 000 1 720 000	
850	1 180	850	850	940	7.5	7.5	21 100 000	72 000 000	2 150 000	7 350 000
860	1 130 1 160	670 735	670 710	934 940	6 7.5	6 4	15 700 000 17 500 000	56 500 000 60 000 000	1 600 000 1 780 000	
900 920	1 230 1 280	895 865	870 850	985 1 015	7.5 7.5	7.5 7.5	22 100 000 24 000 000	76 000 000 80 000 000	2 250 000 2 450 000	

Remarks	1.	For four-row c	vlindrical roll	er bearings	not listed a	bove.	please contact NS	K.
Kemarks		TOT TOUT TOW C	yiii laricar rom	ci bearings	not nateu t	ibovc,	picase contact 145	١٠.

^{2.} Four-row cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.

Bearing Numbers	Mass (kg)	Figures	Reference Bearing Numbers
370 RV 5401	311	1	_
380 RV 5401	280	1(¹)	
390 RV 5521	303	2(1)	_
400 RV 5611	315	3	313015
430 RV 5921	347	2	—
440 RV 6221	430	2	—
450 RV 6321	440	2	_
460 RV 6721	596	2(¹)	_
480 RV 6811	610	3	_
500 RV 6921	580	2(1)	_
500 RV 7021	622	2(1)	_
500 RV 7211	782	3	_
520 RV 7331	750	4	_
530 RV 7811	960	3	_
570 RV 8111	960	3	_
610 RV 8711	1 330	3	_
650 RV 9211	1 520	3	_
690 RV 9831	1 790	4	_
700 RV 9311	1 200	3	_
700 RV 9821	1 720	2(¹)	_
725 RV 1011	1 670	3	_
760 RV 1032	2 430	4	_
800 RV 1032	2 050	4	_
820 RV 1121	2 900	2(¹)	_
820 RV 1132	2 000	4	_
850 RV 1111	2 850	3	_
860 RV 1132	1 780	4	_
860 RV 1133	2 200	4	_
900 RV 1211	3 200	3	_
920 RV 1211	3 510	3	_

Note (1) Oil holes and oil grooves are provided at the center of outer rings.

Axle Bearings Traction Motor Bearings Gear Unit Bearings

Railway Rolling Stock Bearings

Railway rolling stock bearings are important components of rolling stocks that require high

The main bearings consist of axle bearings that are mounted at both ends of axle and support the entire weight of the rolling stock. Additionally, there are railway traction motor bearings that are used for the motor that drives the axle; and gear unit bearings that transfer the power from the motor to the axle. NSK has designed and manufactured specific bearings for these very applications.

Types and Features

Axle Bearings

- Axle bearings consist of the following types of bearings to meet operator demands for high-speed capability of rolling stock, weight reductions, and minimal maintenance and inspection requirements:
 - Cylindrical roller bearings with a thrust collar (oil bath lubrication, grease lubrication)
 Tapered roller bearings (oil bath lubrication)

 - > Sealed-clean rotating end cap cylindrical roller bearings(grease lubrication)
 - > Sealed-clean rotating end cap tapered roller bearings (grease lubrication)
- NSK has been approved by AAR (Association of American Railroads).

Traction Motor Bearings

- · Bearings for inverter controlled AC motors are speciality designed to meet high-speed specifications and requirements for ensuring dimensional stability. NSK recommends longlife grease for these bearings.
- NSK offers the following bearings as a measure against electric erosion, which occurs when electric current is allowed to flow through the motor bearings:
 Ceramic-insulated bearings (ceramic-coated bearings) and PPS-insulated bearings
- High capacity bearings also available for locomotive-type large traction motors

Gear Unit Bearings

- These bearings are designed to meet high-speed specifications and offer excellent seizure
- · A reinforced cage has been adopted for these bearings.

Specified catalogs

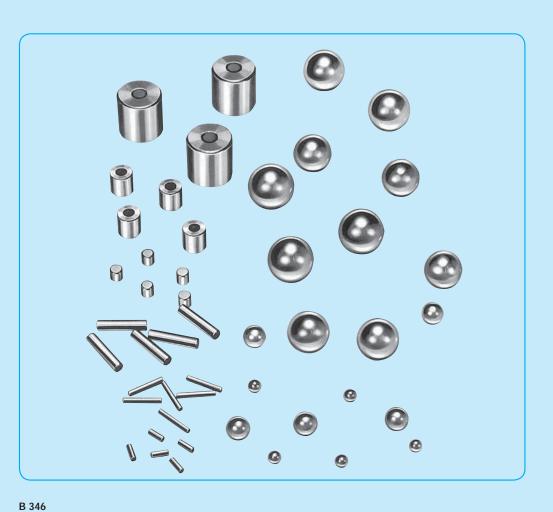
- Bearings for Railway Rolling Stock CAT. No. E1156
- Axle Bearings for Railway Rolling Stock (Cylindrical Roller Bearings) CAT. No. E1239
 Axle Bearings for Railway Rolling Stock (Spherical Roller Bearings) CAT. No. E1240
 Bearings for Traction Motors CAT. No. E1241

B 344 B 345

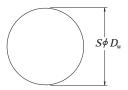


STEEL BALLS AND ROLLERS

STEEL BALLS FOR BALL BEARINGS	Nominal Diameter 0.3 – 114.3mm B34
CYLINDRICAL ROLLERS FOR ROLLER BEARINGS	Nominal Diameter 3 – 80mm····· B35
LONG CYLINDRICAL ROLLERS FOR ROLLER BEARINGS	Nominal Diameter 5.5 – 15mm····· B35
NEEDLE ROLLERS FOR ROLLER BEARINGS	Nominal Diameter 1 – 5mm B35







Nominal Size, Basic Diameters, and Mass

Nominal Size	Basic Diameter $D_{ m w}$ (mm)	Mass (kg) per 10000 pcs approx.	Nominal Size	Basic Diameter $D_{ m w}$ (mm)	Mass (kg) per 1000 pcs approx.	Nominal Size	Basic Diameter $D_{\rm w}$ (mm)	Mass (kg) per 10 pcs approx.
0.3 mm	0.30000	0.0011	3/8	9.52500	3.523	30 mm	30.00000	1.101
0.4 mm	0.40000	0.0026	10 mm	10.00000	4.076	1 ³ /16	30.16250	1.119
0.5 mm	0.50000	0.0051	13/32	10.31875	4.479	1 ¹ /4	31.75000	1.305
0.6 mm	0.60000	0.0088	11 mm	11.00000	5.425	32 mm	32.00000	1.336
0.025	0.63500	0.0104	7/16	11.11250	5.594	1 ⁵ /16	33.33750	1.510
0.7 mm	0.70000	0.0140	11.5 mm	11.50000	6.199	34 mm	34.00000	1.602
1/32	0.79375	0.0204	15/32	11.90625	6.880	1 ³ / ₈	34.92500	1.736
0.8 mm	0.80000	0.0209	12 mm	12.00000	7.044	35 mm	35.00000	1.748
1 mm	1.00000	0.0408	1/2	12.70000	8.350	36 mm	36.00000	1.902
3/64	1.19062	0.0688	13 mm	13.00000	8.955	1 ⁷ / ₁₆	36.51250	1.984
1.2 mm	1.20000	0.0704	17/32	13.49375	10.02	38 mm	38.00000	2.237
1.5 mm	1.50000	0.1376	14 mm	14.00000	11.19	1 ¹ / ₂	38.10000	2.254
1/16	1.58750	0.1631	9/16	14.28750	11.89	1 9/16	39.68750	2.548
5/64	1.98438	0.3185	15 mm	15.00000	13.76	40 mm	40.00000	2.609
2 mm	2.00000	0.3261	19/32	15.08125	13.98	1 5/8	41.27500	2.866
3/32	2.38125	0.5504	5/8	15.87500	16.31	1 ¹¹ / ₁₆	42.86250	3.210
2.5 mm	2.50000	0.6369	16 mm	16.00000	16.70	1 ³ / ₄	44.45000	3.580
7/64	2.77812	0.8740	21/32	16.66875	18.88	45 mm	45.00000	3.714
3 mm	3.00000	1.101	17 mm	17.00000	20.03	1 ¹³ /16	46.03750	3.977
1/8	3.17500	1.305	11/16	17.46250	21.71	1 ⁷ /8	47.62500	4.403
3.5 mm	3.50000	1.748	18 mm	18.00000	23.77	1 ¹⁵ /16	49.21250	4.858
9/64	3.57188	1.858	23/32	18.25625	24.80	50 mm	50.00000	5.095
5/32	3.96875	2.548	19 mm	19.00000	27.96	2	50.80000	5.344
4 mm	4.00000	2.609	3/4	19.05000	28.18	2 1/8	53.97500	6.410
4.5 mm	4.50000	3.714	25/32	19.84375	31.85	55 mm	55.00000	6.782
3/16	4.76250	4.403	20 mm	20.00000	32.61	2 1/4	57.15000	7.609
5 mm	5.00000	5.095	13/16	20.63750	35.83	60 mm	60.00000	8.805
5.5 mm	5.50000	6.782	21 mm	21.00000	37.75	2 3/8	60.32500	8.948
7/32	5.55625	7.016	27/32	21.43125	40.12	2 1/2	63.50000	10.44
15/64	5.95312	8.600	22 mm	22.00000	43.40	65 mm	65.00000	11.19
6 mm	6.00000	8.805	7/8	22.22500	44.75	2 ⁵ / ₈	66.67500	12.08
1/4	6.35000	10.44	23 mm	23.00000	49.60	2 ³ / ₄	69.85000	13.89
6.5 mm	6.50000	11.19	29/32	23.01875	49.72	2 ⁷ / ₈	73.02500	15.87
7 mm 9/32	6.74688 7.00000 7.14375	12.52 13.98 14.86	15/16 24 mm 31/32	23.81250 24.00000 24.60625	55.04 56.35 60.73	3 3 1/4 3 1/2	76.20000 82.55000 88.90000	18.04 22.93 28.64
7.5 mm 5/16 8 mm	7.50000 7.93750 8.00000	17.20 20.38 20.87	25 mm 1 26 mm	25.00000 25.40000 26.00000	63.69 66.80 71.64	3 ³ / ₄	95.25000 101.60000	35.23 42.75
8.5 mm 11/32 9 mm	8.50000 8.73125 9.00000	25.03 27.13 29.72	1 1/16 28 mm 1 1/8	26.98750 28.00000 28.57500	80.12 89.48 95.11			

Application, Nominal Size, Tolerances, Roughness, and Gauges

Units : µm

						•		
		Tolerances(1)			Gauges			
Class	Variation in Dia. max.	Sphericity max.	Roughness R_a max.	Diameter Difference per Lot max.	Gauge Interval	Gauge		
G 3	0.08	0.08	0.010	0.13	0.5	- 5, ·····, - 0.5, 0, + 0.5, ·····, + 5		
G 5	0.13	0.13	0.014	0.25	1	- 5,, - 1 , 0, + 1 ,, + 5		
G 10	0.25	0.25	0.020	0.5	1	- 9,, - 1 , 0, + 1 ,, + 9		
G 16	0.4	0.4	0.025	0.8	2	-10,, - 2 , 0, + 2 ,, +10		
G 20	0.5	0.5	0.032	1	2	-10,, - 2 , 0, + 2 ,, +10		
G 24	0.6	0.6	0.040	1.2	2	-12, ·····, - 2 , 0, + 2 , ·····, +12		
G 28	0.7	0.7	0.050	1.4	2	-12, ·····, - 2 , 0, + 2 , ·····, +12		
G 40	1	1	0.060	2	4	-16, ·····, - 4 , 0, + 4 , ·····, +16		
G 60	1.5	1.5	0.080	3	6	-18, ·····, - 6 , 0, + 6 , ·····, +18		
G100	2.5	2.5	0.100	5	10	-40, ·····, -10 , 0, +10 , ·····, +40		
G200	5	5	0.150	10	15	–60, ······, –15 , 0, +15 , ······, +60		

Note (1) The values do not take into account surface defects; hence measurement shall be taken outside such defects.

Hardness

	Hardness				
Nominal Size	HV	HRC			
0.3 mm ~ 3 mm	772~900	(63~67)(1)			
1/8 ~ 30 mm	_	62~67			
1 3/16 ~ 4	_	61~67			

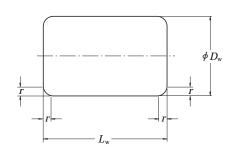
Note (1) Values in () are converted values for reference.

Remarks A column blue letter of Nominal Size is inch dimensions.



Tolerances for Cylindrical Roller Chamfers

Units: mm



	Units : mm
min.	max.
0.1 0.2 0.3 0.5 0.6 0.7 1 1.5 2	0.3 0.5 0.8 1.2 1.5 1.7 2.2(1) 3.5

Note (1) If $D_{\rm W}$ exceeds 40 mm, r (max.) is 2.7 mm.

U	n	its	:	mn
_		113		11111

Nominal Size	$D_{ m W}$	$L_{ m W}$	r min.	Mass (kg) per 100 pcs approx.
3 × 3	3	3	0.1	0.016
3 × 5		5	0.1	0.027
3.5× 5	3.5	5	0.2	0.037
4 × 4	4	4	0.2	0.039
4 × 6	4	6	0.2	0.058
4 × 8	4	8	0.2	0.078
4.5× 4.5	4.5	4.5	0.2	0.055
4.5× 6	4.5	6	0.2	0.073
5 × 5	5	5	0.2	0.075
5 × 8	5	8	0.2	0.121
5 ×10	5	10	0.2	0.152
5.5× 5.5	5.5	5.5	0.2	0.10
5.5× 8	5.5	8	0.2	0.146
6 × 6	6	6	0.2	0.13
6 × 8	6	8	0.2	0.178
6 ×12	6	12	0.2	0.261
6.5× 6.5	6.5	6.5	0.3	0.166
6.5× 9	6.5	9	0.3	0.23
7 × 7	7	7	0.3	0.206
7 ×10	7	10	0.3	0.296
7 ×14	7	14	0.3	0.415
7.5× 7.5	7.5	7.5	0.3	0.254
7.5×11	7.5	11	0.3	0.375
8 × 8	8	8	0.3	0.31
8 ×12	8	12	0.3	0.465
9 × 9	9	9	0.3	0.44
9 ×14	9	14	0.3	0.68
10 ×10	10	10	0.3	0.60
10 ×14	10	14	0.3	0.85
11 ×11	11	11	0.3	0.81
11 ×15	11	15	0.3	1.1
12 ×12	12	12	0.3	1.04
12 ×18	12	18	0.3	1.57

13 ×13 13 ×20

14 ×14 14 ×20

13 13

14 14

13 20

14 20

0.3 0.3

0.3 0.3

1.33 2.04

1.66 2.38

Nominal Size	D_{W}	$L_{ m W}$	r min.	Mass (kg) per 100 pcs approx.
15 × 15 15 × 22 16 × 16 16 × 24 17 × 17 17 × 24 18 × 18 18 × 26 19 × 19 19 × 28 20 × 20 20 × 30 21 × 21 21 × 30 22 × 22 22 × 34 23 × 23 23 × 34 24 × 24 24 × 26 25 × 25 26 × 40 28 × 28 28 × 28 28 × 24 24 × 36 25 × 25 26 × 36 26 × 36 30 × 30 30 × 48 32 × 32 32 × 32 33 × 34 40 × 65	15 15 16 16 17 17 18 18 19 20 20 21 21 22 23 23 24 24 25 26 26 28 28 30 30 32 32 34 34 36 36 38 38 40 40	15 22 16 24 17 24 18 26 19 28 20 30 21 30 22 34 23 34 24 36 25 36 40 28 44 30 48 32 55 36 55 36 55 36 56 40 40 48 57 57 57 57 58 58 58 58 58 58 58 58 58 58 58 58 58	0.5 0.5 0.5 0.5 0.5 0.5 0.6 0.6 0.6 0.6 0.6 0.6 0.7 0.7 0.7 0.7 0.7 0.7 0.7 1 1 1 1 1	2.04 3.0 2.48 3.75 2.97 4.2 3.55 5.1 4.16 6.1 4.85 7.3 5.6 8.0 6.4 10 7.4 11.2 8.4 11.2 8.4 10.7 10.7 10.7 16.4 13.3 21 16.3 22.9 32.5 23.9 32.5 23.9 33.5 33.5 33.5 33.5 33.5 33.5 33.5 3
- 1 0 / 03	70	0.5	'	0.5

1	ī	ni	ts	m	m

				OTHES ! IIIII
Nominal Size	D_{W}	$L_{ m W}$	r min.	Mass (kg) per 100 pcs approx.
42 × 42	42	42	1	45
45 × 45	45	45	1	55.5
48 × 48	48	48	1	67
50 × 50	50	50	1	76
52 × 52	52	52	1.5	85
54 × 54	54	54	1.5	95.5
56 × 56	56	56	1.5	107
60 × 60	60	60	1.5	131
64 × 64	64	64	1.5	159
68 × 68	68	68	1.5	191
75 × 75	75	75	2	256
80 × 80	80	80	2	310

Accuracy of Cylindrical Rollers

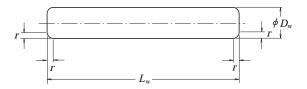
Units : μm

Class		w m)	Out-of- Roundness (1)	Single Plane Mean Roller Diameter Variation(2)	Lot Diameter Variation(1)	Length Deviation $^{(3)}$ $\Delta L_{ m Ws}$		Roller Gauge Lot Length Variation	End Face Runout
	over	incl.	ΔR max.	$V\!D_{ m Wmp}$ max.	$V\!D_{ m WL}$ max.	high	low ⁽⁴⁾	$VL_{ m WL}$ max.	$S_{ m W}$ max.
1	3	18	0.5	0.8	1	+10	-[(IT9)-10]	5	3
1A	3	30	0.7	1	1.5	+10	-[(IT9)-10]	7	5
2	3	50	1	1.5	2	+10	-[(IT9)-10]	10	6
2A	10	80	1.3	2	2.5	+10	-[(IT9)-10]	13	8
3	18	80	1.5	3	3	+10	-[(IT9)-10]	15	10
5	30	80	2.5	4	5	+10	-[(IT9)-10]	25	15

- (¹) Applicable to roller center (length direction).
 (²) Applicable to cylindrical outside surface.
 (³) To find the IT9 standard tolerance according to the L_W size classification, refer to the IT9 column of the Appendix Table 11
- (4) The value for low of length deviation is subtracted 10 μm from the value of the standard tolerance for each roller length.

B 350 B 351





Remarks The figure shows an example of a flat-end long cylindrical roller.

U	In	its	÷	mm

				Units : mm
Nominal Size	$D_{ m W}$	$L_{ m W}$	r (¹) min.	Mass (kg) per 100 pcs approx.
5.5×18	5.5	18	0.2	0.333
5.5×22.4	5.5	22.4	0.2	0.414
5.5×28	5.5	28	0.2	0.518
6 ×20 6 ×25 6 ×31.5 6 ×40 6 ×50	6 6 6 6	20 25 31.5 40 50	0.2 0.2 0.2 0.2 0.2 0.2	0.44 0.55 0.693 0.88 1.1
6.5×20	6.5	20	0.3	0.516
6.5×25	6.5	25	0.3	0.645
6.5×31.5	6.5	31.5	0.3	0.813
7 ×22.4	7	22.4	0.3	0.671
7 ×28	7	28	0.3	0.838
7 ×35.5	7	35.5	0.3	1.06
7 ×45	7	45	0.3	1.35
7 ×56	7	56	0.3	1.68
7.5×31.5	7.5	31.5	0.3	1.08
7.5×40	7.5	40	0.3	1.38

Nominal Size	$D_{ m W}$	$L_{ m W}$	<i>r</i> (¹) min.	Mass (kg) per 100 pcs approx.
8 ×25 8 ×31.5 8 ×40 8 ×50 8 ×63	0000000	25 31.5 40 50 63	0.3 0.3 0.3 0.3 0.3	0.978 1.23 1.56 1.96 2.46
9 ×28 9 ×35.5 9 ×45 9 ×56	9 9 9	28 35.5 45 56	0.3 0.3 0.3 0.3	1.39 1.76 2.23 2.77
10×31.5 10×40 10×50 10×63	10 10 10 10	31.5 40 50 63	0.3 0.3 0.3 0.3	1.93 2.44 3.06 3.85
12×40 12×50 12×63	12 12 12	40 50 63	0.3 0.3 0.3	3.52 4.4 5.54
15×45 15×56 15×71 15×90	15 15 15	45 56 71 90	0.5 0.5 0.5 0.5	6.16 7.68 9.74 12.4

Units: mm

(1) Only for flat-end rollers.

Tolerances for Long Cylindrical Roller Chamfers

	Units : mm
min.	max.
0.2 0.3 0.5	0.5 0.8 1.2

Accuracy of Long Cylindrical Rollers

Units: um

				- · · · · · · · · · · · · · ·
Class	Out-of-Roundness (1)	Single Plane Mean Roller Diameter Variation ⁽³⁾ <i>VD</i> _{Wmp} max.	Roller Gauge Lot Diameter Variation $^{(1)}$ $VD_{ m WL}$ max.	Length Deviation(2) $ extstyle eta L_{ extstyle Ws}$
3	1.5	3	3	h12
5	2	5	5	h12

- $\begin{array}{ll} \text{(1)} & \text{Applicable to roller center (length direction).} \\ \text{(2)} & \text{Classified by L_{W}}. \text{ Refer to Tolerauce for Length Doviation.} \\ \text{(3)} & \text{Applicable to cylindrical outside surface.} \end{array}$

Tolerance for Length Deviation

Units: mm

Length		h12		h13	
over	incl.	high low		high	low
3	6	_		0	- 0.18
6	10	_		0	- 0.22
10	18	_		0	- 0.27
18	30	0	- 0.21	0	-0.33
30	50	0	- 0.25	0	-0.39
50	80	0 - 0.30			_
80	120	0	- 0.35	-	_

B 352 B 353





Spherical-end Type

Units: mm

Units: mm

				OTIKS . IIIII					OTHES . IIIII
Nominal Size	D_{W}	$L_{ m W}$	<i>r</i> (¹) min.	Mass (kg) per 1000 pcs approx.	Nominal Size	$D_{ m W}$	$L_{ m W}$	<i>r</i> (¹) min.	Mass (kg) per 1000 pcs approx.
1 × 5.8 1 × 6.8 1 × 9.8 1.5× 6.8 1.5× 6.8 1.5× 11.8 1.5× 11.8 2 × 11.8 3 × 11.	1 1 1 1 1 1 1 1 1 222 222 22 222 222 22	5.888.888.888.888.888.888.888.888.888.8	0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	0.035 0.0448 0.060 0.080 0.105 0.135 0.165 0.165 0.1690 0.240 0.2335 0.385 0.485 0.485 0.485 0.485 0.450 0.525 0.680 0.755 0.680 0.755 0.680 0.760 0.7	3.5×21.8 3.5×223.8 3.5×25.8 3.5×27.8 3.5×27.8 3.5×34.8 4 ×17.8 4 ×17.8 4 ×21.8 4 ×21.8 4 ×27.8 4 ×27.8 4 ×27.8 4 ×27.8 4 ×27.8 4 ×27.8 4 ×37.8 4 ×37.8 4 ×37.8 4 ×37.8 4 ×37.8 5 ×34.8 5 ×34.8 5 ×34.8 5 ×34.8 5 ×34.8 5 ×37.8 5 ×37.8	555 555 555 33 333 333 444 444 444 444 444 444 555 555	191.88 213.888 223.888 225.888	0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	1.50 1.65 1.80 1.95 2.10 2.40 2.63 1.55 1.75 2.35 1.75 2.35 2.70 2.90 3.40 3.70 2.45 2.95 3.40 3.70 2.45 3.70 3.30 4.70 3.33 4.70 3.33 4.70 4.70 3.33 4.70 4.70 4.70 4.70 4.70 4.70 4.70 4.70

Note (1) Only for flat-end rollers.

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Remarks 1. The figure shows a spherical-end type and a flat-end type.

2. The radius R of the spherical-end type is bounded by the following range:

Minimum: $D_{\rm w}/2$ Maximum: $L_{\rm W}/2$



Flat-end Type

Tolerances for Needle Roller Chamfers

			Othico : min
L	\ w	г	Г
over	incl.	min.	max.
_	1	0.1	0.4
1	3	0.1	0.6
3	5	0.1	0.9

Remarks Only for flat-end needle rollers.

Accuracy of Needle Rollers

Units : μm

Class	Single Plane Mean Roller Diameter Variation ⁽¹⁾ <i>VD</i> _{WP} max.	Out-of-Roundness (1) ΔR max.	Roller Gauge Lot Diameter Variation ⁽¹⁾ <i>VD</i> _{WL} max.	Length Deviation(2) $ extstyle extstyle L_{ m Ws}$
2	1	1	2	h13
3	1.5	1.5	3	h13
5	2	2.5	5	h13

- (¹) Applicable to roller center (length direction). (²) Classified by $L_{\rm W}$. Refer to Tolerance for Length Deviation in Page

Remarks The actual diameter at any place along the entire length should not exceed the following figures compared to the actual maximum diameter at the roller center (length direction).

Class2: 0.5µm

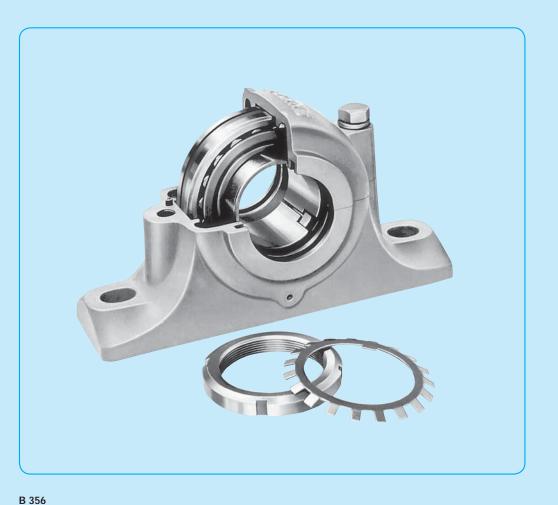
Class3: 0.8µm

Class5: 1.0µm



ACCESSORIES FOR ROLLING BEARINGS

ADAPTERS FOR ROLLING BEARINGS	Shaft Diameter 17 – 470mm·····	B358
WITHDRAWAL SLEEVES FOR ROLLING BEARINGS	Shaft Diameter 35 – 480mm·····	B36
NUTS FOR ROLLING BEARINGS		B37:
STOPPERS FOR ROLLING BEARI	NGS	B37
LOCK-WASHERS FOR ROLLING	BEARINGS	B378

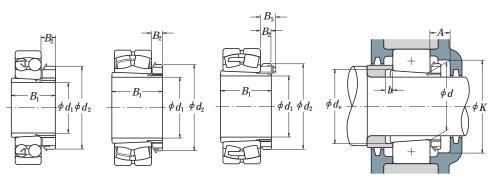


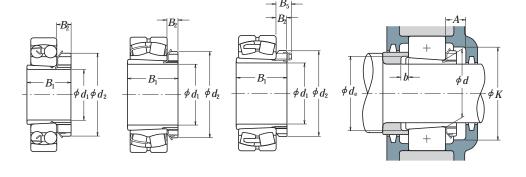
B 356 B 357

NSK

Shaft Diameter 45 – 60 mm

Shaft Diameter 17 – 40 mm





Shaft	Nominal Bearing			Dimens (mr			Adapter	Abu	tment D (mr		ons	Mass (kg)
Diameter (mm) d_1	(mm) d	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	A min.	<i>K</i> min.	$d_{ m e}$ min.	${\color{red} b}_{\text{min.}}$	approx.
17	20 20 20 20	1204K + H 204X 2204K + H 304X 1304K + H 304X 2304K + H2304X	24 28 28 31	32 32 32 32	7 7 7 7	_ _ _ _	A 204X A 304X A 304X A 2304X	14 14 14 14	39 39 39 39	23 24 24 24	5 5 8 5	0.045 0.045 0.045 0.050
20	25 25 25	1205K + H 205X 2205K + H 305X 1305K + H 305X	26 29 29	38 38 38	8 8 8	_ _ _	A 205X A 305X A 305X	15 15 15	45 45 45	28 29 29	5 5 6	0.065 0.075 0.075
	25 25	21305C DKE4 + H 305X 2305K + H2305X	29 35	38 38	8 8	_	A 305X A 2305X	15 15	45 45	29 29	6 5	0.075 0.090
25	30 30 30	1206K + H 206X 2206K + H 306X 1306K + H 306X	27 31 31	45 45 45	8 8 8	_	A 206X A 306X A 306X	15 15 15	50 50 50	33 34 34	5 5 6	0.10 0.11 0.11
	30 30	21306C DKE4 + H 306X 2306K + H2306X	31 38	45 45	8 8	_	A 306X A 2306X	15 15	50 50	34 35	6 5	0.11 0.125
30	35 35 35	1207K + H 207X 2207K + H 307X 1307K + H 307X	29 35 35	52 52 52	9 9 9	_	A 207X A 307X A 307X	17 17 17	58 58 58	38 39 39	5 5 7	0.125 0.145 0.145
	35 35	21307C DKE4 + H 307X 2307K + H2307X	35 43	52 52	9 9	_	A 307X A 2307X	17 17	58 58	39 40	7 5	0.145 0.16
35	40 40 40	1208K + H 208X 2208K + H 308X 1308K + H 308X	31 36 36	58 58 58	10 10 10	_	A 208X A 308X A 308X	17 17 17	65 65 65	44 44 44	5 5 5	0.175 0.19 0.19
	40 40 40	21308E AKE4 + H 308X 2308K + H2308X 22308E AKE4 + H2308X	36 46 46	58 58 58	10 10 10	_	A 308X A 2308X A 2308X	17 17 17	65 65 65	44 45 45	5 5 5	0.19 0.225 0.225
40	45 45 45	1209K + H 209X 2209K + H 309X 1309K + H 309X	33 39 39	65 65 65	11 11 11	_ _ _	A 209X A 309X A 309X	17 17 17	72 72 72	49 49 49	5 8 5	0.225 0.26 0.26
	45 45 45	21309E AKE4 + H 309X 2309K + H2309X 22309E AKE4 + H2309X	39 50 50	65 65 65	11 11 11	_ _	A 309X A 2309X A 2309X	17 17 17	72 72 72	49 50 50	5 5 5	0.26 0.30 0.30

Shaft	Nominal Bearing			Dimens (mn			Adapter	Abut	tment D (mr		ons	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	$A \atop ext{min.}$	<i>K</i> min.	$d_{\!$	$m{b}_{ ext{min.}}$	approx.
45	50 50 50	1210K + H 210X 2210K + H 310X 1310K + H 310X	35 42 42	70 70 70	12 12 12	_ _ _	A 210X A 310X A 310X	19 19 19	76 76 76	53 54 54	5 10 5	0.275 0.30 0.30
	50 50 50	21310E AKE4 + H 310X 2310K + H2310X 22310E AKE4 + H2310X	42 55 55	70 70 70	12 12 12		A 310X A 2310X A 2310X	19 19 19	76 76 76	54 56 56	5 5 5	0.30 0.35 0.35
50	55 55 55	1211K + H 211X 2211K + H 311X 22211E AKE4 + H 311X	37 45 45	75 75 75	12 12 12		A 211X A 311X A 311X	19 19 19	85 85 85	60 60 60	6 11 11	0.305 0.35 0.35
	55 55 55 55	1311K + H 311X 21311E AKE4 + H 311X 2311K + H2311X 22311E AKE4 + H2311X	45 45 59 59	75 75 75 75	12 12 12 12	_ _ _	A 311X A 311X A2311X A2311X	19 19 19 19	85 85 85 85	60 60 61 61	6 6 6	0.35 0.35 0.40 0.40
55	60 60 60	1212K + H 212X 2212K + H 312X 22212E AKE4 + H 312X	38 47 47	80 80 80	13 13 13		A 212X A 312X A 312X	20 20 20	90 90 90	64 65 65	5 9 9	0.365 0.40 0.40
	60 60 60	1312K + H 312X 21312E AKE4 + H 312X 2312K + H2312X 22312E AKE4 + H2312X	47 47 62 62	80 80 80 80	13 13 13 13	_ _ _	A 312X A 312X A2312X A2312X	20 20 20 20	90 90 90 90	65 65 66 66	5 5 5 5	0.40 0.40 0.45 0.45
60	65 65 65	1213K + H 213X 2213K + H 313X 22213E AKE4 + H 313X	40 50 50	85 85 85	14 14 14	_ _ _	A 213X A 313X A 313X	21 21 21	96 96 96	70 70 70	5 8 8	0.40 0.45 0.45
	65 65 65 65	1313K + H 313X 21313E AKE4 + H 313X 2313K + H2313X 22313E AKE4 + H2313X	50 50 65 65	85 85 85 85	14 14 14 14	_ _ _	A 313X A 313X A2313X A2313X	21 21 21 21	96 96 96 96	70 70 72 72	5 5 5 5	0.45 0.45 0.55 0.55
	70 70 70	22214E AKE4 + H 314X 21314E AKE4 + H 314X 22314E AKE4 + H2314X	52 52 68	92 92 92	14 14 14	_ _ _	A 314X A 314X A2314X	21 21 21	96 96 96	70 70 72	8 5 5	0.65 0.65 0.80

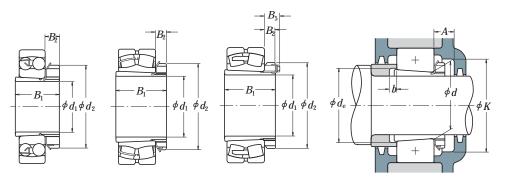
Remarks The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

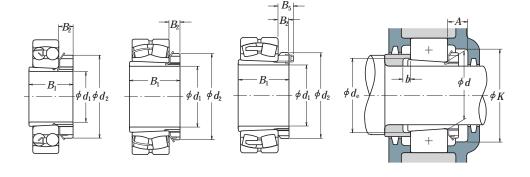
Remarks The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

Shaft Diameter 85 – 115 mm

NSK

Shaft Diameter 65 – 80 mm





Shaft	Nominal Bearing			Dimen: (mr			Adapter	Abu	tment D (mr		ons	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	A min.	<i>K</i> min.	$d_{ m e}$ min.	$m{b}_{ ext{min.}}$	approx.
65	75 75 75	1215K + H 215X 2215K + H 315X 22215E AKE4 + H 315X	43 55 55	98 98 98	15 15 15	_ _ _	A 215X A 315X A 315X	23 23 23	110 110 110	80 80 80	5 12 12	0.70 0.85 0.85
	75 75 75 75	1315K + H 315X 21315E AKE4 + H 315X 2315K + H2315X 22315E AKE4 + H2315X	55 55 73 73	98 98 98 98	15 15 15 15	_ _ _	A 315X A 315X A 2315X A 2315X	23 23 23 23	110 110 110 110	80 80 82 82	5 5 5 5	0.85 0.85 1.05 1.05
70	80 80 80	1216K + H 216X 2216K + H 316X 22216E AKE4 + H 316X	46 59 59	105 105 105	17 17 17	 	A 216X A 316X A 316X	25 25 25	120 120 120	85 86 86	5 12 12	0.85 1.05 1.05
	80 80 80 80	1316K + H 316X 21316E AKE4 + H 316X 2316K + H2316X 22316E AKE4 + H2316X	59 59 78 78	105 105 105 105	17 17 17 17		A 316X A 316X A 2316X A 2316X	25 25 25 25	120 120 120 120	86 86 87 87	5 5 5 5	1.05 1.05 1.3 1.3
75	85 85 85	1217K + H 217X 2217K + H 317X 22217E AKE4 + H 317X	50 63 63	110 110 110	18 18 18		A 217X A 317X A 317X	27 27 27	128 128 128	90 91 91	6 12 12	1.0 1.2 1.2
	85 85 85 85	1317K + H 317X 21317E AKE4 + H 317X 2317K + H2317X 22317E AKE4 + H2317X	63 63 82 82	110 110 110 110	18 18 18 18	_ _ _	A 317X A 317X A 2317X A 2317X	27 27 27 27	128 128 128 128	91 91 94 94	6 6 6	1.2 1.2 1.45 1.45
80	90 90 90	1218K + H 218X 2218K + H 318X 22218E AKE4 + H 318X	52 65 65	120 120 120	18 18 18	_ _ _	A 218X A 318X A 318X	28 28 28	139 139 139	95 96 96	6 10 10	1.15 1.4 1.4
	90 90 90	1318K + H 318X 21318E AKE4 + H 318X 2318K + H2318 X	65 65 86	120 120 120	18 18 18		A 318X A 318X A2318X	28 28 28	139 139 139	96 96 99	6 6 6	1.4 1.4 1.7
	90 90	23218C KE4 + H2318X 22318E AKE4 + H2318X	86 86	120 120	18 18	_	A 2318X A 2318X	28 28	139 139	99 99	6 6	1.7 1.7

Shaft Diameter	Nominal Bearing Bore Dia.	Nominal Numbers		Dimen (mr			Adapter Sleeve	Abu	tment D (mi		ons	Mass (kg)
(mm) d_1	(mm) d	Applicable Bearings	B_1	d_2	B_2	B_5	Numbers	A min.	<i>K</i> min.	$d_{\!\scriptscriptstyle m e}$ min.	$m{b}$ min.	approx.
85	95 95 95	1219K + H 219X 2219K + H 319X 22219E AKE4 + H 319X	55 68 68	125 125 125	19 19 19	_	A 219X A 319X A 319X	29 29 29	145 145 145	101 102 102	7 9 9	1.35 1.55 1.55
	95 95 95 95	1319K + H 319X 21319C KE4 + H 319X 2319K + H2319X 22319E AKE4 + H2319X	68 68 90 90	125 125 125 125	19 19 19 19	_ _ _	A 319X A 319X A 2319X A 2319X	29 29 29 29	145 145 145 145	102 102 105 105	7 7 7 7	1.55 1.55 1.9 1.9
90	100 100 100	1220K + H 220X 2220K + H 320X 22220E AKE4 + H 320X	58 71 71	130 130 130	20 20 20	_	A 220X A 320X A 320X	30 30 30	150 150 150	106 107 107	7 8 8	1.45 1.7 1.7
	100 100 100	1320K + H 320X 21320C KE4 + H 320X 2320K + H2320X	71 71 97	130 130 130	20 20 20	_	A 320X A 320X A 2320X	30 30 30	150 150 150	107 107 110	7 7 7	1.7 1.7 2.15
	100 100	23220C KE4 + H2320X 22320E AKE4 + H2320X	97 97	130 130	20 20	_	A 2320X A 2320X	30 30	150 150	110 110	7 7	2.15 2.15
100	110 110 110	23122C KE4 + H3122X 1222K + H 222X 2222K + H 322X	81 63 77	145 145 145	21 21 21	_	A 3122X A 222X A 322X	32 32 32	170 170 170	117 116 117	7 7 6	2.25 1.95 2.3
	110 110 110	22222E AKE4 + H 322X 1322K + H 322X 2322K + H2322X	77 77 105	145 145 145	21 21 21	_	A 322X A 322X A 2322X	32 32 32	170 170 170	117 117 121	6 9 7	2.3 2.3 2.75
	110 110	23222C KE4 + H2322X 22322E AKE4 + H2322X	105 105	145 145	21 21	_	A 2322X A 2322X	32 32	170 170	121 121	17 7	2.75 2.75
110	120 120 120	23024C DKE4 + H3024 23124C KE4 + H3124 22224E AKE4 + H3124	72 88 88	145 155 155	22 22 22	_	A 3024 A 3124 A 3124	33 33 33	180 180 180	127 128 128	7 7 11	1.95 2.65 2.65
	120 120	23224C KE4 + H2324 22324E AKE4 + H2324	112 112	155 155	22 22	_	A 2324 A 2324	33 33	180 180	131 131	17 7	3.2 3.2
115	130 130 130	23026C DKE4 + H3026 23126C KE4 + H3126 22226E AKE4 + H3126	80 92 92	155 165 165	23 23 23	_	A 3026 A 3126 A 3126	34 34 34	190 190 190	137 138 138	8 8 8	2.85 3.65 3.65
	130 130	23226C KE4 + H2326 22326C KE4 + H2326	121 121	165 165	23 23	=	A 2326 A 2326	34 34	190 190	142 142	21 8	4.6 4.6

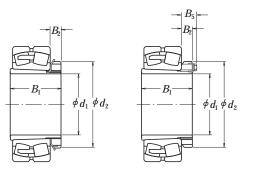
Remarks The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

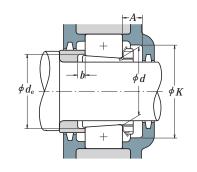
Remarks The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

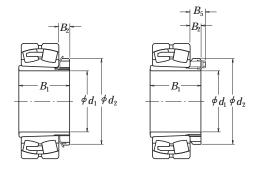
Shaft Diameter 180 – 260 mm

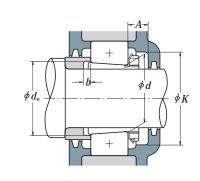
NSK

Shaft Diameter 125 – 170 mm









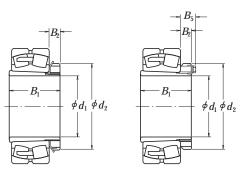
Shaft	Nominal Bearing			Dimen (mr			Adapter	Abu	tment D (mi		ons	Mass (kg)
Diameter (mm) d_1	(mm) (d	Nominal Numbers Applicable Bearings	B_1	$d_{\scriptscriptstyle 2}$	B_2	B_5	Sleeve Numbers	A min.	<i>K</i> min.	$d_{ m e}$ min.	b min.	approx.
125	140 140 140	23028C DKE4 + H3028 23128C KE4 + H3128 22228C DKE4 + H3128	82 97 97	165 180 180	24 24 24	_	A 3028 A 3128 A 3128	36 36 36	205 205 205	147 149 149	8 8 8	3.15 4.35 4.35
	140 140	23228C KE4 + H2328 22328C KE4 + H2328	131 131	180 180	24 24	_	A 2328 A 2328	36 36	205 205	152 152	22 8	5.55 5.55
135	150 150 150	23030C DKE4 + H3030 23130C KE4 + H3130 22230C DKE4 + H3130	87 111 111	180 195 195	26 26 26	_	A 3030 A 3130 A 3130	37 37 37	220 220 220	158 160 160	8 8 15	3.9 5.5 5.5
	150 150	23230C KE4 + H2330 22330C AKE4 + H2330	139 139	195 195	26 26	_	A 2330 A 2330	37 37	220 220	163 163	20 8	6.6 6.6
140	160 160 160	23932C AKE4 + H3932 23032C DKE4 + H3032 23132C KE4 + H3132	78 93 119	190 190 210	28 28 28	_	A 3932 A 3032 A 3132	39 39 39	205 230 230	168 168 170	8 8 8	4.64 5.2 7.65
	160 160 160	22232C DKE4 + H3132 23232C KE4 + H2332 22332C AKE4 + H2332	119 147 147	210 210 210	28 28 28	_	A 3132 A 2332 A 2332	39 39 39	230 230 230	170 174 174	14 18 8	7.65 9.15 9.15
150	170 170 170	23934B CAKE4 + H3934 23034C DKE4 + H3034 23134C KE4 + H3134	79 101 122	200 200 220	29 29 29	_	A 3934 A 3034 A 3134	40 40 40	215 250 250	179 179 180	8 8 8	5.07 6.0 8.4
	170 170 170	22234C DKE4 + H3134 23234C KE4 + H2334 22334C AKE4 + H2334	122 154 154	220 220 220	29 29 29	_	A 3134 A 2334 A 2334	40 40 40	250 250 250	180 185 185	10 18 8	8.4 10 10
160	180 180 180	23936C AKE4 + H3936 23036C DKE4 + H3036 23136C KE4 + H3136	87 109 131	210 210 230	30 30 30	_	A 3936 A 3036 A 3136	41 41 41	230 260 260	189 189 191	8 8 8	5.87 6.85 9.5
	180 180 180	22236C DKE4 + H3136 23236C KE4 + H2336 22336C AKE4 + H2336	131 161 161	230 230 230	30 30 30	_	A 3136 A 2336 A 2336	41 41 41	260 260 260	191 195 195	18 22 8	9.5 11.5 11.5
170	190 190 190	23938C AKE4 + H3938 23038C AKE4 + H3038 23138C KE4 + H3138	89 112 141	220 220 240	31 31 31	_	A 3938 A 3038 A 3138	43 43 43	240 270 270	199 199 202	9 9 9	6.35 7.45 11
	190 190 190	22238C AKE4 + H3138 23238C KE4 + H2338 22338C AKE4 + H2338	141 169 169	240 240 240	31 31 31	_ _ _	A 3138 A 2338 A 2338	43 43 43	270 270 270	202 206 206	21 21 9	11 12.5 12.5

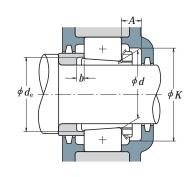
Shaft	Nominal Bearing Bore Dia.	Nominal Numbers		Dimen: (mr			Adapter Sleeve	Abu	tment D (mr		ons	Mass (kg)
d_1	(mm) d	Applicable Bearings	B_1	d_2	B_2	B_5	Numbers	$A \atop ext{min.}$	${\it K}$ min.	$d_{ m e}$ min.	$m{b}_{ ext{min.}}$	approx.
180	200	23940C AKE4 + H3940	98	240	32	_	A 3940	46	260	210	10	8.0
	200	23040C AKE4 + H3040	120	240	32	_	A 3040	46	280	210	10	9.2
	200	23140C KE4 + H3140	150	250	32	_	A 3140	46	280	212	10	12
	200 200 200	22240C AKE4 + H3140 23240C KE4 + H2340 22340C AKE4 + H2340	150 176 176	250 250 250	32 32 32		A 3140 A 2340 A 2340	46 46 46	280 280 280	212 216 216	24 20 10	12 14 14
200	220	23944C AKE4 + H3944	96	260	30	41	A 3944	55	280	231	10	8.32
	220	23044C AKE4 + H3044	128	260	30	41	A 3044	55	320	231	12	10.5
	220	23144C KE4 + H3144	158	280	32	44	A 3144	55	320	233	10	14.5
	220	22244C AKE4 + H3144	158	280	32	44	A 3144	55	320	233	22	14.5
	220	23244C KE4 + H2344	183	280	32	44	A 2344	55	320	236	11	16.5
	220	22344C AKE4 + H2344	183	280	32	44	A 2344	55	320	236	10	16.5
220	240	23948C AKE4 + H3948	101	290	34	46	A 3948	60	300	251	11	11.2
	240	23048C AKE4 + H3048	133	290	34	46	A 3048	60	340	251	11	13
	240	23148C KE4 + H3148	169	300	34	46	A 3148	60	340	254	11	17.5
	240	22248C AKE4 + H3148	169	300	34	46	A 3148	60	340	254	19	17.5
	240	23248C AKE4 + H2348	196	300	34	46	A 2348	60	340	257	6	19.5
	240	22348C AKE4 + H2348	196	300	34	46	A 2348	60	340	257	11	19.5
240	260	23952C AKE4 + H3952	116	310	34	46	A 3952	60	330	272	11	13.4
	260	23052C AKE4 + H3052	147	310	34	46	A 3052	60	370	272	13	15.5
	260	23152C AKE4 + H3152	187	330	36	49	A 3152	60	370	276	11	22
	260	22252C AKE4 + H3152	187	330	36	49	A 3152	60	370	276	25	22
	260	23252C AKE4 + H2352	208	330	36	49	A 2352	60	370	278	2	24
	260	22352C AKE4 + H2352	208	330	36	49	A 2352	60	370	278	11	24
260	280	23956C AKE4 + H3956	121	330	38	50	A 3956	65	350	292	12	15.5
	280	23056C AKE4 + H3056	152	330	38	50	A 3056	65	390	292	12	17.5
	280	23156C AKE4 + H3156	192	350	38	51	A 3156	65	390	296	12	24.5
	280	22256C AKE4 + H3156	192	350	38	51	A 3156	65	390	296	28	24.5
	280	23256C AKE4 + H2356	221	350	38	51	A 2356	65	390	299	11	28
	280	22356C AKE4 + H2356	221	350	38	51	A 2356	65	390	299	12	28

Shaft Diameter 430 – 470 mm

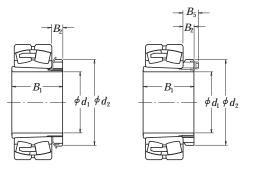
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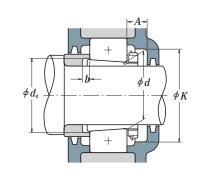
Shaft Diameter 280 – 410 mm





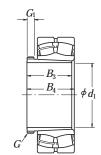
Shaft	Nominal Bearing			Dimen: (mr			Adapter	Abu	tment D (mi		ons	Mass (kg)
Diameter (mm) d_1	(mm) d	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	A min.	<i>K</i> min.	$d_{ m e}$ min.	$m{b}_{ ext{min.}}$	approx.
280	300	23960C AKE4 + H3960	140	360	42	54	A 3960	69	380	313	12	20.7
	300	23060C AKE4 + H3060	168	360	42	54	A 3060	69	430	313	12	23
	300	23160C AKE4 + H3160	208	380	40	53	A 3160	69	430	317	12	30
	300	22260C AKE4 + H3160	208	380	40	53	A 3160	69	430	317	32	30
	300	23260C AKE4 + H3260	240	380	40	53	A 3260	69	430	321	12	34
300	320	23964C AKE4 + H3964	140	380	42	55	A 3964	72	400	334	13	21.8
	320	23064C AKE4 + H3064	171	380	42	55	A 3064	72	450	334	13	24.5
	320	23164C AKE4 + H3164	226	400	42	56	A 3164	72	450	339	13	35
	320	22264C AKE4 + H3164	226	400	42	56	A 3164	72	450	339	39	35
	320	23264C AKE4 + H3264	258	400	42	56	A 3264	72	450	343	13	39.5
320	340	23968C AKE4 + H3968	144	400	45	58	A 3968	75	430	354	14	24.6
	340	23068C AKE4 + H3068	187	400	45	58	A 3068	75	490	355	14	28.5
	340	23168C AKE4 + H3168	254	440	55	72	A 3168	75	490	360	14	49.5
	340	23268C AKE4 + H3268	288	440	55	72	A 3268	75	490	364	14	54.5
340	360	23972C AKE4 + H3972	144	420	45	58	A 3972	75	450	374	14	25.7
	360	23072C AKE4 + H3072	188	420	45	58	A 3072	75	510	375	14	30.5
	360	23172C AKE4 + H3172	259	460	58	75	A 3172	75	510	380	14	54
	360	23272C AKE4 + H3272	299	460	58	75	A 3272	75	510	385	14	60.5
360	380	23976C AKE4 + H3976	164	450	48	62	A 3976	82	480	396	15	31.9
	380	23076C AKE4 + H3076	193	450	48	62	A 3076	82	540	396	15	36
	380	23176C AKE4 + H3176	264	490	60	77	A 3176	82	540	401	15	61.5
	380	23276C AKE4 + H3276	310	490	60	77	A 3276	82	540	405	15	69.5
380	400	23980C AKE4 + H3980	168	470	52	66	A 3980	86	500	417	15	35.2
	400	23080C AKE4 + H3080	210	470	52	66	A 3080	86	580	417	15	41.5
	400	23180C AKE4 + H3180	272	520	62	82	A 3180	86	580	421	15	70.5
	400	23280C AKE4 + H3280	328	520	62	82	A 3280	86	580	427	15	81
400	420	23984C AKE4 + H3984	168	490	52	66	A 3984	86	520	437	16	36.6
	420	23084C AKE4 + H3084	212	490	52	66	A 3084	86	600	437	16	43.5
	420	23184C AKE4 + H3184	304	540	70	90	A 3184	86	600	443	16	84
	420	23284C AKE4 + H3284	352	540	70	90	A 3284	86	600	448	16	94
410	440	23988C AKE4 + H3988	189	520	60	77	A 3988	99	550	458	17	58.6
	440	23088C AKE4 + H3088	228	520	60	77	A 3088	99	620	458	17	65
	440	23188C AKE4 + H3188	307	560	70	90	A 3188	99	620	464	17	104
	440	23288C AKE4 + H3288	361	560	70	90	A 3288	99	620	469	17	118

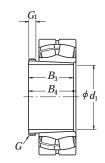




Shaft Diameter	Nominal Bearing Bore Dia.	Nominal Numbers		Dimen: (mr			Adapter Sleeve	Abu	tment D (mr		ons	Mass (kg)
d_1	(mm) d	Applicable Bearings	B_1	d_2	B_2	B_5	Numbers	A min.	<i>K</i> min.	$d_{\! m e}$ min.	b min.	арргох.
430	460	23992C AKE4 + H3992	189	540	60	77	A 3992	99	570	478	17	62
	460	23092C AKE4 + H3092	234	540	60	77	A 3092	99	650	478	17	69.5
	460	23192C AKE4 + H3192	326	580	75	95	A 3192	99	650	485	17	116
	460	23292C AKE4 + H3292	382	580	75	95	A 3292	99	650	491	17	132
450	480	23996C AKE4 + H3996	200	560	60	77	A 3996	99	600	499	18	67.5
	480	23096C AKE4 + H3096	237	560	60	77	A 3096	99	690	499	18	73.5
	480	23196C AKE4 + H3196	335	620	75	95	A 3196	99	690	505	18	133
	480	23296C AKE4 + H3296	397	620	75	95	A 3296	99	690	512	18	152
470	500	239/500C AKE4 + H39/500	208	580	68	85	A 39/500	109	620	519	18	74.6
	500	230/500C AKE4 + H30/500	247	580	68	85	A 30/500	109	700	519	18	82
	500	231/500C AKE4 + H31/500	356	630	80	100	A 31/500	109	700	527	18	143
	500	232/500C AKE4 + H32/500	428	630	80	100	A 32/500	109	700	534	18	166

Shaft Diameter 35 – 85 mm Shaft Diameter 90 – 135 mm



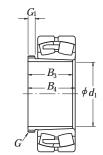


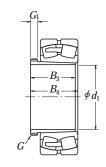
Shaft	Nominal Bearing	Naminal Number	Screw Thread	D	imensions (mm)	i	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	approx.
35 40	40 40 45 45	21308EAKE4 + AH 308 22308EAKE4 + AH 2308 21309EAKE4 + AH 309 22309EAKE4 + AH 2309	M 45 × 1.5 M 45 × 1.5 M 50 × 1.5 M 50 × 1.5	29 40 31 44	6 7 6 7	32 43 34 47	0.09 0.13 0.11 0.165
45	50	21310EAKE4 + AHX 310	M 55 × 2	35	7	38	0.16
	50	22310EAKE4 + AHX 2310	M 55 × 2	50	9	53	0.235
50	55	22211EAKE4 + AHX 311	M 60 × 2	37	7	40	0.19
	55	21311EAKE4 + AHX 311	M 60 × 2	37	7	40	0.19
	55	22311EAKE4 + AHX 2311	M 60 × 2	54	10	57	0.285
55	60	22212EAKE4 + AHX 312	M 65 × 2	40	8	43	0.215
	60	21312EAKE4 + AHX 312	M 65 × 2	40	8	43	0.215
	60	22312EAKE4 + AHX 2312	M 65 × 2	58	11	61	0.34
60	65	22213EAKE4 + AH 313	M 75 × 2	42	8	45	0.255
	65	21313EAKE4 + AH 313	M 75 × 2	42	8	45	0.255
	65	22313EAKE4 + AH 2313	M 75 × 2	61	12	64	0.395
65	70	22214EAKE4 + AH 314	M 80 × 2	43	8	47	0.28
	70	21314EAKE4 + AH 314	M 80 × 2	43	8	47	0.28
	70	22314EAKE4 + AHX 2314	M 80 × 2	64	12	68	0.53
70	75	22215EAKE4 + AH 315	M 85 × 2	45	8	49	0.315
	75	21315EAKE4 + AH 315	M 85 × 2	45	8	49	0.315
	75	22315EAKE4 + AHX 2315	M 85 × 2	68	12	72	0.605
75	80	22216EAKE4 + AH 316	M 90 × 2	48	8	52	0.365
	80	21316EAKE4 + AH 316	M 90 × 2	48	8	52	0.365
	80	22316EAKE4 + AHX 2316	M 90 × 2	71	12	75	0.665
80	85	22217EAKE4 + AHX 317	M 95 × 2	52	9	56	0.48
	85	21317EAKE4 + AHX 317	M 95 × 2	52	9	56	0.48
	85	22317EAKE4 + AHX 2317	M 95 × 2	74	13	78	0.745
85	90	22218E AKE4 + AHX 318	M 100 × 2	53	9	57	0.52
	90	21318E AKE4 + AHX 318	M 100 × 2	53	9	57	0.52
	90	23218C KE4 + AHX 3218	M 100 × 2	63	10	67	0.58
	90	22318E AKE4 + AHX 2318	M 100 × 2	79	14	83	0.845

Shaft	Nominal Bearing Bore Dia.	Nominal Numbers	Screw Thread	D	imensions (mm)	i	Mass (kg)
Diameter (mm) d_1	(mm) d	Applicable Bearings	G	B_3	G_1	B_4	approx.
90	95	22219EAKE4 + AHX 319	M 105 × 2	57	10	61	0.595
	95	21319CKE4 + AHX 319	M 105 × 2	57	10	61	0.595
	95	22319EAKE4 + AHX 2319	M 105 × 2	85	16	89	0.89
95	100	21320CKE4 + AHX 3120	M 110 × 2	64	11	68	0.70
	100	22220EAKE4 + AHX 320	M 110 × 2	59	10	63	0.66
	100	21320CKE4 + AHX 320	M 110 × 2	59	10	63	0.66
	100	23220CKE4 + AHX 3220	M 110 × 2	73	11	77	0.77
	100	22320EAKE4 + AHX 2320	M 110 × 2	90	16	94	1.0
105	110	23122CKE4 + AHX 3122	M 120 × 2	68	11	72	0.76
	110	22222EAKE4 + AHX 3122	M 120 × 2	68	11	72	0.76
	110	24122CK30E4 + AH 24122	M 115 × 2	82	13	91	0.73
	110	23222CKE4 + AHX 3222	M 125 × 2	82	11	86	1.04
	110	22322EAKE4 + AHX 2322	M 125 × 2	98	16	102	1.35
115	120	23024C DKE4 + AHX 3024	M 130 x 2	60	13	64	0.75
	120	24024C K30E4 + AH 24024	M 125 x 2	73	13	82	0.70
	120	23124C KE4 + AHX 3124	M 130 x 2	75	12	79	0.95
	120	22224E AKE4 + AHX 3124	M 130 × 2	75	12	79	0.95
	120	24124C K30E4 + AH 24124	M 130 × 2	93	13	102	1.02
	120	23224C KE4 + AHX 3224	M 135 × 2	90	13	94	1.3
	120	22324E AKE4 + AHX 2324	M 135 × 2	105	17	109	1.6
125	130	23026C DKE4 + AHX 3026	M 140 × 2	67	14	71	0.95
	130	24026C K30E4 + AH 24026	M 135 × 2	83	14	93	0.89
	130	23126C KE4 + AHX 3126	M 140 × 2	78	12	82	1.08
	130	22226EAKE4 + AHX 3126	M 140 × 2	78	12	82	1.08
	130	24126CK30E4 + AH 24126	M 140 × 2	94	14	104	1.14
	130	23226CKE4 + AHX 3226	M 145 × 2	98	15	102	1.58
	130	22326CKE4 + AHX 2326	M 145 × 2	115	19	119	1.97
135	140	23028C DKE4 + AHX 3028	M 150 × 2	68	14	73	1.01
	140	24028C K30E4 + AH 24028	M 145 × 2	83	14	93	0.96
	140	23128C KE4 + AHX 3128	M 150 × 2	83	14	88	1.28
	140	22228C DKE4 + AHX 3128	M 150 × 2	83	14	88	1.28
	140	24128C K30E4 + AH 24128	M 150 × 2	99	14	109	1.3
	140	23228C KE4 + AHX 3228	M 155 × 3	104	15	109	1.84
	140	22328C KE4 + AHX 2328	M 155 × 3	125	20	130	2.33

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Shaft Diameter 145 – 180 mm



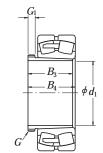


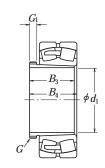
Shaft Diameter	Nominal Bearing Bore Dia.	Nominal Numbers	Screw Thread	D	imensions (mm)	5	Mass (kg)
(mm) d_1	(mm) d	Applicable Bearings	G	B_3	G_1	B_4	арргох.
145	150	23030C DKE4 + AHX 3030	M 160 × 3	72	15	77	1.15
	150	24030C K30E4 + AH 24030	M 155 × 3	90	15	101	1.11
	150	23130C KE4 + AHX 3130	M 165 × 3	96	15	101	1.79
	150	22230C DKE4 + AHX 3130	M 165 × 3	96	15	101	1.79
	150	24130C K30E4 + AH 24130	M 160 × 3	115	15	126	1.63
	150	23230C KE4 + AHX 3230	M 165 × 3	114	17	119	2.22
	150	22330C AKE4 + AHX 2330	M 165 × 3	135	24	140	2.82
150	160	23032C DKE4 + AH 3032	M 170 × 3	77	16	82	2.05
	160	24032C K30E4 + AH 24032	M 170 × 3	95	15	106	2.28
	160	23132C KE4 + AH 3132	M 180 × 3	103	16	108	3.2
	160	22232C DKE4 + AH 3132	M 180 × 3	103	16	108	3.2
	160	24132C K30E4 + AH 24132	M 170 × 3	124	15	135	3.03
	160	23232C KE4 + AH 3232	M 180 × 3	124	20	130	4.1
	160	22332C AKE4 + AH 2332	M 180 × 3	140	24	146	4.7
160	170	23034C DKE4 + AH 3034	M 180 × 3	85	17	90	2.45
	170	24034C K30E4 + AH 24034	M 180 × 3	106	16	117	2.74
	170	23134C KE4 + AH 3134	M 190 × 3	104	16	109	3.4
	170	22234C DKE4 + AH 3134	M 190 × 3	104	16	109	3.4
	170	24134C K30E4 + AH 24134	M 180 × 3	125	16	136	3.26
	170	23234C KE4 + AH 3234	M 190 × 3	134	24	140	4.8
	170	22334C AKE4 + AH 2334	M 190 × 3	146	24	152	5.25
170	180	23036C DKE4 + AH 3036	M 190 x 3	92	17	98	2.8
	180	24036C K30E4 + AH 24036	M 190 x 3	116	16	127	3.19
	180	23136C KE4 + AH 3136	M 200 x 3	116	19	122	4.2
	180	24136CK30E4 + AH 24136	M 190 × 3	134	16	145	3.74
	180	22236CDKE4 + AH 2236	M 200 × 3	105	17	110	3.75
	180	23236CKE4 + AH 3236	M 200 × 3	140	24	146	5.3
	180	22336CAKE4 + AH 2336	M 200 × 3	154	26	160	5.85
180	190	23038C AKE4 + AH 3038	Tr 205 × 4	96	18	102	3.35
	190	24038C K30E4 + AH 24038	M 200 × 3	118	18	131	3.47
	190	23138C KE4 + AH 3138	Tr 210 × 4	125	20	131	4.9
	190	24138CK30E4 + AH 24138	M 200 × 3	146	18	159	4.38
	190	22238CAKE4 + AH 2238	Tr 210 × 4	112	18	117	4.25
	190	23238CKE4 + AH 3238	Tr 210 × 4	145	25	152	5.9
	190	22338CAKE4 + AH 2338	Tr 210 × 4	160	26	167	6.65

Shaft Diameter	Nominal Bearing Bore Dia.	Nominal Numbers	Screw Thread	D	imensions (mm)	;	Mass (kg)
d_1	(mm) d	Applicable Bearings	G	B_3	G_1	B_4	арргох.
190	200	23040CAKE4 + AH 3040	Tr 215 × 4	102	19	108	3.8
	200	24040CK30E4 + AH 24040	Tr 210 × 4	127	18	140	3.92
	200	23140CKE4 + AH 3140	Tr 220 × 4	134	21	140	5.5
	200	24140CK30E4 + AH 24140	Tr 210 × 4	158	18	171	5.0
	200	22240CAKE4 + AH 2240	Tr 220 × 4	118	19	123	4.7
	200	23240CKE4 + AH 3240	Tr 220 × 4	153	25	160	6.7
	200	22340CAKE4 + AH 2340	Tr 220 × 4	170	30	177	7.55
200	220	23044CAKE4 + AH 3044	Tr 235 × 4	111	20	117	7.4
	220	24044CK30E4 + AH 24044	Tr 230 × 4	138	20	152	8.23
	220	23144CKE4 + AH 3144	Tr 240 × 4	145	23	151	10.5
	220 220 220 220	24144CK30E4 + AH 24144 22244CAKE4 + AH 2244 23244CKE4 + AH 2344 22344CAKE4 + AH 2344	Tr 230 × 4 Tr 240 × 4 Tr 240 × 4 Tr 240 × 4	170 130 181 181	20 20 30 30	184 136 189 189	10.3 9.1 13.5 13.5
220	240	23048C AKE4 + AH 3048	Tr 260 × 4	116	21	123	8.75
	240	24048C K30E4 + AH 24048	Tr 250 × 4	138	20	153	9.0
	240	23148C KE4 + AH 3148	Tr 260 × 4	154	25	161	12
	240 240 240 240	24148CK30E4 + AH 24148 22248CAKE4 + AH 2248 23248CAKE4 + AH 2348 22348CAKE4 + AH 2348	Tr 260 × 4 Tr 260 × 4 Tr 260 × 4 Tr 260 × 4	180 144 189 189	20 21 30 30	195 150 197 197	12.6 11 15.5 15.5
240	260	23052CAKE4 + AH 3052	Tr 280 × 4	128	23	135	10.5
	260	24052CAK30E4 + AH 24052	Tr 270 × 4	162	22	178	11.7
	260	23152CAKE4 + AH 3152	Tr 290 × 4	172	26	179	16
	260	24152C AK30E4 + AH 24152	Tr 280 × 4	202	22	218	15.5
	260	22252C AKE4 + AH 2252	Tr 290 × 4	155	23	161	14
	260	23252C AKE4 + AH 2352	Tr 290 × 4	205	30	213	19.5
	260	22352C AKE4 + AH 2352	Tr 290 × 4	205	30	213	19.5
260	280	23056C AKE4 + AH 3056	Tr 300 × 4	131	24	139	12
	280	24056C AK30E4 + AH 24056	Tr 290 × 4	162	22	179	12.6
	280	23156C AKE4 + AH 3156	Tr 310 × 5	175	28	183	17.5
	280	24156C AK30E4 + AH 24156	Tr 300 × 4	202	22	219	16.8
	280	22256C AKE4 + AH 2256	Tr 310 × 5	155	24	163	15
	280	23256C AKE4 + AH 2356	Tr 310 × 5	212	30	220	21.5
	280	22356C AKE4 + AH 2356	Tr 310 × 5	212	30	220	21.5

Shaft Diameter 400 – 480 mm

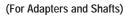
Shaft Diameter 280 – 380 mm

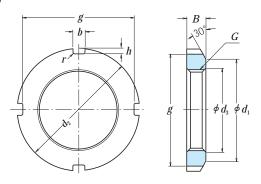




Shaft	Nominal Bearing		Screw Thread	D	imensions (mm)	5	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	арргох.
280	300	23060CAKE4 + AH 3060	Tr 320 × 5	145	26	153	14.5
	300	24060CAK30E4 + AH 24060	Tr 310 × 5	184	24	202	15.5
	300	23160CAKE4 + AH 3160	Tr 330 × 5	192	30	200	21
	300	24160C AK30E4 + AH 24160	Tr 320 × 5	224	24	242	20.3
	300	22260C AKE4 + AH 2260	Tr 330 × 5	170	26	178	18
	300	23260C AKE4 + AH 3260	Tr 330 × 5	228	34	236	20
300	320	23064C AKE4 + AH 3064	Tr 345 × 5	149	27	157	16
	320	24064C AK30E4 + AH 24064	Tr 330 × 5	184	24	202	16.4
	320	23164C AKE4 + AH 3164	Tr 350 × 5	209	31	217	24.5
	320	24164CAK30E4 + AH 24164	Tr 340 × 5	242	24	260	23.5
	320	23264CAKE4 + AH 3264	Tr 350 × 5	246	36	254	25
320	340	23068CAKE4 + AH 3068	Tr 365 × 5	162	28	171	19.5
	340	24068CAK30E4 + AH 24068	Tr 360 × 5	206	26	225	21.2
	340	23168CAKE4 + AH 3168	Tr 370 × 5	225	33	234	29
	340	24168CAK30E4 + AH 24168	Tr 360 × 5	269	26	288	28.3
	340	23268CAKE4 + AH 3268	Tr 370 × 5	264	38	273	35.5
340	360	23072CAKE4 + AH 3072	Tr 385 × 5	167	30	176	21
	360	24072CAK30E4 + AH 24072	Tr 380 × 5	206	26	226	22.5
	360	23172CAKE4 + AH 3172	Tr 400 × 5	229	35	238	33
	360	24172CAK30E4 + AH 24172	Tr 380 × 5	269	26	289	30
	360	23272CAKE4 + AH 3272	Tr 400 × 5	274	40	283	41.5
360	380	23076C AKE4 + AH 3076	Tr 410 × 5	170	31	180	23.5
	380	24076C AK30E4 + AH 24076	Tr 400 × 5	208	28	228	24.1
	380	23176C AKE4 + AH 3176	Tr 420 × 5	232	36	242	35.5
	380	24176CAK30E4 + AH 24176	Tr 400 × 5	271	28	291	32.1
	380	23276CAKE4 + AH 3276	Tr 420 × 5	284	42	294	45.5
380	400	23080CAKE4 + AH 3080	Tr 430 × 5	183	33	193	27.5
	400	24080CAK30E4 + AH 24080	Tr 420 × 5	228	28	248	28
	400	23180CAKE4 + AH 3180	Tr 440 × 5	240	38	250	39.5
	400	24180CAK30E4 + AH 24180	Tr 420 × 5	278	28	298	34.8
	400	23280CAKE4 + AH 3280	Tr 440 × 5	302	44	312	51.5

Shaft	Nominal Bearing		Screw Thread	D	Dimensions (mm)		
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	арргох.
400	420	23084CAKE4 + AH 3084	Tr 450 × 5	186	34	196	29
	420	24084CAK30E4 + AH 24084	Tr 440 × 5	230	30	252	29.8
	420	23184CAKE4 + AH 3184	Tr 460 × 5	266	40	276	46.5
	420	24184CAK30E4 + AH 24184	Tr 440 × 5	310	30	332	41.4
	420	23284CAKE4 + AH 3284	Tr 460 × 5	321	46	331	59
420	440	23088CAKE4 + AHX 3088	Tr 470 × 5	194	35	205	42
	440	24088CAK30E4 + AH 24088	Tr 460 × 5	242	30	264	33
	440	23188CAKE4 + AHX 3188	Tr 480 × 5	270	42	281	50
	440	24188CAK30E4 + AH 24188	Tr 460 × 5	310	30	332	43.5
	440	23288CAKE4 + AHX 3288	Tr 480 × 5	330	48	341	64
440	460	23092C AKE4 + AHX 3092	Tr 490 × 5	202	37	213	46
	460	24092C AK30E4 + AH 24092	Tr 480 × 5	250	32	273	35.9
	460	23192C AKE4 + AHX 3192	Tr 510 × 6	285	43	296	58
	460	24192CAK30E4 + AH 24192	Tr 480 × 5	332	32	355	49.7
	460	23292CAKE4 + AHX 3292	Tr 510 × 6	349	50	360	74.5
460	480	23096CAKE4 + AHX 3096	Tr 520 × 6	205	38	217	51
	480	24096CAK30E4 + AH 24096	Tr 500 × 5	250	32	273	37.5
	480	23196CAKE4 + AHX 3196	Tr 530 × 6	295	45	307	63
	480	24196C AK30E4 + AH 24196	Tr 500 × 5	340	32	363	53
	480	23296C AKE4 + AHX 3296	Tr 530 × 6	364	52	376	82
480	500	230/500CAKE4 + AHX 30/500	Tr 540 × 6	209	40	221	54.5
	500	240/500CAK30E4 + AH 240/500	Tr 530 × 6	253	35	276	41.9
	500	231/500CAKE4 + AHX 31/500	Tr 550 × 6	313	47	325	71
	500	241/500C AK30E4 + AH 241/500	Tr 530 × 6	360	35	383	61.2
	500	232/500C AKE4 + AHX 32/500	Tr 550 × 6	393	54	405	94.5





Nut with Washer

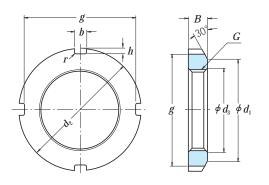
III VVASIICI	
	Units : mm

				Reference											
	ominal umbers	Screw Thread		d_2	d_1	g B	asic Di	mensio <i>h</i>	ns d_3	В	r max.	Mass (kg) approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Washer Numbers	Shaft Dia.
F	AN 02 AN 03 AN 04	M 15×1 M 17×1 M 20×1	2	!5 !8 !2	21 24 26	21 24 28	4 4 4	2 2 2	15.5 17.5 20.5	5 5 6	0.4 0.4 0.4	0.010 0.013 0.019	_ _ 04	AW 02 X AW 03 X AW 04 X	15 17 20
F	AN 05 AN 06 AN 07	M 25×1.5 M 30×1.5 M 35×1.5	1	18 5 5 2	32 38 44	34 41 48	5 5 5	2 2 2	25.8 30.8 35.8	7 7 8	0.4 0.4 0.4	0.025 0.043 0.053	05 06 07	AW 05 X AW 06 X AW 07 X	25 30 35
F	AN 08 AN 09 AN 10	M 40×1.5 M 45×1.5 M 50×1.5	1 6	18 15 10	50 56 61	53 60 65	6 6 6	2.5 2.5 2.5	40.8 45.8 50.8	9 10 11	0.5 0.5 0.5	0.085 0.119 0.148	08 09 10	AW 08 X AW 09 X AW 10 X	40 45 50
F	AN 11 AN 12 AN 13	M 55×2 M 60×2 M 65×2	8	5 80 85	67 73 79	69 74 79	7 7 7	3 3 3	56 61 66	11 11 12	0.5 0.5 0.5	0.158 0.174 0.203	11 12 13	AW 11 X AW 12 X AW 13 X	55 60 65
F	AN 14 AN 15 AN 16	M 70×2 M 75×2 M 80×2)2)8)5	85 90 95	85 91 98	8 8 8	3.5 3.5 3.5	71 76 81	12 13 15	0.5 0.5 0.6	0.242 0.287 0.395	14 15 16	AW 14 X AW 15 X AW 16 X	70 75 80
F	AN 17 AN 18 AN 19	M 85×2 M 90×2 M 95×2	11 12 12	0	102 108 113	103 112 117	8 10 10	3.5 4 4	86 91 96	16 16 17	0.6 0.6 0.6	0.45 0.555 0.66	17 18 19	AW 17 X AW 18 X AW 19 X	85 90 95
F	AN 20 AN 21 AN 22	M 100×2 M 105×2 M 110×2	13 14 14	0	120 126 133	122 130 135	10 12 12	4 5 5	101 106 111	18 18 19	0.6 0.7 0.7	0.70 0.845 0.965	20 21 22	AW 20 X AW 21 X AW 22 X	100 105 110
F	AN 23 AN 24 AN 25	M 115×2 M 120×2 M 125×2	15 15 16	5	137 138 148	140 145 150	12 12 12	5 5 5	116 121 126	19 20 21	0.7 0.7 0.7	1.01 1.08 1.19	 24 	AW 23 AW 24 AW 25	115 120 125

Note (1) Applicable to adapter sleeve Series A31, A2, A3, and A23.

Remarks The basic design and dimensions of screw threads are in accordance with JIS B 0205.





Nut with Washer

Units: mm

				Reference									
Nominal Numbers	Screw Threads $\it G$	$d_{\scriptscriptstyle 2}$	$d_{\scriptscriptstyle 1}$	в д	asic Di b	mensio <i>h</i>	ns $oldsymbol{d}_3$	В	r max.	Mass (kg) approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Washer Numbers	Shaft Dia.
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 AN 30 AN 31	M 145×2 M 150×2 M 155×3	190 195 200	172 171 182	178 183 186	14 14 16	6 6 7	146 151 156.5	24 24 25	0.7 0.7 0.7	2.0 2.03 2.21	30	AW 29 AW 30	145 150 —
AN 32 AN 33 AN 34	M 160×3 M 165×3 M 170×3	210 210 220	182 193 193	196 196 206	16 16 16	7 7 7	161.5 166.5 171.5	25 26 26	0.7 0.7 0.7	2.59 2.43 2.8	32 — 34	AW 32 AW 34	160 — 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 S	Series <i>i</i>	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.

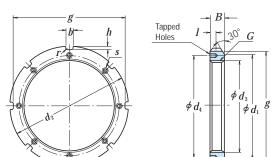
Remarks The basic design and dimensions of screw threads are in accordance with **JIS B 0205**.

B 372 B 373 (For Adapters and Shafts)

ANL 76 Tr 380×5

ANL 80 Tr 400×5

ANL 84 Tr 420×5



Nut with Stopper

Nut Series AN Reference Nominal Screw Basic Dimensions Mass Adapter (1) Stopper Shaft Numbers Threads Tapped Holes Sleeve Bore (kg) b В d_2 d_1 h Numbers Dia. d_4 Dia. Numbers 1 Screw Threads (S) max. approx. 280 250 260 20 10 222 300 270 280 20 10 242 32 0.8 15 M 8×1.25 238 34 0.8 15 M 8×1.25 258 AL 44 220 **AL 44** 240 **AN 48** Tr 240×4 48 5.95 **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 **56** Tr 280×4 350 320 326 24 12 282 **60** Tr 300×4 380 340 356 24 12 302 18 M 10×1.5 **AN 56** Tr 280×4 38 0.8 **AL 52** 280 40 0.8 18 M 10×1.5 AL 60 300 60 64 Tr 320×5 | 400 360 376 24 12 322.5 42 0.8 | 18 M 10×1.5 345 | 13.1 **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 **AL 68** 340 **72** Tr 360×5 460 420 430 28 15 362.5 58 1 **76** Tr 380×5 490 450 454 32 18 382.5 60 1 21 M 12×1.75 392 25.1 72 **AL 68** 360 **AL 76** 380 21 M 12×1.75 414 31 520 470 484 32 18 402.5 62 1 540 490 504 32 18 422.5 70 1 560 510 520 36 20 442.5 70 1 **AN 80** Tr 400×5 27 M 16×2 439 37 80 **AL 80** 400 **84** Tr 420×5 27 M 16×2 459 43.5 AL 80 420 84 **88** Tr 440×5 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 **AN 96** Tr 480×5 620 560 580 36 20 482.5 75 1 27 M 16×2 27 M 16×2 497 50.5 **AL 88** 460 527 62 **AL 96** 480 96 **AN 100** Tr 500×5 630 580 584 40 23 502.5 80 1 27 M 16×2 /500 539 63.5 **AL 100** 500 Nut Series ANL **ANL 44** Tr 220×4 260 242 242 20 222 0.8 12 M **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 **ALL 56** 280 **ANL 60** Tr 300×4 360 336 336 24 12 302 42 0.8 15 M 8×1.25 316 380 356 356 24 12 322.5 42 0.8 15 M 8×1.25 335 **ALL 60** 300 **ANL 64** Tr 320×5 9.95 64 ALL 64 320 400 376 376 24 12 342.5 45 1 **ANL 68** Tr 340×5 15 M 8×1.25 355 11.7 68 **ALL 64** 340 **ANL 72** Tr 360×5 420 394 394 28 13 362.5 45 450 422 422 28 14 382.5 48 15 M 8×1.25 374 **ALL 72** 360

(1) Series AN is applicable to adapter sleeve Series A31, A32 and A23. Series ANL is applicable to adapter sleeve Series A30.

18 M 10×1.5 398 14.9

18 M 10×1.5 438 17.4

21 M 12×1.75 462 26.2 21 M 12×1.75 482 28

21 M 12×1.75 522 33.5

21 M 12×1.75 502

18 M 10×1.5

76

80

84

88

92

ALL 76 380

ALL 76 400

ALL 84 420

ALL 88 440

ALL 88 460

ALL 96 480

ALL 96 500

Remarks 1. The basic design and dimensions of screw threads are in accordance with JIS B 0216.

470 442 442 28 14 402.5 52 1

490 462 462 32 14 422.5 52 1

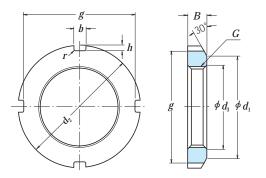
ANL 88 Tr 440×5 520 490 490 32 15 442.5 60 1 **ANL 92** Tr 460×5 540 510 510 32 15 462.5 60 1

 ANL 96
 Tr 480×5
 560
 530
 530
 36
 15
 482.5
 60
 1

 ANL 100
 Tr 500×5
 580
 550
 550
 36
 15
 502.5
 68
 1

2. The basic design and dimensions of threads in tapped holes are in accordance with JIS B 0205.

(For Withdrawal Sleeves)



NSK

														l	Jnits : mm
					Nut	Serie	s HN						Refer	ence	
	Nominal Numbers	Screw			Bas	ic Dir	nens	ions			Mass	w	ithdrawal Sle	eeve Numbers	
	Number 5	Threads $\it G$	d_2	d_1	g	b	h	d_3	В	r max.	(kg) approx.	AH 31	AH 22	AH 32	AH 23
	HN 42 HN 44 HN 48	Tr 210×4 Tr 220×4 Tr 240×4	270 280 300		250 260 280		10 10 10	212 222 242	30 32 34	0.8 0.8 0.8	4.75 5.35 6.2	AH 3138 AH 3140 AH 3144	AH 2238 AH 2240 AH 2244	AH 3238 AH 3240	AH 2338 AH 2340 AH 2344
	HN 52 HN 58 HN 62	Tr 260×4 Tr 290×4 Tr 310×5	330 370 390	350	346 366	24 24	12	262 292 312.5	36 40 42	0.8 0.8 0.8	8.55 11.8 13.4	AH 3148 AH 3152 AH 3156	AH 2248 AH 2252 AH 2256	_ _	AH 2348 AH 2352 AH 2356
	HN 66 HN 70 HN 74	Tr 330×5 Tr 350×5 Tr 370×5	420 450 470	410 430		28 28	15 15 15	332.5 352.5 372.5	52 55 58	1 1 1	20.4 25.2 28.2	AH 3160 AH 3164 AH 3168	AH 2260 AH 2264	AH 3260 AH 3264 AH 3268	_ _ _
	HN 80 HN 84 HN 88	Tr 400×5 Tr 420×5 Tr 440×5	520 540 560	490 510	484 504 520	32 36	18 18 20	402.5 422.5 442.5	62 70 70	1 1 1	40 46.9 48.5	AH 3172 AH 3176 AH 3180		AH 3272 AH 3276 AH 3280	_ _ _
	HN 92 HN 96 HN 102	Tr 460×5 Tr 480×5 Tr 510×6	580 620 650	560 590		36 40	20 20 23	462.5 482.5 513	75 75 80	1 1 1	55 67 75	AH 3184 AHX 3188 AHX 3192		AH 3284 AHX 3288 AHX 3292	_ _ _
	HN 106 HN 110	Tr 530×6 Tr 550×6	670 700		624 654		23 23	533 553	80 80	1 1	78 92.5	AHX 3196 AHX 31/500	_	AHX 3296 AHX 32/500	_
Ī					Nut S	Series	s HNI	_				AH 30	AH 2		
	HNL 41 HNL 43 HNL 47		250 260 280	242	234 242 262	20	8 9 9	207 217 237	30 30 34	0.8 0.8 0.8	3.45 3.7 4.6	AH 3038 AH 3040 AH 3044	AH 238 AH 240 AH 244		
	HNL 52 HNL 56 HNL 60	Tr 280×4 Tr 300×4	310 330 360	310 336	290 310 336	24 24	10 10 12	262 282 302	34 38 42	0.8 0.8 0.8	5.8 6.7 9.6	AH 3048 AH 3052 AH 3056	AH 248 AH 252 AH 256		
	HNL 64 HNL 69 HNL 73		380 410 430	384 404	356 384 404	28 28	12 13 13	322.5 347.5 367.5	42 45 48	1 1 1	10.3 11.5 14.2	AH 3060 AH 3064 AH 3068	_ _ _		
	HNL 77 HNL 82 HNL 86	Tr 430×5	450 480 500	452 472	422 452 472	32 32	14 14 14	387.5 412.5 432.5	48 52 52	1 1 1	15 19 19.8	AH 3072 AH 3076 AH 3080	_ _ _		
		Tr 470×5 Tr 490×5	520 540 580	510 550	490 510 550	32 36	15 15 15	452.5 472.5 492.5	60 60	1 1 1	23.8 25 34	AH 3084 AHX 3088 AHX 3092			
	HNL 104 HNL 108	Tr 520×6 Tr 540×6	600 630		570 590	36 40	15 20	523 543	68 68	1 1	37 43.5	AHX 3096 AHX 30/500	_		

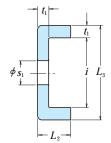
Remarks 1. The basic design and dimensions of screw threads are in accordance with JIS B 0216

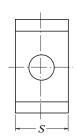
2. The number of notches in the nut may be bigger than that shown in the above figure

B 374 B 375

Units: mm

(Combination of Withdrawal Sleeves and Nuts)

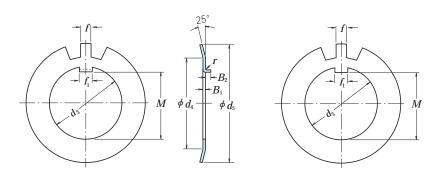




								Units : mm
				Stopper S	eries AL			Reference
Nominal Numbers	t_1	S	Basic L_2	Dimensions S_1	i	L3	Mass (kg) per 100 pcs approx.	Nut Numbers
AL 44 AL 52 AL 60	4 4 4 4	20 24 24	12 12 12 12	9 12 12	22.5 25.5 30.5	30.5 33.5 38.5	2.6 3.4 3.8	AN 44, AN 48 AN 52, AN 56 AN 60
AL 64	5	24	15	12	31	41	5.35	AN 64
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 Se	ries 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

				Reference			
Nominal Numbers			Witho	drawal Sleeve Nu	mbers		
	AH 30	AH 31	AH 2	AH 22	AH 32	AH 3	AH 23
AN 09 AN 10 AN 11	_ _ _	_ _ _	AH 208 AH 209 AH 210	_ _ _	_ _ _	AH 308 AH 309 AHX 310	AH 2308 AH 2309 AHX 2310
AN 12 AN 13 AN 14	_ _ _	_ _ _	AH 211 AH 212 —	_ _ _	_ _ _	AHX 311 AHX 312	AHX 2311 AHX 2312
AN 15 AN 16 AN 17	_ _ _	_ _ _	AH 213 AH 214 AH 215	_ _ _	_ _ _	AH 313 AH 314 AH 315	AH 2313 AHX 2314 AHX 2315
AN 18 AN 19 AN 20	_ _ _	_ _ _	AH 216 AH 217 AH 218	_ _ _	_	AH 316 AHX 317 AHX 318	AHX 2316 AHX 2317 AHX 2318
AN 21 AN 22 AN 23	_ _ _	_ _ _	AH 219 AH 220 AH 221	_ _ _	AHX 3220	AHX 319 AHX 320 AHX 321	
AN 24 AN 25 AN 26	 AHX 3024	_	AH 222 — AH 224	_ _ _	AHX 3222 —	AHX 322 AHX 324	AHX 2322 —
AN 27 AN 28 AN 29	AHX 3026	AHX 3126	AH 226		AHX 3224 — AHX 3226	AHX 326	AHX 2324 AHX 2326
AN 30 AN 31 AN 32	AHX 3028 — AHX 3030	AHX 3128 — —	AH 228 — AH 230	_ _ _	AHX 3228	AHX 328 	AHX 2328
AN 33 AN 34 AN 36	— AH 3032 AH 3034	AHX 3130 — AH 3132	— AH 232 AH 234	_ _ _	AHX 3230 AH 3232	AHX 330 AH 332	AHX 2330 AH 2332
AN 38 AN 40	AH 3036 —	AH 3134 AH 3136	AH 236 —	— AH 2236	AH 3234 AH 3236	AH 334 —	AH 2334 AH 2336

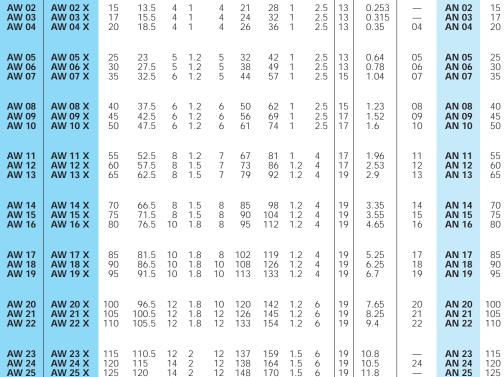




Bent-Tab Straight-Tab

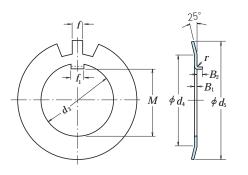
 ϕd_4

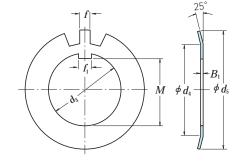
Units: mm Lock-washer Series AW Reference Nominal Numbers No. of Teeth Per 100 pcs Adapter (¹) Sleeve Bore **Basic Dimensions** Nut Shaft Dia. Numbers Bent-Tab Bent-Tab Straight-Tab M f_1 B_1 f d_4 Dia. Numbers approx. B_{2} 2.5 2.5 2.5 13.5 15.5 21 24 26 AW 02 X 28 32 13 0.253 AN 02 17 AW 03 X 13 13 AN 03 0.315 AW 04 X 20 04 0.35 AN 04 AW 05 X AW 06 X 25 30 23 27.5 5 5 1.2 1.2 5 5 32 38 2.5 2.5 13 13 0.64 AN 05 49 0.78 **AN 06** 06



Note (1) Applicable to adapter sleeve Series A31, A2, A3, and A23.

Remarks Lock-washers with straight tabs shall be used with adapter sleeves having narrow slits, and for those having wide slits, either type of lock-washer may be used.





Bent-Tab

Straight-Tab

Units: mm

Nomin	ninal Numbers Lock-washer Series AW									Reference					
Bent-Tab	Straight-Tab	d_3	M	f_1	Basic I	Dimen	sions d_4	d_5	Ben r	it-Tab B_2	No. of Teeth	Mass (kg) per 100 pcs approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Nut Numbers	Shaft Dia.
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	30	AN 29	145
AW 30	AW 30 X	150	145	16	2	14	171	205	1.5	8	19	15.9		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
						Wash	ner Seri	es 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 38 AWL 40	AWL 36 X AWL 38 X AWL 40 X	180 190 200	174 184 194 blicable to	20 20 20	2.5 2.5 2.5	18 18 18	192 202 218	220 230 250	1.5 1.5 1.5	8 8 8	19 19 19	18 20.5 21.4	36 38 40	ANL 36 ANL 38 ANL 40	180 190 200

Note (1) Series AW is applicable to adapter sleeve Series A31 and A23

Series AWL is applicable to adapter sleeve Series A30.

Remarks Lock-washers with straight tabs shall be used with adapter sleeves having narrow slits, and for those having wide slits, either type of lock-washer may be used.



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INTRODUCTION OF NSK PRODUCTS

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NSK

AUTOMOTIVE PRODUCTS

Column Type Electric Power Steering (CAT.No. E4102)



Pinion Type Electric Power Steering (CAT.No. E4102)



Offeet Ball Screw Type Electric Power Steering (CAT.No. E4102)



Long Life Water Pump Bearings (CAT.No. E396, E4102)



Hub Unit Bearings (CAT.No. E4201)



One-Way Clutch

PRECISION MACHINE COMPONENTS

BALL SCREWS



NSK Standard Ball Screws Compact FA Series (CAT. No. E3239, E3162)



Ball Screws for High-Speed Machine Tools HMD Series (CAT. No. E3162)



Highly Dust-Resistant Ball Screws, **NSK Linear Guides** V1 Series (CAT. No. E3162)

MONOCARRIERS



Monocarriers (CAT. No. E3419, E3162)



NSK Standard Ball Screws High Speed SS Series (CAT.No.E3241)



Ball Screws for Twin-Drive Systems TW Series (CAT. No. E3162)



High-Speed, Low-Noise Ball Screws BSS Series (CAT. No. E3162)



Ball Screws for High-Load Drive HTF-SRC Series, HTF-SRD Series, HTF Series, A1 Series (CAT. No. E3238, E3162)



Ball Screws, NSK Linear Guides with NSK K1™ Lubrication Unit (CAT. No. E3331, E3162)



Ball Screws, NSK Linear Guides with E-DFO Thin-Film Lubrication for Vacuum Environments (CAT. No. E1258)



Toughcarrier (CAT. No. E3421)

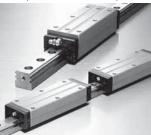
NSK

PRECISION MACHINE COMPONENTS

LINEAR BEARINGS



NSK Linear Guides Roller Guides RA Series (CAT. No. E3328, E3162)



NSK Linear Guides High-Accuracy Series (CAT. No. E3329, E3162)



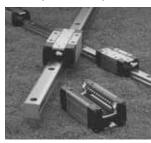
NSK Linear Guides LH Series, LS Series (CAT. No. E3162)



NSK Linear Guides Miniature PU Series, PE Series (CAT. No. E3327, E3162)



NSK Low-Noise Linear Guides SH Series, SS Series (CAT. No. E3162)



NSK Linear Guides TS Series (CAT. No. E3324, E3162)

PRECISION MACHINE COMPONENTS

MECHATRONIC ACTUATORS

Megatorque Motor™ (CAT.No. E3511)



XY Modules



Megapositioner™



XY Tables



ASSORTED SPINDLES



High Speed Integrated Motor Spindles



Precision Grinding Spindles (CAT.No. E2202)



Live Centers (CAT.No. E2202)



Oil/Air Lubricating Unit, Fine Lube (CAT.No. E1254/A1387)



Standard Type Precision Boring Heads (CAT.No. E2202)

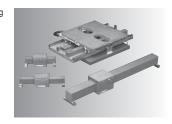


Spindles for Electrical and Electric Equipment

Positioning Actuator™



Air Bearing Slides





AIR SPINDLES



Air-spindle



RELATED PRODUCT WITH BEARING



Bearing Induction Heater (CAT.No. E398)



Extra Small Bearing Monitor NB-4 (Bearing Abnormality Detector) (CAT.No. E410)

Large Size Proximity Stepper RZ Series





Appendix Table 1 Conversion Table from SI (International Units) System

Comparison of SI, CGS, and Engineering Units

Units Unit System	Length	ı 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/cm²	dyn/cm²	erg	erg/s
Engineering Unit System	m	$kgf\cdot s^2/m$	s	°C	m/s²	kgf	kgf/m²	kgf/m²	kgf · m	kgf⋅m/s

Conversion Factors from SI Units

Parameter	SI Units		Units other than S	I	Conversion Factors	
rarameter	Names of Units	Symbols	Name of Units	Symbols	from SI Units	
Angle	Radian	rad	Degree Minute Second		180/π 10 800/π 648 000/π	
Length	Meter	m	Micron Angstrom	$\overset{\mu}{\text{\AA}}$	10 ⁶ 10 ¹⁰	
Area	Square meter	m ²	Are Hectare	a ha	10 ⁻² 10 ⁻⁴	
Volume	Cubic meter	m ³	Liter Deciliter	l, L dl, dL	10 ³ 10 ⁴	
Time	Second	s	Minute Hour Day	min h d	1/60 1/3 600 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 Knot	km/h kn	3 600/1 000 3 600/1 852	
Acceleration	Meter per second per second	m/s²	Gal g	Gal G	10 ² 1/9.806 65	
Mass	Kilogram	kg	Ton	t	10 ⁻³	
Force	Newton	N	Kilogram-force Ton-force Dyne	kgf tf dyn	1/9.806 65 1/ (9.806 65×10³) 10⁵	
Torque or Moment	Newton · meter	N·m	Kilogram-force meter	kgf · m	1/9.806 65	
Stress	Pascal	Pa (N/m²)	Kilogram-force per square centimeter Kilogram-force per square millimeter		1/ (9.806 65×10 ⁴) 1/ (9.806 65×10 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
109	Giga	G	10-6	Micro	μ
106	Mega	M	10-9	Nano	n
103	Kilo	k	10-12	Pico	p
10²	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 S	I	Conversion Factors	
rarameter	Names of Units	Symbols	Names of Units	Units	from SI Units	
Pressure	Pascal (Newton per square meter)	Pa (N/m²)	Kilogram-force per square meter Water Column Mercury Column Torr Bar Atmosphere	kgf/m² mH ₂ O mmHg Torr bar atm	1/9.806 65 1/(9.806 65×10³) 760/(1.013 25×10⁵) 760/(1.013 25×10⁵) 10-5 1/(1.013 25×10⁵)	
Energy	Joule (Newton · meter)	J (N·m)	Erg Calorie (International) Kilogram-force meter Kilowatt hour French horse power hour	$\begin{array}{c} erg \\ cal_{IT} \\ kgf \cdot m \\ kW \cdot h \\ PS \cdot h \end{array}$	10 ⁷ 1/4.186 8 1/9.806 65 1/(3.6×10 ⁶) ≈ 3.776 72×10 ⁻⁷	
Work	Watt (Joule per second)	W (J/s)	Kilogram-force meter per second Kilocalorie per hour French horse power	kgf·m/s kcal/h PS	1/9.806 65 1/1.163 ≈ 1/735.498 8	
Viscosity, Viscosity Index	Pascal second	Pa · s	Poise	P	10	
Kinematic Viscosity, Kinematic Viscosity Index	Square meter per second	m²/s	Stokes Centistokes	St cSt	10 ⁴ 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 Density	Tesla	Т	Gauss Gamma	Gs γ	10 ⁴ 10 ⁹	
Electrical Resistance	Ohm	Ω	(Volts per ampere)	(V/A)	1	

Note (1) The conversion from TK into θ °C is $\theta = T$ —273.15 but for a temperature difference, it is $\Delta T = \Delta \theta$. However, ΔT 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 Conversion Table

Appendix Table 3 kg-lb Conversion Table

[Method of using this table] For example, to convert 10N 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 10N is 1.0197kgf. To convert 10kgf into N, read the figure in the left N column of the same row, which indicates that the answer is 98.066N.

1 N=0.1019716 kgf 1 kgf=9.80665 N

[Method of using this table] For example, to convert 10kg 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 10kg is 22.046lb. To convert 10lb into kg, read the figure in the left kg column of the same row, which indicates that the answer is 4.536kg.

1 kg=2.2046226 lb 1 lb=0.45359237 kg

N		kgf	N		kgf	N		kgf		kg		lb	kg		lb	kg		lb
9.8066 19.613 29.420 39.227 49.033	1 2 3 4 5	0.1020 0.2039 0.3059 0.4079 0.5099	333.43 343.23 353.04 362.85 372.65	34 35 36 37 38	3.4670 3.5690 3.6710 3.7729 3.8749	657.05 666.85 676.66 686.47 696.27	67 68 69 70 71	6.8321 6.9341 7.0360 7.1380 7.2400	•	0.454 0.907 1.361 1.814 2.268	1 2 3 4 5	2.205 4.409 6.614 8.818 11.023	15.422 15.876 16.329 16.783 17.237	34 35 36 37 38	74.957 77.162 79.366 81.571 83.776	30.391 30.844 31.298 31.751 32.205	67 68 69 70 71	147.71 149.91 152.12 154.32 156.53
58.840 68.647 78.453 88.260 98.066	6 7 8 9 10	0.6118 0.7138 0.8158 0.9177 1.0197	382.46 392.27 402.07 411.88 421.69	39 40 41 42 43	3.9769 4.0789 4.1808 4.2828 4.3848	706.08 715.89 725.69 735.50 745.31	72 73 74 75 76	7.3420 7.4439 7.5459 7.6479 7.7498		2.722 3.175 3.629 4.082 4.536	6 7 8 9 10	13.228 15.432 17.637 19.842 22.046	17.690 18.144 18.597 19.051 19.504	39 40 41 42 43	85.980 88.185 90.390 92.594 94.799	32.659 33.112 33.566 34.019 34.473	72 73 74 75 76	158.73 160.94 163.14 165.35 167.55
107.87 117.68 127.49 137.29 147.10	11 12 13 14 15	1.1217 1.2237 1.3256 1.4276 1.5296	431.49 441.30 451.11 460.91 470.72	44 45 46 47 48	4.4868 4.5887 4.6907 4.7927 4.8946	755.11 764.92 774.73 784.53 794.34	77 78 79 80 81	7.8518 7.9538 8.0558 8.1577 8.2597		4.990 5.443 5.897 6.350 6.804	11 12 13 14 15	24.251 26.455 28.660 30.865 33.069	19.958 20.412 20.865 21.319 21.772	44 45 46 47 48	97.003 99.208 101.41 103.62 105.82	34.927 35.380 35.834 36.287 36.741	77 78 79 80 81	169.76 171.96 174.17 176.37 178.57
156.91 166.71 176.52 186.33 196.13	16 17 18 19 20	1.6315 1.7335 1.8355 1.9375 2.0394	480.53 490.33 500.14 509.95 519.75	49 50 51 52 53	4.9966 5.0986 5.2006 5.3025 5.4045	804.15 813.95 823.76 833.57 843.37	82 83 84 85 86	8.3617 8.4636 8.5656 8.6676 8.7696		7.257 7.711 8.165 8.618 9.072	16 17 18 19 20	35.274 37.479 39.683 41.888 44.092	22.226 22.680 23.133 23.587 24.040	49 50 51 52 53	108.03 110.23 112.44 114.64 116.84	37.195 37.648 38.102 38.555 39.009	82 83 84 85 86	180.78 182.98 185.19 187.39 189.60
205.94 215.75 225.55 235.36 245.17	21 22 23 24 25	2.1414 2.2434 2.3453 2.4473 2.5493	529.56 539.37 549.17 558.98 568.79	54 55 56 57 58	5.5065 5.6084 5.7104 5.8124 5.9144	853.18 862.99 872.79 882.60 892.41	87 88 89 90 91	8.8715 8.9735 9.0755 9.1774 9.2794		9.525 9.979 10.433 10.886 11.340	21 22 23 24 25	46.297 48.502 50.706 52.911 55.116	24.494 24.948 25.401 25.855 26.308	54 55 56 57 58	119.05 121.25 123.46 125.66 127.87	39.463 39.916 40.370 40.823 41.277	87 88 89 90 91	191.80 194.01 196.21 198.42 200.62
254.97 264.78 274.59 284.39 294.20	26 27 28 29 30	2.6513 2.7532 2.8552 2.9572 3.0591	578.59 588.40 598.21 608.01 617.82	59 60 61 62 63	6.0163 6.1183 6.2203 6.3222 6.4242	902.21 912.02 921.83 931.63 941.44	92 93 94 95 96	9.3814 9.4834 9.5853 9.6873 9.7893		11.793 12.247 12.701 13.154 13.608	26 27 28 29 30	57.320 59.525 61.729 63.934 66.139	26.762 27.216 27.669 28.123 28.576	59 60 61 62 63	130.07 132.28 134.48 136.69 138.89	41.730 42.184 42.638 43.091 43.545	92 93 94 95 96	202.83 205.03 207.23 209.44 211.64
304.01 313.81 323.62	31 32 33	3.1611 3.2631 3.3651	627.63 637.43 647.24	64 65 66	6.5262 6.6282 6.7301	951.25 961.05 970.86	97 98 99	9.8912 9.9932 10.095		14.061 14.515 14.969	31 32 33	68.343 70.548 72.753	29.030 29.484 29.937	64 65 66	141.10 143.30 145.51	43.998 44.452 44.906	97 98 99	213.85 216.05 218.26

C 10 C 11



Appendix Table 4 $\,^{\circ}\text{C-}^{\circ}\text{F}$ Conversion Table

[Method of using this table] For example, to convert 38°C into $^{\circ}F$, read the figure in the right $^{\circ}F$ 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.

$$C = \frac{5}{9}(F - 32)$$

$$\mathbf{F} = 32 + \frac{9}{5}\mathbf{C}$$

°C		°F	°C		°F	°C		°F	°C		°F
-73.3 -62.2 -51.1 -40.0 -34.4	-100 - 80 - 60 - 40 - 30	-148.0 -112.0 - 76.0 - 40.0 - 22.0	0.0 0.6 1.1 1.7 2.2	32 33 34 35 36	89.6 91.4 93.2 95.0 96.8	21.7 22.2 22.8 23.3 23.9	71 72 73 74 75	159.8 161.6 163.4 165.2 167.0	43.3 46.1 48.9 51.7 54.4	110 115 120 125 130	230 239 248 257 266
-28.9 -23.3 -17.8 -17.2 -16.7	- 20 - 10 0 1 2	- 4.0 14.0 32.0 33.8 35.6	2.8 3.3 3.9 4.4 5.0	37 38 39 40 41	98.6 100.4 102.2 104.0 105.8	24.4 25.0 25.6 26.1 26.7	76 77 78 79 80	168.8 170.6 172.4 174.2 176.0	57.2 60.0 65.6 71.1 76.7	135 140 150 160 170	275 284 302 320 338
-16.1 -15.6 -15.0 -14.4 -13.9	3 4 5 6 7	37.4 39.2 41.0 42.8 44.6	5.6 6.1 6.7 7.2 7.8	42 43 44 45 46	107.6 109.4 111.2 113.0 114.8	27.2 27.8 28.3 28.9 29.4	81 82 83 84 85	177.8 179.6 181.4 183.2 185.0	82.2 87.8 93.3 98.9 104.4	180 190 200 210 220	356 374 392 410 428
-13.3 -12.8 -12.2 -11.7 -11.1	8 9 10 11 12	46.4 48.2 50.0 51.8 53.6	8.3 8.9 9.4 10.0 10.6	47 48 49 50 51	116.6 118.4 120.2 122.0 123.8	30.0 30.6 31.1 31.7 32.2	86 87 88 89 90	186.8 188.6 190.4 192.2 194.0	110.0 115.6 121.1 148.9 176.7	230 240 250 300 350	446 464 482 572 662
-10.6 -10.0 - 9.4 - 8.9 - 8.3	13 14 15 16 17	55.4 57.2 59.0 60.8 62.6	11.1 11.7 12.2 12.8 13.3	52 53 54 55 56	125.6 127.4 129.2 131.0 132.8	32.8 33.3 33.9 34.4 35.0	91 92 93 94 95	195.8 197.6 199.4 201.2 203.0	204 232 260 288 316	400 450 500 550 600	752 842 932 1022 1112
- 7.8 - 7.2 - 6.7 - 6.1 - 5.6	18 19 20 21 22	64.4 66.2 68.0 69.8 71.6	13.9 14.4 15.0 15.6 16.1	57 58 59 60 61	134.6 136.4 138.2 140.0 141.8	35.6 36.1 36.7 37.2 37.8	96 97 98 99 100	204.8 206.6 208.4 210.2 212.0	343 371 399 427 454	650 700 750 800 850	1202 1292 1382 1472 1562
- 5.0 - 4.4 - 3.9 - 3.3 - 2.8	23 24 25 26 27	73.4 75.2 77.0 78.8 80.6	16.7 17.2 17.8 18.3 18.9	62 63 64 65 66	143.6 145.4 147.2 149.0 150.8	38.3 38.9 39.4 40.0 40.6	101 102 103 104 105	213.8 215.6 217.4 219.2 221.0	482 510 538 593 649	900 950 1000 1100 1200	1652 1742 1832 2012 2192
- 2.2 - 1.7 - 1.1 - 0.6	28 29 30 31	82.4 84.2 86.0 87.8	19.4 20.0 20.6 21.1	67 68 69 70	152.6 154.4 156.2 158.0	41.1 41.7 42.2 42.8	106 107 108 109	222.8 224.6 226.4 228.2	704 760 816 871	1300 1400 1500 1600	2372 2552 2732 2912

Appendix Table	5 Viscosity	Conversion Table

Kinematic Viscosity mm ² /s		bolt ersal (sec)		Type wood sec)	Engler E (degree)	Kinematic Viscosity mm ² /s	Say Univ SUS	ersal	No.1 Redw R (s	rood	Engler E (degree)
mm²/s	100°F	210°F	50°C	100°C		mm²/s	100°F	210°F	50°C	100°C	
2	32.6	32.8	30.8	31.2	1.14	35	163	164	144	147	4.70
3	36.0	36.3	33.3	33.7	1.22	36	168	170	148	151	4.83
4	39.1	39.4	35.9	36.5	1.31	37	172	173	153	155	4.96
5	42.3	42.6	38.5	39.1	1.40	38	177	178	156	159	5.08
6	45.5	45.8	41.1	41.7	1.48	39	181	183	160	164	5.21
7	48.7	49.0	43.7	44.3	1.56	40	186	187	164	168	5.34
8	52.0	52.4	46.3	47.0	1.65	41	190	192	168	172	5.47
9	55.4	55.8	49.1	50.0	1.75	42	195	196	172	176	5.59
10	58.8	59.2	52.1	52.9	1.84	43	199	201	176	180	5.72
11	62.3	62.7	55.1	56.0	1.93	44	204	205	180	185	5.85
12	65.9	66.4	58.2	59.1	2.02	45	208	210	184	189	5.98
13	69.6	70.1	61.4	62.3	2.12	46	213	215	188	193	6.11
14	73.4	73.9	64.7	65.6	2.22	47	218	219	193	197	6.24
15	77.2	77.7	68.0	69.1	2.32	48	222	224	197	202	6.37
16	81.1	81.7	71.5	72.6	2.43	49	227	228	201	206	6.50
17	85.1	85.7	75.0	76.1	2.54	50	231	233	205	210	6.63
18	89.2	89.8	78.6	79.7	2.64	55	254	256	225	231	7.24
19	93.3	94.0	82.1	83.6	2.76	60	277	279	245	252	7.90
20	97.5	98.2	85.8	87.4	2.87	65	300	302	266	273	8.55
21	102	102	89.5	91.3	2.98	70	323	326	286	294	9.21
22	106	107	93.3	95.1	3.10	75	346	349	306	315	9.89
23	110	111	97.1	98.9	3.22	80	371	373	326	336	10.5
24	115	115	101	103	3.34	85	394	397	347	357	11.2
25	119	120	105	107	3.46	90	417	420	367	378	11.8
26	123	124	109	111	3.58	95	440	443	387	399	12.5
27	128	129	112	115	3.70	100	464	467	408	420	13.2
28	132	133	116	119	3.82	120	556	560	490	504	15.8
29	137	138	120	123	3.95	140	649	653	571	588	18.4
30	141	142	124	127	4.07	160	742	747	653	672	21.1
31	145	146	128	131	4.20	180	834	840	734	757	23.7
32	150	150	132	135	4.32	200	927	933	816	841	26.3
33	154	155	136	139	4.45	250	1 159	1 167	1 020	1 051	32.9
34	159	160	140	143	4.57	300	1 391	1 400	1 224	1 241	39.5

Remarks 1mm²/s=1cSt



Appendix Table 6	inch - mm	Conversion Table
------------------	-----------	------------------

1'' = 25.4 mm

inch	0	1	2	3	4	5	6	7	8	9	10
Fraction Decimal						mm					
0 0.000000 1/64 0.015625 1/32 0.031250 3/64 0.046875	0.000 0.397 0.794 1.191	25.400 25.797 26.194 26.591	50.800 51.197 51.594 51.991	76.200 76.597 76.994 77.391	101.600 101.997 102.394 102.791	127.000 127.397 127.794 128.191	152.400 152.797 153.194 153.591	177.800 178.197 178.594 178.991	203.200 203.597 203.994 204.391	228.600 228.997 229.394 229.791	254.000 254.397 254.794 255.191
1/16 0.062500 5/64 0.078125 3/32 0.093750 7/64 0.109375	1.588 1.984 2.381 2.778	26.988 27.384 27.781 28.178	52.388 52.784 53.181 53.578	77.788 78.184 78.581 78.978	103.188 103.584 103.981 104.378	128.588 128.984 129.381 129.778	153.988 154.384 154.781 155.178	179.388 179.784 180.181 180.578	204.788 205.184 205.581 205.978	230.188 230.584 230.981 231.378	255.588 255.984 256.381 256.778
1/8 0.125000 9/64 0.140625 5/32 0.156250 11/64 0.171875	3.175 3.572 3.969 4.366	28.575 28.972 29.369 29.766	53.975 54.372 54.769 55.166	79.375 79.772 80.169 80.566	104.775 105.172 105.569 105.966	130.175 130.572 130.969 131.366	155.575 155.972 156.369 156.766	180.975 181.372 181.769 182.166	206.375 206.772 207.169 207.566	231.775 232.172 232.569 232.966	257.175 257.572 257.969 258.366
3/16 0.187500 13/64 0.203125 7/32 0.218750 15/64 0.234375	4.762 5.159 5.556 5.953	30.162 30.559 30.956 31.353	55.562 55.959 56.356 56.753	80.962 81.359 81.756 82.153	106.362 106.759 107.156 107.553	131.762 132.159 132.556 132.953	157.162 157.559 157.956 158.353	182.562 182.959 183.356 183.753	207.962 208.359 208.756 209.153	233.362 233.759 234.156 234.553	258.762 259.159 259.556 259.953
1/4 0.250000 17/64 0.265625 9/32 0.281250 19/64 0.296875	6.350 6.747 7.144 7.541	31.750 32.147 32.544 32.941	57.150 57.547 57.944 58.341	82.550 82.947 83.344 83.741	107.950 108.347 108.744 109.141	133.350 133.747 134.144 134.541	158.750 159.147 159.544 159.941	184.150 184.547 184.944 185.341	209.550 209.947 210.344 210.741	234.950 235.347 235.744 236.141	260.350 260.747 261.144 261.541
5/16 0.312500 21/64 0.328125 11/32 0.343750 23/64 0.359375	7.938 8.334 8.731 9.128	33.338 33.734 34.131 34.528	58.738 59.134 59.531 59.928	84.138 84.534 84.931 85.328	109.538 109.934 110.331 110.728	134.938 135.334 135.731 136.128	160.338 160.734 161.131 161.528	185.738 186.134 186.531 186.928	211.138 211.534 211.931 212.328	236.538 236.934 237.331 237.728	261.938 262.334 262.731 263.128
3/8 0.375000 25/64 0.390625 13/32 0.406250 27/64 0.421875	9.525 9.922 10.319 10.716	34.925 35.322 35.719 36.116	60.325 60.722 61.119 61.516	85.725 86.122 86.519 86.916	111.125 111.522 111.919 112.316	136.525 136.922 137.319 137.716	161.925 162.322 162.719 163.116	187.325 187.722 188.119 188.516	212.725 213.122 213.519 213.916	238.125 238.522 238.919 239.316	263.525 263.922 264.319 264.716
7/16 0.437500 29/64 0.453125 15/32 0.468750 31/64 0.484375	11.112 11.509 11.906 12.303	36.512 36.909 37.306 37.703	61.912 62.309 62.706 63.103	87.312 87.709 88.106 88.503	112.712 113.109 113.506 113.903	138.112 138.509 138.906 139.303	163.512 163.909 164.306 164.703	188.912 189.309 189.706 190.103	214.312 214.709 215.106 215.503	239.712 240.109 240.506 240.903	265.112 265.509 265.906 266.303
1/2 0.500000 33/64 0.515625 17/32 0.531250 35/64 0.546875	12.700 13.097 13.494 13.891	38.100 38.497 38.894 39.291	63.500 63.897 64.294 64.691	88.900 89.297 89.694 90.091	114.300 114.697 115.094 115.491	139.700 140.097 140.494 140.891	165.100 165.497 165.894 166.291	190.500 190.897 191.294 191.691	215.900 216.297 216.694 217.091	241.300 241.697 242.094 242.491	266.700 267.097 267.494 267.891
9/16 0.562500 37/64 0.578125 19/32 0.593750 39/64 0.609375	14.288 14.684 15.081 15.478	39.688 40.084 40.481 40.878	65.088 65.484 65.881 66.278	90.488 90.884 91.281 91.678	115.888 116.284 116.681 117.078	141.288 141.684 142.081 142.478	166.688 167.084 167.481 167.878	192.088 192.484 192.881 193.278	217.488 217.884 218.281 218.678	242.888 243.284 243.681 244.078	268.288 268.684 269.081 269.478
5/8 0.625000 41/64 0.640625 21/32 0.656250 43/64 0.671875	15.875 16.272 16.669 17.066	41.275 41.672 42.069 42.466	66.675 67.072 67.469 67.866	92.075 92.472 92.869 93.266	117.475 117.872 118.269 118.666	142.875 143.272 143.669 144.066	168.275 168.672 169.069 169.466	193.675 194.072 194.469 194.866	219.075 219.472 219.869 220.266	244.475 244.872 245.269 245.666	269.875 270.272 270.669 271.066
11/16 0.687500 45/64 0.703125 23/32 0.718750 47/64 0.734375	17.462 17.859 18.256 18.653	42.862 43.259 43.656 44.053	68.262 68.659 69.056 69.453	93.662 94.059 94.456 94.853	119.062 119.459 119.856 120.253	144.462 144.859 145.256 145.653	169.862 170.259 170.656 171.053	195.262 195.659 196.056 196.453	220.662 221.059 221.456 221.853	246.062 246.459 246.856 247.253	271.462 271.859 272.256 272.653
3/4 0.750000 49/64 0.765625 25/32 0.781250 51/64 0.796875	19.050 19.447 19.844 20.241	44.450 44.847 45.244 45.641	69.850 70.247 70.644 71.041	95.250 95.647 96.044 96.441	120.650 121.047 121.444 121.841	146.050 146.447 146.844 147.241	171.450 171.847 172.244 172.641	196.850 197.247 197.644 198.041	222.250 222.647 223.044 223.441	247.650 248.047 248.444 248.841	273.050 273.447 273.844 274.241
13/160.81250053/640.82812527/320.84375055/640.859375	20.638 21.034 21.431 21.828	46.038 46.434 46.831 47.228	71.438 71.834 72.231 72.628	96.838 97.234 97.631 98.028	122.238 122.634 123.031 123.428	147.638 148.034 148.431 148.828	173.038 173.434 173.831 174.228	198.438 198.834 199.231 199.628	223.838 224.234 224.631 225.028	249.238 249.634 250.031 250.428	274.638 275.034 275.431 275.828
7/8 0.875000 57/64 0.890625 29/32 0.906250 59/64 0.921875	22.225 22.622 23.019 23.416	47.625 48.022 48.419 48.816	73.025 73.422 73.819 74.216	98.425 98.822 99.219 99.616	123.825 124.222 124.619 125.016	149.225 149.622 150.019 150.416	174.625 175.022 175.419 175.816	200.025 200.422 200.819 201.216	225.425 225.822 226.219 226.616	250.825 251.222 251.619 252.016	276.225 276.622 277.019 277.416
15/16 0.937500 61/64 0.953125 31/32 0.968750 63/64 0.984375	23.812 24.209 24.606 25.003	49.212 49.609 50.006 50.403	74.612 75.009 75.406 75.803	100.012 100.409 100.806 101.203	125.412 125.809 126.206 126.603	150.812 151.209 151.606 152.003	176.212 176.609 177.006 177.403	201.612 202.009 202.406 202.803	227.012 227.409 227.806 228.203	252.412 252.809 253.206 253.603	277.812 278.209 278.606 279.003

1	"	=25.4	mn
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in	ıch	11	12	13	14	15	16	17	18	19	20	
Fraction	n Decimal		mm									
0 1/16 1/8 3/16	0.0000 0.0625 0.1250 0.1875	279.400 280.988 282.575 284.162	304.800 306.388 307.975 309.562	330.200 331.788 333.375 334.962	355.600 357.188 358.775 360.362	381.000 382.588 384.175 385.762	406.400 407.988 409.575 411.162	431.800 433.388 434.975 436.562	457.200 458.788 460.375 461.962	482.600 484.188 485.775 487.362	508.000 509.588 511.175 512.762	
1/4 5/16 3/8 7/16	0.2500 0.3125 0.3750 0.4375	285.750 287.338 288.925 290.512	311.150 312.738 314.325 315.912	336.550 338.138 339.725 341.312	361.950 363.538 365.125 366.712	387.350 388.938 390.525 392.112	412.750 414.338 415.925 417.512	438.150 439.738 441.325 442.912	463.550 465.138 466.725 468.312	488.950 490.538 492.125 493.712	514.350 515.938 517.525 519.112	
1/2 9/16 5/8 11/16	0.5000 0.5625 0.6250 0.6875	292.100 293.688 295.275 296.862	317.500 319.088 320.675 322.262	342.900 344.488 346.075 347.662	368.300 369.888 371.475 373.062	393.700 395.288 396.875 398.462	419.100 420.688 422.275 423.862	444.500 446.088 447.675 449.262	469.900 471.488 473.075 474.662	495.300 496.888 498.475 500.062	520.700 522.288 523.875 525.462	
3/4 13/16 7/8 15/16	0.7500 0.8125 0.8750 0.9375	298.450 300.038 301.625 303.212	323.850 325.438 327.025 328.612	349.250 350.838 352.425 354.012	374.650 376.238 377.825 379.412	400.050 401.638 403.225 404.812	425.450 427.038 428.625 430.212	450.850 452.438 454.025 455.612	476.250 477.838 479.425 481.012	501.650 503.238 504.825 506.412	527.050 528.638 530.225 531.812	

1" = 25.4 **mm**

ir	ıch	21	22	23	24	25	26	27	28	29	30
Fraction	n Decimal					m	m				
0 1/16 1/8 3/16	0.1250	533.400 534.988 536.575 538.162	558.800 560.388 561.975 563.562	584.200 585.788 587.375 588.962	609.600 611.188 612.775 614.362	635.000 636.588 638.175 639.762	660.400 661.988 663.575 665.162	685.800 687.388 688.975 690.562	711.200 712.788 714.375 715.962	736.600 738.188 739.775 741.362	762.000 763.588 765.175 766.762
1/4 5/16 3/8 7/16	0.2500 0.3125 0.3750 0.4375	539.750 541.338 542.925 544.512	565.150 566.738 568.325 569.912	590.550 592.138 593.725 595.312	615.950 617.538 619.125 620.712	641.350 642.938 644.525 646.112	666.750 668.338 669.925 671.512	692.150 693.738 695.325 696.912	717.550 719.138 720.725 722.312	742.950 744.538 746.125 747.712	768.350 769.938 771.525 773.112
1/2 9/16 5/8 11/16	0.5000 0.5625 0.6250 0.6875	546.100 547.688 549.275 550.862	571.500 573.088 574.675 576.262	596.900 598.488 600.075 601.662	622.300 623.888 625.475 627.062	647.700 649.288 650.875 652.462	673.100 674.688 676.275 677.862	698.500 700.088 701.675 703.262	723.900 725.488 727.075 728.662	749.300 750.888 752.475 754.062	774.700 776.288 777.875 779.462
3/4 13/16 7/8 15/16	0.7500 0.8125 0.8750 0.9375	552.450 554.038 555.625 557.212	577.850 579.438 581.025 582.612	603.250 604.838 606.425 608.012	628.650 630.238 631.825 633.412	654.050 655.638 657.225 658.812	679.450 681.038 682.625 684.212	704.850 706.438 708.025 709.612	730.250 731.838 733.425 735.012	755.650 757.238 758.825 760.412	781.050 782.638 784.225 785.812

1" = 25.4 **mm**

in	ch	31	32	33	34	35	36	37	38	39	40
Fraction	n Decimal					m	m				
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 0.3125 0.3750 0.4375	793.750	819.150	844.550	869.950	895.350	920.750	946.150	971.550	996.950	1022.350
5/16		795.338	820.738	846.138	871.538	896.938	922.338	947.738	973.138	998.538	1023.938
3/8		796.925	822.325	847.725	873.125	898.525	923.925	949.325	974.725	1000.125	1025.525
7/16		798.512	823.912	849.312	874.712	900.112	925.512	950.912	976.312	1001.712	1027.112
1/2	0.5000 0.5625 0.6250 0.6875	800.100	825.500	850.900	876.300	901.700	927.100	952.500	977.900	1003.300	1028.700
9/16		801.688	827.088	852.488	877.888	903.288	928.688	954.088	979.488	1004.888	1030.288
5/8		803.275	828.675	854.075	879.475	904.875	930.275	955.675	981.075	1006.475	1031.875
11/16		804.862	830.262	855.662	881.062	906.462	931.862	957.262	982.662	1008.062	1033.462
3/4	0.7500 0.8125 0.8750 0.9375	806.450	831.850	857.250	882.650	908.050	933.450	958.850	984.250	1009.650	1035.050
13/16		808.038	833.438	858.838	884.238	909.638	935.038	960.438	985.838	1011.238	1036.638
7/8		809.625	835.025	860.425	885.825	911.225	936.625	962.025	987.425	1012.825	1038.225
15/16		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 471N) {150kgf}	Vickers Hardness	Brinell F Standard Ball	lardness Tungsten Carbide Ball	Rockwell A Scale Load ^{588.4} N (60kgf) Brale Indenter	Hardness B Scale Load 980.7N {100kgf} 1.588 mm (1/16in) Ball	Shore Hardness
68 67 66 65 64	940 900 865 832 800	_ _ _ _	— — — 739 722	85.6 85.0 84.5 83.9 83.4	_ _ _ _	97 95 92 91 88
63 62 61 60 59	772 746 720 697 674	_ _ _ _	705 688 670 654 634	82.8 82.3 81.8 81.2 80.7		87 85 83 81 80
58 57 56 55 54	653 633 613 595 577		615 595 577 560 543	80.1 79.6 79.0 78.5 78.0		78 76 75 74 72
53 52 51 50 49	560 544 528 513 498	500 487 475 464	525 512 496 481 469	77.4 76.8 76.3 75.9 75.2		71 69 68 67 66
48 47 46 45 44	484 471 458 446 434	451 442 432 421 409	455 443 432 421 409	74.7 74.1 73.6 73.1 72.5		64 63 62 60 58
43 42 41 40 39	423 412 402 392 382	400 390 381 371 362	400 390 381 371 362	72.0 71.5 70.9 70.4 69.9		57 56 55 54 52
38 37 36 35 34	372 363 354 345 336	353 344 336 327 319	353 344 336 327 319	69.4 68.9 68.4 67.9 67.4	(109.0) (108.5) (108.0)	51 50 49 48 47
33 32 31 30 29	327 318 310 302 294	311 301 294 286 279	311 301 294 286 279	66.8 66.3 65.8 65.3 64.7	(107.5) (107.0) (106.0) (105.5) (104.5)	46 44 43 42 41
28 27 26 25 24	286 279 272 266 260	271 264 258 253 247	271 264 258 253 247	64.3 63.8 63.3 62.8 62.4	(104.0) (103.0) (102.5) (101.5) (101.0)	41 40 38 38 37
23 22 21 20	254 248 243 238	243 237 231 226	243 237 231 226	62.0 61.5 61.0 60.5	100.0 99.0 98.5 97.8	36 35 35 34
(18) (16) (14) (12)	230 222 213 204	219 212 203 194	219 212 203 194	_ _ _ _	96.7 95.5 93.9 92.3	33 32 31 29
(10) (8) (6) (4) (2) (0)	196 188 180 173 166 160	187 179 171 165 158 152	187 179 171 165 158 152	_ _ _ _ _	90.7 89.5 87.1 85.5 83.5 81.7	28 27 26 25 24 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	12.5×10 ⁻⁶	650 to 740	208 000 {21 200}	1 570 to 1 960 {160 to 200}	_	_
Martensitic Stainless Steel SUS 440C	7.68	10.1×10 ⁻⁶	580	200 000 {20 400}	1 960 {200}	1 860 {190}	_
Mild Steel (C=0.12~0.20%)	7.86	11.6×10 ⁻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	11.3×10 ⁻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	16.3×10 ⁻⁶	150	193 000 {19 700}	588 {60}	245 {25}	60
Gray Iron FC200	7.3	10.4×10 ⁻⁶	223	98 100	More than 200 {20}	_	_
Spheroidal graphite Iron FCD400	7.0	11.7×10 ⁻⁶	Less than 201	{10 000}	More than 400 {41}	_	More than 12
Aluminum	2.69	23.7×10 ⁻⁶	15 to 26	70 600 {7 200}	78 {8}	34 {3.5}	35
Zinc	7.14	31×10 ⁻⁶	30 to 60	92 200 {9 400}	147 {15}	_	30 to 40
Copper	8.93	16.2×10 ⁻⁶	50	123 000 {12 500}	196 {20}	69 {7}	15 to 20
(Annealed) Brass	8.5	19.1×10 ⁻⁶	45	103 000	294 to 343 {30 to 35}	_	65 to 75
(Machined)			85 to 130	{10 500}	363 to 539 {37 to 55}		15 to 50

Remarks The hardness of hardened bearing steel and martensitic stainless steel is usually expressed using the Rockwell C Scale, but for comparison, it is converted into Brinell hardness.



Appendix Table 9 Tolerances

for Shaft	Diameters
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	meter ation (mm)	Single Plane Mean B.D. Deviation	d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6
over	incl.	(Normal) Δ_{dmp}	do	CO	10	go	gu	113	110	117	110	113	1110	J30	J30
3	6	- 8 - 8	- 30 - 38	- 20 - 28	- 10 - 18		- 4 - 12	0 - 5	0 - 8	- 12	_ 0 _ 18	_ 0 _ 30	0 - 48	± 2.5	± 4
6	10	- 8	- 40 - 49	- 25 - 34	- 13 - 22	- 5 - 11	- 5 - 14	- 6	- 9	0 - 15	0 - 22	0 - 36	0 - 58	± 3	± 4.5
10	18	- 8	- 50 - 61	- 32 - 43	- 16 - 27	- 6 - 14	- 6 - 17	- 8	0 -11	0 - 18	0 - 27	0 - 43	0 - 70	± 4	± 5.5
18	30	0 - 10	- 65 - 78	- 40 - 53	- 20 - 33	- 7 - 16	- 7 - 20	_ 0 _ 9	0 -13	0 - 21	0 - 33	0 - 52	0 - 84	± 4.5	± 6.5
30	50	0 - 12	- 80 - 96	- 50 - 66	- 25 - 41	- 9 - 20	- 9 - 25	0 -11	0 -16	0 - 25	0 39	0 - 62	0 -100	± 5.5	± 8
50	80	0 - 15	-100 -119	- 60 - 79	- 30 - 49	- 10 - 23	- 10 - 29	0 -13	0 - 19	- 30	- 46	- 74	0 -120	± 6.5	± 9.5
80	120	- ⁰	-120 -142	- 72 - 94	- 36 - 58	- 12 - 27	- 12 - 34	0 -15	0 - 22	0 - 35	0 - 54	- 87	0 -140	± 7.5	± 11
120	180	0 - 25	-145 -170	- 85 -110	- 43 - 68	- 14 - 32	- 14 - 39	0 -18	0 -25	- ⁰	- 63	0 100	0 -160	± 9	± 12.5
180	250	- 30	-170 -199	- 100 - 129	- 50 - 79	- 15 - 35	- 15 - 44	0 -20	0 -29	- ⁰	- ⁰ 72	0 -115	0 -185	±10	± 14.5
250	315	0 - 35	-190 -222	-110 -142	- 56 - 88	- 17 - 40	- 17 - 49	0 -23	0 -32	0 - 52	0 - 81	0 -130	0 -210	± 11.5	± 16
315	400	- 40	-210 -246	- 125 - 161	- 62 - 98	- 18 - 43	- 18 - 54	0 -25	0 -36	0 - 57	0 - 89	0 -140	0 -230	± 12.5	± 18
400	500	0 - 45	-230 -270	135 175	- 68 - 108	- 20 - 47	- 20 - 60	0 -27	0 - 40	- 63	- 97	0 155	0 -250	± 13.5	± 20
500	630	0 - 50	-260 -304	- 145 - 189	- 76 -120	_	- 22 - 66	_	0 - 44	- ⁰	0 -110	0 175	0 -280	_	± 22
630	800	0 - 75	-290 -340	-160 -210	- 80 -130	_	- 24 - 74	_	0 -50	- 80	0 125	0 -200	0 -320	_	± 25
800	1 000	0 -100	-320 -376	-170 -226	- 86 -142	_	- 26 - 82	_	0 - 56	- ⁰	0 -140	0 -230	0 -360	_	± 28
1 000	1 250	0 -125	-350 -416	- 195 - 261	- 98 -164	_	- 28 - 94		0 -66	0 -105	0 165	0 -260	0 -420	_	± 33
1 250	1 600	0 -160	-390 -468	-220 -298	-110 -188	_	- 30 - 108	_	0 - 78	0 -125	0 195	-310	0 -500	_	± 39
1 600	2 000	0 -200	-430 -522	-240 -332	120 212	_	- 32 -124	_	0 - 92	0 150	0 -230	0 -370	0 -600	_	± 46

for Shai	it Diaiii	eter 3										U	nits : μ m
j5	j6	j7	k5	k6	k7	m5	m6	n6	р6	r6	r7	Diameter Cl (m	
Jo	Jo	J'	KJ	KU	K/	шэ	1110	110	рo	10	17	over	incl.
+ 3 - 2	+ 6 - 2	+ 8 - 4	+ 6 + 1	+ 9 + 1	+ 13 + 1	+ 9 + 4	+ 12 + 4	+ 16 + 8	+ 20 + 12	+ 23 + 15	+ 27 + 15	3	6
+ 4 - 2	+ 7 - 2	+ 10 - 5	+ 7 + 1	+ 10 + 1	+ 16 + 1	+ 12 + 6	+ 15 + 6	+ 19 + 10	+ 24 + 15	+ 28 + 19	+ 34 + 19	6	10
+ 5 - 3	+ 8 - 3	+ 12	+ 9 + 1	+ 12 + 1	+ 19 + 1	+ 15 + 7	+ 18 + 7	+ 23 + 12	+ 29 + 18	+ 34 + 23	+ 41 + 23	10	18
+ 5 - 4	+ 9 - 4	+ 13 - 8	+ 11 + 2	+ 15 + 2	+ 23 + 2	+ 17 + 8	+ 21 + 8	+ 28 + 15	+ 35 + 22	+ 41 + 28	+ 49 + 28	18	30
+ 6 - 5	+ 11 - 5	+ 15 10	+ 13 + 2	+ 18 + 2	+ 27 + 2	+ 20 + 9	+ 25 + 9	+ 33 + 17	+ 42 + 26	+ 50 + 34	+ 59 + 34	30	50
+ 6	+ 12 - 7	+ 18	+ 15	+ 21	+ 32	+ 24	+ 30	+ 39	+ 51	+ 60 + 41	+ 71 + 41	50	65
- 7	- 7	-12	+ 2	+ 2	+ 2	+ 11	+ 11	+ 20	+ 32	+ 62 + 43	+ 73 + 43	65	80
+ 6	+ 13	+ 20	+ 18	+ 25	+ 38	+ 28	+ 35	+ 45	+ 59	+ 73 + 51	+ 86 + 51	80	100
- 9	- 9	– 15	+ 3	+ 3	+ 3	+ 13	+ 13	+ 23	+ 37	+ 76 + 54	+ 89 + 54	100	120
										+ 88 + 63	+ 103 + 63	120	140
+ 7 —11	+ 14 — 11	+ 22 — 18	+ 21 + 3	+ 28 + 3	+ 43 + 3	+ 33 + 15	+ 40 + 15	+ 52 + 27	+ 68 + 43	+ 90 + 65	+ 105 + 65	140	160
										+ 93 + 68	+ 108 + 68	160	180
										+ 106 + 77	+ 123 + 77	180	200
+ 7 -13	+ 16 13	+ 25 21	+ 24 + 4	+ 33 + 4	+ 50 + 4	+ 37 + 17	+ 46 + 17	+ 60 + 31	+ 79 + 50	+ 109 + 80	+ 126 + 80	200	225
										+ 113 + 84	+ 130 + 84	225	250
+ 7	± 16	± 26	+ 27	+ 36	+ 56	+ 43	+ 52	+ 66	+ 88	+ 126 + 94	+ 146 + 94	250	280
-16			+ 4	+ 4	+ 4	+ 20	+ 20	+ 34	+ 56	+ 130 + 98	+ 150 + 98	280	315
+ 7	± 18	+ 29	+ 29	+ 40	+ 61	+ 46	+ 57	+ 73	+ 98	+ 144 + 108	+ 165 + 108	315	355
-18	± 10	- 28	+ 4	+ 4	+ 4	+ 21	+ 21	+ 37	+ 62	+ 150 + 114	+ 171 + 114	355	400
+ 7	1.20	+ 31	+ 32	+ 45	+ 68	+ 50	+ 63	+ 80	+ 108	+ 166 + 126	+ 189 + 126	400	450
-20	± 20	-32	+ 5	+ 5	+ 5	+ 23	+ 23	+ 40	+ 68	+ 172 + 132	+ 195 + 132	450	500
				+ 44	+ 70		+ 70	+ 88	+ 122	+ 194 + 150	+ 220 + 150	500	560
_	_	_		0	0	_	+ 26	+ 44	+ 78	+ 199 + 155	+ 225 + 155	560	630
				+ 50	+ 80		+ 80	+ 100	+ 138	+ 225 + 175	+ 255 + 175	630	710
	_	_	1	0	0		+ 30	+ 50	+ 88	+ 235 + 185	+ 265 + 185	710	800
		_		+ 56	+ 90		+ 90	+ 112	+ 156	+ 266 + 210 + 276	+ 300 + 210 + 310	800	900
				0	0		+ 34	+ 56	+ 100	+ 220	+ 220	900	1 000
_	_	_	_	+ 66	+ 105	_	+ 106	+ 132	+ 186	+ 316 + 250 + 326	+ 355 + 250	1 000	1 120
				0	0		+ 40	+ 66	+ 120	+ 260	+ 365 + 260	1 120	1 250
_	_	_	_	+ 78	+ 125	_	+ 126	+ 156	+ 218	+ 378 + 300	+ 425 + 300	1 250	1 400
				0	0		+ 48	+ 78	+ 140	+ 408 + 330	+ 455 + 330	1 400	1 600
_	_	_	_	+ 92	+ 150	_	+ 150	+ 184	+ 262	+ 462 + 370	+ 520 + 370	1 600	1 800
				0	0		+ 58	+ 92	+ 170	+ 492 + 400	+ 550 + 400	1 800	2 000

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Appendix Table 10

Classifica	neter tion (mm)	Single Plane Mean O.D. Deviation (Normal)	E6	F6	F7	G6	G7	Н6	Н7	Н8	Ј6	J7	JS6	JS7
over	incl.	(Normal) D _{mp}	. 42	. 27	. 24	. 17	+ 24	. 11	. 10	. 27	. 4	. 10		
10	18	- 8	+ 43 + 32	+ 27 + 16	+ 34 + 16	+ 17 + 6	+ 24 + 6	+ 11	+ 18	+ 27	+ 6 - 5	+ 10 - 8	± 5.5	± 9
18	30	- ⁰	+ 53 + 40	+ 33 + 20	+ 41 + 20	+ 20 + 7	+ 28 + 7	+ 13	+ 21	+ 33	+ 8 - 5	+ 12 - 9	± 6.5	± 10.5
30	50	0 - 11	+ 66 + 50	+ 41 + 25	+ 50 + 25	+ 25 + 9	+ 34 + 9	+ 16	+ 25	+ 39	+ 10 — 6	+ 14 — 11	± 8	± 12.5
50	80	0 - 13	+ 79 + 60	+ 49 + 30	+ 60 + 30	+ 29 + 10	+ 40 + 10	+ 19	+ 30	+ 46	+ 13 - 6	+ 18 — 12	± 9.5	± 15
80	120	0 - 15	+ 94 + 72	+ 58 + 36	+ 71 + 36	+ 34 + 12	+ 47 + 12	+ 22	+ 35	+ 54	+ 16 — 6	+ 22 — 13	± 11	± 17.5
120 150	150 180	0 - 18 0 - 25	+ 110 + 85	+ 68 + 43	+ 83 + 43	+ 39 + 14	+ 54 + 14	+ 25 0	+ 40	+ 63	+ 18 - 7	+ 26 14	± 12.5	± 20
180	250	0 - 30	+ 129 + 100	+ 79 + 50	+ 96 + 50	+ 44 + 15	+ 61 + 15	+ 29	+ 46	+ 72 0	+ 22 - 7	+ 30 — 16	± 14.5	± 23
250	315	0 - 35	+ 142 + 110	+ 88 + 56	+ 108 + 56	+ 49 + 17	+ 69 + 17	+ 32	+ 52	+ 81	+ 25 — 7	+ 36 — 16	± 16	± 26
315	400	0 - 40	+ 161 + 125	+ 98 + 62	+ 119 + 62	+ 54 + 18	+ 75 + 18	+ 36	+ 57 0	+ 89	+ 29 — 7	+ 39 — 18	± 18	± 28.5
400	500	0 - 45	+ 175 + 135	+ 108 + 68	+ 131 + 68	+ 60 + 20	+ 83 + 20	+ 40	+ 63	+ 97	+ 33 — 7	+ 43 - 20	± 20	± 31.5
500	630	0 - 50	+ 189 + 145	+ 120 + 76	+ 146 + 76	+ 66 + 22	+ 92 + 22	+ 44	+ 70	+ 110	_	_	± 22	± 35
630	800	0 - 75	+ 210 + 160	+ 130 + 80	+ 160 + 80	+ 74 + 24	+ 104 + 24	+ 50 0	+ 80	+ 125 0	_	_	± 25	± 40
800	1 000	0 100	+ 226 + 170	+ 142 + 86	+ 176 + 86	+ 82 + 26	+ 116 + 26	+ 56	+ 90	+ 140	_	_	± 28	± 45
1 000	1 250	0 125	+ 261 + 195	+ 164 + 98	+ 203 + 98	+ 94 + 28	+ 133 + 28	+ 66	+ 105 0	+ 165 0	_	_	± 33	± 52.5
1 250	1 600	0 160	+ 298 + 220	+ 188 + 110	+ 235 + 110	+ 108 + 30	+ 155 + 30	+ 78	+ 125 0	+ 195 0	_	_	± 39	± 62.5
1 600	2 000	0 - 200	+ 332 + 240	+ 212 + 120	+ 270 + 120	+ 124 + 32	+ 182 + 32	+ 92	+ 150 0	+ 230	_	_	± 46	± 75
2 000	2 500	0 - 250	+ 370 + 260	+ 240 + 130	+ 305 + 130	+ 144 + 34	+ 209 + 34	+ 110	+ 175 0	+ 280	_	_	± 55	± 87.5

Tolerances for Housing Bore Diameters

П	Inits	٠	пm

K5	K6	K7	M5	M6	M7	N5	N6	N7	P6	P7	Diameter CI (m	
IK5	110	IX/	IVIS	IVIO	1417	143	140	147	10	17	over	incl.
+ 2 - 6	+ 2 - 9	+ 6 - 12	- 4 -12	- 4 - 15	- 18	- 9 -17	- 9 - 20	- 5 - 23	- 15 - 26	- 11 - 29	10	18
+ 1 - 8	+ 2 - 11	+ 6 - 15	- 5 -14	- 4 - 17	0 - 21	- 12 - 21	- 11 - 24	- 7 - 28	- 18 - 31	- 14 - 35	18	30
+ 2 - 9	+ 3 - 13	+ 7 - 18	- 5 -16	- 4 - 20	0 - 25	-13 -24	- 12 - 28	- 8 - 33	- 21 - 37	- 17 - 42	30	50
+ 3 -10	+ 4 - 15	+ 9 - 21	- 6 -19	- 5 - 24	- 30	- 15 - 28	- 14 - 33	- 9 - 39	- 26 - 45	- 21 - 51	50	80
+ 2 -13	+ 4 - 18	+ 10 - 25	- 8 -23	- 6 - 28	0 - 35	- 18 - 33	- 16 - 38	- 10 - 45	- 30 - 52	- 24 - 59	80	120
+ 3 -15	+ 4 - 21	+ 12 - 28	- 9 -27	- 8 - 33	0 - 40	-21 -39	- 20 - 45	- 12 - 52	- 36 - 61	- 28 - 68	120	180
+ 2 -18	+ 5 - 24	+ 13 - 33	-11 -31	- 8 - 37	0 - 46	- 25 - 45	- 22 - 51	- 14 - 60	- 41 - 70	- 33 - 79	180	250
+ 3 -20	+ 5 - 27	+ 16 - 36	-13 -36	- 9 - 41	0 - 52	- 27 - 50	- 25 - 57	- 14 - 66	- 47 - 79	- 36 - 88	250	315
+ 3 -22	+ 7 - 29	+ 17 - 40	-14 -39	- 10 - 46	0 - 57	- 30 - 55	- 26 - 62	- 16 - 73	- 51 - 87	- 41 - 98	315	400
+ 2 -25	+ 8 - 32	+ 18 - 45	-16 -43	- 10 - 50	0 - 63	-33 -60	- 27 - 67	- 17 - 80	- 55 - 95	- 45 -108	400	500
_	0 - 44	- ⁰	_	- 26 - 70	- 26 - 96	_	- 44 - 88	- 44 -114	- 78 -122	- 78 -148	500	630
_	0 - 50	- 80	_	- 30 - 80	- 30 -110	_	- 50 -100	- 50 -130	- 88 -138	- 88 -168	630	800
	0 - 56	- 90	_	- 34 - 90	- 34 -124	_	- 56 -112	- 56 -146	- 100 - 156	-100 -190	800	1 000
_	- 66	0 - 105	_	- 40 -106	- 40 -145	_	- 66 -132	- 66 -171	- 120 - 186	- 120 - 225	1 000	1 250
_	0 - 78	0 125	_	- 48 -126	- 48 -173	_	- 78 -156	- 78 -203	-140 -218	-140 -265	1 250	1 600
_	0 - 92	0 150	_	- 58 -150	- 58 -208	_	- 92 -184	- 92 -242	- 170 - 262	- 170 - 320	1 600	2 000
_	0 110	0 175	_	- 68 - 178	- 68 -243	_	110 220	110 285	- 195 - 305	195 370	2 000	2 500

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Appendix Table 11 Values of

Basic	Size											Standard
(m	m)	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11
over	incl.					Tol	erances (μ	m)				
_	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.

Standard Tolerance Grades IT

Grades			Basic Size					
IT12	IT13	IT14	IT15	IT16	IT17	IT18	(n	nm)
		Tole	erances (m	nm)			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

^{2.} Values for standard tolerance grades IT1 to IT5 for basic sizes over 500 mm are included for experimental use.



Appedix Table 12 Speed Factor $f_{\rm n}$

Appendix Table 13 Fatigue Life Factor $f_{\rm n}$ and Fatigue Life $L \cdot L_{\rm h}$

Ball Bearings $f_{\rm n}$ = (0.03 n) $^{-1/3}$ Roller Bearings $f_{
m n}$ = (0.03 n) $^{-3/10}$ Ball Bearings $L=(C/P)^3$ $L_{\rm h}=500~f_{\rm h}^3$ Roller Bearings $L = (C / P)^{10/3} L_h = 500 f_h^{10/3}$

Speed	Speed F	actor $f_{ m n}$	Speed		actor $f_{ m n}$	Speed	Speed F	actor $f_{ m n}$
<i>n</i> (min ⁻¹)	Ball Bearings	Roller Bearings	<i>n</i> (min ⁻¹)	Ball Bearings	Roller Bearings	<i>n</i> (min ⁻¹)	Ball Bearings	Roller Bearings
10	1.49	1.44	180	0.570	0.603	3 000	0.223	0.259
11	1.45	1.39	190	0.560	0.593	3 200	0.218	0.254
12	1.41	1.36	200	0.550	0.584	3 400	0.214	0.250
13	1.37	1.33	220	0.533	0.568	3 600	0.210	0.245
14	1.34	1.30	240	0.518	0.553	3 800	0.206	0.242
15	1.30	1.27	260	0.504	0.540	4 000	0.203	0.238
16	1.28	1.25	280	0.492	0.528	4 200	0.199	0.234
17	1.25	1.22	300	0.481	0.517	4 400	0.196	0.231
18	1.23	1.20	320	0.471	0.507	4 600	0.194	0.228
19	1.21	1.18	340	0.461	0.498	4 800	0.191	0.225
20	1.19	1.17	360	0.452	0.490	5 000	0.188	0.222
21	1.17	1.15	380	0.444	0.482	5 200	0.186	0.220
22	1.15	1.13	400	0.437	0.475	5 400	0.183	0.217
23	1.13	1.12	420	0.430	0.468	5 600	0.181	0.215
24	1.12	1.10	440	0.423	0.461	5 800	0.179	0.213
25 26 27 28 29	1.10 1.09 1.07 1.06 1.05	1.09 1.08 1.07 1.05 1.04	460 480 500 550 600	0.417 0.411 0.405 0.393 0.382	0.455 0.449 0.444 0.431 0.420	6 000 6 200 6 400 6 600 6 800	0.177 0.175 0.173 0.172 0.170	0.211 0.209 0.207 0.207 0.205 0.203
30	1.04	1.03	650	0.372	0.410	7 000	0.168	0.201
31	1.02	1.02	700	0.362	0.401	7 200	0.167	0.199
32	1.01	1.01	750	0.354	0.393	7 400	0.165	0.198
33.3	1.00	1.00	800	0.347	0.385	7 600	0.164	0.196
34	0.993	0.994	850	0.340	0.378	7 800	0.162	0.195
36	0.975	0.977	900	0.333	0.372	8 000	0.161	0.193
38	0.957	0.961	950	0.327	0.366	8 500	0.158	0.190
40	0.941	0.947	1 000	0.322	0.360	9 000	0.155	0.186
42	0.926	0.933	1 050	0.317	0.355	9 500	0.152	0.183
44	0.912	0.920	1 100	0.312	0.350	10 000	0.149	0.181
46	0.898	0.908	1 150	0.307	0.346	11 000	0.145	0.176
48	0.886	0.896	1 200	0.303	0.341	12 000	0.141	0.171
50	0.874	0.885	1 250	0.299	0.337	13 000	0.137	0.167
55	0.846	0.861	1 300	0.295	0.333	14 000	0.134	0.163
60	0.822	0.838	1 400	0.288	0.326	15 000	0.130	0.160
65	0.800	0.818	1 500	0.281	0.319	16 000	0.128	0.157
70	0.781	0.800	1 600	0.275	0.313	17 000	0.125	0.154
75	0.763	0.784	1 700	0.270	0.307	18 000	0.123	0.151
80	0.747	0.769	1 800	0.265	0.302	19 000	0.121	0.149
85	0.732	0.755	1 900	0.260	0.297	20 000	0.119	0.147
90	0.718	0.742	2 000	0.255	0.293	22 000	0.115	0.143
95	0.705	0.730	2 100	0.251	0.289	24 000	0.112	0.139
100	0.693	0.719	2 200	0.247	0.285	26 000	0.109	0.136
110	0.672	0.699	2 300	0.244	0.281	28 000	0.106	0.133
120	0.652	0.681	2 400	0.240	0.277	30 000	0.104	0.130
130	0.635	0.665	2 500	0.237	0.274	32 000	0.101	0.127
140	0.620	0.650	2 600	0.234	0.271	34 000	0.099	0.125
150	0.606	0.637	2 700	0.231	0.268	36 000	0.097	0.123
160	0.593	0.625	2 800	0.228	0.265	38 000	0.096	0.121
170	0.581	0.613	2 900	0.226	0.262	40 000	0.094	0.119

			Roller Bearings $L=(C/P)^{10/3} L_{\rm h}=500 f_{\rm h}^{-10/3}$						
	Ball Bear	ing Life	Roller Bea	aring Life		Ball Bear	ing Life	Roller Be	aring Life
C/P or $f_{ m h}$	<i>L</i> (10 ⁶ rev)	<i>L</i> _h (h)	L (10 ⁶ rev)	<i>L</i> _h (h)	$\it C/P$ or $\it f_{\rm h}$	<i>L</i> (10 ⁶ rev)	<i>L</i> _h (h)	<i>L</i> (10 ⁶ rev)	L _h (h)
0.70	0.34	172	0.30	152	3.45	41.1	20 500	62.0	31 000
0.75	0.42	211	0.38	192	3.50	42.9	21 400	65.1	32 500
0.80	0.51	256	0.48	238	3.55	44.7	22 400	68.2	34 100
0.85	0.61	307	0.58	291	3.60	46.7	23 300	71.5	35 800
0.90	0.73	365	0.70	352	3.65	48.6	24 300	74.9	37 400
0.95	0.86	429	0.84	421	3.70	50.7	25 300	78.3	39 200
1.00	1.00	500	1.00	500	3.75	52.7	26 400	81.9	41 000
1.05	1.16	579	1.18	588	3.80	54.9	27 400	85.6	42 800
1.10	1.33	665	1.37	687	3.85	57.1	28 500	89.4	44 700
1.15	1.52	760	1.59	797	3.90	59.3	29 700	93.4	46 700
1.20	1.73	864	1.84	918	3.95	61.6	30 800	97.4	48 700
1.25	1.95	977	2.10	1 050	4.00	64.0	32 000	102	50 800
1.30	2.20	1 100	2.40	1 200	4.05	66.4	33 200	106	52 900
1.35	2.46	1 230	2.72	1 360	4.10	68.9	34 500	110	55 200
1.40	2.74	1 370	3.07	1 530	4.15	71.5	35 700	115	57 400
1.45	3.05	1 520	3.45	1 730	4.20	74.1	37 000	120	59 800
1.50	3.38	1 690	3.86	1 930	4.25	76.8	38 400	124	62 200
1.55	3.72	1 860	4.31	2 150	4.30	79.5	39 800	129	64 600
1.60	4.10	2 050	4.79	2 400	4.35	82.3	41 200	134	67 200
1.65	4.49	2 250	5.31	2 650	4.40	85.2	42 600	140	69 800
1.70	4.91	2 460	5.86	2 930	4.45	88.1	44 100	145	72 500
1.75	5.36	2 680	6.46	3 230	4.50	91.1	45 600	150	75 200
1.80	5.83	2 920	7.09	3 550	4.55	94.2	47 100	156	78 000
1.85	6.33	3 170	7.77	3 890	4.60	97.3	48 700	162	80 900
1.90	6.86	3 430	8.50	4 250	4.65	101	50 300	168	83 900
1.95	7.41	3 710	9.26	4 630	4.70	104	51 900	174	87 000
2.00	8.00	4 000	10.1	5 040	4.75	107	53 600	180	90 100
2.05	8.62	4 310	10.9	5 470	4.80	111	55 300	187	93 300
2.10	9.26	4 630	11.9	5 930	4.85	114	57 000	193	96 600
2.15	9.94	4 970	12.8	6 410	4.90	118	58 800	200	99 900
2.20	10.6	5 320	13.8	6 920	4.95	121	60 600	207	103 000
2.25	11.4	5 700	14.9	7 460	5.00	125	62 500	214	107 000
2.30	12.2	6 080	16.1	8 030	5.10	133	66 300	228	114 000
2.35	13.0	6 490	17.3	8 630	5.20	141	70 300	244	122 000
2.40	13.8	6 910	18.5	9 250	5.30	149	74 400	260	130 000
2.45	14.7	7 350	19.8	9 910	5.40	157	78 700	276	138 000
2.50	15.6	7 810	21.2	10 600	5.50	166	83 200	294	147 000
2.55	16.6	8 290	22.7	11 300	5.60	176	87 800	312	156 000
2.60	17.6	8 790	24.2	12 100	5.70	185	92 600	331	165 000
2.65	18.6	9 300	25.8	12 900	5.80	195	97 600	351	175 000
2.70	19.7	9 840	27.4	13 700	5.90	205	103 000	371	186 000
2.75	20.8	10 400	29.1	14 600	6.00	216	108 000	392	196 000
2.80	22.0	11 000	30.9	15 500	6.50	275	137 000	513	256 000
2.85	23.1	11 600	32.8	16 400	7.00	343	172 000	656	328 000
2.90	24.4	12 200	34.8	17 400	7.50	422	211 000	826	413 000
2.95 3.00 3.05 3.10 3.15	25.7 27.0 28.4 29.8 31.3	12 800 13 500 14 200 14 900 15 600	36.8 38.9 41.1 43.4 45.8	18 400 19 500 20 600 21 700 22 900	8.00 8.50 9.00 9.50 10.0	512 614 729 857 1 000	256 000 307 000 365 000 429 000	1 020 1 250 1 520 1 820 2 150	512 000 627 000 758 000 908 000
3.20 3.25 3.30 3.35 3.40	32.8 34.3 35.9 37.6 39.3	16 400 17 200 18 000 18 800 19 700	48.3 50.8 53.5 56.3 59.1	24 100 25 400 26 800 28 100 29 600	11.0 12.0 13.0 14.0 15.0	1 330 1 730 2 200 2 740 3 380	_ _ _ _	2 960 3 960 5 170 6 610 8 320	_ _ _ _ _

C 25 C 24



Appendix Table14 Index of Inch Design Tapered Roller Bearings

Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages
332	D 80.000	B140,B144,B146	497	d 85.725	B162	657	d 73.025	B158	1328	D 52.388	B136
336	d 41.275	B146	498	d 84.138	B162	658	d 74.612	B158	1329	D 53.975	B136
342	d 41.275	B146	522	D 101.600	B148,B150	659	d 76.200	B158	1380	d 22.225	B136
342 S	d 42.875	B146	528	d 47.625	B148	661	d 79.375	B160	1620	D 66.675	B142
344	d 40.000	B144	529	d 50.800	B150	663	d 82.550	B160	1680	d 33.338	B142
344 A	d 40.000	B144	529 X	d 50.800	B150	664	d 84.138	B162	1729	D 56.896	B136,B138
346	d 31.750	B140	532 X	D 107.950	B152	665	d 85.725	B162	1755	d 22.225	B136
354 A	D 85.000	B148	539	d 53.975	B152	665 A	d 85.725	B162	1779	d 23.812	B138
359 S	d 46.038	B148	552 A	D 123.825	B152,B154,B156	672	D 168.275	B162,B164,B166	1922	D 57.150	B138
362 A	D 88.900	B148,B150	553 X	<i>D</i> 122.238	B154,B156	677	d 85.725	B162	1988	d 28.575	B138
366	d 50.000	B150	555 S	<i>d</i> 57.150	B152	681	d 92.075	B164	1997 X	d 26.988	B138
368	d 50.800	B150	557 S	<i>d</i> 53.975	B152	683	d 95.250	B164	A2047	d 12.000	B136
368 A	d 50.800	B150	558	d 60.325	B154	685	d 98.425	B164	A2126	D 31.991	B136
369 A	d 47.625	B148	559	d 63.500	B154	687	d 101.600	B166	2523	D 69.850	B140,B142
372	D 100.000	B150	560	d 66.675	B156	742	D 150.089	B156,B160,B162	2558	d 30.162	B140
374	D 93.264	B148	560 S	d 68.262	B156	743	D 150.000	B160	2559	d 30.162	B140
376	d 45.000	B148	563	D 127.000	B154,B156,B158	745 A	d 69.850	B156	2580	d 31.750	B140
377	d 52.388	B150	563 X	D 127.000	B156	749	d 85.026	B162	2582	d 31.750	B140
382	D 98.425	B152	565	d 63.500	B154	749 A	d 82.550	B160	2585	d 33.338	B142
382 A	D 96.838	B152	566	d 69.850	B156	749 S	d 85.026	B162	2631	D 66.421	B140
382 S	D 96.838	B152	567	d 73.025	B158	750	d 79.375	B160	2690	d 29.367	B140
385	d 55.000	B152	567 A	 d 71.438 d 71.438 d 73.817 	B158	752	D 161.925	B160,B162	2720	D 76.200	B144
387	d 57.150	B152	567 S		B158	753	D 168.275	B160,B162	2729	D 76.200	B144
387 A	d 57.150	B152	568		B158	757	d 82.550	B160	2735 X	D 73.025	B144
388 A	d 57.531	B152	569	d 64.963	B154	758	d 85.725	B162	2788	d 38.100	B144
390 A	d 63.500	B154	570	d 68.262	B156	759	d 88.900	B162	2789	d 39.688	B144
394 A	D 110.000	B154,B156	572	D 139.992	B158,B160	760	d 90.488	B162	2820	D 73.025	B142
395	d 63.500	B154	572 X	<i>D</i> 139.700	B160	766	d 88.900	B162	2877	d 34.925	B142
395 A	d 66.675	B156	575	<i>d</i> 76.200	B158	772	D 180.975	B164,B166	2924	D 85.000	B148
395 S	d 66.675	B156	580	<i>d</i> 82.550	B160	776	d 95.250	B164	2984	d 46.038	B148
397	d 60.000	B154	581	d 80.962	B160	779	 d 98.425 d 101.600 d 104.775 	B164	3120	D 72.626	B140,B142
399 A	d 68.262	B156	582	d 82.550	B160	780		B166	3188	d 31.750	B140
414	D 88.501	B144	590 A	d 76.200	B158	782		B166	3197	d 33.338	B142
418	d 38.100	B144	592	<i>D</i> 152.400	B164	787	 d 104.775 D 206.375 d 120.650 	B166	3320	D 80.167	B144
432	D 95.250	B146	592 A	<i>D</i> 152.400	B158,B162,B164	792		B168	3386	d 39.688	B144
432 A	D 95.250	B148	593	<i>d</i> 88.900	B162	795		B168	3420	D 79.375	B142,B144
436	d 46.038	B148	594	d 95.250	B164	797	 d 130.000 d 128.588 d 130.175 	B168	3478	d 34.925	B142
438	d 44.450	B146	596	d 85.725	B162	799		B168	3479	d 36.512	B144
453 A	D 107.950	B148	597	d 93.662	B164	799 A		B168	3490	d 38.100	B144
453 X	D 104.775	B152	598	 d 92.075 d 92.075 D 115.000 	B164	832	D 168.275	B160,B162	3525	D 87.312	B146
460	d 44.450	B148	598 A		B164	837	d 76.200	B160	3576	d 41.275	B146
462	d 57.150	B152	614 X		B152	842	d 82.550	B160	3578	d 44.450	B146
469	d 57.150	B152	622 X	d 55.000	B152	843	d 76.200	B160	3720	D 93.264	B146
472	D 120.000	B156,B158	632	D 136.525	B154,B158	850	d 88.900	B162	3730	D 93.264	B150
472 A	D 120.000	B156	633	D 130.175	B154,B156,B158	854	D 190.500	B162,B164,B166	3775	d 50.800	B150
478	d 65.000	B156	637	d 60.325	B154	855	d 88.900	B162	3780	d 50.800	B150
480	d 68.262	B156	639	d 63.500	B154	857	d 92.075	B164	3782	d 44.450	B146
484	d 70.000	B158	643	d 69.850	B156	861	d 101.600	B166	3820	D 85.725	B146
492 A	D 133.350	B160,B162	644	 d 71.438 d 71.438 D 152.400 	B158	864	d 95.250	B164	3877	d 41.275	B146
493	D 136.525	B158,B160,B162	645		B158	866	d 98.425	B164	3920	D 112.712	B154,B156
495	d 82.550	B160	652		B158,B160	932	D 212.725	B166	3926	D 112.712	B152,B154
495 A	d 76.200	B158	653	<i>D</i> 146.050	B156,B158,B160,B162	938	 d 114.300 D 57.150 d 22.225 	B166	3981	d 58.738	B152
495 AX	d 76.200	B158	653 X	<i>D</i> 150.000	B158	1220		B136	3982	d 63.500	B154
496	d 80.962	B160	655	<i>d</i> 69.850	B156	1280		B136	3984	d 66.675	B156



Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mn d :CONE (Bore Dia.) D :CUP (Outside Dia	Pages	Bearing No. CONE, CUP	d :C0	nal Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages
3994 A4050 A4059	d 66.675 d 12.700 d 15.000	B156 B136 B136	02820 02872 02878	D 73.025 d 28.575 d 34.925	B138,B142 B138 B142	13685 13687 13830	 d 38.100 d 38.100 D 63.500 	B144 B144 B144	19150 19268 21075	d D d	38.100 68.262 19.050	B144 B142,B144 B136
A4138 4335 4388	D 34.988 D 90.488 d 41.275	B136 B146 B146	03062 03162 05062	<i>d</i> 15.875 <i>D</i> 41.275 <i>d</i> 15.875	B136 B136 B136	13889 14123 A 14125 A	 d 38.100 d 31.750 d 31.750 	B140	21212 L21511 L21549	D D d	53.975 34.988 15.875	B136 B136 B136
4535 4595 A 5069	D 104.775 d 53.975 d 17.455	B152 B152 B136	05068 05075 05079	<i>d</i> 17.462 <i>d</i> 19.050 <i>d</i> 19.990	B136 B136 B136	14130 14131 14137 A	 d 33.338 d 33.338 d 34.925 	B142	22168 22325 23100	d D d	42.862 82.550 25.400	B146 B146 B138
A5144 5335 5356	D 36.525 D 103.188 d 44.450	B136 B148 B148	05175 05185 07079	D 44.450 D 47.000 d 20.000	B136 B136 B136	14138 A 14139 14274	 d 34.925 d 34.976 D 69.012 	B142	23256 23621 23691	D D d	65.088 73.025 35.000	B138 B142 B142
5535 5566 5582	D 122.238 d 55.562 d 60.325	B152,B154 B152 B154	07087 07097 07098	 d 22.225 d 25.000 d 24.981 	B136 B138 B138	14276 14283 15100	<i>D</i> 69.012 <i>D</i> 72.085 <i>d</i> 25.400	B140,B142 B142 B138	24720 24721 24780	D D d	76.200 76.200 41.275	B146 B146 B146
5584 5735 5760	d 63.500 D 135.733 d 76.200	B154 B158,B160 B158	07100 07100SA 07196	d 25.400 d 25.400 D 50.005	B138 B138 B136,B138	15101 15106 15112	d 25.400 d 26.988 d 28.575	B138	25520 25521 25523	D D D	82.931 83.058 82.931	B146,B148 B146 B146,B148
5795 A6062 A6067	d 77.788 d 15.875 d 16.993	B160 B136 B136	07204 07205 08118	<i>D</i> 51.994 <i>D</i> 52.001 <i>d</i> 30.162	B136,B138 B138 B140	15113 15116 15117	 d 28.575 d 30.112 d 30.000 	B140	25577 25578 25580	d d d	42.875 42.862 44.450	B146 B146 B146
A6075 A6157 6220	<i>d</i> 19.050 <i>D</i> 39.992 <i>D</i> 127.000	B136 B136 B150,B152	08125 08231 09062	d 31.750 D 58.738 d 15.875	B140 B140 B136	15118 15119 15120	 d 30.213 d 30.213 d 30.213 	B140	25584 25590 25820	d d D	44.983 45.618 73.025	B148 B148 B142
6279 6280 6320	d 50.800 d 53.975 D 135.755	B150 B152 B154,B156	09067 09074 09078	<i>d</i> 19.050 <i>d</i> 19.050 <i>d</i> 19.050	B136 B136 B136	15123 15125 15126	 d 31.750 d 31.750 d 31.750 	B140	25821 25877 25878	D d d	73.025 34.925 34.925	B142,B144 B142 B142
6376 6379 6420	 d 60.325 d 65.088 D 149.225 	B154 B156 B152,B156,B158	09081 09194 09195	d 20.625 D 49.225 D 49.225	B136 B136 B136	15245 15250 15250 X	D 62.000 D 63.500 D 63.500	B140	25880 26118 26131	d d d	36.487 30.000 33.338	B144 B140 B142
6454 6455 6460	d 69.850 d 57.150 d 73.025	B156 B152 B158	09196 11162 11300	D 49.225 d 41.275 D 76.200	B136 B146 B146	15520 15523 15578	<i>D</i> 57.150 <i>D</i> 60.325 <i>d</i> 25.400	B138	26283 26820 26822	D D D	72.000 80.167 79.375	B140,B142 B146 B146
6461 6535 6536	d 76.200 D 161.925 D 161.925	B158 B158,B160,B162 B158	11520 11590 LM11710	D 42.862 d 15.875 D 39.878	B136 B136 B136	15580 16150 16284	d 26.988 d 38.100 D 72.238	B144	26823 26882 26884	D d d	76.200 41.275 42.875	B146 B146 B146
6559 6575 6576	d 82.550 d 76.200 d 76.200	B160 B158 B158	LM11749 LM11910 LM11949	<i>d</i> 17.462 <i>D</i> 45.237 <i>d</i> 19.050	B136 B136 B136	16929 16986 17098	<i>D</i> 74.988 <i>d</i> 43.000 <i>d</i> 24.981	B146	27620 27687 27689	D d d	125.412 82.550 83.345	B160 B160 B160
6580 9121 9180	d 88.900 D 152.400 d 61.912	B162 B154,B156 B154	12168 12303 12520	d 42.862 D 76.992 D 49.225	B146 B146 B136	17118 17244 17520	d 30.000 D 62.000 D 42.862	B138,B140	27690 27820 27880	d D d	83.345 80.035 38.100	B160 B144 B144
9185 9220 9285	d 68.262 D 161.925 d 76.200	B156 B158 B158	12580 M12610 M12648	d 20.638 D 50.005 d 22.225	B136 B136 B136	17580 17831 17887	 d 15.875 D 79.985 d 45.230 	B148	28138 28315 28521	d D D	34.976 80.000 92.075	B142 B142 B150
9320 9321 9378	D 177.800 D 171.450 d 76.200	B160 B160,B162 B160	M12649 LM12710 LM12711	d 21.430 D 45.237 D 45.975	B136 B136 B136	18200 18337 18520	d 50.800 D 85.725 D 73.025	B150	28580 28584 28622	d d D	50.800 52.388 97.630	B150 B150 B152
9380 9385 02420	d 76.200 d 84.138 D 68.262	B160 B162 B138,B140	LM12749 13175 13181	d 22.000 d 44.450 d 46.038	B136 B146 B148	18590 18620 18690	 d 41.275 D 79.375 d 46.038 	B148	28680 28920 28921	d D D	55.562 101.600 100.000	B152 B154 B154
02473 02474 02475	d 25.400 d 28.575 d 31.750	B138 B138 B140	13318 13620 13621	D 80.962 D 69.012 D 69.012	B146,B148 B144 B144	18720 18790 19138	<i>D</i> 85.000 <i>d</i> 50.800 <i>d</i> 34.976	B150	28985 29520 29586	d D d	60.325 107.950 63.500	B154 B154 B154



Bearing No.	Nominal Dimension (mm) d:CONE (Bore Dia.)	Pages	Bearing No.	Nominal Dimension (mm) d:CONE (Bore Dia.)	Pages
CONE, CUP	D:CUP (Outside Dia.)		CONE, CUP	D:CUP (Outside Dia.)	. 3
29620 29630 29675	D 120.650 B	8156,B158 8156 8156	42690 43118 43131	 d 77.788 d 30.162 d 33.338 	B160 B140 B142
29685 LM29710 LM29711	D 65.088 B	8158 8144 8144	43300 43312 44143	<i>D D T T T T T T T T T T</i>	B140 B142 B144
LM29748 LM29749 31520	d 38.100 B	8144 8144 8142	44150 44157 44162	 d 38.100 d 40.000 d 41.275 	B144 B144 B146
31594	d 66.675 B	3142	44348	<i>D</i> 88.501	B144,B146
33262		3156	L44610	<i>D</i> 50.292	B138
33275		3156	L44640	<i>d</i> 23.812	B138
33281	d 73.025 B	8158	L44643	d 25.400	B138
33287		8158	L44649	d 26.988	B138
JHM33410		8138	45220	D 104.775	B152
JHM33449 33462 33821	<i>D</i> 117.475 B	3138 3156,B158 3150	45221 45289 L45410	<i>D</i> 104.775 <i>d</i> 57.150 <i>D</i> 50.292	B152 B152 B140
33889	d 76.200 B	3150	L45449	d 29.000	B140
34300		3158	46143	d 36.512	B144
34306		3160	46162	d 41.275	B146
34478	D 193.675 B	3158,B160	46176	d 44.450	B146
36620		3168	46368	D 93.662	B144,B146
36690		3168	46720	D 225.425	B168
36920 36990 37425	d 177.800 B	8170 8170 8166	46780 47420 47487	 d 158.750 D 120.000 d 69.850 	B168 B156,B158 B156
37625 M38510 M38511	D 66.675 B	8166 8142 8142	47490 47620 47680	 d 71.438 D 133.350 d 76.200 	B158 B158,B160 B158
M38547	d 34.925 B	8142	47685	d 82.550	B160
M38549		8142	47686	d 82.550	B160
39236		8154	47687	d 82.550	B160
39250	D 104.775 B	8154	47820	<i>D</i> 146.050	B164
39412		8154	47890	<i>d</i> 92.075	B164
39520		8154,B156	47896	<i>d</i> 95.250	B164
39521	D 112.712 B d 63.500 B d 66.675 B	8156	48120	<i>D</i> 161.925	B166
39585		8154	48190	<i>d</i> 107.950	B166
39590		8156	48220	<i>D</i> 182.562	B168
41100 41125 41126	d 28.575 B	8138 8138 8138	48282 48286 48290	 d 120.650 d 123.825 d 127.000 	B168 B168 B168
41286	d 88.900 B	3138	48320	D 190.500	B168
42350		3162	48385	d 133.350	B168
42362		3164	48393	d 136.525	B168
42368	d 95.250 B	3164	LM48510	D 65.088	B142
42375		3164	LM48511	D 65.088	B142
42376		3164	LM48548	d 34.925	B142
42381	D 148.430 B	8164	48620	D 200.025	B168
42584		8164	48685	d 142.875	B168
42587		8162,B164	49175	d 44.450	B146
42620	d 76.200 B	8158,B160	49176	d 44.450	B146
42687		8158	49368	D 93.662	B146
42688		8158	49520	D 101.600	B150

Bearing No. CONE, CUP	Nominal Dimension (mm) d :CONE (Bore Dia.) D :CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages
49585	 d 50.800 d 98.425 d 100.012 	B150	67920	D 282.575	B170
52387		B164	67983	d 203.200	B170
52393		B164	67985	d 206.375	B170
52400	d 101.600D 157.162D 161.925	B166	L68110	<i>D</i> 59.131	B142
52618		B164,B166	L68111	<i>D</i> 59.975	B142
52637		B164,B166	L68149	<i>d</i> 35.000	B142
53150	d 38.100	B144	68450	d 114.300d 117.475D 180.000	B166
53162	d 41.275	B146	68462		B166
53176	d 44.450	B148	68709		B166
53177	d 44.450	B148	68712	<i>D</i> 180.975	B166
53178	d 44.450	B148	JL69310	<i>D</i> 63.000	B144
53375	D 95.250	B144,B148	JL69349	<i>d</i> 38.000	B144
53387	D 98.425	B146,B148	71412	 d 104.775 d 107.950 d 111.125 	B166
55175	d 44.450	B148	71425		B166
55187	d 47.625	B148	71437		B166
55200	d 50.800	B150	71450	d 114.300d 115.087D 190.500	B166
55200 C	d 50.800	B150	71453		B166
55206	d 52.388	B150	71750		B166
55437	 D 111.125 D 112.712 d 106.362 	B148,B150	72187	d 47.625	B148
55443		B148	72200	d 50.800	B150
56418		B166	72200 C	d 50.800	B150
56425	<i>d</i> 107.950	B166	72212	d 53.975	B152
56650	<i>D</i> 165.100	B166	72212C	d 53.975	B152
59200	<i>d</i> 50.800	B150	72218	d 55.562	B152
59429	<i>D</i> 108.966	B150	72218C	d 55.562	B152
64433	<i>d</i> 109.992	B166	72225C	d 57.150	B152
64450	<i>d</i> 114.300	B166	72487	D 123.825	B148,B150,B152
64700	<i>D</i> 177.800	B166	LM72810	<i>D</i> 47.000	B138
65200	<i>d</i> 50.800	B150	LM72849	<i>d</i> 22.606	B138
65212	<i>d</i> 53.975	B152	74500	<i>d</i> 127.000	B168
65237 65320 65385	 d 60.325 D 114.300 d 44.450 	B154 B148 B148	74525 74537 74550	 d 133.350 d 136.525 d 139.700 	B168 B168 B168
65500	<i>D</i> 127.000	B150,B152,B154	74850	<i>D</i> 215.900	B168
66187	<i>d</i> 47.625	B148	74856	<i>D</i> 217.488	B168
66462	<i>D</i> 117.475	B148	77375	<i>d</i> 95.250	B164
66520	<i>D</i> 122.238	B152,B154	77675	<i>D</i> 171.450	B164
66584	<i>d</i> 53.975	B152	78225	<i>d</i> 57.150	B152
66585	<i>d</i> 60.000	B154	78250	<i>d</i> 63.500	B154
66587	 d 57.150 D 59.131 d 28.575 	B152	LM78310	<i>D</i> 62.000	B142
LM67010		B138,B140	LM78310 A	<i>D</i> 62.000	B142
LM67043		B138	LM78349	<i>d</i> 35.000	B142
LM67048	d 31.750D 203.200D 196.850	B140	78537	D 136.525	B154
67320		B168	78551	D 140.030	B152,B154
67322		B168	78571	D 144.983	B152
67388	 d 127.000 d 130.175 d 133.350 	B168	HM81610	D 47.000	B136
67389		B168	HM81649	d 16.000	B136
67390		B168	M84210	D 59.530	B138
67720 67780 67787	<i>D</i> 247.650 <i>d</i> 165.100 <i>d</i> 174.625	B168,B170 B168 B170	M84249 M84510 M84548	 d 25.400 D 57.150 d 25.400 	B138 B138 B138
67790	 d 177.800 D 266.700 d 190.500 	B170	M86610	D 64.292	B138,B140
67820		B170	M86643	d 25.400	B138
67885		B170	M86647	d 28.575	B138



Bearing No. CONE, CUP	d :C	nal Dimension (mm) ONE (Bore Dia.) UP (Outside Dia.)	Pages	Bearing No. CONE, CUP	d :C0	al Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages
M86648 A	d	30.955	B140	HH221432	d	87.312	B162
M86649	d	30.162	B140	HH221434	d	88.900	B162
M88010	D	68.262	B140,B142	HH221440	d	95.250	B164
M88043	d	30.162	B140	HH221442	d	98.425	B164
M88046	d	31.750	B140	HH221447	d	99.982	B164
M88048	d	33.338	B142	HH221449	d	101.600	B166
HM88510	D	73.025	B140,B142	HH224310	D	212.725	B166
HM88542	d	31.750	B140	HH224335	d	101.600	B166
HM88547	d	33.338	B142	HH224340	d	107.950	B166
HM88610	D	72.233	B138,B140,B142,B144	HH224346	d	114.300	B166
HM88630	d	25.400	B138	M224710	D	174.625	B168
HM88638	d	32.000	B140	M224748	d	120.000	B168
HM88648	d	35.717	B144	LL225710	D	165.895	B168
HM88649	d	34.925	B142	LL225749	d	127.000	B168
HM89410	D	76.200	B142,B144	HM231110	D	236.538	B168
HM89411	D	76.200	B142	HM231140	d	146.050	B168
HM89443	d	33.338	B142	M236810	D	260.350	B170
HM89444	d	33.338	B142	M236849	d	177.800	B170
HM89446	d	34.925	B142	LM300811	D	68.000	B144
HM89446A	d	34.925	B142	LM300849	d	41.000	B144
HM89449	d	36.512	B144	L305610	D	80.962	B150
99100	D	254.000	B168	L305649	d	50.800	B150
99550	d	139.700	B168	JH307710	D	110.000	B152
99575	d	146.050	B168	JH307749	d	55.000	B152
99587	d	149.225	B168	JHM318410	D	155.000	B162
99600	d	152.400	B168	JHM318448	d	90.000	B162
LM102910	D	73.431	B148	L327210	D	177.008	B168
LM102949	d	45.242	B148	L327249	d	133.350	B168
JLM104910	D	82.000	B150	LM328410	D	187.325	B168
LM104911	D	82.550	B150	LM328448	d	139.700	B168
LM104911A	D	82.550	B150	H414210	D	136.525	B156,B158
LM104912	D	82.931	B150	H414245	d	68.262	B156
LM104947A	d	50.000	B150	H414249	d	71.438	B158
JLM104948	d	50.000	B150	JH415610	D	145.000	B158
LM104949	d	50.800	B150	JH415647	d	75.000	B158
M201011	D	73.025	B144	LM501310	D	73.431	B144
M201047	d	39.688	B144	LM501314	D	73.431	B144
JM205110	D	90.000	B150	LM501349	d	41.275	B144
JM205149	d	50.000	B150	LM503310	D	75.000	B148
JM207010	D	95.000	B152	LM503349	d	46.000	B148
JM207049	d	55.000	B152	HH506310	D	114.300	B150
JH211710	D	120.000	B156	HH506348	d	49.212	B150
JH211749	d	65.000	B156	JLM506810	D	90.000	B152
HM212010	D	122.238	B154,B156	JLM506849	d	55.000	B152
HM212011	D	122.238	B154,B156	JLM508710	D	95.000	B154
HM212044	d	60.325	B154	JLM508748	d	60.000	B154
HM212046	d	63.500	B154	JM511910	D	110.000	B156
HM212047	d	63.500	B154	JM511946	d	65.000	B156
HM212049	d	66.675	B156	JM515610	D	130.000	B160
JH217210	D	150.000	B162	JM515649	d	80.000	B160
JH217249	d	85.000	B162	HM516410	D	133.350	B160
HM218210	D	147.000	B162	HM516448	d	82.550	B160
HM218248	d	90.000	B162	JHM516810	D	140.000	B162
HH221410	D	190.500	B162,B164,B166	JHM516849	d	85.000	B162

	None	I.D'	
Bearing No. CONE, CUP	d :C0	nal Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages
HM518410	D	152.400	B162
HM518445	d	88.900	B162
LM522510	D	159.987	B166
LM522546	d	107.950	B166
LM522548	d	109.987	B166
LM522549	d	109.987	B166
JHM522610	D	180.000	B166
JHM522649	d	110.000	B166
JHM534110	D	230.000	B170
JHM534149	d	170.000	B170
LM603011	D	77.788	B148
LM603012	D	77.788	B148
LM603049	d	45.242	B148
L610510	D	94.458	B154
L610549	d	63.500	B154
JM612910	D	115.000	B158
JM612949	d	70.000	B158
LM613410	D	112.712	B156
LM613449	d	69.850	B156
HM617010	D	142.138	B162
HM617049	d	85.725	B162
L623110	D	152.400	B166
L623149	d	114.300	B166
JLM710910	D	105.000	B156
JLM710949	d	65.000	B156
JLM714110	D	115.000	B158
JLM714149	d	75.000	B158
JM714210	D	120.000	B158
JM714249	d	75.000	B158
H715311	D	136.525	B154,B156,B158
H715334	d	61.912	B154
H715340	d	65.088	B156
H715341	d	66.675	B156
H715343	d	68.262	B156
H715345	d	71.438	B158
JM716610	D	130.000	B162
JM716648	d	85.000	B162
JM716649	d	85.000	B162
JM718110	D	145.000	B162
JM718149	d	90.000	B162
JM719113	D	150.000	B164
JM719149	d	95.000	B164
JM720210	D	155.000	B164
JHM720210	D	160.000	B164
JM720249	d	100.000	B164
JHM720249	d	100.000	B164
JL724314	D	170.000	B168
JL724348	d	120.000	B168
JL725316	D	175.000	B168
JL725346	d	125.000	B168
JM734410	D	240.000	B170
JM734449	d	170.000	B170
JM738210	D	260.000	B170
JM738249	d	190.000	B170

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HM801310	D	82.550	B144
HM801346	d	38.100	B144
M802011	D	82.550	B146
M802048	d	41.275	B146
HM803110	D	88.900	B146
HM803145	d	41.275	B146
HM803146	d	41.275	B146
HM803149	d	44.450	B146
M804010	D	88.900	B148
M804049	d	47.625	B148
HM804810	D	95.250	B146,B148,B150
HM804840	d	41.275	B146
HM804843	d	44.450	B148
HM804846	d	47.625	B148
HM804848	d	48.412	B150
HM804849	d	48.412	B150
HM807010	D	104.775	B148,B150
HM807011	D	104.775	B150
JHM807012	D	105.000	B150
HM807040	d	44.450	B148
HM807044	d	49.212	B150
JHM807045	d	50.000	B150
HM807046	d	50.800	B150
JLM813010	D	110.000	B158
JLM813049	d	70.000	B158
JLM820012	D	150.000	B164
JLM820048	d	100.000	B164
JM822010	D	165.000	B166
JM822049	d	110.000	B166
JHM840410	D	300.000	B170
JHM840449	d	200.000	B170
HM903210	D	95.250	B148
HM903247	d	44.450	B148
HM903249	d	44.450	B148
HM911210	D	130.175	B152
HM911242	d	53.975	B152
H913810	D	146.050	B154,B156
H913842	d	61.912	B154
H913849	d	69.850	B156



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Part A	1.TYPES AND FEATURES OF ROLLING BEARINGS	Part B	BEARING HANDLING
	2.SELECTION OF BEARING TYPES		BEARING DAMAGE AND MEASURES (Bearing Doctor)
	3.SELECTION OF BEARING ARRANGEMENT	Part C	DEEP GROOVE BALL BEARINGS
	4.SELECTION OF BEARING SIZE		EXTRA SMALL BALL BEARINGS AND MINIATURE BALL BEARINGS
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		Part E	APPENDICES



ROLLING BEARINGS for INDUSTRIAL MACHINERY

CAT. No. E1103



Introduction to the Revised NSK Rolling Bearings Catalog (CAT.No.E1103)

Thank you for your interest in this edition of our Rolling Bearings Catalog.

Rolling bearings are vital components in improving the efficiency and reliability of machines, and as technology advances, the requirements of bearings become ever more challenging.

NSK will celebrate its 100th anniversary in 2016. As a leading bearing manufacturer, we have continued to make breakthroughs in the research and development of bearings, alongside our customers, and have actively contributed to the advancement of society and the preservation of the environment.

This catalog is a culmination of all our technological expertise acquired over our 100-year history, and is intended to provide you with all the information necessary to make your bearing selection, no matter the application.

The catalog is divided into four parts, labelled A through E. Part A contains general information for bearing selection. Part B provides information on bearing handling. Part C lists product information relating to bearing type and dimensions, where you can also find information on our new High Performance Standard Bearings series (NSKHPS™). Part D covers industry-related product information. Lastly, part E provides information on appendices.

We hope this catalog provides you with all the information you need to select the optimum bearing for your application. However, please don't hesitate to contact us should you require any assistance.

NSK

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Part A

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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.

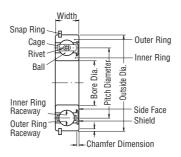
The most common bearing types and name of bearing parts are shown in Fig.1.1, and a general classification of rolling bearings is shown in Fig. 1.2.

1.2 Characteristics of Rolling Bearings

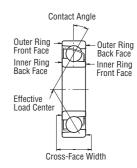
Compared with plain bearings, rolling bearings have the following major advantages:

- (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.

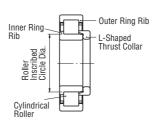
Furthermore, different types of rolling bearings have their own individual advantages. The features of the most common rolling bearings are described on Pages A010 to A013 and in Table 1.1 (Pages A014 and A015).



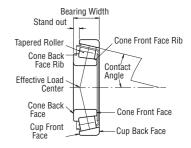
Single-Row Deep Groove Ball Bearing



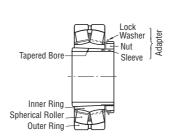
Single-Row Angular Contact Ball Bearing



Cylindrical Roller Bearing



Tapered Roller Bearing



Spherical Roller Bearing

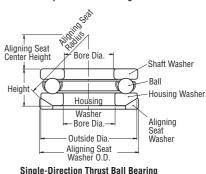
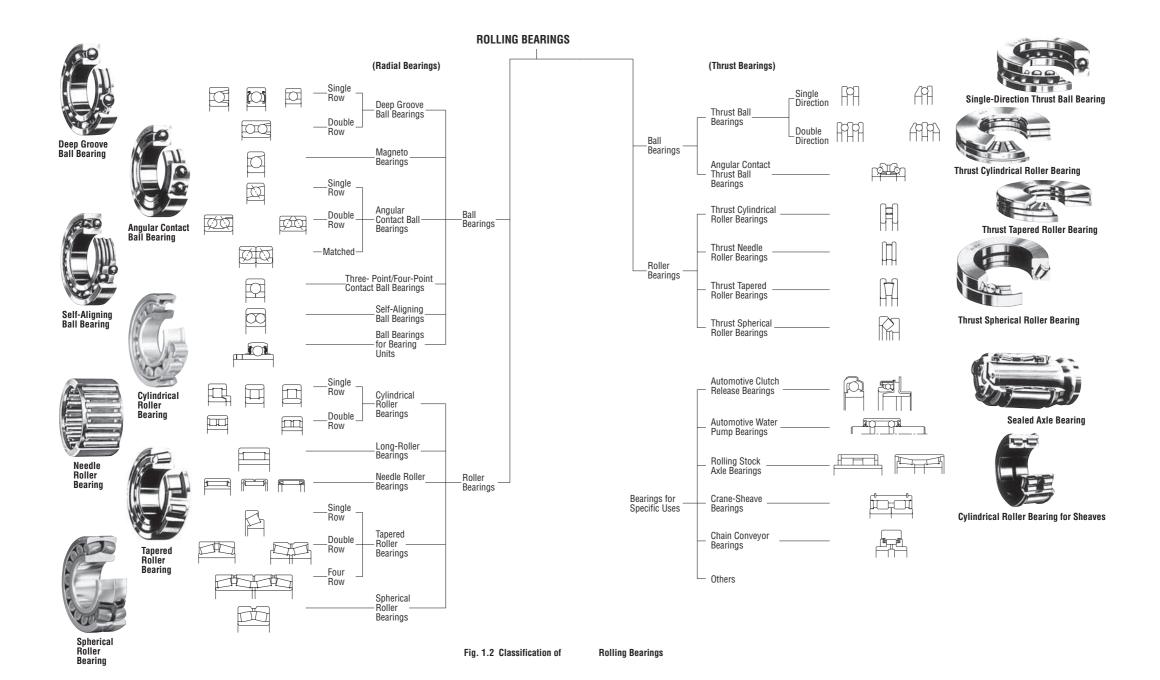


Fig. 1.1 Name of Bearing Parts

A 006



A 008



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 **Ball Bearings**



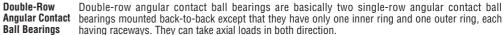
Individual bearings of this type are capable of taking radial loads and also axial loads in one Angular Contact direction. Four contact angles of 15°, 25°, 30°, and 40° are available. The larger the contact angle, the higher the axial load capacity. For high speed operation, however, the smaller contact 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 both 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 **Ball Bearings**





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-Alianina **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.

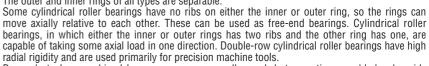
Cylindrical



In bearings of this type, the cylindrical rollers are in linear contact with the raceways. They have a **Roller Bearings** 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 design or absence of side ribs.

The outer and inner rings of all types are separable.



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

A 010 A 011



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

Bearings of this type use conical rollers guided by a back-face rib on the cone. These bearings Roller 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 the 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

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) Double-Direction being fixed to the shaft.

Thrust Ball Bearings

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



Spherical Thrust These bearings have a spherical raceway in the housing washer and barrel-shaped rollers obliquely Roller Bearings arranged around it. Since the raceway in the housing washer in spherical, these bearings are selfaligning. 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.

A 012 A 013



Table 1. 1 Types and Characteristics

	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
Fe	eatures					Ø Ø	翔				
oity	Radial Loads		0	0	0	<u></u>	0		<u></u>	0	<u></u>
Load Capacity	Axial Loads	\bigcirc	0	\bigcirc	\bigcirc	\bigcirc	\bigcirc	$\overset{\longleftarrow}{\circ}$	×	×	\bigcirc
9	Combined Loads	\bigcirc	0	0	0	\odot	\bigcirc	0	×	×	
ŀ	High Speeds		0	(a)	\bigcirc	\odot	0	\odot	(0	\bigcirc
ŀ	High Accuracy			0		0	\odot			0	
	Low Noise and Torque								\odot		
i	Rigidity					\odot			\odot	0	\odot
Ī	Angular Misalignment	\odot	0	0	0	0	0	0		0	
(Self-Aligning Capability							☆			
ļ	Ring Separability		☆				☆		☆	☆	☆
	Fixed-End Bearing	☆			☆	☆	☆	☆			
F	Free-End Bearing	*			*	*	*	*	☆	☆	
i	Tapered Bore in Inner Ring							☆		☆	
I	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
ŀ	Page No.	C005 C053	C005 C050	C072	C072 C106	C072	C072 C108	C114	C124	C124 C158	C124
Excellent		⊙ Go	ood	O Fair	0 1	Poor ×	Impossible	10 → 00	ne direction nly	←→ Tw	o directions

of Rolling 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	Thrust Cylindrical Roller Bearings	Thrust Tapered Roller Bearings	Thrust Spherical Roller Bearings	Page No.
		A			FA	RA	Bearings		H		T ugo 110.
\bigcirc	0	0	0	0	×	×	×	×	×	0	_
\bigcirc	×	\bigcirc	$\bigcirc \downarrow$			\bigcirc	\bigcirc	(i)	(i)	(i)	_
	×	0		\odot	×	×	×	×	×	0	_
\odot	0			\bigcirc	×	×		0	0	0	A022 A098
		0			\odot		0				A023 A126 A151
											A023
\odot	0	0	0				\odot	0	0		A023 A192
	0	\bigcirc	0	<u></u>	×	(a)	×	×	×	(A022 Blue pages of each brg. type
				☆		☆				☆	A022
☆	☆	☆	☆		☆	☆	☆	☆	☆	☆	A023 A024
☆			☆	☆							A026 to A029
	☆		*	*							A026 to A029
				☆							A150 B008 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	
C124	C341	C182	C182 C246	C258	C296	C296	_	C314	C322	C332	

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

1.3 Contact Angle and Bearing Types

The contact angle (α) 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 α : Less than 45° (A primarily radial load is applied.)

Thrust bearing α : Over 45° (A primarily axial load is applied.)

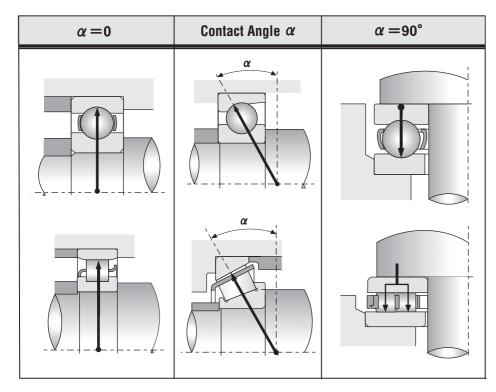


Fig. 1.3 Contact Angle α

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.

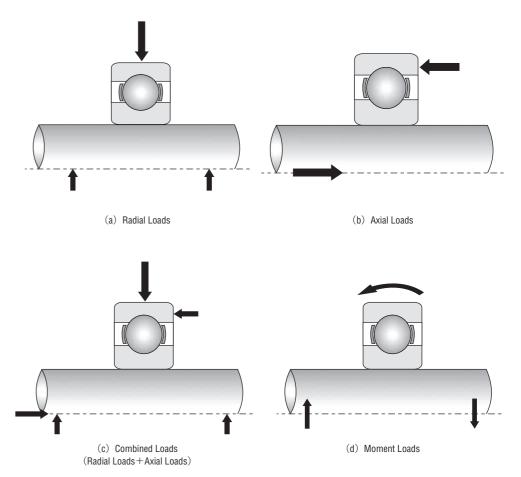


Fig. 1.4 Types of Load



2. SE	LECTION OF BEARING TYPES
2.1	Bearing Selection Procedure A 020
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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 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.

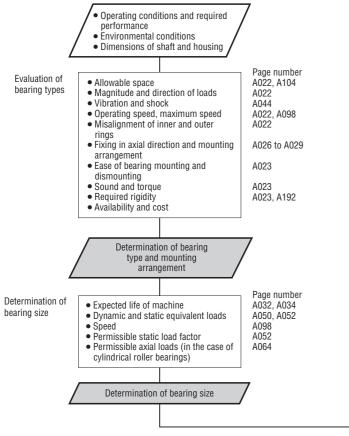
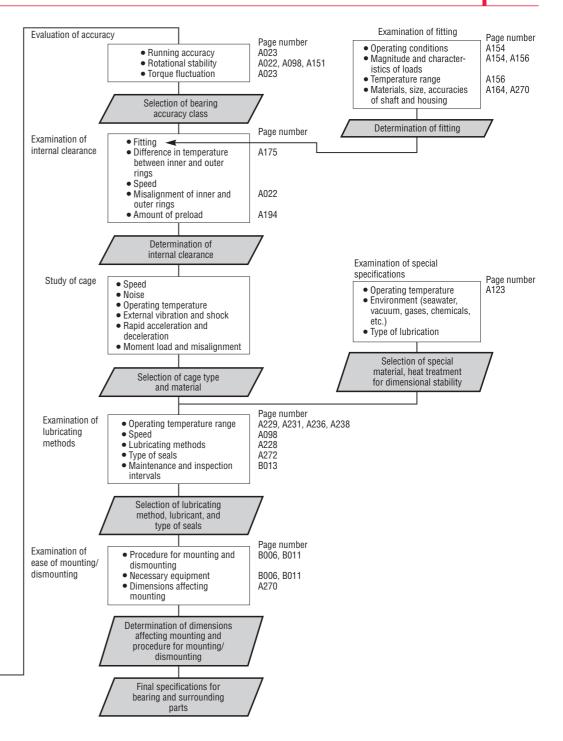


Fig. 2.1 Flow Chart for Selection of Rolling Bearings



A 020

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).

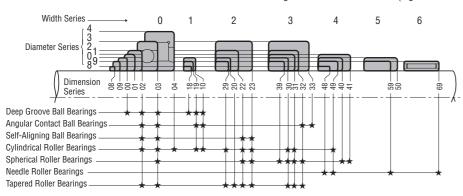
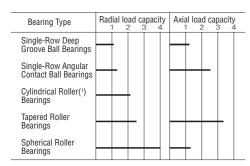
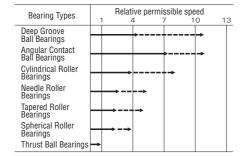


Fig. 2.2 Dimension Series of Radial Bearings



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

Fig. 2.3 Relative Load Capacities of Various Bearing Types



Remarks → Oil bath lubrication
---> With special measures to increase speed limit

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.

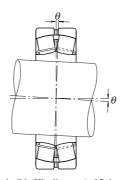


Fig. 2.5 Permissible Misalignment of Spherical Roller Bearings

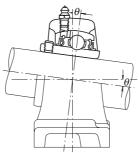


Fig. 2.6 Permissible Misalignment of Ball Bearing Units

Bearing Types	Highest accuracy specified	Tolerance comparison of inner ring radial runout
	оростои	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.

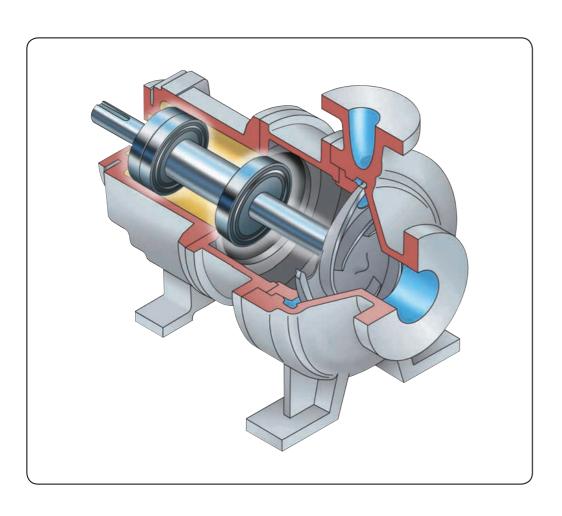
The running accuracy of rolling bearings is specified in various ways, and the specified accuracy classes vary depending on the bearing type. A comparison of the inner ring radial runout for the highest running accuracy specified for each bearing type is shown in Fig. 2.7.

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.

A 022 A 023



3. SE	LECTION OF BEARING ARRANGEMENT
3.1	Fixed-End and Free-End Bearings A 026
3.2	Example of Bearing Arrangements A 022

3. SELECTION OF BEARING ARRANGEMENT

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

- 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.

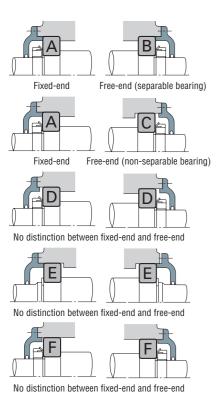
Bearings other than the fixed-end one must be "free-end" bearings that carry only radial loads to relieve the shaft's thermal elongation and contraction.

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 D,E(2)

- · Angular Contact Ball Bearing · Tapered Roller Bearing
- · Magneto Bearing
- · Cylindrical Roller Bearing (NJ, NF types)

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 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 Example 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 Arr	angements		
Fixed-end	Free-end	Remarks	Application Examples
		 This is a common arrangement in which abnormal loads are not applied to bearings even if the shaft expands or contracts. If the mounting error is small, this is suitable for high speeds. 	Medium size electric motors, blowers
		OThis can withstand heavy loads and shock loads and can take some axial load. 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. For maximum rigidity of the fixed-end bearing, it is a back-to-back type. 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
		OThis 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. 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 payt nego

Fig. 3.1 Bearing Mounting Arrangements and Bearing Types

Continued on next page



Table 3. 1 Representative Bearing Mounting Arrangements and Application Examples (cont'd)

Bearing Arrangements		
Fixed-end Free-end	Remarks	Application Examples
	This is the most common arrangement.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. 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. Double row angular contact bearings may be used instead of a arrangement of two angular contact ball bearings. 	Worm gear reducers
When there is no distinction between fixed-end and free-end	Remarks	Application Examples
Back-to-back mounting Face-to-face mounting	 This arrangement is widely used since it can withstand heavy loads and shock loads. The back-to-back arrangement is especially good when the distance between bearings is short and moment loads are applied. 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. 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
Back-to-back mounting	 This is used at high speeds when radial loads are not so heavy and axial loads are relatively heavy. It provides good rigidity of the shaft by preloading. For moment loads, back-to-back mounting is better than face-to-face mounting. 	Grinding wheel shafts

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. ○It can be used if interference is necessary for both the inner and outer rings. ○Care must be taken so the axial clearance doesn't become too small during running. ○NF type + NF type mounting is also possible. 	Final reduction gears of construction machines
	OSometimes 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. 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. The upper bearing is on the free end. 	Vertical openers (spinning and weaving machines)

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4. SELECTION OF BEARING SIZE

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4. SELECTION OF BEARING SIZE

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.

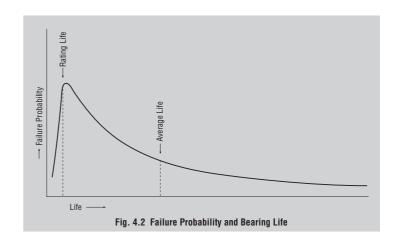
4.2 Basic Load Rating and Fatigue Life

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



A 032

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 Fatique Life Factor f_b for Various Bearing Applications

Operating Periods	Fatigue Life Factor $f_{ m h}$						
Operating Periods	~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 Hand power tools	· Agricultural equipment					
Used only occasionally but reliability is important		Motors for home heaters and air conditioners Construction equipment	· Conveyors · Elevator cable sheaves				
Used intermittently for relatively long periods	·Rolling mill roll necks	Small motors Deck cranes General cargo cranes Pinion stands Passenger cars	Factory motors Machine tools Transmissions Vibrating screens Crushers	Crane sheaves Compressors Specialized transmissions			
Used intermittently for more than eight hours daily		·Escalators	Centrifugal separators Air conditioning equipment Blowers Woodworking machines Large motors Axle boxes on railway rolling stock	Mine hoists Press flywheels Railway traction motors Locomotive axle boxes	• Paper making machines		
Used continuously and high reliability is impor- tant					Waterworks pumps Electric power stations Mine draining pumps		

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

Life Parameters	Ball Bearings	Roller Bearings
Basic Rating Life	$L_{\rm h} = \frac{10^6}{60n} \left(\frac{C}{P}\right)^3 = 500 f_{\rm h}^3$	$L_{\rm h} = \frac{10^6}{60n} \left(\frac{C}{P}\right)^{\frac{10}{3}} = 500 f_{\rm h}^{\frac{10}{3}}$
Fatigue Life Factor	$f_{\rm h} = f_{\rm n} \frac{C}{P}$	$f_{\rm h} = f_{\rm n} \frac{C}{P}$
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_nFig. 4.3 (See Page A036), Appendix Table 12 (See Page E018)

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
$$L = \left(\frac{C}{P}\right)^3$$
 (4.1)

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

where L: Basic rating life (10⁶ rev)

P: Bearing load (equivalent load) (N), {kgf}(Refer to Page A30)

C: Basic load rating (N), {kgf} For radial bearings, C is written $C_{\rm r}$ For thrust bearings, C is written $C_{\rm a}$

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 mileage.

By designating the basic rating life as $L_{\rm h}$ (h), bearing speed as n (min⁻¹), fatigue life factor as $f_{\rm h}$, and speed factor as $f_{\rm h}$, 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.

$$C = \frac{f_{\rm h} \cdot P}{f_{\rm n}} \qquad (4.3)$$

A bearing which satisfies this value of ${\cal C}$ 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:

$$C_t = f_t \cdot C \cdot \cdots \cdot (4.4)$$

where C_t : Basic load rating after temperature correction (N), $\{kgf\}$

f_t: Temperature factor (See Table 4.3.)

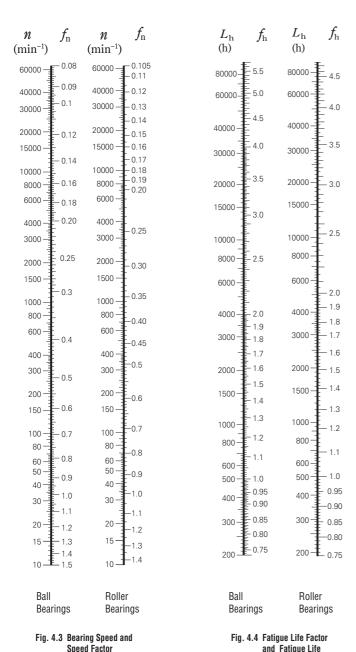
C: Basic load rating before temperature adjustment (N), {kgf}

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 $f_{\rm t}$

Bearing Temperature °C	125	150	175	200	250
Temperature Factor $f_{\rm t}$	1.00	1.00	0.95	0.90	0.75

 $L_{\rm h}, f_{\rm h}$...Fig. 4.4 (See Page A036), Appendix Table 13 (See Page E019)



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
$$L_{10} = \left(\frac{C}{P}\right)^{\frac{10}{3}} \cdots$$
 (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:

where $L_{\rm na}$: 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

a₂: Life adjustment factor for special bearing properties

a₃: 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 $C_{\rm r}$ and $C_{\rm a}$ 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	0.64	0.55	0.47	0.37	0.25

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 $P_{\rm r}$ exceeds $C_{\rm or}$ (Basic static load rating) or 0.5 $C_{\rm r}$, whichever is smaller, for radial bearings or $P_{\rm a}$ exceeds 0.5 $P_{\rm a}$ for thrust bearings, please consult NSK to establish the applicability 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:

$$\frac{1}{L^{e}} = \frac{1}{L_{1}^{e}} + \frac{1}{L_{2}^{e}} + \frac{1}{L_{3}^{e}} + \cdots$$
 (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 $L_{\rm A}$ of

$$\frac{1}{L_{\rm A}^{\rm e}} = \frac{1}{L_{\rm 1}^{\rm e}} + \frac{1}{L_{\rm 2}^{\rm e}}$$

is determined. Take this value $L_{\rm A}$ on the $L_{\rm 1}$ scale and the value $L_{\rm 3}$ on the $L_{\rm 2}$ 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 $85\ 000\ km$.

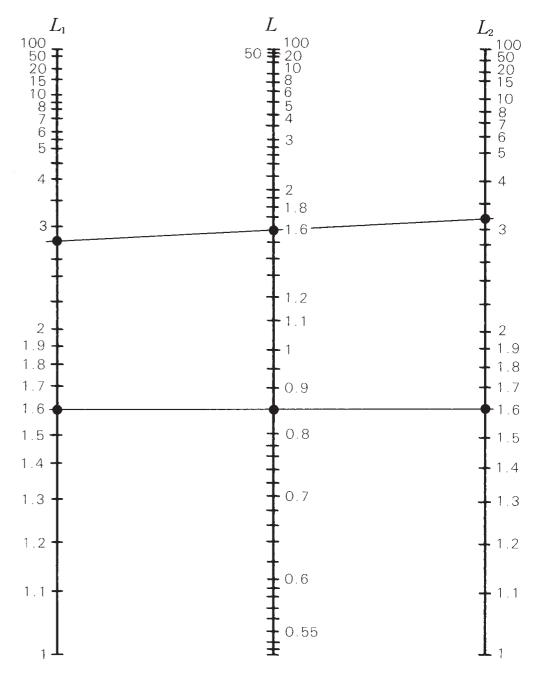


Fig. 4.5 Chart for Life Calculation

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.

$$ln \frac{1}{S} \propto \frac{\tau_o^c \cdot N^c \cdot V}{Z_o^h}$$
 (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 $L_{\rm 10}$ life for each test condition with maximum surface contact pressure $(P_{\rm max})$ and the number of repeated stresses applied on the ordinate and the abscissa, respectively.

In the figure, line $L_{\rm 10}$ 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 $P_{\rm u}$ below which no rolling fatigue occurs. This is better illustrated in Fig. 4.7.

$$ln\frac{1}{S} \propto N^{\epsilon} \int_{V} \frac{(\tau - \tau_{\rm u})^{\rm c}}{Z_{\rm o}^{\rm h}} dV \cdots$$
 (4.10)

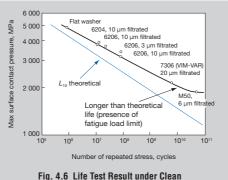
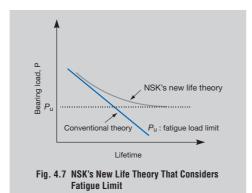


Fig. 4.6 Life Test Result under Clea Lubrication Condition



(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

	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	filtration or no filtration	No filtration, presence of many fine particles
Application	appliances and	Sealed grease lubricated bearing for electric motors Sealed grease bearing for railway axle boxes and machine tools, etc.	Normal usage Automotive hub unit bearing, etc.	Bearing for automotive transmission; Bearing for industrial gearbox; Bearing for construction machine, etc.	_

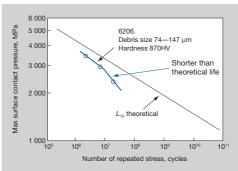


Fig. 4.8 Life Test Result under Contaminated Lubrication Condition

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 $(P-P_{\rm u})/C$, 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 $(P-P_{\rm u})/C\cdot 1/a$.

Calculation formula for surface originated flaking, based on the above concept, is as follows:

$$ln\frac{1}{S} \propto N^{c} \int_{V} \frac{(\tau - \tau_{u})^{c}}{Z_{o}^{h}} dV \times \left[\frac{1}{f(a_{c}, a_{L})} - 1 \right] \cdot \cdot \cdot \cdot \cdot$$
 (4.11)

(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.

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

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

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

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

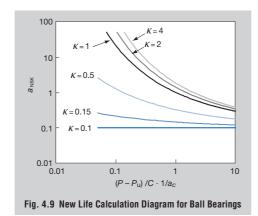
Life Correction Factor $a_{ m NSK}$

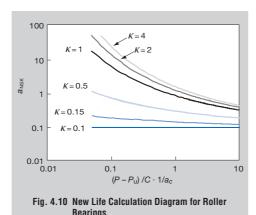
The life correction factor $a_{\rm NSK}$ is the function of lubrication parameter $(P-P_{\rm u})/C \cdot 1/a_c$ as shown below:

$$a_{\text{NSK}} \propto F \left\{ \frac{P - P_{\text{u}}}{C} \cdot \frac{1}{a_{\text{c}}}, a_{\text{L}} \right\} \cdots$$
 (4.14)

NSK's new life theory considers the life extending affect of improved material and heat treatment by correcting the contamination factor a_c . The theory also utilizes viscosity ratio K ($K = \nu/\nu_1$ where ν is the operational viscosity and ν_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 K) the longer the life.

Figures 4.9 and 4.10 show the diagrams of the correction factor $a_{\rm NSK}$ 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.





To Access the NSK Calculation Tools

Visit our website at http://www.nsk.com

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:

$$\begin{cases}
F_{\rm r} = f_{\rm w} \cdot F_{\rm rc} \\
F_{\rm a} = f_{\rm w} \cdot F_{\rm ac}
\end{cases}$$
(4.15)

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

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

 $f_{\rm w}$: Load factor

The values given in Table 4.6 are usually used for the load factor $f_{\rm uv}$.

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.

$$M = 9 550 000H / n(N \cdot mm)$$

= 974 000H / n(kgf·mm) \} \cdots (4.16)

$$P_{\rm k} = M / r$$
 ······ (4.17)

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

 $P_{\rm k}$: 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 $K_{\rm b}$ in the case of a belt transmission, the effective transmitting power is multiplied by the belt factor $f_{\rm b}$, which represents the belt tension. The values of the belt factor $f_{\rm b}$ for different types of belts are shown in Table 4.7.

$$K_{\rm b} = f_{\rm b} \cdot P_{\rm k} \cdot \cdots \cdot (4.18)$$

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 $f_{
m w}$

Operating Conditions	Typical Applications	$f_{ m w}$
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 $f_{\rm b}$

Type of Belt	$f_{ m b}$
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:

$$M = 9550000H / n(N \cdot mm)$$

= 974 000H / n{kgf·mm}} ······ (4.19)

$$P_{\rm k} = M / r$$
 (4.20)

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

 $P_{\rm k}$: Tangential force on gear (N), {kgf}

 S_{i} : Radial force on gear (N), {kgf}

 $K_{\rm c}$: Combined force imposed on gear (N), {kgf}

H: Power transmitted (kW)

n: Speed (min⁻¹)

r: Pitch circle radius of drive gear (mm)

 θ : 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 $f_{\rm g}$ by multiplying the theoretically calculated load by this factor.

The values of $f_{\rm g}$ 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.

ssion

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:

$$F_{\rm CI} = \frac{b}{c}K \qquad (4.23)$$

$$F_{\text{CII}} = \frac{a}{C}K$$
 (4.24)

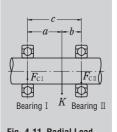
where F_{CI} : Radial load applied on bearing I (N), {kgf}

4.3.4 Load Distribution on Bearings

 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.



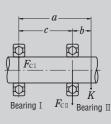


Fig. 4.11 Radial Load Distribution (1)

Fig. 4.12 Radial Load Distribution (2)

Table 4.8 Values of Gear Factor f_g

Gear Finish Accuracy	$f_{ m g}$
Precision ground gears	1 ~1.1
Ordinary machined gears	1.1~1.3

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:

where $F_{\rm m}$: Average fluctuating load (N), {kgf}

p = 3 for ball bearings

p = 10/3 for roller bearings

The average speed $n_{\rm m}$ may be calculated as follows:

$$n_{\rm m} = \frac{n_1 t_1 + n_2 t_2 + \dots + n_{\rm n} t_{\rm n}}{t_1 + t_2 + \dots + t_{\rm n}}$$
 (4.26)

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

$$F_{\rm m} = \frac{1}{3} (F_{\rm min} + 2F_{\rm max}) \cdots (4.27)$$

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

> $F_{
> m max}$: 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 $F_{\rm m}$ may be calculated from the following equation:

In the case of Fig. 4.15 (a)

$$F_{\rm m} = 0.65 F_{\rm max}$$
 (4.28)

In the case of Fig. 4.15 (b)

$$F_{\rm m} = 0.75 \, F_{\rm max} \, \cdots \, (4.29)$$

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

 $F_{\mathbb{R}}$: Rotating load (N), {kgf}

 F_s : Stationary load (N), {kgf}

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

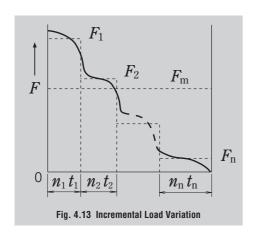
a) Where $F_{\rm R} \ge F_{\rm S}$

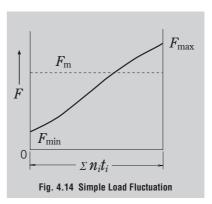
where
$$F_{R} = F_{S}$$

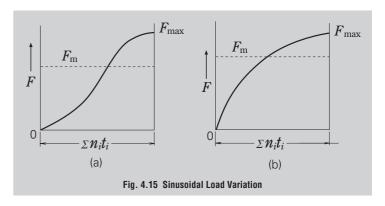
 $F_{m} = F_{R} + 0.3F_{S} + 0.2 \frac{F_{S}^{2}}{F_{R}}$ (4.30)

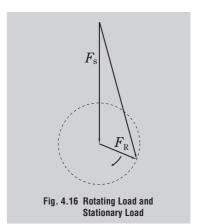
b) Where
$$F_{\rm R} < F_{\rm S}$$

$$F_{\rm m} = F_{\rm S} + 0.3 F_{\rm R} + 0.2 \frac{F_{\rm R}^2}{F_{\rm S}} \cdots (4.31)$$









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:

$$F = \sqrt{F_R^2 + F_S^2 - 2F_R F_S \cos \theta} \qquad (4.32)$$

where, $F_{\rm R}$: Rotating load (N), {kgf} $F_{\rm S}$: Stationary load (N), {kgf} θ : 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 $F_{\rm R}$ and $F_{\rm S}$, that is, in such a manner that $F_{\rm R}+F_{\rm S}$ becomes the maximum load $F_{\rm min}$ and $F_{\rm R}-F_{\rm S}$ becomes the minimum load $F_{\rm min}$ for $F_{\rm R}\gg F_{\rm S}$ or $F_{\rm R}\ll F_{\rm S}$.

$$F_R \gg F_S$$
, $F = F_R - F_S \cos \theta$ (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 $F_{\rm R} = F_{\rm S}$.

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

 $F_{R} < F_{S}$,

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

Curves of Equations (4.32), (4.33), (4.35), and (4.36) are as shown in Fig. 2.

The mean value $F_{\rm m}$ 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).

$$\begin{array}{lll} F_{\text{m}} = F_{\text{min}} + 0.65 & (F_{\text{max}} - F_{\text{min}}) \\ F_{\text{R}} \geq F_{\text{S}}, & F_{\text{m}} = F_{\text{R}} + 0.3F_{\text{S}} & \cdots & \cdots & \cdots \\ F_{\text{R}} \leq F_{\text{S}}, & F_{\text{m}} = F_{\text{S}} + 0.3F_{\text{R}} & \cdots & \cdots & \cdots \\ \end{array} \tag{4.37}$$

$$\begin{array}{ll} F_{\rm m} = F_{\rm min} + 0.75 \; (F_{\rm max} - F_{\rm min}) \\ F_{\rm R} \geqq F_{\rm S}, \; F_{\rm m} = F_{\rm R} + 0.5 F_{\rm S} & \cdots & \cdots & \cdots \\ F_{\rm R} \leqq F_{\rm S}, \; F_{\rm m} = F_{\rm S} + 0.5 F_{\rm R} & \cdots & \cdots & \cdots \\ \end{array} \tag{4.39}$$

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 $F_{\rm S}/F_{\rm R}$ or $F_{\rm R}/F_{\rm S}$. Then, these factors may be expressed as follows:

$$0.3+0.2\frac{F_{\rm S}}{F_{\rm R}}, 0 \le \frac{F_{\rm S}}{F_{\rm R}} \le 1$$

or
$$0.3+0.2\frac{F_{R}}{F_{S}}, 0 \le \frac{F_{R}}{F_{S}} \le 1$$

Accordingly, $F_{\rm m}$ can be expressed by the following equation:

 $F_{\rm R} \geq F_{\rm S}$.

$$F_{\rm m} = F_{\rm R} + (0.3 + 0.2 \frac{F_{\rm S}}{F_{\rm R}}) F_{\rm S}$$

$$= F_{\rm R} + 0.3 F_{\rm S} + 0.2 \frac{F_{\rm S}^2}{F_{\rm R}}$$
(4.41)

 $F_{\rm R} \leq F_{\rm S}$

$$F_{m}=F_{S}+(0.3+0.2\frac{F_{R}}{F_{S}})F_{R}$$

$$=F_{S}+0.3F_{R}+0.2\frac{F_{R}^{2}}{F_{S}}\cdots (4.42)$$

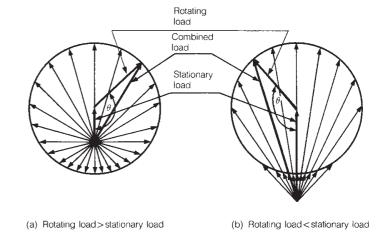
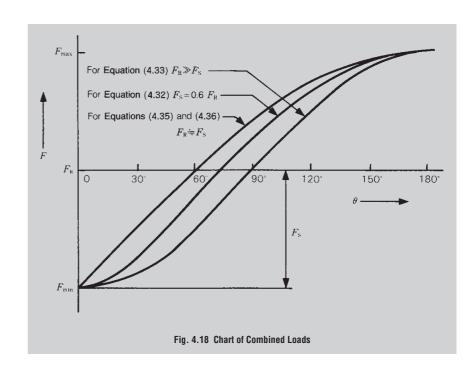


Fig. 4.17 Combined Load of Rotating and Stationary Loads



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:

where P:

P: Equivalent Load (N), {kgf}

 $F_{\rm r}$: 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 $\alpha=0^\circ$ is

$$P = F_{\rm r}$$

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:

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:

$$F_{ai} = \frac{0.6}{V} F_{r} \cdots (4.45)$$

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

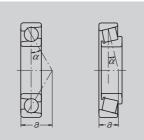
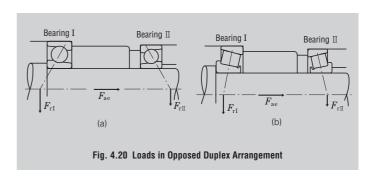


Fig. 4.19 Effective Load Centers



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 nonelastic 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 600MPa {469kgf/mm²} 4 200MPa For other ball bearings {428kgf/mm²} For roller bearings 4 000MPa {408kgf/mm²}

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_{or} for radial bearings and C_{oa} 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_{o} : Static equivalent load (N), {kgf}

 $F_{\rm r}$: 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

where P_0 : Static equivalent load (N), {kgf}

 α : Contact angle

When $F_a < X_o F_r$, 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

$$\alpha = 90^{\circ}$$
 is $P_0 = F_2$

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 generally 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.

$$f_{\rm S} = \frac{C_{\rm o}}{P_{\rm o}} \qquad (4.50)$$

where C_0 : Basic static load rating (N), {kgf}

 P_{\circ} : 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 $f_{ m s}$		
Operating Conditions	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	

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4.6 Examples of Bearing Calculations

(Example1)

Obtain the fatigue life factor $f_{\rm h}$ of single-row deep groove ball bearing **6208** when it is used under a radial load $F_{\rm r}$ =2 500 N, [255kgf] and speed n =900 min⁻¹.

The basic load rating $C_{\rm r}$ of **6208** is 29 100N, $(2\ 970{\rm kgf})$ (Bearing Table, Page C024). Since only a radial load is applied, the equivalent load P may be obtained as follows:

$$P = F_r = 2500$$
N, (255kgf)

Since the speed is $n = 900 \text{ min}^{-1}$, the speed factor f_n can be obtained from the equation in Table 4.2 (Page A034) or Fig. 4.3(Page A036).

$$f_{\rm n} = 0.333$$

The fatigue life factor $f_{\rm h}$, under these conditions, can be calculated as follows:

$$f_{\rm h} = f_{\rm n} \frac{C_{\rm r}}{P} = 0.333 \times \frac{29\ 100}{2\ 500} = 3.88$$

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 $50~\mathrm{mm}$ and outside diameter under $100~\mathrm{mm}$ that satisfies the following conditions:

Radial load $F_r = 3000$ N, (306kgf)

Speed $n = 1900 \text{ min}^{-1}$

Basic rating life $L_h \ge 10~000h$

The fatigue life factor f_h of ball bearings with a rating fatigue life longer than 10 000 hours is $f_h \ge 2.72$. Because $f_n = 0.26$, $P = F_r = 3\,000$ N. (306kgf)

$$f_h = f_n \frac{C_r}{P} = 0.26 \times \frac{C_r}{3.000} \ge 2.72$$

therefore,
$$C_r \ge 2.72 \times \frac{3000}{0.26} = 31380 \text{N}$$
, (3 200kgf)

Among the data listed in the bearing table on Page C026, **6210** should be selected as one that satisfies the above conditions.

(Example3)

Obtain C_r/P or fatigue life factor $f_{\rm h}$ when an axial load $F_{\rm a}$ =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 $f_{\rm o}F_{\rm a}/C_{\rm or}$, from the table above the single-row deep groove ball bearing table.

The basic static load rating $C_{\rm or}$ of ball bearing **6208** is 17 900N, (1 820kgf) (Page C024)

$$f_0 F_a / C_{or} = 14.0 \times 1\ 000/17\ 900 = 0.782$$

 $e = 0.26$

and $F_a / F_r = 1000/2500 = 0.4 > e$

X = 0.56

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

Therefore, the dynamic equivalent load P is

$$P = XF_{\rm r} + YF_{\rm a}$$

 $= 0.56 \times 2500 + 1.67 \times 1000$

= 3 070N, (313kgf)

$$\frac{C_{\rm r}}{P} = \frac{29\ 100}{3\ 070} = 9.48$$

$$f_{\rm h} = f_{\rm n} \frac{C_{\rm r}}{P} = 0.333 \times \frac{29 \ 100}{3 \ 070} = 3.16$$

This value of $f_{\rm h}$ corresponds approximately to 15 800 hours for ball bearings.

(Example 4)

Select a spherical roller bearing of series 23⁻¹ satisfying the following conditions:

Radial load $F_r = 45\,000$ N

Axial load $F_a = 8000$ N

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

Basic rating life $L_h \ge 30~000h$

The value of the fatigue life factor $f_{\rm h}$ which makes $L_{\rm h}{\ge}30~000{\rm h}$ 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 $F_a/F_r > e$

$$P = XF_{\rm r} + YF_{\rm a} = 0.67 F_{\rm r} + Y_2 F_{\rm a}$$

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

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,
$$P = XF_r + YF_a = F_r + Y_3F_a$$

= 45 000 + 2.2 × 8 000
= 62 600N

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

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

consequently, $C_r \ge 490000N$

Among spherical roller bearings of series 231 satisfying this value of C_r , the smallest is **23126CE4** ($C_r = 505\ 000\ N$)

Once the bearing is determined, substitude the value of Y_2 in the equation and obtain the value of P_2 .

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

= 64 200N

$$L_{\rm h} = 500 \left(f_{\rm h} \frac{C_{\rm r}}{P} \right)^{\frac{10}{3}}$$

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

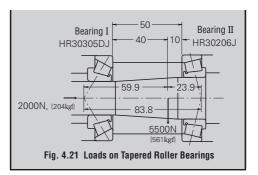
$$= 500 \times 3.49^{\frac{10}{3}} \stackrel{3}{=} 32\ 000\ \rm h$$

(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 $F_r = 5500N$, (561kgf),

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



To distribute the radial load $F_{\rm r}$ 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 $F_{\rm r}$ 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:

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

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

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

Bearings	Basic dynamic load rating $C_{ m r}$ (N) {kgf}		Axial load factor Y_1	Constant <i>e</i>
Bearing I (HR30305DJ)	38 000	{3 900}	1 -	0.83
Bearing II (HR30206J)	43 000	{4 400}	$Y_{\mathrm{II}} = 1.6$	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).

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

= 3 474N, (354kgf)

$$\frac{0.6}{Y_{\text{I}}} F_{r_{\text{I}}} = \frac{0.6}{0.73} \times 1569 = 1290 \text{N}, \text{ (132kgf)}$$

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

For bearing I

$$F_{ri} = 1569N$$
, (160kgf)

$$F_{\rm a\,I} = 3\,474\,{
m N},~{
m (354kgf)}$$

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

the dynamic equivalent load $P_{\rm I} = XF_{\rm r\,I} + Y_{\rm I}F_{\rm a\,I}$

$$= 0.4 \times 1569 + 0.73 \times 3474$$

$$= 3 164N, (323kgf)$$

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

$$=\frac{0.42\times38\ 000}{3\ 164}=5.04$$

and the rating fatigue life $L_{\rm h} = 500 \times 5.04^{\frac{10}{3}} = 109$

For bearing II

since $F_{r\, \text{II}}=3~931\, \text{N}$, (401kgf), $F_{a\, \text{II}}=0$

the dynamic equivalent load

$$P_{\Pi} = F_{r\Pi} = 3 \text{ 931N}, \text{ (401kgf)}$$

the fatigue life factor

$$f_{\rm h} = f_{\rm n} \frac{C_{\rm r}}{P_{\rm II}} = \frac{0.42 \times 43\ 000}{3\ 931} = 4.59$$

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

Remarks 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 $F_r = 245~000$ N

Axial load $F_a = 49000$ N

Speed

 $n = 500 \text{min}^{-1}$

Size limitation

Shaft diameter: 300mm

Bore of housing: Less than 500mm

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 C284)

d	D	В	Bearing No.	Basic dynamic load rating $C_{ m r}$ $({ m N})$	Constant $oldsymbol{e}$	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
	500 500		23160 CAE4 24160 CAE4		0.31 0.38	2.2 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.

$$f_h = f_n \frac{C_r}{P} = \frac{0.444 \ C_r}{F_r + Y_2 F_2} = 3 \text{ to } 5$$

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

$$C_{\rm r} = \frac{(F_{\rm r} + Y_3 F_{\rm a}) \times (3 \text{ to } 5)}{0.444}$$

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

= 2 350 000 to 3 900 000 N

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 $F_{\rm a}$ on a bearing, the load of rolling element Q, and the contact angle α when the load is applied. (See Equations (9.8), (9.9), and (9.10) in Section 9.6.2)

$$F_a=Z Q \sin \alpha$$

=
$$KZD_{\rm w}^2 \{\sqrt{(\sin\alpha_0+h)^2+\cos^2\alpha_0}-1\}^{3/2}\cdot\sin\alpha$$
 (4.51

$$\alpha = \sin^{-1} \frac{\sin \alpha_0 + h}{\sqrt{(\sin \alpha_0 + h)^2 + \cos^2 \alpha_0}} \dots (4.52)$$

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

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

$$C_{0r} = f_0 Z D_w^2 \cos \alpha_0 \cdots (4.53)$$

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

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

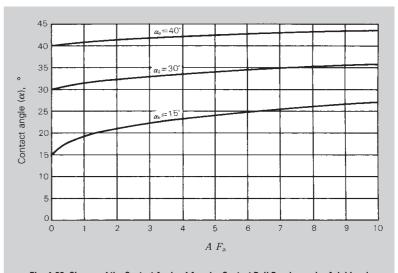
where, K: Constant determined from material and design of bearing

In other words, "h" is assumed and α is determined from Equation (4.52). Then "h" and α 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 α is shown in Fig. 4.22.

Example 1

Change in the contact angle is calculated when the pure axial load $F_{\rm a}$ = 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 α =26° are obtained from Fig. 4.22. An initial contact angle of 15° has changed to 26° under the axial load.



 $\textbf{Fig. 4.22 \ Change of the Contact Angle of Angular Contact Ball Bearing under Axial Load } \\$

Table 4.10 Constant A Value of Angular Contact Ball Bearing

Units: kN-

Bearing	Ве	earing series	Bearing series 70		Bearing series 72			Bearing series 73		
bore No.	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 C014. A=0.303 is determined from Table 4.11 and A F_a=0.303×24.75 \pm 7.5 and α \pm 24 $^{\circ}$ from Fig. 4.23.

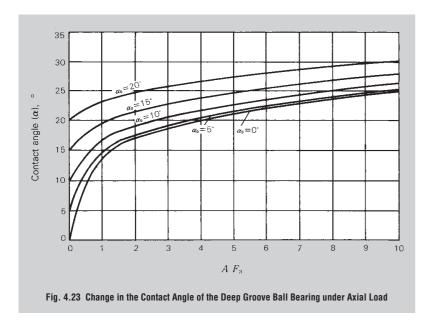


Table 4.11 Contact A Value of Deep Groove Ball Bearing

Units: kN⁻¹

Bearing	Bearing series 62					
bore No.	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	

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(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

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

$$Q = \frac{F_{a}}{Z \sin \alpha}$$

limit value of P_0 .

 θ of Fig. 4.24 is also determined as follows:

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

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

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

$$\gamma \ge \alpha + \theta$$

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.

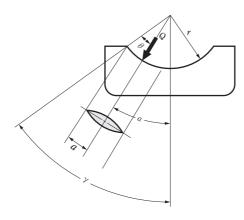
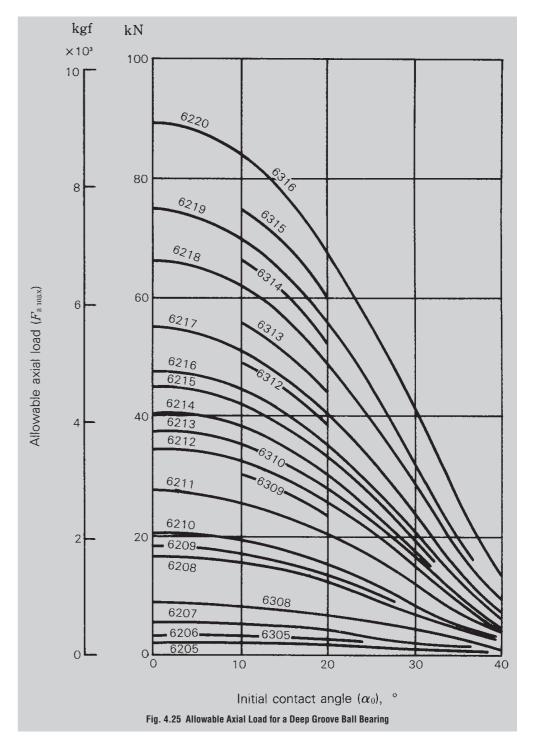


Fig. 4.24



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)

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

$$= f\left\{\frac{900 (k \cdot d)^{2}}{n+1 500} - 0.023 \times (k \cdot d)^{2.5}\right\} \{kgf\}$$
......(4.55)

Oil lubrication (Empirical equation)

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

$$= f\left\{\frac{490 (k \cdot d)^{2}}{n+1 000}-0.000135 \times (k \cdot d)^{3.4}\right\} \{kgf\}$$
.....(4.56)

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.

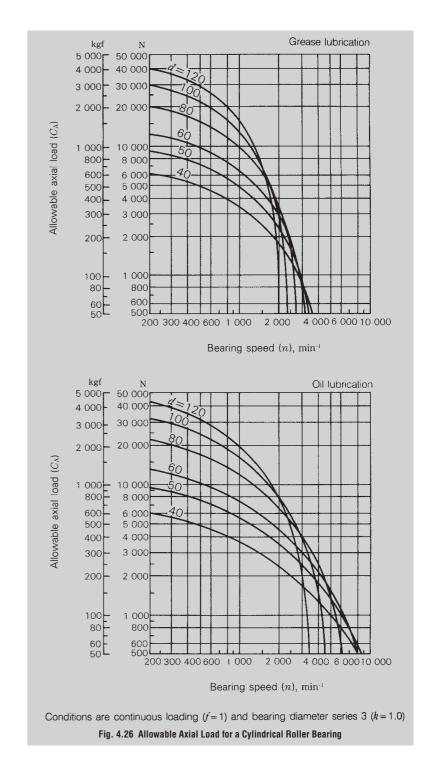
Moreover, if the bearing speed is very slow or exceeds 50% of the allowable speed in the bearing catalog, or if the bearing bore diameter exceeds 200 mm, it is required for each bearing to be precisely checked for lubrication, cooling method, etc. Please contact NSK in such cases.

f: Load factor

	<i>f</i> 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



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

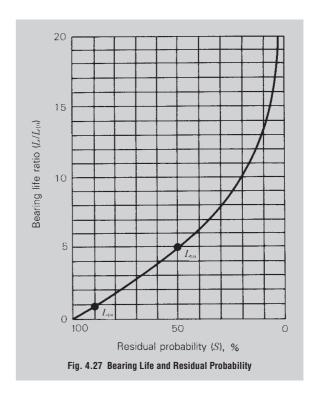
within a damage ratio of 10 to 60% (residual probability of 90 to 40%). Below the damage ratio of 10% (residual probability of 90% or more), however, the rolling fatigue life becomes longer than the theoretical curve of the Weibull distribution, as shown in Fig. 4.28. This is a conclusion drawn from the life test of numerous, widely-varying bearings and an analysis of the data.

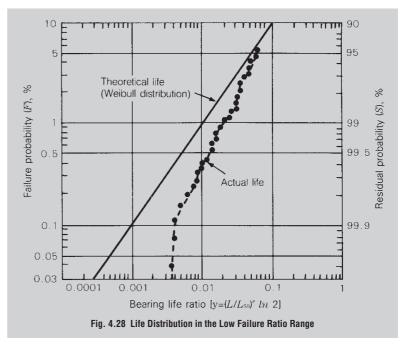
When bearing life with a failure ratio of 10% or less (for example, the 95% life or 98% life) is to be considered on the basis of the above concept, the reliability factor a_1 as shown in the table below is used to check the life. Assume here that the 98% life L_2 is to be calculated for a bearing whose rating fatigue life L_{10} was calculated at 10 000 hours. The life can be calculated at L_2 =0.33× L_{10} =3 300 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	$L_{\scriptscriptstyle 10}$ 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.





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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):

$$L = \left(\frac{C}{P}\right)^{p} \qquad (4.57)$$

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,

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 ε =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 fatique life can be calculated as follows. Equations (4.58) and (4.59) can be established between the bearing radial clearance Δ_r and a function $f(\varepsilon)$ of load factor ε :

For deep groove ball bearing

$$f(\varepsilon) = \frac{\Delta_{r} \cdot D_{w}^{1/3}}{0.00044 \left(\frac{F_{r}}{Z}\right)^{2/3}} \dots (N)$$

$$f(\varepsilon) = \frac{\Delta_{r} \cdot D_{w}^{1/3}}{0.002 \left(\frac{F_{r}}{Z}\right)^{2/3}} \dots \{kgf\}$$

For cylindrical roller bearing

$$f(\varepsilon) = \frac{\Delta_{r} \cdot L_{we}^{0.8}}{0.000077 \left(\frac{F_{r}}{Z \cdot i}\right)^{0.9}} \dots (N)$$

$$f(\varepsilon) = \frac{\Delta_{r} \cdot L_{we}^{0.8}}{0.0006 \left(\frac{F_{r}}{Z \cdot i}\right)^{0.9}} \dots \{kgf\}$$

where, Δ_r : Radial clearance (mm)

 F_r : Radial load (N), {kgf}

Z: Number of rolling elements

i: No. of rows of rolling elements

 $D_{\rm w}$: Ball diameter (mm)

 $L_{\rm we}$: Effective roller length (mm)

 L_{ε} : Life with clearance of Δ_{r}

 \vec{L} : Life with zero clearance, obtained from

Equation (4.57)

The relationship between load factor ε and $f(\varepsilon)$, and the life ratio L_{ε}/L , when the radial internal clearance is $\Delta_{\rm r}$ 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.

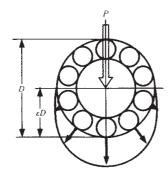
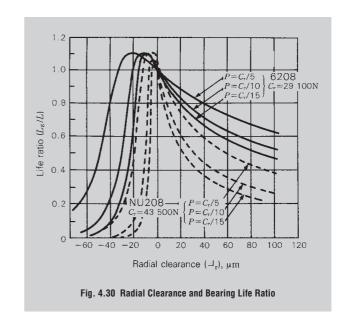


Fig. 4.29 Load Distribution with ε =0.5

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

	Deep groove ball bearing		Cylindrical roller bearing		
ε	$f(\varepsilon)$	$\frac{L_{arepsilon}}{L}$	$f(\varepsilon)$	$\frac{L_{arepsilon}}{L}$	
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	



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 \sim 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_{θ} . 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%

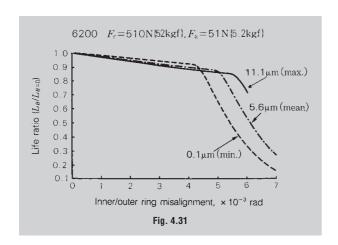
(normal load) and 1% (light preload) of the dynamic load rating C_r (N) {kgf} of a bearing and were used as load conditions for the calculation. Normal radial clearance was used and the shaft fit was set to around j5. Also taken into account was the decrease of the internal clearance due to expansion of the inner ring.

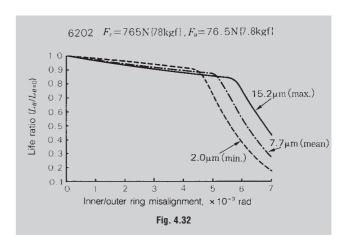
Moreover, assuming that the temperature difference between the inner and outer rings was 5°C during operation, inner/outer ring misalignment, $L_{\theta}/L_{\theta-0}$ was calculated for the maximum, minimum, and mean effective clearances.

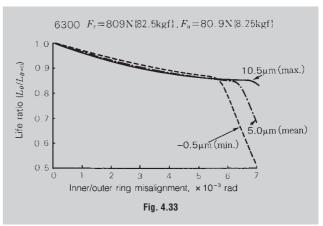
As shown in Figs. 4.31 to 4.34, degradation of the fatigue life is limited to 5 to 10% or less when the misalignment ranges from 0.0006 to 0.003 rad (2' to 10'), thus not presenting much problem.

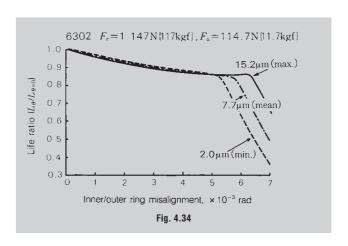
When the misalignment exceeds a certain limit, however, the fatigue life degrades rapidly as shown in the figure. Attention is therefore necessary in this respect.

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.









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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.

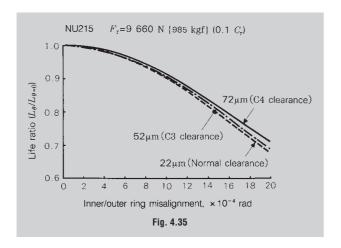
The relationship between the misalignment of inner/outer rings and fatigue life was determined, as shown in Figs. 4.35 to 4.38, while using cylindrical roller bearings NU215 and NU315 of standard design.

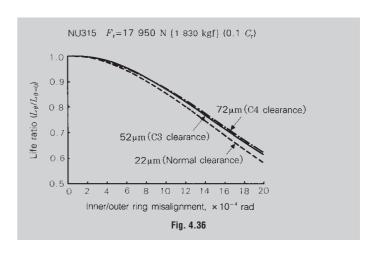
In these figures, the horizontal axis shows the misalignment of inner/outer rings (rad) while the vertical axis shows the fatigue life ratio $L_{\theta}/L_{\theta-0}$. The fatigue life without misalignment is $L_{\theta-0}$ and that with misalignment is L_{θ} .

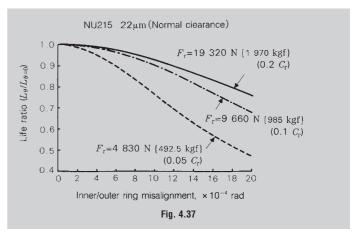
Figs. 4.35 and 4.36 show the case with constant load (10% of basic dynamic load rating $C_{\rm r}$ of a bearing) for each case when the internal clearance is a normal, C3 clearance, or C4 clearance. Figs. 4.37 and 4.38 show the case with constant clearance (normal clearance) when the load is 5%, 10%, and 20% of the basic dynamic load rating $C_{\rm r}$.

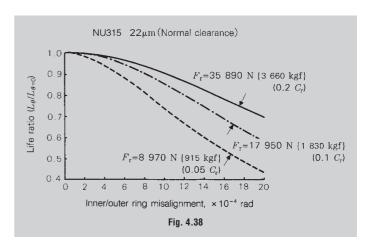
Note that the median effective clearance in these examples was determined using m5/H7 fits and a temperature difference of 5°C between the inner and outer rings.

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.









4.8.5 Oil Film Parameters and Rolling Fatigue Life

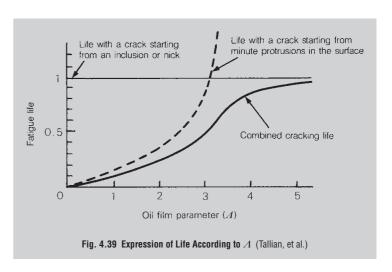
Based on numerous experiments and experiences, the rolling fatigue life of rolling bearings can be shown to be closely related to the lubrication.

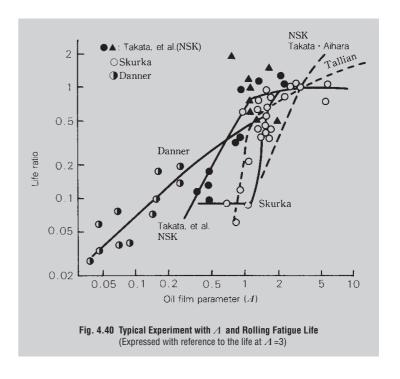
The rolling fatigue life is expressed by the maximum number of rotations, which a bearing can endure, until the raceway or rolling surface of a bearing develops fatigue in the material, resulting in flaking of the surface, under action of cyclic stress by the bearing. Such flaking begins with either microscopic non-uniform 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 (\varLambda), 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 \varLambda . Namely, when \varLambda 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 \varLambda 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 ${\scriptstyle \varLambda}$ =0.3 ${\scriptstyle \sim}$ 3 using different lubricants and bearing materials (${\Large lacktled{ \bullet}}$ and ${\Large lacktled{ \land}}$ 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 ${\scriptstyle \varLambda}$ =1 when compared with the life values at around ${\scriptstyle \varLambda}$ =3 ${\scriptstyle \sim}$ 4 where life changes at a slower rate. The life becomes about 1/10 or less at ${\scriptstyle \varLambda}$ = ${\Large lacktled{ \circ}}$ 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.





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 (1) 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.

$$\Lambda = h/\sigma$$
 (4.60)

where h: EHL oil film thickness σ : Combined roughness $(\sqrt{\sigma_1^2 + \sigma_2^2})$

 σ_1 , σ_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:

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.

$$\Lambda = t \cdot R \cdot A \cdot F \cdot J \cdot \cdots \cdot (4.62)$$

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_{∞} $P^{-0.13}$. 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:

$$\Lambda = T \cdot R \cdot A \cdot D$$
 (4.63)

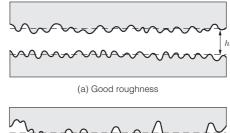
where, T: Factor determined by the bearing **T**ype

R: Factor related to Rotation speed

A: Factor related to viscosity (viscosity grade

 α . Alpha

D: Factor related to bearing Dimensions



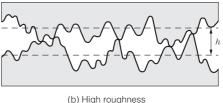


Fig. 4.41 Oil Film and Surface Roughness

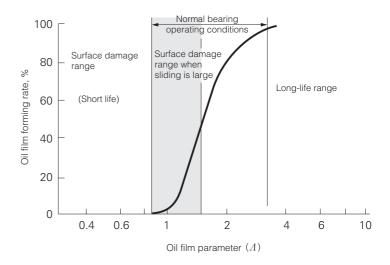


Fig. 4.42 Effect of Oil Film on Bearing Performance

| NSK

The oil film parameter \varLambda , 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 \varLambda is smaller.

In the equation $A = T \cdot R \cdot A \cdot D$ terms include A for oil viscosity η_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 ν_0 (mm²/s, {cSt}) is used and conversion is made as follows:

 ρ is the density (g/cm³) and uses the approximate value as shown below:

 $\begin{array}{ll} \text{Mineral oil} & \rho {=} 0.85 \\ \text{Silicon oil} & \rho {=} 1.0 \\ \text{Diester oil} & \rho {=} 0.9 \end{array}$

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

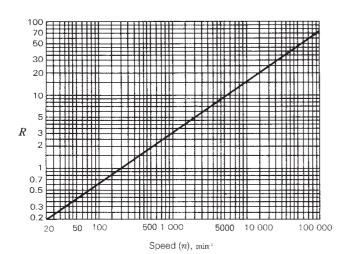


Fig. 4.43 Speed Term, R

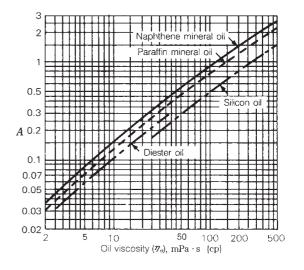


Fig. 4.44 Term Related to Lubricant Viscosity, ${\cal A}$

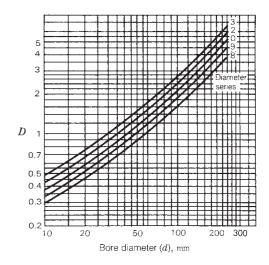


Fig. 4.45 Term Related to Bearing Specifications, D



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 (η_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. Δ =2.5

(Example 2)

The oil film parameter is determined when a cylindrical roller bearing NU240 is operated with paraffin mineral oil (η_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, A=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 parameter 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).

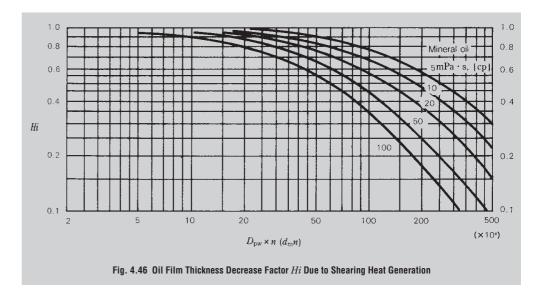
Another effect is the localized temperature rise of oil in the contact inlet due to heavy shearing during high-speed operation, resulting in a decrease of the oil viscosity. In this case, the oil film parameter becomes smaller than the isothermal theoretical value. The effect of shearing heat generation 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 $D_{\rm pw} \times$ 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. Nameny;

$$\Lambda = Hi \cdot T \cdot R \cdot A \cdot D \cdot \dots \cdot (4.65)$$

Note that the average of the bore and outside diameters of the bearings may be used as the pitch diameter $D_{\mathrm{nw}}\left(d_{\mathrm{m}}\right)$ of rolling element set.

Conditions for the calculation (Example 1) include $d_{\rm m}n$ =9.5 \times 10⁴ and $\eta_{\rm 0}$ =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 $d_{\rm m}n=7\times10^5$ and $\eta_{\rm 0}=10$ mPa·s, {cp} while Hi=0.76, which means that the oil film parameter is smaller by about 25%. Accordingly, Δ is actually 2.7, not 3.6.



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:

$$P_{1}=P_{2}=\frac{9\ 550\ 000H}{n_{1}\left(\frac{d_{p_{1}}}{2}\right)}=\frac{9\ 550\ 000H}{n_{2}\left(\frac{d_{p_{2}}}{2}\right)} \tag{N}$$

$$=\frac{974\ 000H}{n_{1}\left(\frac{d_{p_{1}}}{2}\right)}=\frac{974\ 000H}{n_{2}\left(\frac{d_{p_{2}}}{2}\right)} \tag{kgf}$$

 $S_1=S_2=P_1\tan\alpha$

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:

$$P_{1}=P_{2}=\frac{9\ 550\ 000H}{n_{1}\left(\frac{d_{p1}}{2}\right)}=\frac{9\ 550\ 000H}{n_{2}\left(\frac{d_{p2}}{2}\right)} \tag{N}$$

$$=\frac{974\ 000H}{n_{1}\left(\frac{d_{p1}}{2}\right)}=\frac{974\ 000H}{n_{2}\left(\frac{d_{p2}}{2}\right)} \tag{sgf}$$

$$S_{1}=S_{2}=\frac{P_{1}\tan\alpha_{n}}{n_{2}}$$

 $T_1=T_2=P_1\tan\beta$

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:

$$P_{1}=P_{2}=\frac{9\ 550\ 000H}{n_{1}\left(\frac{d_{p_{1}}}{2}\right)}=\frac{9\ 550\ 000H}{n_{2}\left(\frac{d_{p_{2}}}{2}\right)}$$
(N)
$$=\frac{974\ 000H}{n_{1}\left(\frac{d_{p_{1}}}{2}\right)}=\frac{974\ 000H}{n_{2}\left(\frac{d_{p_{2}}}{2}\right)}$$
(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) α : Gear pressure angle

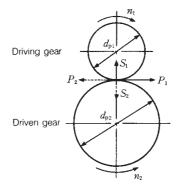
 α_n : Gear normal pressure angle

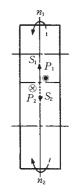
 $\ddot{\beta}$: Twist angle

Subscript 1: Driving gear

Subscript 2: Driven gear

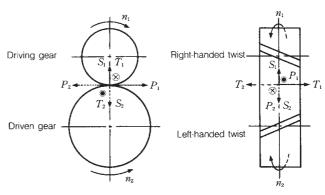
In the case of double-helical gears, thrust of the helical gears offsets each other and thus only tangential and separating forces act. For the directions of tangential, separating, and thrust forces, please refer to Figs. 4.47 and 4.48.





Vertical upward on paper
 Vertical downward on paper

Fig. 4.47 Spur Gear



Vertical upward on paper
 Vertical downward on paper

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:

$$P_{1}=P_{2}=\frac{9\ 550\ 000H}{n_{1}\left(\frac{d_{p_{1}}}{2}\right)}=\frac{9\ 550\ 000H}{n_{2}\left(\frac{d_{p_{2}}}{2}\right)}$$
.....(N)
$$=\frac{974\ 000H}{d_{2}}=\frac{974\ 000H}{d_{2}}$$
{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 sification	Bearing A	Bearing B
p.	From P_1	$P_{\mathbf{A}} = \frac{\mathbf{b}}{\mathbf{a} + \mathbf{b}} P_{1} \otimes$	$P_{\rm B} = \frac{{\sf a}}{{\sf a} + {\sf b}} P_1 \otimes$
Radial load	From S_1	$S_{A} = \frac{b}{a+b} S_{1}$	$S_{\rm B} = \frac{\rm a}{\rm a+b} S_{\rm 1}$
<u> </u>	From T_1	$U_{A} = \frac{d_{p1}/2}{a+b} T_{1} \qquad \uparrow $	$U_{\rm B} = \frac{d_{\rm pl}/2}{{\rm a} + {\rm b}} T_{\rm 1} \blacksquare$
	mbined lial load	$F_{\rm rA} = \sqrt{P_{\rm A}^2 + (S_{\rm A} + U_{\rm A})^2}$	$F_{\rm rB} = \sqrt{P_{\rm B}^2 + (S_{\rm B} - U_{\rm B})^2}$
Ax	ial load	F_{a}	$=T_1$

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

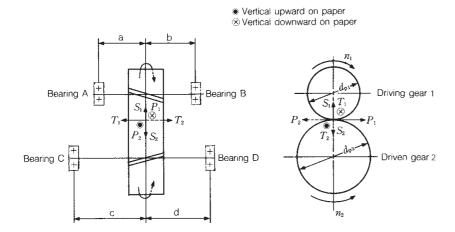


Fig. 4.49

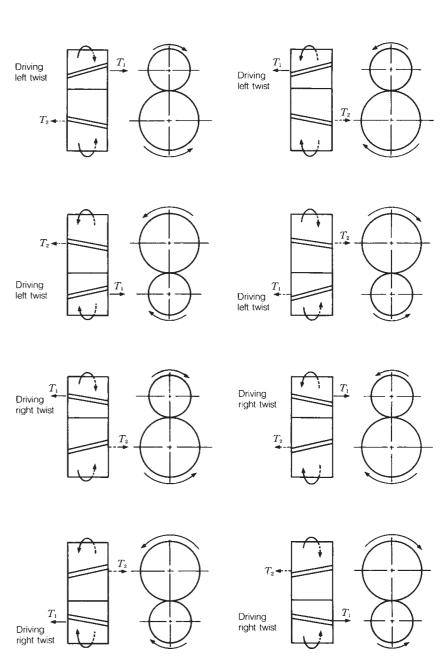


Fig. 4.50 Thrust Direction



(2) Calculation of Load Acting on Straight Bevel Gears The load at the meshing point of straight bevel gears is calculated as follows:

$$P_{1}=P_{2}=\frac{9\ 550\ 000H}{n_{1}\left(\frac{D_{m1}}{2}\right)}=\frac{9\ 550\ 000H}{n_{2}\left(\frac{D_{m2}}{2}\right)}$$
.....(N)

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

 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, $D_{\rm m}$: Average pitch diameter (mm)

 d_p : Noted diameter (mm) d_p : Gear width (pitch line length) (mm) α_n : Gear normal pressure angle

 α_n to the normal pressure angle δ : Pitch cone angle Generally, $\delta_1 + \delta_2 = 90^\circ$. 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 δ 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

cla	Load assification	Bearing A	Bearing B	Bearing C	Bearing D
pı	From P	$P_{\mathbf{A}} = \frac{\mathbf{b}}{\mathbf{a}} P_{1}$	$P_{\rm B} = \frac{{\sf a} + {\sf b}}{{\sf a}} P_{1} \otimes$	$P_{\rm C} = \frac{\rm d}{\rm c + \rm d} P_2 \bullet$	$P_{\mathrm{D}} = \frac{C}{c + d} P_{2} \bullet$
Radial Ioad	From S	$S_{A} = \frac{b}{a} S_{1}$	$S_{\rm B} = \frac{a+b}{a} S_{\rm i}$	$S_{c} = \frac{d}{c+d}S_{2} \rightarrow$	$S_{\rm D} = \frac{{\rm c}}{{\rm c} + {\rm d}} S_2 \Rightarrow $
čč	From T	$U_{\rm A} = \frac{D_{\rm m1}}{2 \cdot {\rm a}} T_{\rm 1} \qquad \uparrow \qquad \uparrow$	$U_{\rm B} = \frac{D_{\rm m1}}{2 \cdot {\rm a}} T_{\rm 1} \blacksquare$	$U_{\rm C} = \frac{D_{\rm m2}}{2({\rm c} + {\rm d})} T_2 \leftarrow$	$U_{\rm D} = \frac{D_{\rm m2}}{2({\rm c} + {\rm d})} T_2 \Longrightarrow$
_	Combined adial load	$F_{\rm rA} = \sqrt{P_{\rm A}^2 + (S_{\rm A} - U_{\rm A})^2}$	$F_{\rm rB} = \sqrt{P_{\rm B}^2 + (S_{\rm B} - U_{\rm B})^2}$	$F_{\rm rC} = \sqrt{P_{\rm C}^2 + (S_{\rm C} - U_{\rm C})^2}$	$F_{\rm rD} = \sqrt{P_{\rm D}^2 + (S_{\rm D} + U_{\rm D})^2}$
F	Axial load	F_{a} =	= T ₁	F_{a} =	= T ₂ ↓

Load direction is shown referring to Fig. 4.52.

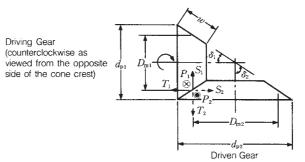


Fig. 4.51

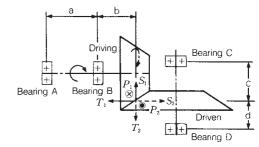


Fig. 4.52

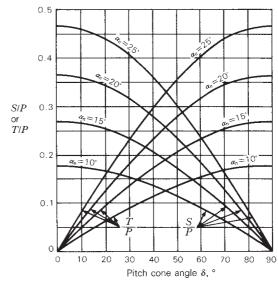


Fig. 4.53

(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:

$$P_1 = P_2 = \frac{9550000H}{n_1 \left(\frac{D_{\text{m1}}}{2}\right)} = \frac{9550000H}{n_2 \left(\frac{D_{\text{m2}}}{2}\right)}$$

$$= \frac{974000H}{n_1 \left(\frac{D_{\text{m1}}}{2}\right)} = \frac{974000H}{n_2 \left(\frac{D_{\text{m2}}}{2}\right)}$$
(N)

where, $\alpha_{\rm n}$: Gear normal pressure angle

 β : Twisting angle δ : Pitch cone angle

w: Gear width (mm)

 $D_{
m m}$: Average pitch diameter (mm)

 $d_{\scriptscriptstyle
m p}$: Pitch diameter (mm)

Note that the following applies:

$$D_{ ext{m1}}$$
= $d_{ ext{p1}}$ - w sin δ_1
 $D_{ ext{m2}}$ = $d_{ ext{p2}}$ - w sin δ_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

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

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

Driven Gear

Separating Force

$$S_2 = \frac{P}{\cos\beta} (\tan\alpha_n \cos\delta_2 - \sin\beta \sin\delta_2)$$

Thrust
$$T_2 = \frac{P}{\cos\beta} (\tan\alpha_n \sin\delta_2 + \sin\beta \cos\delta_2)$$

(ii) Counterclockwise with Right Twist or Clockwise with Left Twist

Driving Gear Separating Force

$$S_1 = \frac{P}{\cos\beta} (\tan\alpha_n \cos\delta_1 - \sin\beta \sin\delta_1)$$

Thrust
$$T_1 = \frac{P}{\cos\beta} \left(\tan\alpha_n \sin\delta_1 + \sin\beta \cos\delta_1 \right)$$

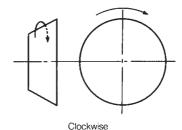
Driven Gear Separating Force

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

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

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.

Generally, $\delta_1+\delta_2=90^\circ$. In this case, T_1 and S_2 (S_1 and T_2) are the same in magnitude but opposite in direction. 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."



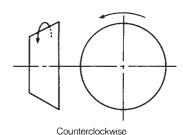
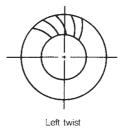
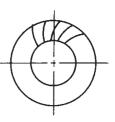


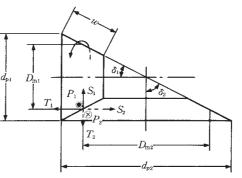
Fig. 4.54

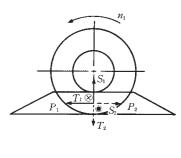
Fig. 4.55





Right twist





Vertical upward on paper
 Vertical downward on paper

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:

$$P_{1} = \frac{9550000H}{n_{1} \left(\frac{D_{m1}}{2}\right)} = \frac{\cos\beta_{1}}{\cos\beta_{2}} P_{2} \dots (N)$$

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

$$P_{2} = \frac{9\ 550\ 000H}{n_{2} \left(\frac{D_{m2}}{2}\right)}$$
 (N)

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

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

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

where, α_n : Gear normal pressure angle

- $\ddot{\beta}$: Twisting angle
- δ : Pitch cone angle
- w : Gear width (mm)
- $D_{\rm m}$: Average pitch diameter (mm)
- $d_{\rm p}$: Pitch diameter (mm)
- z: Number of teeth

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

$$S_1 = \frac{P_1}{\cos \beta_1} (\tan \alpha_n \cos \delta_1 + \sin \beta_1 \sin \delta_1)$$

Thrust
$$T_1 = \frac{P_1}{\cos \beta_1} (\tan \alpha_n \sin \delta_1 - \sin \beta_1 \cos \delta_1)$$

Driven Gear

Separating Force

$$S_2 = \frac{P_2}{\cos \beta_2} (\tan \alpha_n \cos \delta_2 - \sin \beta_2 \sin \delta_2)$$

Thrust
$$T_2 = \frac{P_2}{\cos \beta_2} (\tan \alpha_n \sin \delta_2 + \sin \beta_2 \cos \delta_2)$$

(ii) Counterclockwise with Right Twist or Clockwise with Left Twist

Driving Gear

Separating Force

$$S_1 = \frac{P_1}{\cos \beta_1} (\tan \alpha_n \cos \delta_1 - \sin \beta_1 \sin \delta_1)$$

Thrust
$$T_1 = \frac{P_1}{\cos \beta_1} (\tan \alpha_n \sin \delta_1 + \sin \beta_1 \cos \delta_1)$$

Driven Gear

Separating Force

$$S_2 = \frac{P_2}{\cos \beta_2} (\tan \alpha_n \cos \delta_2 + \sin \beta_2 \sin \delta_2)$$

Thrust
$$T_2 = \frac{P_2}{\cos \beta_2} (\tan \alpha_n \sin \delta_2 - \sin \beta_2 \cos \delta_2)$$

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."

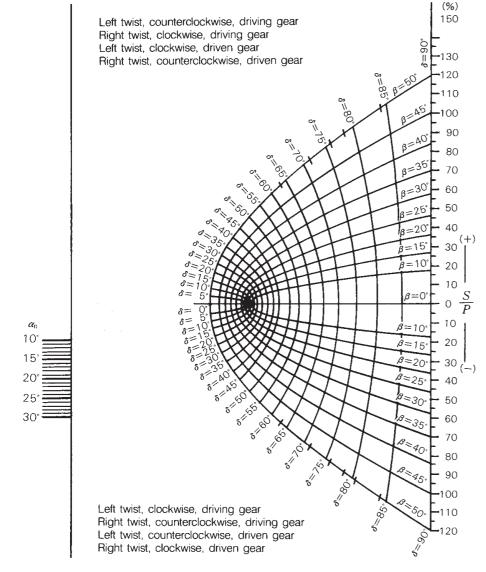


The next calculation diagram is used to determine the approximate value and direction of separating force S and thrust T.

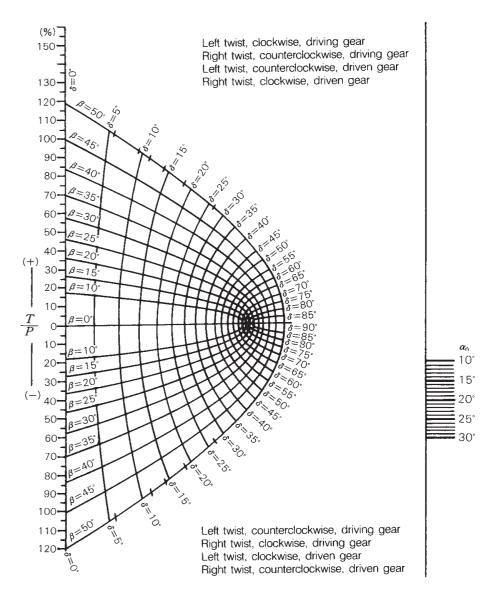
[How To Use]

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 $\alpha_{\rm n}$ from the vertical scale on the left side of the diagram.
- 2. Determine the intersection between the pitch cone angle δ and the twist angle β . Determine one point which is either above or below the β =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 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 $\left(\gamma = an^{-1} rac{d_{
m p2}}{i d_{
m p1}}
ight)$

 ψ : For the frictional angle, the value obtained

from
$$V_{\mathbb{R}} = \frac{\pi d_{\text{pl}} n_1}{\cos \gamma} \times \frac{10^{-3}}{60}$$

as shown in Fig. 4.57 is used.

When V_R is 0.2 m/s or less, then use ψ =8°. When V_R exceeds 6 m/s, use ψ =1°4′.

 $\alpha_{\rm n}$: Gear normal pressure angle

 $\alpha_{\rm a}$: Shaft plane pressure angle

 $Z_{\rm w}$: No. of threads (No. of teeth of worm gear)

 $Z_{\scriptscriptstyle 2}$: 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	$\frac{9550000H}{n_1\left(\frac{d_{p1}}{2}\right)} \qquad \cdots \cdots (N)$	$\frac{9550000Hi\eta}{n_1\left(\frac{d_{n^2}}{2}\right)} = \frac{P_1\eta}{\tan\gamma} = \frac{P_1}{\tan(\gamma+\psi)}$ (N)			
P	$\frac{974\ 000H}{n_1\left(\frac{d_{\rm pl}}{2}\right)} \qquad \cdots \qquad {\rm \{kgf\}}$	$\frac{974\ 000Hi\eta}{n_1\left(\frac{d_{p^2}}{2}\right)} = \frac{P_1\ \eta}{\tan\gamma} = \frac{P_1}{\tan(\gamma + \psi)}$ $\cdots\cdots\cdot\{\text{kgf}\}$			
Thrust	$\frac{9550000H\eta}{n_1\left(\frac{d_{n^2}}{2}\right)} = \frac{P_1 \eta}{\tan \gamma} = \frac{P_1}{\tan(\gamma + \psi)}$ (N)	$\frac{9\ 550\ 000H}{n_1\left(\frac{d_{p1}}{2}\right)} \qquad \cdots \cdots (N)$			
T	$\frac{974\ 000H\eta}{n_1\left(\frac{d_{\mathbb{P}^2}}{2}\right)} = \frac{P_1\ \eta}{\tan\gamma} = \frac{P_1}{\tan(\gamma+\psi)}$ $\cdots\cdots\cdot\{\text{kgf}\}$	$\frac{974\ 000H}{n_1\left(\frac{d_{\rm pl}}{2}\right)} \qquad \qquad$			
Separating S	$\frac{P_1 \tan \alpha_n}{\sin (\gamma + \psi)} = \frac{P_1 \tan \alpha_n}{\tan (\gamma + \psi)}$ (N), {kgf}	$\frac{P_1 \tan \alpha_n}{\sin (\gamma + \psi)} = \frac{P_1 \tan \alpha_a}{\tan (\gamma + \psi)}$ (N), {kgf}			

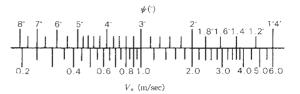


Fig. 4.57

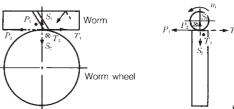
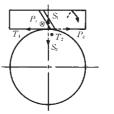


Fig. 4.58 Right Twist Worm Gear

Vertical upward on paperVertical downward on paper



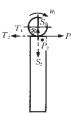
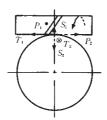


Fig. 4.59 Right Twist Worm Gear (Worm Rotation is Opposite that of Fig. 4.58)



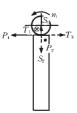
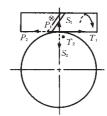


Fig. 4.60 Left Twist Worm Gear



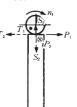
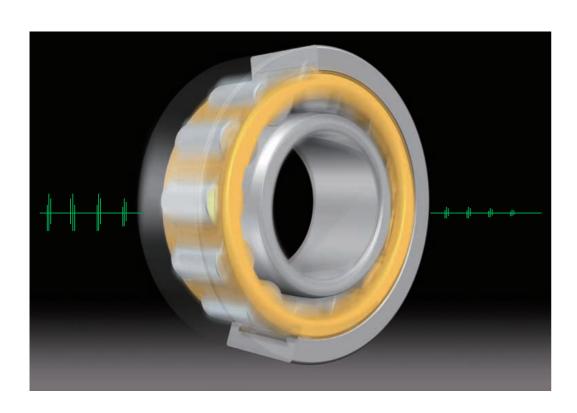


Fig. 4.61 Left Twist Worm Gear (Worm Rotation is Opposite that of Fig. 4.60)



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

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. $C/P \ge 12$ and $F_a/F_r \le 0.2$ 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 237)
Table 11.5 Example of Selection of Lubricant for
Bearing Operating Conditions (Page A239)

Table 11.6 Bands 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 $F_{\rm a}$ exceeds 20 % of the radial load $F_{\rm r}$, 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.

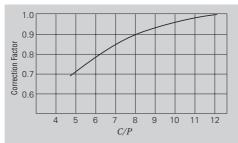
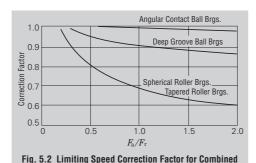


Fig. 5.1 Limiting Speed Correction Factor Variation with Load Ratio



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.

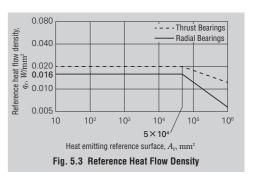
5.2 Thermal Reference Speed

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, $A_{\rm r}~({\rm mm^2})$ is the heat emitting reference surface area. ISO defines $A_{\rm r}$ as the total area of the bearing's inner ring bore surface and outer ring outside surface (radial bearings), and $q_{\rm r}~({\rm W/mm^2})$ as the heat flow density. The heat dissipation is calculated by multiplying the bearing seating surface area $(A_{\rm r})$ by the heat flow density $(q_{\rm r})$.



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 n_i and n_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

$$n_{\rm a} = \left(\frac{D_{\rm pw}}{D_{\rm w}} - \frac{D_{\rm w} \cos^2 \alpha}{D_{\rm pw}}\right) - \frac{n_{\rm c} - n_i}{2}$$

$$(\min^{-1}) \cdots (5.1)$$

Rotational circumferential speed

$$v_{a} = \frac{\pi D_{w}}{60 \times 10^{3}} \left(\frac{D_{pw}}{D_{w}} - \frac{D_{w} \cos^{2} \alpha}{D_{pw}} \right) \frac{n_{e} - n_{i}}{2}$$
(m/s) (5.2)

No. of revolutions (No. of cage rotation)

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

$$v_{c} = \frac{\pi D_{pw}}{60 \times 10^{3}} \left[\left(1 - \frac{D_{w} \cos \alpha}{D_{pw}} \right) \frac{n_{i}}{2} + \left(1 + \frac{D_{w} \cos \alpha}{D_{pw}} \right) \frac{n_{c}}{2} \right] (m/s) \cdots (5.4)$$

where, $D_{\scriptscriptstyle \mathrm{pw}}$: Pitch diameter of rolling elements (mm)

 $D_{\rm w}$: Diameter of rolling element (mm)

 α : Contact angle (°)

 n_e : Outer ring speed (min⁻¹)

 n_i : Inner ring speed (min⁻¹)

The rotation and revolution of the rolling element is shown in Table 5.3 for inner ring rotating $(n_e=0)$ and outer ring rotating $(n_i=0)$ respectively at $0^{\circ} \le \alpha < 90^{\circ}$ and at $\alpha = 90^{\circ}$.

As an example, Table 5.4 shows the rotation speed n_a and revolution speed n_c of the rolling element during rotating of the inner ring of ball bearings 6210 and 6310

Table 5.4 n_a and n_c for Ball Bearings 6210 and 6310

Ball bearing	γ	$n_{\rm a}$	$n_{\rm c}$
6210	0.181	$-2.67n_i$	$0.41n_i$
6310	0.232	$-2.04n_i$	$0.38n_i$

Remarks
$$\gamma = \frac{D_{\rm w} \cos \alpha}{D_{\rm pw}}$$

Table 5.3 Rolling Element's Rotation Speed $n_{\rm a}$, Rotational Circumferential Speed $v_{\rm a}$, Revolution Speed $n_{\rm c}$, and Revolutional Circumferential Speed $v_{\rm c}$

Contact angle	Rotation/revolution speed	Inner ring rolling $(n_{ m e}$ =0 $)$	Outer ring rolling $(n_i=0)$					
	$n_{ m a}$ (min ⁻¹)	$-\left(\frac{1}{\gamma}-\gamma\right)\frac{n_i}{2}\cdot\cos\alpha$	$\left(\frac{1}{\gamma} - \gamma\right) \frac{n_{\rm e}}{2} \cdot \cos \alpha$					
$0^{\circ} \leq \alpha < 90^{\circ}$	$v_{ m a}$ (m/s)	$rac{\pi D_{ m w}}{60 imes 10^3}$ – $n_{ m a}$						
0 = 4 < 30	$n_{ m c}$ (min ⁻¹)	$(1-\gamma)\frac{n_i}{2}$	$(1+\gamma)\frac{n_c}{2}$					
	v _c (m/s)	$-\frac{\pi D_{\rm pw}}{60 imes 10^3} \; n_{ m c}$						
	n _a (min ⁻¹)	$-\frac{1}{\gamma}\cdot\frac{n_i}{2}$	$\frac{1}{\gamma}\cdot \frac{n_{\rm e}}{2}$					
$lpha\!=\!90^\circ$	$v_{ m a}$ (m/s)	$\frac{\pi D}{60\times 1}$						
a — 90	n _c (min ⁻¹)	$\frac{n_i}{2}$	<u>n_e</u> 2					
	v₀ (m/s)	$\frac{\pi D_{\rm p}}{60\times 1}$						

 $\begin{tabular}{lll} \bf Reference & 1. \pm : The "+" symbol indicates clockwise rotation while the "-" symbol indicates counterclockwise rotation. \end{tabular}$

2.
$$\gamma = \frac{D_{\text{w}} \cos \alpha}{D_{\text{pw}}} (0^{\circ} \le \alpha < 90^{\circ}), \gamma = \frac{D_{\text{w}}}{D_{\text{pw}}} (\alpha = 90^{\circ})$$



6. BOUNDARY DIMENSIONS AND IDENTIFYING **NUMBERS FOR BEARINGS**

	Boundary Dimensions and Dimensions of Snap Ring GroovesA 10
6.1.1	Boundary Dimensions A 10
6.1.2	2 Dimensions of Snap Ring Grooves and Locating Snap Rings A 10
6 2	Formulation of Rearing Numbers

6. BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS

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).

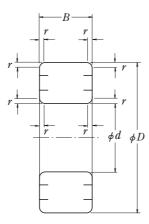


Fig. 6.1 Boundary Dimensions of Radial Ball and Roller Bearings

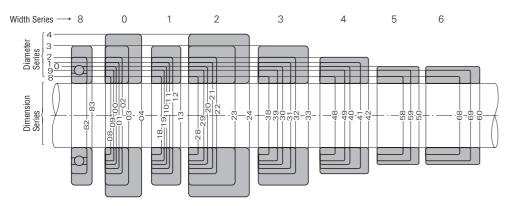


Fig. 6.6 Comparison of Cross Sections of Radial Bearings (except Tapered Roller Bearings) for various Dimensional Series

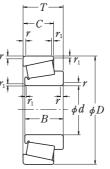


Fig. 6.2 Tapered Roller Bearings

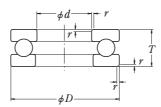


Fig. 6.3 Single-Direction Thrust Ball Bearings

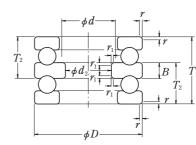


Fig. 6.4 Double-Direction Thrust Ball Bearings

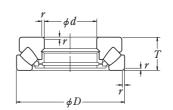


Fig. 6.5 Spherical Thrust Roller Bearings

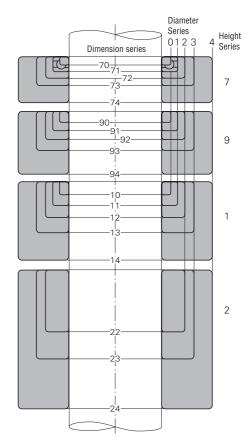


Fig. 6.7 Comparison of Cross Sections of Thrust Bearings (except Diameter Series 5) for Various Dimension Series

A 104 A 105

Boundary Dimensions of Radial Bearings (except Tapered Roller Bearings)

Table 6. 1 F

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						Dimension Series	19~39 49~69	r (min.)	0.1 0.15	0.15 0.15 0.15	0.15 0.2 0.2	0000	0000	0000	0000	0.0 0.6 0.6	0.6			===	
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L			NA59		eries 9			29		111	111	1.1.1	1.1.1	9 1 9 8	18 23	23 23	27 30 30	3888	48 34	444	46 54 54 54
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BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS

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			2. 3, 0,	= = = = =					289	288	433	888	8886	15	1.1.1	111
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145 150 165 14	180 16 190 16 210 19	220 19 230 19 250 22	260 22 280 25 300 25	320 25 360 31 380 31	420 37 440 37 460 37	480 37 520 44 540 44	560 600 50 620 50	650 54 670 54 710 57	750 60 800 63 850 71	900 73 950 78 1000 80	1060 82 1120 85 1180 88	1250 95 1320 103 1400 109	1460 109 1540 115 1630 122	1720 128 1820 — 1950 —	2060 — 2180 — 2300 —	2430 —
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30 40 40 45	37 37 50 45 60	45 60 52 69	80 80 80 80 80 80	60 75 100 75	90 118 90 118	90 106 140 140	106 118 118 160	128 170 128 170 136 180	140 190 150 200 165 218	170 230 180 243 185 250	195 258 200 272 206 280	224 300 236 315 250 335	250 335 272 355 280 375	300 400 315 425 335 450	345 462 355 475 375 500	400 530
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888	888	8249	52 24	8888	4 4 4	885	06 60	1,100	178	136	155	1982	200 212 218	243	8808	11
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41 56 45 60 46 60	52 69 53 69 56 75	60 80 67 90 74 100	75 100 82 109 90 118	92 118 104 140 106 140	118 121 133 180	134 135 148 200	150 200 157 212 163 218	165 218 167 218 185 250	195 258 200 272 212 290	230 308 236 315 250 335	258 345 272 365 280 375	300 412 308 412 325 438	345 462 355 475 375 500	400 530 412 545 462 615	475 630 500 650 530 690	11
98 80	100	109 138	136 150 160	966	218 218 243	243 243 272	272 280 300	33500	3865	425 438 462	475 500 515	9290	615			11
969	125 125 1.1 136 1.1	145 1.5 160 1.5 180 2	180 2 200 2 218 2.1	218 2.1 250 3 250 3	290 4 290 4 325 4	325 4 325 4 355 5	355 5 375 5 400 5	400 400 5 450 6	462 6 488 6 515 6	560 6 580 6 615 7.5	630 7.5 670 7.5 690 7.5	730 7.5 750 7.5 800 9.5	825 9.5 875 9.5 —	111	111	11
		222	228	w 4 4	440	വവവ	0 0 0	999	6 7.5	7.5	7.5	7.5	9 9 9 5	222	12 12	1 1

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.

Remarks

BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS

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earings)
Roller B
Tapered
(except
3earings
Radial
Boundary Dimensions of Radial Bearings (except Tapered Roller Bearings) -
Boundary I
Table 6. 1

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						_	41 D		111			24 22 26	32 35	40 47 50		65 72 80	886	120 125 125	130	2 160 2 170
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622	25	N 22		222	Diameter Series	Dimension Series	22	В	111	111	111	111	<u>444</u>	€ 6 6 6	8198	23 23	23	31 38	33	43
632	2322	N 32		232	ies 2	s	32		111	1	7 8 OI	122	15.9 0.31	17.5 20.6 20.6	20.6 23 23.8	25 27 30.2	30.2	36.5 38.1 39.7	444.4 49.2	52.4
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7383	13	N 3		213	Diam	Jimensic	03	В	111		7 6 5	660		4 £ £ 6 	181	828	275	888 	41833	
623	343	N 23		223	Diameter Series 3	Dimension Series	13 23		111		11=									
633	33	_			3s 3		33		111		e 6 E			22.2		3,34.9	39.7	¥888	7888	
						Dim	83	7	111	111	111	1 1 1	0000	9:0	9.0	0.0		<u></u>	2 1.5	225
						imension Series	03~33	r (min.)	111	0.2	0000	0.03	1 0.6	-55	222	<u>_ 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5 </u>	2 2 .5	2:1	3.2.1	ოოი
					О		D		1.1.1	111	111	30 32	37 42 52	62 72 —	08 06	100	120 130 140	150 160 180	190 200 210	240
64	104	A 2			Diameter Series	Dimension Series	40	В	111	111	111	197	12 12 12	19	21	25 27	33 33	35 37 42	45 48 52	55
					Series 4				111	111	111	1 4 5	16 13 24	33 73	98 94	1 4 4 4 4	22320	944	77 88 86	0000
					_	Dimension Series	04~24	min.)	111	111	111	0.0	1.1	<u> </u>	1.5	1.5	2.1	3.1	ωω 4	444

4 4 0	വവവ	0 2 2	999	6 7.5 7.5	7.5 9.5 6.5	9.5 9.5	222	5 5 5	15 15	1 12	111	111	111	1.1.1
000000000000000000000000000000000000000	128 132 138	142 145 150	155 160 180	190 206 224	236 250 265	280 300 315	325 335 345	365 375 400	412 438 450	475	111	111	111	111
288	82 88	928	98 102 115	122 132 140	150 165 165	200 200 200	206 212 218	230	258 272 280	790	111	1.1.1	111	111
260 280 310	340 360 380	400 420 440	460 480 540	580 620 670	710 750 800	850 900 950	980 1030 1060	1120 1150 1220	1280 1360 1420	1500	111	1.1.1	111	1.1.1
ოოო	444	444	വവവ	992	7.5 7.5 7.5	7.5 7.5 7.5	9 9 9 5 5 5 5	9.5 12 12	515	रुरु	555	<u>66</u>	111	111
23 8 8	ω4	111	111	111	111	111	111	111	111	111	111	111	111	1.1.1
87.3 92.1 106	112 118 128	136 140 150	155 165 180	195 206 224	236 258 272	300	315 345 365	375 388 412	438 488 488	515 530 560	920 920 920	670 710	111	1.1.1
77 80 86	93 102 108	114 120 126	132 138 145	155 165 175	185 200 212	224 230 243	250 265 280	290 300 325	335 355 375	400 412 438	462 488 500	515 545 —	111	1.1.1
53	96 70 75	79 88 88	92 97 106	114 123 132	140 155 165	170 175 185	190 200 212	218 230 243	258 272 280	300 308 325	355 375 388	400	111	1.1.1
50 22	58 62 65	68 72 75	78 88 88	95 102 108	109	125 128 136	136 145 155	150	190 200 206	218 224 236	258 272 280	300	111	1.1.1
£ 44 4	148	111	111	111	111	111	111	111	111	111	111	111	111	111
225 240 260	280 300 320	340 360 380	400 420 460	500 540 580	620 670 710	750 780 820	850 900 950	980 1030 1090	1150 1220 1280	1360 1420 1500	1600 1700 1780	1850 1950 —	111	1.1.1
2.17	ოოო	644	444	400	0 20 20	999	7.5 7.5 7.5	7.5 7.5 9.5	9.5 9.5	122	555	1 12	111	111
- -	111	111	111	111	111	111	111	111	111	111	111	111	111	111
8082	100	128 140 140	150 160 180	200 218 218	243 258 280	290 300 315	335 345 365	388 412 450	475 488 515	545 560 615	615 650 670	710	111	1.1.1
65.1 69.8 76	888	104 110 112	120 128 144	160 174 176	192 208 224	232 240 256	272 280 296	310 336 355	365 388 412	438 450 475	488 515 515	530 560	111	111
2222	64 68 73	888	98 108	21 20 13 20 13 20 13	140 150 165	170 175 185	195 200 212	224 243 258	272 280 300	315 325 345	355 375 388	412 425	111	111
1 42	20 24 24	58 62 62	65 70 78	9008	98 118	2224	888	200 200 200	206 212 230	243 250 265	272 280 300	330	111	111
888	844	8223	왕왕윘	882	8888	882	118	138	855	175 180 195	200 206 218	243	111	111
27 28	111	111	111	111	111	111	111	111	111	111	111	111	111	111
190 200 215	230 250 270	290 310 320	340 360 400	440 480 500	540 580 620	650 680 720	760 790 830	870 920 980	1030 1090 1150	1220 1280 1360	1420 1500 1580	1660 1750 —	111	1.1.1
222	2 2.1 2.1	2.1	ωω 4	440	വവവ	0 2 2	6 6 7.5	7.5 7.5	7.5 7.5 7.5	7.5 9.5 9.5	9.5 12 12	12 15	5 1 2 2	0 0 D
	1.5	2 2.1	ოოო	444	വവവ	യവവ	999	6 7.5 7.5	7.5 7.5 7.5	7.5 9.5 9.5	9.5 12 12	122	111	1 1 1
888	886	109	178	988	200 218 243	243 243 250	388	308 325 335	355 375 400	412 438 475	475 500 515	545 580 600	630 670 710	750 775 800
62 82 82	888	888	104 112 120	144 146	091 176 190	192 200	224 226 240	248 264 272	300 315	336 345 365	375 400 412	438 462 475	475 500 530	280
444	8209	96 66 72	888	36 100 100	118 128 140	041 145	165 175	868	206 218 230	243 250 272	272 280 300	345	385	422 450 462
888	38 40 46	51	888	88 4	855	108	222	845	822	185 206 206	212 224 230	243 258 265	308	325 345 355
222	37 33	888	448	212120	87.8	8833	888	555	1128	848	888	586	111	111
175 180 200	210 225 250	270 280 300	320 340 370	400 440 460	500 540 580	620 650 650	700 720 760	790 830 870	920 980 1030	1090 1150 1220	1280 1360 1420	1500 1580 1660	1750 1850 1950	2060 2180 2300
	222	928	200	900	320 340	989	640	8008	9998	102	0000	900	20 80	320 1400 1500
	30 84 14 15													5 4 5

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

Tap Ro Br	ller					329						32	0 X				330					33	31		
					Diam	eter Se	ries 9							Diam	eter Se	eries 0					Di	ameter	Series	s 1	
mber				Din	nensior	n Serie	s 29		Cha Dime	mfer nsion		Dime	nsion S	Series	Dime	nsion S	Series	Cha Dime	mfer nsion		Dime	nsion S	Series	Chai Dime	mfer nsion
Bore Number	d	n		I			П		Cone	Cup			20			30		Cone	Cup	, n		31		Cone	Cup
ĕ		D	В	С	T	В	С	Т	% (1	min.)	D	В	С	T	В	С	T	% (1	min.)	D	В	С	T	γ (r	min.)
00 01 02	10 12 15		=	_				_	_	=	28 32	 11 12		 11 12	13 14	_	13 14	0.3 0.3	0.3 0.3		=		_		
03 04 /22	17 20 22	- 37 40	11 -	=	_ 11.6 _	12 12	9 9	12 12	- 0.3 0.3	0.3 0.3	35 42 44	13 15 15	— 12 11.5	13 15 15	15 17 —	_	15 17 —	0.3 0.6 0.6	0.3 0.6 0.6	_ _ _	_ _ _	_	=	_ _ _	_ _ _
05 /28 06	25 28 30	42 45 47	11 - 11	_ _ _	11.6 — 11.6	12 12 12	9 9 9	12 12 12	0.3 0.3 0.3	0.3 0.3 0.3	47 52 55	15 16 17	11.5 12 13	15 16 17	17 — 20	14 — 16	17 — 20	0.6 1 1	0.6 1 1	_ _ _	_ _	_ _ _	_ _ _	_ _ _	_ _ _
/32 07 08	32 35 40	52 55 62	13 14	_ _ _	— 14 15	15 14 15	10 11.5 12	14 14 15	0.6 0.6 0.6	0.6 0.6 0.6	58 62 68	17 18 19	13 14 14.5	17 18 19	21 22	— 17 18	— 21 22	1 1 1	1 1 1	— — 75	_ _ 26	— — 20.5	— — 26	— — 1.5	— — 1.5
09 10 11	45 50 55	68 72 80	14 14 16	_ _ _	15 15 17	15 15 17	12 12 14	15 15 17	0.6 0.6 1	0.6 0.6 1	75 80 90	20 20 23	15.5 15.5 17.5	20 20 23	24 24 27	19 19 21	24 24 27	1 1 1.5	1 1 1.5	80 85 95	26 26 30	20.5 20 23	26 26 30	1.5 1.5 1.5	1.5 1.5 1.5
12 13 14	60 65 70	85 90 100	16 16 19	_ _ _	17 17 20	17 17 20	14 14 16	17 17 20	1 1 1	1 1 1	95 100 110	23 23 25	17.5 17.5 19	23 23 25	27 27 31	21 21 25.5	27 27 31	1.5 1.5 1.5	1.5 1.5 1.5	100 110 120	30 34 37	23 26.5 29	30 34 37	1.5 1.5 2	1.5 1.5 1.5
15 16 17	75 80 85	105 110 120	19 19 22	_ _ _	20 20 23	20 20 23	16 16 18	20 20 23	1 1 1.5	1 1 1.5	115 125 130	25 29 29	19 22 22	25 29 29	31 36 36	25.5 29.5 29.5	31 36 36	1.5 1.5 1.5	1.5 1.5 1.5	125 130 140	37 37 41	29 29 32	37 37 41	2 2 2.5	1.5 1.5 2
18 19 20	90 95 100	125 130 140	22 22 24	_ _ _	23 23 25	23 23 25	18 18 20	23 23 25	1.5 1.5 1.5	1.5 1.5 1.5	140 145 150	32 32 32	24 24 24	32 32 32	39 39 39	32.5 32.5 32.5	39 39 39	2 2 2	1.5 1.5 1.5	150 160 165	45 49 52	35 38 40	45 49 52	2.5 2.5 2.5	2 2 2
21 22 24	105 110 120	145 150 165	24 24 27	=	25 25 29	25 25 29	20 20 23	25 25 29	1.5 1.5 1.5	1.5 1.5 1.5	160 170 180	35 38 38	26 29 29	35 38 38	43 47 48	34 37 38	43 47 48	2.5 2.5 2.5	2 2 2	175 180 200	56 56 62	44 43 48	56 56 62	2.5 2.5 2.5	2 2 2
26 28 30	130 140 150	180 190 210	30 30 36	=	32 32 38	32 32 38	25 25 30	32 32 38	2 2 2.5	1.5 1.5 2	200 210 225	45 45 48	34 34 36	45 45 48	55 56 59	43 44 46	55 56 59	2.5 2.5 3	2 2 2.5	=	=	_	_	_ _ _	_ _ _
32 34 36	160 170 180	220 230 250	36 36 42	_ _ _	38 38 45	38 38 45	30 30 34	38 38 45	2.5 2.5 2.5	2 2 2	240 260 280	51 57 64	38 43 48	51 57 64	_ _ _	_ _ _	_ _ _	3 3 3	2.5 2.5 2.5	_ _ _	_ _ _	_ _ _	_	_	_ _ _
38 40 44	190 200 220	260 280 300	42 48 48	_ _ _	45 51 51	45 51 51	34 39 39	45 51 51	2.5 3 3	2 2.5 2.5	290 310 340	64 70 76	48 53 57	64 70 76	_ _ _		_ _ _	3 3 4	2.5 2.5 3	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _
48 52 56	240 260 280	320 360 380	48 — —	=	51 — —	51 63.5 63.5	39 48 48	51 63.5 63.5	3 3 3	2.5 2.5 2.5	360 400 420	76 87 87	57 65 65	76 87 87	=	_	=	4 5 5	3 4 4	=	=	_ _ _	_ _ _		_ _ _
60 64 68 72	300 320 340 360	420 440 460 480	=	_ _ _	_ _ _	76 76 76 76	57 57 57 57	76 76 76 76	4 4 4 4	3 3 3 3	460 480 —	100 100 —	74 74 —	100 100 —	_ _ _ _	_ _ _	_ _ _	5 5 —	4 4 —	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _ _

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 the ISO.

Dimension Series not classified conform to dimensions (D, B, C, T) 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.

Tapered Roller Bearings

																								Units:	mm	
	3	02			322				332				303	3 or 3	03D			313				323			Ro	ered Iller gs.
				Di	amete	r Serie	s 2										Diam	eter S	eries 3							
	Di	imensi	ion	Di	mensi	on	D	imensi	on	Cha Dime	mfer		Di	mensi	on Ser	ies	Di	mensi	ion	D	imens	on	Cha	mfer		per
	S	eries (02	S	eries 2	22	S	eries 3	2		Cup			(3		S	eries '	13	S	eries :	23		Cup	d	Bore Number
D	В	С	T	В	С	Т	В	С	T	r (1	min.)	D	В	C	C (1)	Т	В	С	T	В	С	T	r (min.)		Bore
30 32 35	9 10 11	9 10	9.7 10.75 11.75	14 14 14	=	14.7 14.75 14.75	=	_	=	0.6 0.6 0.6	0.6 0.6 0.6	35 37 42	11 12 13	_ _ 11		11.9 12.9 14.25	_	=	=	17 17 17	_ 14	17.9 17.9 18.25	0.6 1	0.6 1 1	10 12 15	00 01 02
40 47 50	12 14 14	11 12 12	13.25 15.25 15.25	16 18 18	14 15 15	17.25 19.25 19.25	_ _ _	_ _ _	_ _ _	1 1 1	1 1 1	47 52 56	14 15 16	12 13 14	_ _ _	15.25 16.25 17.25	_ _ _	 - -	 - -	19 21 21	16 18 18	20.25 22.25 22.25	1.5	1 1.5 1.5	17 20 22	03 04 /22
52 58 62	15 16 16	13 14 14	16.25 17.25 17.25	18 19 20	15 16 17	19.25 20.25 21.25	22 24 25	18 19 19.5	22 24 25	1 1 1	1 1 1	62 68 72	17 18 19	15 15 16	13 14 14	18.25 19.75 20.75	_ _ _	 - 	 - -	24 24 27	20 20 23	25.25 25.75 28.75	1.5	1.5 1.5 1.5	25 28 30	05 /28 06
65 72 80	17 17 18	15 15 16	18.25 18.25 19.75	21 23 23	18 19 19	22.25 24.25 24.75		20.5 22 25	26 28 32	1 1.5 1.5	1 1.5 1.5	75 80 90	20 21 23	17 18 20	15 15 17	21.75 22.75 25.25	_ _ _	 - 	 - -	28 31 33	24 25 27	29.75 32.75 35.25	2	1.5 1.5 1.5	32 35 40	/32 07 08
85 90 100	19 20 21	16 17 18	20.75 21.75 22.75	23 23 25	19 19 21	24.75 24.75 26.75	32 32 35	25 24.5 27	32 32 35	1.5 1.5 2	1.5 1.5 1.5	100 110 120	25 27 29	22 23 25	18 19 21	27.25 29.25 31.5	=	=	_ _ _	36 40 43	30 33 35	38.25 42.25 45.5		1.5 2 2	45 50 55	09 10 11
110 120 125	22 23 24	19 20 21	23.75 24.75 26.25	28 31 31	24 27 27	29.75 32.75 33.25	41	29 32 32	38 41 41	2 2 2	1.5 1.5 1.5	130 140 150	31 33 35	26 28 30	22 23 25	33.5 36 38	=	=	_ _ _	46 48 51	37 39 42	48.5 51 54	3 3 3	2.5 2.5 2.5	60 65 70	12 13 14
130 140 150	25 26 28	22 22 24	27.25 28.25 30.5	31 33 36	27 28 30	33.25 35.25 38.5	41 46 49	31 35 37	41 46 49	2 2.5 2.5	1.5 2 2	160 170 180	37 39 41	31 33 34	26 27 28	40 42.5 44.5	_ _ _	_ _ _	 - -	55 58 60	45 48 49	58 61.5 63.5	3 3 4	2.5 2.5 3	75 80 85	15 16 17
160 170 180	30 32 34	26 27 29	32.5 34.5 37	40 43 46	34 37 39	42.5 45.5 49	55 58 63	42 44 48	55 58 63	2.5 3 3	2 2.5 2.5	190 200 215	43 45 47	36 38 39	30 32 —	46.5 49.5 51.5	— — 51	— — 35	— — 56.5	64 67 73	53 55 60	67.5 71.5 77.5	4 4 4	3 3 3	90 95 100	18 19 20
190 200 215	36 38 40	30 32 34	39 41 43.5	50 53 58	43 46 50	53 56 61.5	68 — —	52 — —	68 —	3 3 3	2.5 2.5 2.5	225 240 260	49 50 55	41 42 46		53.5 54.5 59.5	53 57 62	36 38 42	58 63 68	77 80 86	63 65 69	81.5 84.5 90.5	4 4 4	3 3 3	105 110 120	21 22 24
230 250 270	40 42 45	34 36 38	43.75 45.75 49	64 68 73	54 58 60	67.75 71.75 77	_	_ _ _	=	4 4 4	3 3 3	280 300 320	58 62 65	49 53 55		63.75 67.75 72	66 70 75	44 47 50	72 77 82	93 102 108	78 85 90	98.75 107.75 114		4 4 4	130 140 150	26 28 30
290 310 320	48 52 52	40 43 43	52 57 57	80 86 86	67 71 71	84 91 91	_	_	=	4 5 5	3 4 4	340 360 380	68 72 75	58 62 64		75 80 83	79 84 88	=	87 92 97	114 120 126	95 100 106	121 127 134	5 5 5	4 4 4	160 170 180	32 34 36
340 360 400	55 58 65	46 48 54	60 64 72	92 98 108	75 82 90	97 104 114	_	_ _ _	=	5 5 5	4 4 4	400 420 460	78 80 88	65 67 73	_	86 89 97	92 97 106	_	101 107 117	132 138 145	109 115 122	140 146 154	6 6 6	5 5 5	190 200 220	38 40 44
440 480 500	72 80 80	60 67 67	79 89 89	120 130 130	100 106 106	127 137 137	_	_ _ _	=	5 6 6	4 5 5	500 540 580	95 102 108	80 85 90	_	105 113 119	114 123 132	=	125 135 145	155 165 175	132 136 145	165 176 187	6 6 6	5 6 6	240 260 280	48 52 56
540 580 —	85 92 —	71 75 —	96 104 —	140 150 —	115 125 —	149 159 —	_ _ _	_ _ _	_ _ _	6 6 —	5 5 —	_ _ _ _	=	_ _ _	_ _ _	_ _ _ _	_ _ _	_ _ _	_ _ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _ _	300 320 340 360	60 64 68 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.

A 110 A 111



Table 6. 3 Boundary Dimensions of

Thrust E	all Brgs.									511					512		522			
Spherica Roller	al Thrust Brgs.													292						
			Dian	neter Sei	ries 0			Dian	neter Se	ries 1					Diam	neter Se	ries 2			
per			Dime	ension S	eries			Dime	ension S	Series					Dimensi	on Serie	S			
Bore Number	d	D	70	90	10	Nr (min)	D	71	91	11	Nr (main)	D	72	92	12	22	2	2	N/min \	W (min)
Bor		D		T		1 (min.)	D		T		∤ (min.)	D		,	Г		Central	Washer	(111111.)	r_1 (min.)
																	d_2	В		
4 6 8	4 6 8	12 16 18	4 5 5	_ _ _	6 7 7	0.3 0.3 0.3	_ _ _	=	_ _ _	=	=	16 20 22	6 6 6	=	8 9 9	_ _ _	=		0.3 0.3 0.3	_ _ _
00 01 02	10 12 15	20 22 26	5 5 5	=	7 7 7	0.3 0.3 0.3	24 26 28	6 6 6	_ _ _	9 9 9	0.3 0.3 0.3	26 28 32	7 7 8	=	11 11 12	_ _ 22	_ 10	_ _ 5	0.6 0.6 0.6	_ 0.3
03 04 05	17 20 25	28 32 37	5 6 6	=	7 8 8	0.3 0.3 0.3	30 35 42	6 7 8	=	9 10 11	0.3 0.3 0.6	35 40 47	8 9 10	=	12 14 15	26 28	— 15 20	- 6 7	0.6 0.6 0.6	0.3 0.3
06 07 08	30 35 40	42 47 52	6 6 6	_ _ _	8 8 9	0.3 0.3 0.3	47 52 60	8 8 9	_ _ _	11 12 13	0.6 0.6 0.6	52 62 68	10 12 13	_ _ _	16 18 19	29 34 36	25 30 30	7 8 9	0.6 1 1	0.3 0.3 0.6
09 10 11	45 50 55	60 65 70	7 7 7	_ 	10 10 10	0.3 0.3 0.3	65 70 78	9 9 10	_ _ _	14 14 16	0.6 0.6 0.6	73 78 90	13 13 16	_ _ 21	20 22 25	37 39 45	35 40 45	9 9 10	1 1 1	0.6 0.6 0.6
12 13 14	60 65 70	75 80 85	7 7 7	_ _ _	10 10 10	0.3 0.3 0.3	85 90 95	11 11 11	_ _ _	17 18 18	1 1 1	95 100 105	16 16 16	21 21 21	26 27 27	46 47 47	50 55 55	10 10 10	1 1 1	0.6 0.6 1
15 16 17	75 80 85	90 95 100	7 7 7	=	10 10 10	0.3 0.3 0.3	100 105 110	11 11 11	_ _ _	19 19 19	1 1 1	110 115 125	16 16 18	21 21 24	27 28 31	47 48 55	60 65 70	10 10 12	1 1 1	1 1 1
18 20 22	90 100 110	105 120 130	7 9 9	 	10 14 14	0.3 0.6 0.6	120 135 145	14 16 16	21 21	22 25 25	1 1 1	135 150 160	20 23 23	27 30 30	35 38 38	62 67 67	75 85 95	14 15 15	1.1 1.1 1.1	1 1 1
24 26 28	120 130 140	140 150 160	9 9 9	_ _ _	14 14 14	0.6 0.6 0.6	155 170 180	16 18 18	21 24 24	25 30 31	1 1 1	170 190 200	23 27 27	30 36 36	39 45 46	68 80 81	100 110 120	15 18 18	1.1 1.5 1.5	1.1 1.1 1.1
30 32 34	150 160 170	170 180 190	9 9 9		14 14 14	0.6 0.6 0.6	190 200 215	18 18 20	24 24 27	31 31 34	1 1 1.1	215 225 240	29 29 32	39 39 42	50 51 55	89 90 97	130 140 150	20 20 21	1.5 1.5 1.5	1.1 1.1 1.1
36 38 40	180 190 200	200 215 225	9 11 11	_ _ _	14 17 17	0.6 1 1	225 240 250	20 23 23	27 30 30	34 37 37	1.1 1.1 1.1	250 270 280	32 36 36	42 48 48	56 62 62	98 109 109	150 160 170	21 24 24	1.5 2 2	2 2 2
44 48 52	220 240 260	250 270 290	14 14 14	_ _ _	22 22 22	1 1 1	270 300 320	23 27 27	30 36 36	37 45 45	1.1 1.5 1.5	300 340 360	36 45 45	48 60 60	63 78 79	110 — —	190 —	24 —	2 2.1 2.1	2
56 60 64	280 300 320	310 340 360	14 18 18	— 24 24	22 30 30	1 1 1	350 380 400	32 36 36	42 48 48	53 62 63	1.5 2 2	380 420 440	45 54 54	60 73 73	80 95 95	_ _ _	_ _ _		2.1 3 3	_ _ _

Thrust Bearings (Flat Seats) — 1 —

																				Un	its: mm	
			513		523							514		524							Thrus Bro	t Ball
		293									294											al Thrust
			Diam	eter Se	ries 3							Diam	eter Se	ries 4				Diam	neter Se	ries 5		
		D	imensi	on Serie	es						D	imensio	on Serie	es					Dimension	1		ъ
	73	93	13	23		3				74	94	14	24	2	1	1			Series 95	1		qun
D	75	55	10	25	Central		γ (min.)	r_1 (min.)	D	74	J-4	14	24	Central		* (min.)	γ_1 (min.)	D	- 55		d	Bore Number
		1	r				-				1	Γ		Central	· · ·				T			
		1			d_2	В								d_2	В				_			
20 24 26	7 8 8	=	11 12 12	_ _ _	_ _ _	_ _ _	0.6 0.6 0.6		=	_ _ _	_ _ _	_ _	_	_ _	=	- - -	_ _ _	_ _ _	=		4 6 8	4 6 8
30 32 37	9 9 10	=	14 14 15	_ _	_ _	_	0.6 0.6 0.6	=	_	=	_ _	_	=	_ _	=	 - 	_ 	_ _	=	_ _	10 12 15	00 01 02
40	4.0		40																			
40 47 52	10 12 12	_	16 18 18	34	_ _ 20	_ _ 8	0.6 1 1	— 0.3	 60	_ 16	_ _ 21	 24	— 45	_ _ 15	_ _ 11	_ _ 1	 0.6	52 60 73	21 24 29	1 1 1.1	17 20 25	03 04 05
							'									'						
60 68 78	14 15 17	_ 22	21 24 26	38 44 49	25 30 30	9 10 12	1 1 1	0.3 0.3 0.6	70 80 90	18 20 23	24 27 30	28 32 36	52 59 65	20 25 30	12 14 15	1 1.1 1.1	0.6 0.6 0.6	85 100 110	34 39 42	1.1 1.1 1.5	30 35 40	06 07 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
95 105	20 23	27 30	31 35	58 64	40 45	14 15	1.1	0.6 0.6	110 120	27 29	36 39	43 48	78 87	40 45	18 20	1.5 1.5	0.6	135 150	51 58	2 2.1	50 55	10 11
110 115 125	23 23 25	30 30 34	35 36 40	64 65 72	50 55 55	15 15 16	1.1 1.1 1.1	0.6 0.6 1	130 140 150	32 34 36	42 45 48	51 56 60	93 101 107	50 50 55	21 23 24	1.5 2 2	0.6 1 1	160 170 180	60 63 67	2.1 2.1 3	60 65 70	12 13 14
135 140 150	27 27 29	36 36 39	44 44 49	79 79 87	60 65 70	18 18 19	1.5 1.5 1.5	1 1 1	160 170 180	38 41 42	51 54 58	65 68 72	115 120 128	60 65 65	26 27 29	2 2.1 2.1	1 1 1.1	190 200 215	69 73 78	3 3 4	75 80 85	15 16 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
170 190	32 36	42 48	55 63	97 110	85 95	21 24	1.5	1 1	210 230	50 54	67 73	85 95	150 166	80 90	33 37	3	1.1	250 270	90 95	4 5	100 110	20 22
210 225 240	41 42 45	54 58 60	70 75 80	123 130 140	100 110 120	27 30 31	2.1 2.1 2.1	1.1 1.1 1.1	250 270 280	58 63 63	78 85 85	102 110 112	177 192 196	95 100 110	40 42 44	4 4 4	1.5 2 2	300 320 340	109 115 122	5 5 5	120 130 140	24 26 28
250 270 280	45 50 50	60 67 67	80 87 87	140 153 153	130 140 150	31 33 33	2.1 3 3	1.1 1.1 1.1	300 320 340	67 73 78	90 95 103	120 130 135	209 226 236	120 130 135	46 50 50	4 5 5	2 2 2.1	360 380 400	125 132 140	6 6 6	150 160 170	30 32 34
300 320 340	54 58 63	73 78 85	95 105 110	165 183 192	150 160 170	37 40 42	3 4 4	2 2 2	360 380 400	82 85 90	109 115 122	140 150 155	245 —	140 —	52 —	5 5 5	3 —	420 440 460	145 150 155	6 6 7.5	180 190 200	36 38 40
360 380 420	63 63 73	85 85 95	112 112 130	_ _ _	_ _ _	_ _ _	4 4 5		420 440 480	90 90 100	122 122 132	160 160 175	_	_ _ _	_ _ _	6 6 6	_ _ _	500 540 580	170 180 190	7.5 7.5 9.5	220 240 260	44 48 52
440 480 500	73 82 82	95 109 109	130 140 140	_ _ _	_ _ _	_ _ _	5 5 5	_	520 540 580	109 109 118	145 145 155	190 190 205		_ _ _	_ _ _	6 6 7.5	_ _ _	620 670 710	206 224 236	9.5 9.5 9.5	280 300 320	56 60 64

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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 bearing tables for Thrust Bearings).



Table 6. 3 Boundary Dimensions of

Thrust B	all Brgs.									511					512		522			
Spherica Roller	al Thrust Bras.													292						
			Dian	neter Se	ries 0			Dian	neter Se	ries 1					Diam	neter Sei	ries 2			
ber			Dime	ension S	Series			Dime	ension S	Series				[Dimensi	on Serie	S			
Bore Number	d	_	70	90	10]		71	91	11]		72	92	12	22	2	2	<u> </u>	
Bore		D		T		∤ ′(min.)	D		T		∤ (min.)	D		,	Г		Central	Washer	r(min.)	γ_1 (min.)
																	d_2	В		
68 72 76	340 360 380	380 400 420	18 18 18	24 24 24	30 30 30	1 1 1	420 440 460	36 36 36	48 48 48	64 65 65	2 2 2	460 500 520	54 63 63	73 85 85	96 110 112	_ _ _	=	_ _ _	3 4 4	=
80 84 88	400 420 440	440 460 480	18 18 18	24 24 24	30 30 30	1 1 1	480 500 540	36 36 45	48 48 60	65 65 80	2 2 2.1	540 580 600	63 73 73	85 95 95	112 130 130	_	=	_ _ _	4 5 5	_ _ _
92 96 /500	460 480 500	500 520 540	18 18 18	24 24 24	30 30 30	1 1 1	560 580 600	45 45 45	60 60 60	80 80 80	2.1 2.1 2.1	620 650 670	73 78 78	95 103 103	130 135 135	_	=	_ _ _	5 5 5	_ _ _
/530 /560 /600	530 560 600	580 610 650	23 23 23	30 30 30	38 38 38	1.1 1.1 1.1	640 670 710	50 50 50	67 67 67	85 85 85	3 3 3	710 750 800	82 85 90	109 115 122	140 150 160	_ _ _	=	_ _ _	5 5 5	_ _ _
/630 /670 /710	630 670 710	680 730 780	23 27 32	30 36 42	38 45 53	1.1 1.5 1.5	750 800 850	54 58 63	73 78 85	95 105 112	3 4 4	850 900 950	100 103 109	132 140 145	175 180 190	_ _ _	=	_ _ _	6 6 6	_ _ _
/750 /800 /850	750 800 850	820 870 920	32 32 32	42 42 42	53 53 53	1.5 1.5 1.5	900 950 1000	67 67 67	90 90 90	120 120 120	4 4 4	1000 1060 1120	112 118 122	150 155 160	195 205 212	_ _ _	=		6 7.5 7.5	=
/900 /950 /1000	900 950 1000	980 1030 1090	36 36 41	48 48 54	63 63 70	2 2 2.1	1060 1120 1180	73 78 82	95 103 109	130 135 140	5 5 5	1180 1250 1320	125 136 145	170 180 190	220 236 250	_ _ _	=		7.5 7.5 9.5	=
/1060 /1120 /1180	1060 1120 1180	1150 1220 1280	41 45 45	54 60 60	70 80 80	2.1 2.1 2.1	1250 1320 1400	85 90 100	115 122 132	150 160 175	5 5 6	1400 1460 1520	155 — —	206 206 206	265 — —	_ _ _	=		9.5 9.5 9.5	=
/1250 /1320 /1400	1250 1320 1400	1360 1440 1520	50 — —	67 — —	85 95 95	3 3 3	1460 1540 1630	=	_ _ _	175 175 180	6 6 6	1610 1700 1790	=	216 228 234	_ _ _	_ _ _	=		9.5 9.5 12	=
/1500 /1600 /1700	1500 1600 1700	1630 1730 1840	_ _ _	=	105 105 112	4 4 4	1750 1850 1970	=	_ _ _	195 195 212	6 6 7.5	1920 2040 2160	_ 	252 264 276	_ _ _	_ _ _	=	_ _ _	12 15 15	=
/1800 /1900 /2000	1800 1900 2000	1950 2060 2160	=	_ _ _	120 130 130	4 5 5	2080 2180 2300	=	_ _ _	220 220 236	7.5 7.5 7.5	2280 — —	=	288 — —	_ _ _	_ _ _	_ _ _	_ _ _	15 — —	_ _ _
/2120 /2240 /2360 /2500	2120 2240 2360 2500	2300 2430 2550 2700	_ _ _ _	_ _ _ _	140 150 150 160	5 5 5 5	2430 2570 2700 2850	_ _ _ _	_ _ _ _	243 258 265 272	7.5 9.5 9.5 9.5	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _		_ _ _ _	_ _ _ _

Thrust Bearings (Flat Seats) — 2 —

																				Un	its: mm	l
			513		523							514		524							Thrus Br	st Ball gs.
		293									294										Spherica Roller	al Thrust Brgs.
			Diam	eter Se	ries 3							Diam	eter Se	ries 4				Dian	neter Se	ries 5		
)imensi	on Serie	es						D	imensi	on Seri	es					Dimension Series			nber
D	73	93	13	23	2	!3	1 (min)	r_1 (min.)	D	74	94	14	24	2	4	1 (min)	γ_1 (min.	D	95	1 (min.)	d	Bore Number
D			Т		Central	Washe	("""",	1 (111111.)	, D		2	Г		Central	Washe	ļ (1 (111111.		T	(11111.)		B
					d_2	В								d_2	В							
540 560 600	90 90 100	122 122 132	160 160 175	=	_	_ _ _	5 5 6	_ _ _	620 640 670	125 125 132	170 170 175	220 220 224		=	_	7.5 7.5 7.5	_ _ _	750 780 820	243 250 265	12 12 12	340 360 380	68 72 76
620 650 680	100 103 109	132 140 145	175 180 190	_ _ _	=	_ _ _	6 6 6		710 730 780	140 140 155	185 185 206	243 243 265		_ 	_ _ _	7.5 7.5 9.5	_ _ _	850 900 950	272 290 308	12 15 15	400 420 440	80 84 88
710 730 750	112 112 112	150 150 150	195 195 195	=	_ 	_ _ _	6 6 6		800 850 870	155 165 165	206 224 224	265 290 290		_ _ _	_ 	9.5 9.5 9.5	_ _ _	980 1000 1060	315 315 335	15 15 15	460 480 500	92 96 /500
800 850 900	122 132 136	160 175 180	212 224 236	=	_ 	_ _ _	7.5 7.5 7.5		920 980 1030	175 190 195	236 250 258	308 335 335		_ _ _	_ 	9.5 12 12	_ _ _	1090 1150 1220	335 355 375	15 15 15	530 560 600	/530 /560 /600
950 1000 1060	145 150 160	190 200 212	250 258 272	_ 	_ _ _	_ _ _	9.5 9.5 9.5	_	1090 1150 1220	206 218 230	280 290 308	365 375 400		_ _ _	_ _ _	12 15 15	_ _ _	1280 1320 1400	388 388 412	15 15 15	630 670 710	/630 /670 /710
1120 1180 1250	165 170 180	224 230 243	290 300 315	_ 	_ _ _	_ _ _	9.5 9.5 12	_	1280 1360 1440	236 250 —	315 335 354	412 438 —		_ _ _	_ _ _	15 15 15	_ 	_ _ _	=	_ _ _	750 800 850	/750 /800 /850
1320 1400 1460	190 200 —	250 272 276	335 355 —	=	_	_ _ _	12 12 12		1520 1600 1670	=	372 390 402	=	_	_ _ _	_ _ _	15 15 15	_ _ _	=	=	_ _ _	900 950 1000	/900 /950 /1000
1540 1630 1710	=	288 306 318	=	=	_	_ _ _	15 15 15		1770 1860 1950	=	426 444 462	=	_	_ _ _	_ _ _	15 15 19	_ _ _	=	=	_ _ _	1060 1120 1180	/1060 /1120 /1180
1800 1900 2000	=	330 348 360	=	_ 	_ _ _	_ _ _	19 19 19	_	2050 2160 2280	=	480 505 530	_ _ _		_ _ _	_ _ _	19 19 19	_ _ _	=	=	_ _ _	1250 1320 1400	/1250 /1320 /1400
2140 2270 —	Ξ	384 402 —	_ _ _	_ _ _	_ _ _	_ _ _	19 19 —			=	_ _ _	_		_ _ _	_ _ _	 - -	_ _ _	=	=	_ _ _	1500 1600 1700	/1500 /1600 /1700
=	=	_ 	_ 	_ _ _	_ _ _	_ _ _	_	_ _ _		=	_ _ _	_ 	_ _ _	_ _ _	_ _ _	 - -	- -	_ 	=	_ _ _	1800 1900 2000	/1800 /1900 /2000
_ _ _	=	_ _ _ _	_ _ _ _	_ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _	_ _ _ _	_ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _	Ē	_ _ _ _	2120 2240 2360 2500	/2120 /2240 /2360 /2500

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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).

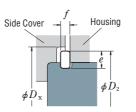


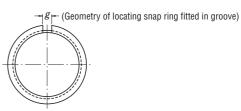
Table 6. 4 Dimensions of Snap Ring Grooves and Locating Snap Rings — (1) Bearings of Dimension Series 18 and 19



Арр	licable Bear	ings				Snap F	Ring Groove				
-	d		Snap Rin Dian	g Groove neter			э		Snap Rin Wi	g Groove dth	Radius of Bottom
Dimonoi	on Series	D	I	O_1		Bearing Dime		9		b	Corners r_0
18	19		max.	min.	max.	min.	max.	min.	max.	min.	max.
	10	22	20.8	20.5	- IIIax.		1.05	0.9	1.05	0.8	0.2
=	12 15	24 28	22.8 26.7	22.5 26.4		=	1.05 1.05 1.3	0.9 1.15	1.05	0.8 0.95	0.2 0.2 0.25
 20	17 —	30 32	28.7 30.7	28.4 30.4	1.3	— 1.15	1.3 —	1.15 —	1.2 1.2	0.95 0.95	0.25 0.25
22	_	34	32.7	32.4	1.3	1.15	_	_	1.2	0.95	0.25
25 — 28	20 22 —	37 39 40	35.7 37.7 38.7	35.4 37.4 38.4	1.3 — 1.3	1.15 — 1.15	1.7 1.7 —	1.55 1.55 —	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
30 32 —	25 — 28	42 44 45	40.7 42.7 43.7	40.4 42.4 43.4	1.3 1.3	1.15 1.15 —	1.7 — 1.7	1.55 — 1.55	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
35 40 —	30 32 35	47 52 55	45.7 50.7 53.7	45.4 50.4 53.4	1.3 1.3	1.15 1.15 —	1.7 1.7 1.7	1.55 1.55 1.55	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
45 — 50	40	58 62 65	56.7 60.7 63.7	56.4 60.3 63.3	1.3 — 1.3	1.15 — 1.15	1.7	1.55	1.2 1.2 1.2	0.95 0.95 0.95	0.25 0.25 0.25
— 55 60	45 50 —	68 72 78	66.7 70.7 76.2	66.3 70.3 75.8	1.7 1.7	 1.55 1.55	1.7 1.7 —	1.55 1.55 —	1.2 1.2 1.6	0.95 0.95 1.3	0.25 0.25 0.4
— 65 70	55 60 65	80 85 90	77.9 82.9 87.9	77.5 82.5 87.5	1.7 1.7	— 1.55 1.55	2.1 2.1 2.1	1.9 1.9 1.9	1.6 1.6 1.6	1.3 1.3 1.3	0.4 0.4 0.4
75 80 —	70 75	95 100 105	92.9 97.9 102.6	92.5 97.5 102.1	1.7 1.7 —	1.55 1.55 —	2.5 2.5		1.6 1.6 1.6	1.3 1.3 1.3	0.4 0.4 0.4
85 90 95	80 — 85	110 115 120	107.6 112.6 117.6	107.1 112.1 117.1	2.1 2.1 2.1	1.9 1.9 1.9	2.5 — 3.3	2.3 — 3.1	1.6 1.6 1.6	1.3 1.3 1.3	0.4 0.4 0.4
100 105 110	90 95 100	125 130 140	122.6 127.6 137.6	122.1 127.1 137.1	2.1 2.1 2.5	1.9 1.9 2.3	3.3 3.3 3.3	3.1 3.1 3.1	1.6 1.6 2.2	1.3 1.3 1.9	0.4 0.4 0.6
120 130	105 110 120	145 150 165	142.6 147.6 161.8	142.1 147.1 161.3	2.5 3.3	 2.3 3.1	3.3 3.3 3.7	3.1 3.1 3.5	2.2 2.2 2.2	1.9 1.9 1.9	0.6 0.6 0.6
140 — 150 160	130 140 —	175 180 190 200	171.8 176.8 186.8 196.8	171.3 176.3 186.3 196.3	3.3 — 3.3 3.3	3.1 — 3.1 3.1	3.7 3.7 —	3.5 3.5 —	2.2 2.2 2.2 2.2	1.9 1.9 1.9 1.9	0.6 0.6 0.6 0.6

Remarks The minimum permissible chamfer dimensions $r_{\rm N}$ on the snap-ring-groove side of the outer rings are as follows: Dimension series 18: For outside diameters of 78mm and less, use 0.3mm chamfer. For all others exceeding 78mm, use 0.5mm chamfer. Dimension series 19: For outside diameters of 24mm and less, use 0.2mm chamfer. For 47mm and less, use 0.3mm 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

		Locati	ng Snap Rin	ıg			Side Cover
Locating Snap Ring Number	He	Sectional ight		kness	fitted	y of snap ring I in groove eference) Snap Ring Outside Diameter D_2	Stepped Bore Diameter (Reference) $D_{\rm X}$
	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

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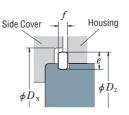
BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS

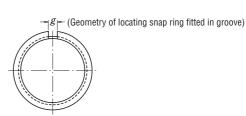
Table 6. 4 Dimensions of Snap Ring Grooves and Locating Snap Rings — (2) Bearing of Diameter Series 0, 2, 3, and 4



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







Units: mm

		Side Cover					
Locating Snap Ring Number	He	Sectional eight		kness	fitted	ry of snap ring d in groove eference) Snap Ring Outside Diameter D_2	Stepped Bore Diameter (Reference)
	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		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

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

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 0.5mm. However, for bearings of diameter series 0 having outside diameters 35mm and below, it is 0.3mm.

(Example 4) NU 3 18 M CM

(Example 5) NN 3 0 17 K CC1 P4

Radial Clearance for

-Machined Brass Cage

Bearing Bore 90mm

-Diameter Series 3

Roller Bearing

NU Type Cylindrical

Accuracy of ISO Class 4

-Radial Clearance in Non-

Interchangeable Cylindrical Roller Bearings **CC1**

Tapered Bore (Taper 1:12)

Bearing Bore 85mm

Diameter Series 0

-Width Series 3

Electric-Motor Bearings CM

NSK

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:

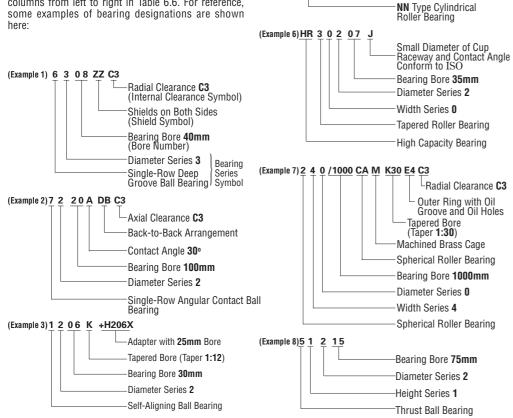


Table 6. 5 Bearing Series Symbols

			Dimension	n Symbols				Dimension	n Symbols
Bearing Type	Bearing Series Symbols	Type Symbols	Width Symbols	Diameter Symbols	Bearing Type	Bearing Series Symbols	Type Symbols	Width Symbols or Height Symbols	Diameter Symbols
	68	6	(1)	8	Double-Row	NNU49	NNU	4	9
Single-Row	69	6	(1)	9	Cylindrical	NN30	NN	3	0
Deep Groove	60	6	(1)	0	Roller Bearings				-
Ball Bearings	62	6	(0)	2		NA48	NA	4	8
	63	6	(0)	3	Needle Roller	NA49	NA	4	9
	70	7	(1)	0	Bearings	NA59	NA NA	5	9
Single-Row	79 70	7	(1)	9	Dearings	NA69	NA	6	9
Angular Contact		7	(1)	2		IVAUS	INA	0	3
Ball Bearings	72 73	7	(0) (0)	3		329	3	2	9
		/	(0)	3					
	12	1	(0)	2		320	3	2	0
Self-Aligning	13	1	(0)	3		330	3	3	0
Ball Bearings	22	(1)	2	2	Tapered Roller	331	3	3	1
	23	(1)	2	3	Bearings	302	3	0	2
	NU10	NU	1	0	Dearings	322	3	2	2
	NU2	NU	(0)	2		332	3	3	2
	NU22	NU	2	2		303	3	0	3
	NU3	NU	(0)	3		323	3	2	3
	NU23	NU	2	3					
	NU4	NU	(0)	4		230	2	3	0
	NJ2	NJ	(0)	2		231	2	3	1
	NJ22	NJ	2	2	Spherical Roller	222	2	2	2
	NJ3	NJ	(0)	3	Bearings	232	2	3	2
	NJ23	NJ	2	3	20a.n.go	213 (1)	2	0	3
Single-Row	NJ4	NJ	(0)	4		223	2	2	3
Cylindrical Roller	NUP2	NUP	(0)	2		=			
Bearings	NUP22	NUP	2	2		511	5	1	1
Dearniys	NUP3	NUP	(0)	3		512	5	1	2
	NUP23	NUP	2	3	Thrust Ball	513	5	1	3
	NUP4	NUP	(0)	4	Bearings with	514	5	1	4
	N10	N	1	0	Flat Seats	522	5	2	2
	N2	N	(0)	2		523	5	2	3
	N3	N	(0)	3		524	5	2	4
	N4	N	(0)	4					
	NF2	NF	(0)	2	Spherical	292	2	9	2
	NF3	NF	(0)	3	Thrust Roller	293	2	9	3
	NF4	NF	(0)	4	Bearings	294	2	9	4

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

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

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Table 6. 6 Formulation of

		Basi	ic Numbers	3										
	ing Series	Bore	e Number		ntact Angle	Intern	al Design Symbol	Mat	terial Symbol	Cag	e Symbol		nal Features	
	nbols (1)				Symbol								ls, Shields Symbol	
Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	
68 69 60	Single- Row Deep Groove Ball Bearings	1 2 3	Bearing 1mm 2	(C	ngular ontact Ball earings Standard Contact Angle	A	Internal Design Differs from Standard One Smaller Diameter	g	Case-Hardened Steel Used in Rings, Rolling Elements	М	Machined Brass Cage	Z ZS	Shield on One Side Only	
: 70 72 73	Single-Row Angular Contact Ball Bearings	9	9	A 5	of 30° Standard Contact Angle of 25°	J	of Outer Ring Raceway, Contact Angle, and Outer Ring Width of Tapered Roller Bearings Conform	h	Stainless Steel	W	Pressed Steel Cage	ZZ ZZS	Shields on Both Sides	
: 12 13 22	Self- Aligning Ball Bearings	00 01 02	10 12 15	В	Standard Contact Angle of 40°		to ISO 355		Used in Rings, Rolling Elements			DU	Contact Rubber Seal	
: NU10 NJ 2 N 3	Cylindrical Roller Bearings	/22	17 22	С	Standard Contact Angle of 15°	(F	or High Capacity) earings			Т	Synthetic Resin Cage	DDU	on One Side Only Contact	
NN 30 :	Needle	/28	28 32		0115	С				V	Without Cage		Rubber Seals on Both Sides	
NA49 NA69 :	Roller Bearings	04(3) 05	20 25		Tapered Roller Bearings / Contact Angle	CA	Spherical Roller Bearings					V	Non- Contact Rubber Seal on One Side	
320 322 323	Tapered Roller Bearings (2)	06	30	С	Less than 17° Contact Angle	EA)					VV	Only Non-	
: 230 222 223	Spherical Roller Bearings	92 96	440 460 480	D	about 20° Contact Angle	E	Cylindrical Roller Bearings Spherical Thrust						Contact Rubber Seals on Both Sides	
511 512	Thrust Ball Bearing with Flat Seats	/500 /530 /560	500 530 560	J	about 28°	EA	Roller Bearings Angular Contact							
513 : 292	Thrust	/2 360	2 360				Ball Bearings							
293 294 :	Spherical Roller Bearings	/2 500	2 500											
HR(4)	High Capacity Tapered Rolle Bearings, and	r												
	Symbols	and Nu	mbers Confe	orm to	JIS(5)	NSK Symbol						NSK Symbol		
					Marked on Bea	rings					t Marked 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 C182.
(3) For Bearing Bore Numbers 04 through 96, five times the bore number gives the bore size (mm) (except doubledirection thrust ball bearings).

(4) HR is prefix to bearing series symbols and it is NSK's original prefix.

Bearing Numbers

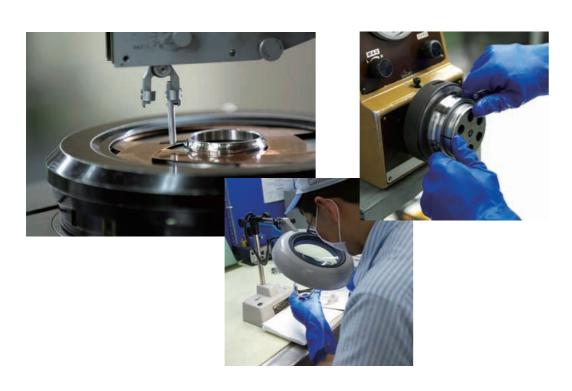
Αι	uxiliary Syn	nbols												
Sym			ngement /mbol			Clearance Symbol		ance Class Symbol	Sp	Special ecification		er or Sleeve Symbol	Grea	se Symbol
	ol for Design f Rings	0,	7111001		110		,	Jyllibol .		Symbol		Jylliboi		
Symbol	Meaning	Symbol	Meaning	Symbol	Mea	aning (radial clearance)	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
K	Tapered Bore of Inner Ring (Taper 1:12)	DB	Back-to-Back Arrangement	C1 C2	Brgs.	Clearance Less than C2 Clearance Less than CN		ISO Normal	tre	arings ated for nensional abilization	+ K	Bearings with Outer Ring Spacers	AS2	SHELL ALVANIA GREASE S2
K30	Tapered	DF	Face-to- Face Arrangement	Omitted C3	IE CN Clearance Clearance Greater than CN Clearance Greater than C3		P6 P6X	ISO Class 6	X26	Working Temperature	+L	Bearings with Inner Ring Spacers	ENS NS7	ENS GREASE
	Bore of Inner Ring (Taper 1:30)	DT	Tandem Arrangement	C4 C5	For	than C3 Clearance Greater than C4				Lower than 150 °C	+KL	Bearings with Both		
E	Notebook and			CC1	able gs.	Clearance Less than CC2 Clearance Less	. P5	ISO Class 5	X28	Working Temperature Lower than 200 °C		Inner and Outer Ring Spacers	PS2	MULTEMP PS No. 2
E	Notch or Lubricating Groove in Ring			CC2 CC	erchangeable Roller Brgs.	than CC Normal Clearance	P4	ISO Class 4	X29	Working Temperature Lower than	н	Adapter Designation		
					ᇢ	Clearance Greater than CC	P2	ISO Class 2		250 °C	АН	Withdrawal		
E4	Lubricating Groove in Outside				For Non- Cylindri	Clearance Greater than CC3 Clearance Greater than CC4	Tap	ABMA(7) Tapered roller bearing	1	Spherical \	HJ	Sleeve Designation Thrust		
	Surface and Holes in Outer Ring			MC1	gs.	Clearance Less than MC2		Class 4	(Roller Bearings /	110	Collar Designation		
N	Snap Ring Groove in				-Small Ball Brgs.	Clearance Less than MC3 Normal Clearance	PN2	Class 2	S11	Dimensional Stabilizing Treatment Working				
	Outer Ring			MC4	For Extra- Miniature	Clearance Greater than MC3 Clearance Greater				Temperature Lower than 200° C				
NR	Snap Ring Groove with Snap Ring			MC5 MC6	and N	than MC4 Clearance Greater than MC5	PN3	Class 3						
	in Outer Ring				Clea Ball Mot	rance in Deep Groove Bearings for Electric ors	PN0	Class 0						
						rance in Cylindrical er Bearings for Electric ors	- PN00	Class 00						
					reloa Iall Be	d of Angular Contact)	:							
				EL L M	Ligl	ra light Preload nt Preload dium Preload								
	H Heavy Preload													
S	rtially the ame as JIS(5)		ame as IIS(5)	NSK S	ymb	Partially the same as JIS(5)/ BAS(6)	San	ne as JIS(5)		NSK Syn	nbol, Pa	rtially the same	as JIS(5)
				In P	rinci	ple, Marked on Bearing	ıs		Not Marked on Bearings				rings	

(5) JIS: Japanese Industrial Standards.

(6) BAS: The Japan Bearing Industrial Association Standard.

(7) ABMA: The American Bearing Manufacturers Association.

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7. BE	EARING TOLERANCES	
7.1	Bearing Tolerance Standards	A 126
7.2	Selection of Accuracy Classes	A 15

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.

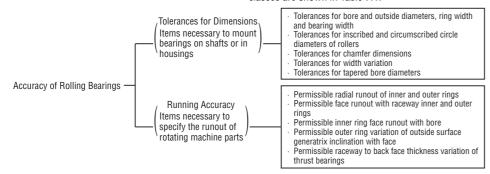


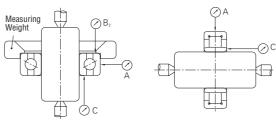
Table 7. 1 Bearing Types and Tolerance Classes

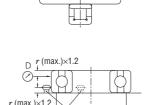
	Ве	aring ⁷	Гуреѕ		Applica	able Tolerance (Classes		Applicable Tables	Reference Pages
	Deep Groo	ve Bal	l Bearings	Normal	Class 6	Class 5	Class 4	Class 2		
	Angular C	ontact	Ball Bearings	Normal	Class 6	Class 5	Class 4	Class 2		
	Self-Aligning Ball Bearings		l Bearings	Normal	Class 6 equivalent	Class 5 equivalent	_	_	Table	A128
	Cylindrical Roller Bearings		r Bearings	Normal	Class 6	Class 5	Class 4	Class 2	7.2	to A131
		Needle Roller Bearings (solid type)		Normal	Tormal Class 6 Class 5 Class 4		_			
		Spherical Roller Bearings		Normal	Normal Class 6 Class 5 —		_			
	Tapered		Metric Design	Normal Class 6X	_	Class 5	Class 4	_	Table 7.3	A132 to A135
	Roller Bearings Inch Design		ANSI/ABMA CLASS 4	ANSI/ABMA CLASS 2	ANSI/ABMA CLASS 3	ANSI/ABMA CLASS 0	ANSI/ABMA CLASS 00	Table 7.4	A136 and A137	
	Magneto E	Bearing	ıs	Normal	Class 6	Class 5	_	_	Table 7.5	A138 and A139
	Thrust Bal	I Beari	ngs	Normal	Class 6	Class 5	Class 4	_	Table 7.6	A140 to A142
	Tapered R	oller T	hrust Bearings	Normal	_	_	_	_	Table 7.7	A143 and A144
	Thrust Sp	herical	Roller Bearings	Normal	_	_	_	_	Table 7.8	A145
		JIS(1)	Class 0	Class 6	Class 5	Class 4	Class 2	_	
ndard	DIN(²)		(2)	P0	P6	P5	P4	P2	_	_
ent sta			Ball Bearings	ABEC 1	ABEC 3	ABEC 5 (CLASS 5P)	ABEC 7 (CLASS 7P)	ABEC 9 (CLASS 9P)	Table 7.2	A128 to A131
Equivalent standards	ANSI ABM		Roller Bearings	RBEC 1	RBEC 3	RBEC 5	_	_	Table 7.9	(A146 and A147)
ш	ABMA(3)		Tapered Roller Bearings	CLASS 4	CLASS 2	CLASS 3	CLASS 0	CLASS 00	Table 7.4	(A136 and A137)

Notes (1) JIS: Japanese Industrial Standards (2) DIN: Deutsch Industrie Norm (3) ANSI/ABMA: The American Bearing Manufacturers Association

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





Stops (at two points)

Supplementary Table

Running Accuracy	Inner Ring	Outer Ring	Dial Gauge
K_{ia}	Rotating	Stationary	А
K_{ea}	Stationary	Rotating	A
S_{ia}	Rotating	Stationary	B ₁
$S_{ m ea}$	Stationary	Rotating	B_2
S_d	Rotating	Stationary	С
S_D	_	Rotating	D
S_i , $S_{ m e}$	Only the shaft or central wash rotated.		E

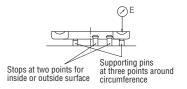


Fig. 7.1 Measuring Methods for Running Accuracy (summarized)

Symbols for Boundary Dimensions and Running Accuracy

Brg bore dia., nominal

Measuring

Weight

Deviation of a single bore dia.

Single plane mean bore dia. deviation

Bore dia. Variation in a single radial plane

Mean bore dia. Variation

BInner ring width, nominal

Deviation of a single inner ring width

Inner ring width variation

Radial runout of assembles brg inner ring

inner ring reference face (backface, where applicable) runout with bore

Assembled brg inner ring face (back face) runout with raceway

 S_i , S_e Raceway to backface thickness variation of thrust brg

Brg width, nominal

Deviation of the actual brg width

Brg outside dia.. nominal Deviation of a single outside dia.

 Δ_{Dmp} Single plane mean outside dia. Deviation

Outside dia. Variation in a single radial plane

Mean outside dia. Variation

Outer ring width, nominal

Deviation of a single outer ring width

Outer ring width variation

Radial runout of assembled brg outer ring Variation of brg outside surface generatrix inclination with outer ring reference face

(backface)

Assembled brg outer ring face (backface) runout with raceway







Table 7. 2 Tolerances for Radial Bearings Table 7. 2. 1 Tolerances for Inner Rings and

Nominal	Bore Diameter					Δ	dmp (2)						Δ	ds (2)	
	d (mm)	N	Iormal	CI	ass 6	C	lass 5	C	lass 4	C	Class 2	Dia S	ass 4 meter eries 2, 3, 4	С	lass 2
over	incl.	high low		high	low	high	low	high	low	high	low	high	low	high	low
0.6(¹) 2.5 10	2.5 10 18	0 0 0	- 8 - 8 - 8	0 0 0	- 7 - 7 - 7	0 0 0	- 5 - 5 - 5	0 0 0	- 4 - 4 - 4	0 0 0	-2.5 -2.5 -2.5	0 0 0	- 4 - 4 - 4	0 0 0	-2.5 -2.5 -2.5
18 30 50	30 50 80	0 0 0	- 10 - 12 - 15	0 0 0	- 8 -10 -12	0 0 0	- 6 - 8 - 9	0 0 0	- 5 - 6 - 7	0 0 0	-2.5 -2.5 -4	0 0 0	- 5 - 6 - 7	0 0 0	-2.5 -2.5 -4
80 120 150 180	120 150 180 250	0 0 0 0	- 20 - 25 - 25 - 30	0 0 0 0	-15 -18 -18 -22	0 0 0	-10 -13 -13 -15	0 0 0	- 8 -10 -10 -12	0 0 0 0	-5 -7 -7 -8	0 0 0 0	- 8 -10 -10 -12	0 0 0 0	-5 -7 -7 -8
250 315 400	315 400 500	0 0 0	- 35 - 40 - 45	0 0 0	-25 -30 -35	0 0 -	-18 -23 -	_	=	- - -		=	_ _ _	- -	
500 630 800	630 800 1 000	0 0 0	- 50 - 75 -100	0 -	-40 - -	_ _		_	=	- - -		=	_ _ _	- -	
1 000 1 250 1 600	1 250 1 600 2 000	0 0 0	-125 -160 -200	_ _ _		_ _ _			=	 - -	_ _ _	_ _ _	_ _ _	- -	=

				Δ_{E}	$_{ m Ss}$ (or $\it \Delta$	Cs)(3)							V_{\perp}	Bs (or V	_{Cs})	
		Single	Bearing				Co	mbined	d Bearing	S (4)		Inner Ri Outer Ri	ng (or ng) (3)		Inner Rin	ıg
	ormal lass 6		lass 5 lass 4	CI	lass 2		ormal lass 6	C	lass 5 lass 4	C	lass 2	Normal	Class 6	Class 5	Class 4	Clas
high	low	high	low	high	low	high	low	high	low	high	low	max.	max.	max.	max.	max
0 0 0	- 40 - 120 - 120	0 0 0	- 40 - 40 - 80	0 0 0	- 40 - 40 - 80	_ 0 0	-250 -250	0 0 0	-250 -250 -250	0 0 0	-250 -250 -250	12 15 20	12 15 20	5 5 5	2.5 2.5 2.5	1.5 1.5 1.5
0 0 0	- 120 - 120 - 150	0 0 0	-120 -120 -150	0 0 0	-120 -120 -150	0 0 0	-250 -250 -380	0 0 0	-250 -250 -250	0 0 0	-250 -250 -250	20 20 25	20 20 25	5 5 6	2.5 3 4	1.5 1.5 1.5
0 0 0 0	- 200 - 250 - 250 - 300	0 0 0 0	-200 -250 -250 -300	0 0 0 0	-200 -250 -250 -300	0 0 0 0	-380 -500 -500 -500	0 0 0 0	-380 -380 -380 -500	0 0 0	-380 -380 -380 -500	25 30 30 30	25 30 30 30	7 8 8 10	4 5 5 6	2. 2. 4 5
0 0 0	- 350 - 400 - 450	0 0	-350 -400 -	<u>-</u>		0 0	-500 -630 -	0 0	-500 -630 -			35 40 50	35 40 45	13 15 —	_ _ _	-
0 0 0	- 500 - 750 -1 000	_		_		- - -	_ _ _	=	_ _ _	=	_ _ _	60 70 80	50 - -	_ _ _	_ _ _	-
0	-1 250 -1 600 -2 000	_	_	_	_	_	_	_	_	_	_	100 120 140	=	_	_	=

- Notes (1) 0.6mm 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.

(excluding Tapered Roller Bearings) Widths of Outer Rings

					$V_{d\mathrm{p}}$ (2)								V_{dr}	_{mp} (2)		
	Norma	l		Class 6	i		ss 5		ss 4	Class 2		C1	Class	Class	Class	
	neter Se			meter Se		Se	neter ries	Se	neter ries	Diameter Series	Normal	Class 6	Class 5	Class 4	Class 2	
9	0, 1	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7						9	0,1,2,3,4	0,1,2,3,4						
	max.		max. max.				ax.	m	ax.	max.	max.	max.	max.	max.	max.	
10 10 10	8 8 8	6 6 6	9 9 9	7 7 7	5 5 5	5 5 5	4 4 4	4 4 4	3 3 3	2.5 2.5 2.5	6 6 6	5 5 5	3 3 3	2 2 2	1.5 1.5 1.5	
13 15 19	10 12 19	8 9 11	10 13 15	8 10 15	6 8 9	6 8 9	5 6 7	5 6 7	4 5 5	2.5 2.5 4	8 9 11	6 8 9	3 4 5	2.5 3 3.5	1.5 1.5 2	
25 31 31 38	25 31 31 38	15 19 19 23	19 23 23 28	19 23 23 28	11 14 14 17	10 13 13 15	8 10 10 12	8 10 10 12	6 8 8 9	5 7 7 8	15 19 19 23	11 14 14 17	5 7 7 8	4 5 5 6	2.5 3.5 3.5 4	
44 50 56	44 50 56	26 30 34	31 38 44	31 38 44	19 23 26	18 23 —	14 18 -	_ _ _	_ _ _	_ _ _	26 30 34	19 23 26	9 12 -	_ _ _	_ _ _	
63	63	38	50	50	30	_	-	_	-	-	38	30	-	_	_	
	_	_	_	_	-	_	_	_	_	_	_	_	_	_	_	
_	_	-	_	_	-	_	-	_	-	_	_	_	-	_	_	
_	_	_	_	_	-	_	_	_	_	_	_	_	_	_	_	

Units: µm

												πιο . μπ	
		K_{ia}				S_d			S ia (5)		Nominal Bore Diameter		
Normal	Class 6	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	Class 5	Class 4	Class 2	d (mm)		
max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	over	incl.	
10	5	4	2.5	1.5	7	3	1.5	7	3	1.5	0.6(¹)	2.5	
10	6	4	2.5	1.5	7	3	1.5	7	3	1.5	2.5	10	
10	7	4	2.5	1.5	7	3	1.5	7	3	1.5	10	18	
13	8	4	3	2.5	8	4	1.5	8	4	2.5	18	30	
15	10	5	4	2.5	8	4	1.5	8	4	2.5	30	50	
20	10	5	4	2.5	8	5	1.5	8	5	2.5	50	80	
25 30 30 40	13 18 18 20	6 8 8 10	5 6 6 8	2.5 2.5 5	9 10 10 11	5 6 6 7	2.5 2.5 4 5	9 10 10 13	5 7 7 8	2.5 2.5 5	80 120 150 180	120 150 180 250	
50	25	13	_	_	13	_	_	15	_	_	250	315	
60	30	15	_	_	15	_	_	20	_	_	315	400	
65	35	—	_	_	—	_	_	—	_	_	400	500	
70	40	_	_	_	_	_	_	_	_	_	500	630	
80	_	_	_	_	_	_	_	_	_	_	630	800	
90	_	_	_	_	_	_	_	_	_	_	800	1 000	
100	_	_	_	_	_	_	_	_	_	_	1 000	1 250	
120	_	_	_	_	_	_	_	_	_	_	1 250	1 600	
140	_	_	_	_	_	_	_	_	_	_	1 600	2 000	

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 *τ* (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.

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Table 7. 2 Tolerances for Radial Bearings Table 7. 2. 2 Tolerances

Nominal O	ıtside					Δ	<i>D</i> mp							I_{Ds}	
Diamete D (mm)	er	N	ormal	Class 6		CI	ass 5	Cl	ass 4	С	lass 2	Dia S	ass 4 ameter eries 2, 3, 4	C	lass 2
over	incl.	high low high low		high	low	high	low	high	low	high	low	high	low		
2.5(1) 6 18	6 18 30	0 0 0	- 8 - 8 - 9	0 0 0	- 7 - 7 - 8	0 0 0	- 5 - 5 - 6	0 0 0	- 4 - 4 - 5	0 0 0	- 2.5 - 2.5 - 4	0 0 0	- 4 - 4 - 5	0 0 0	- 2.5 - 2.5 - 4
30 50 80	50 80 120	0 0 0	- 11 - 13 - 15	0 0 0	- 9 -11 -13	0 0 0	- 7 - 9 -10	0 0 0	- 6 - 7 - 8	0 0 0	- 4 - 4 - 5	0 0 0	- 6 - 7 - 8	0 0 0	- 4 - 4 - 5
120 150 180	150 180 250	0 0 0	- 18 - 25 - 30	0 0 0	-15 -18 -20	0 0 0	-11 -13 -15	0 0 0	- 9 -10 -11	0 0 0	- 5 - 7 - 8	0 0 0	- 9 -10 -11	0 0 0	- 5 - 7 - 8
250 315 400	315 400 500	0 0 0	- 35 - 40 - 45	0 0 0	-25 -28 -33	0 0 0	-18 -20 -23	0 0 —	-13 -15 -	0 0	- 8 -10 -	0 0 -	-13 -15 -	0 0 —	- 8 -10 -
500 630 800	630 800 1 000	0 0 0	- 50 - 75 -100	0 0 0	-38 -45 -60	0 0 —	-28 -35 -	=	_ _ _	_ _ _	_ _ _	=	_ _ _	=	_ _ _
1 000 1 250 1 600 2 000	1 250 1 600 2 000 2 500	0 0 0 0	-125 -160 -200 -250	_ _ _	_ _ _	- - -	_ _ _	_ _ _ _	_ _ _	_ _ _	_ _ _	- - -	_ _ _	_ _ _	- - -

Notes

(1) 2.5mm 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-RBEC5, ABEC7-RBEC7, and ABEC9-RBEC9 are requirelest to Classes Normal and 2 respectively.

are equivalent to Classes Normal, 6, 5, 4, and 2 respectively.

(excluding Tapered Roller Bearings) for Outer Rings

					V_{Dp} ((2)								V	_{Dmp} (2))		
	Nor	mal			Cla	ss 6		Cla	ss 5	Cla	ss 4	Class 2						
	Open Type	9	Shielded Sealed	0	pen Typ	ре	Shielded Sealed	Open	Туре	Open	Туре	Open Type	Normal	Class	Class	Class	Class	
	Diamete	Series		ı	Diamete	er Serie	S	Dian Se	neter ries	Dian Se	neter ries	Diameter Series	Normai	6	5	4	2	
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						
	ma	X.			m	ax.		m	ax.	m	ax.	max.	max.	max.	max.	max.	max.	
10 10 12	8 8 9	6 6 7	10 10 12	9 9 10	7 7 8	5 5 6	9 9 10	5 5 6	4 4 5	4 4 5	3 3 4	2.5 2.5 4	6 6 7	5 5 6	3 3 3	2 2 2.5	1.5 1.5 2	
14 16 19	11 13 19	8 10 11	16 20 26	11 14 16	9 11 16	7 8 10	13 16 20	7 9 10	5 7 8	6 7 8	5 5 6	4 4 5	8 10 11	7 8 10	4 5 5	3 3.5 4	2 2 2.5	
23 31 38	23 31 38	14 19 23	30 38 -	19 23 25	19 23 25	11 14 15	25 30 —	11 13 15	8 10 11	9 10 11	7 8 8	5 7 8	14 19 23	11 14 15	6 7 8	5 5 6	2.5 3.5 4	
44 50 56	44 50 56	26 30 34	_ _ _	31 35 41	31 35 41	19 21 25	=	18 20 23	14 15 17	13 15 —	10 11 —	8 10 —	26 30 34	19 21 25	9 10 12	7 8 —	4 5 -	
63 94 125	63 94 125	38 55 75	_ _ _	48 56 75	48 56 75	29 34 45	=	28 35 —	21 26 —	_ _ _	_ _ _	_ _ _	38 55 75	29 34 45	14 18 —	_ _ _	_ _ _	
_ _ _ _	- - -	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	- - -	- - -	_ _ _	_ _ _	_ _ _ _	- - -	_ _ _	_ _ _	_ _ _ _	_ _ _ _	

- 1	Inits	٠	11	r

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

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Table 7. 3 Tolerances for Metric Design Tapered Roller Bearings

Table 7. 3. 1 Tolerances for Inner Ring Bore Diameter and Running Accuracy

Nomina Diam				Δ	dmp				1 _{ds}		V	<i>d</i> p			V_{a}	<i>l</i> mp	
(m			ormal ss 6X		ass 6 ass 5	Cl	Class 4		ass 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	high low		low	max.	max.	max.	max.	max.	max.	max.	max.
10 18 30	18 30 50	0 0 0	- 8 -10 -12	0 0 0	- 7 - 8 -10	0 0 0	- 5 - 6 - 8	0 0 0	- 5 - 6 - 8	8 10 12	7 8 10	5 6 8	4 5 6	6 8 9	5 6 8	5 5 5	4 4 5
50 80 120	80 120 180	0 0 0	-15 -20 -25	0 0 0	-12 -15 -18	0 0 0	- 9 -10 -13	0 0 0	- 9 -10 -13	15 20 25	12 15 18	9 11 14	7 8 10	11 15 19	9 11 14	6 8 9	5 5 7
180 250 315	250 315 400	0 0 0	-30 -35 -40	0 0 0	-22 -25 -30	0 0 0	-15 -18 -23	0 0 0	-15 -18 -23	30 35 40	22 - -	17 — —	11 - -	23 26 30	16 - -	11 - -	8 - -
400 500 630	500 630 800	0 0 0	-45 -50 -75	0 0 0	-35 -40 -60	0 _ _	-27 - -	0 _ _	-27 - -	_ _ _	_ _ _	_ _ _	- - -	_ _ _	1 1 1	_ _ _	_ _ _

_					
D	m	2	rk	0	

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.
 Some of these tolerances conform to the NSK Standard.

Table 7. 3. 2 Tolerances for Outer Ring Outside Diameter and Running Accuracy

	nal Outside iameter			Δ	Dmp				$1_{D\mathrm{s}}$		V	Dр			V_I	Omp	
	D (mm)		ormal ass 6X		ass 6 ass 5	Cl	Class 4		ass 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	high low		low	max.	max.	max.	max.	max.	max.	max.	max.
18 30 50	50	0 0 0	- 9 - 11 - 13	0 0 0	- 8 - 9 -11	0 0 0	- 6 - 7 - 9	0 0 0	- 6 - 7 - 9	9 11 13	8 9 11	6 7 8	5 5 7	7 8 10	6 7 8	5 5 6	4 5 5
120 150	150	0 0 0	- 15 - 18 - 25	0 0 0	-13 -15 -18	0 0 0	-10 -11 -13	0 0 0	-10 -11 -13	15 18 25	13 15 18	10 11 14	8 8 10	11 14 19	10 11 14	7 8 9	5 6 7
180 250 315	315	0 0 0	- 30 - 35 - 40	0 0 0	-20 -25 -28	0 0 0	-15 -18 -20	0 0 0	-15 -18 -20	30 35 40	20 25 28	15 19 22	11 14 15	23 26 30	15 19 21	10 13 14	8 9 10
400 500 630	630	0 0 0	- 45 - 50 - 75	0 0 0	-33 -38 -45	0 0 —	-23 -28 -	0 0 —	-23 -28 -	45 50 —	_ _ _		_ _ _	34 38 -	_ _ _	_ _ _	_ _ _
800	1 000	0	-100	0	-60	_			-	_	_	_	_	_	_	_	

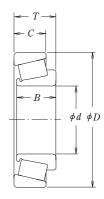
Kema	irks
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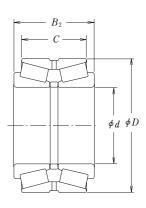
^{1.} The outside diameter "no-go side" tolerances (low) specified in this table do not necessarily apply within a distance of 1.2 times the chamfer dimension r (max.) from the ring face.

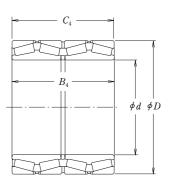
					Units : µ	ım
	K	ia		S	d	S ia
Normal	Class	Class	Class	Class	Class	Class
Class 6X	6	5	4	5	4	4
max.	max.	max.	max.	max.	max.	max.
15	7	3.5	2.5	7	3	3
18	8	4	3	8	4	4
20	10	5	4	8	4	4
25	10	5	4	8	5	4
30	13	6	5	9	5	5
35	18	8	6	10	6	7
50	20	10	8	11	7	8
60	25	13	10	13	8	10
70	30	15	12	15	10	14
70	35	18	14	19	13	17
85	40	20	-	22	-	-
100	45	22	-	27	-	-

ì	Inits			
ı	IIIIIS	ш	m	

Oillis . μm													
	K	ea		S	D	S ea							
Normal	Class	Class	Class	Class	Class	Class							
Class 6X	6	5	4	5	4	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	_								







^{2.} Some of these tolerances conform to the NSK Standard.

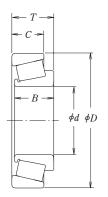


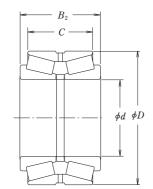
Table 7. 3 Tolerances for Metric Design Table 7. 3. 3 Tolerances for Width, Overall Bearing Width,

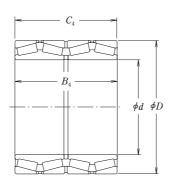
Nomina Diam				4	1 _{Bs}					4	∆ _{C s}					Δ_T	s		
(m			ormal ass 6	Cla	ıss 6X		ass 5 ass 4		ormal ass 6	Cl	ass 6X		lass 5 lass 4		rmal ass 6	Class	6X		ss 5 ss 4
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low
10 18 30	18 30 50	0 0 0	-120 -120 -120	0 0 0	-50 -50 -50	0 0 0	-200 -200 -240	0 0 0	-120 -120 -120	0 0 0	-100 -100 -100	0 0 0	-200 -200 -240	+200 +200 +200	0 0 0	+100 +100 +100	0 0 0	+200 +200 +200	-200 -200 -200
50 80 120	80 120 180	0 0 0	-150 -200 -250	0 0 0	-50 -50 -50	0 0 0	-300 -400 -500	0 0 0	-150 -200 -250	0 0 0	-100 -100 -100	0 0 0	-300 -400 -500	+200 +200 +350	0 -200 -250	+100 +100 +150	0 0 0	+200 +200 +350	-200 -200 -250
180 250 315	250 315 400	0 0 0	-300 -350 -400	0 0 0	-50 -50 -50	0 0 0	-600 -700 -800	0 0 0	-300 -350 -400	0 0 0	-100 -100 -100	0 0 0	-600 -700 -800	+350 +350 +400	-250 -250 -400	+150 +200 +200	0 0 0	+350 +350 +400	-250 -250 -400
400 500 630	500 630 800	0 0 0	-450 -500 -750	- - -	_ _ _	0 0 0	-800 -800 -800	0 0 0	-450 -500 -750	_ _ _	_ _ _	0 0 0	-800 -800 -800	+400 +500 +600	-400 -500 -600		_ _ _	+400 +500 +600	-400 -500 -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.



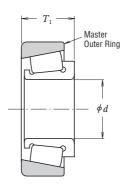




Tapered Roller Bearings and Combined Bearing Width

Units : $\mu\,m$

	R		with Roller	S	Outer Ri		ve Width D	eviation	$\Delta_{B2\mathrm{s}}$ $\Delta_{B4\mathrm{s}}$, $\Delta_{C4\mathrm{s}}$					nal Bore meter
	Nor	mal	Class	s 6X	Nor	mal	Class	s 6X	All classes row be	of double- earings	All classes bear	of four-row ings		d nm)
	high	low	high	low	high	low	high	low	high	low	high	low	over	incl.
_	+100 +100 +100	0 0 0	+ 50 + 50 + 50	0 0 0	+100 +100 +100	0 0 0	+ 50 + 50 + 50	0 0 0	+ 200 + 200 + 200	- 200 - 200 - 200	_ _ _	- - -	10 18 30	18 30 50
	+100 +100 +150	0 -100 -150	+ 50 + 50 + 50	0 0 0	+100 +100 +200	0 -100 -100	+ 50 + 50 +100	0 0 0	+ 300 + 300 + 400	- 300 - 300 - 400	+ 300 + 400 + 500	- 300 - 400 - 500	50 80 120	80 120 180
	+150 +150 +200	-150 -150 -200	+ 50 +100 +100	0 0 0	+200 +200 +200	-100 -100 -200	+100 +100 +100	0 0 0	+ 450 + 550 + 600	- 450 - 550 - 600	+ 600 + 700 + 800	- 600 - 700 - 800	180 250 315	250 315 400
_	- - -	_ _ _	- - -	=	- - -	- - -	- - -	=	+ 700 + 800 +1 200	- 700 - 800 -1 200	+ 900 +1 000 +1 500	- 900 -1 000 -1 500	400 500 630	500 630 800



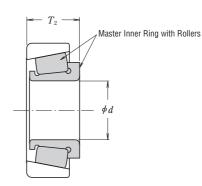




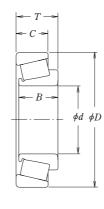
Table 7. 4 Tolerances for Inch Design Tapered Roller Bearings

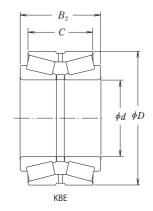
(Refer to page A126 Table 7. 1 for the tolerance class "CLASS ** " that is the tolerance classes of ANSI/ABMA.)

Table 7. 4. 1 Tolerances for Inner Ring Bore Diameter

Units: µm

	Nominal Bo	1				Δ	ds		
over		incl.		CLAS	S 4, 2	CLAS	S 3, 0	CLASS 00	
(mm)	1/25.4	(mm)	1/25.4	high	low	high	low	high	low
	3.0000 10.5000	76.200 266.700 304.800	3.0000 10.5000 12.0000	+ 13 + 25 + 25	0 0 0	+13 +13 +13	0 0 0	+8 +8 -	0 0 —
304.800 609.600 914.400 1 219.200	12.0000 24.0000 36.0000 48.0000	609.600 914.400 1 219.200 —	24.0000 36.0000 48.0000	+ 51 + 76 +102 +127	0 0 0	+25 +38 +51 +76	0 0 0 0	_ _ _ _	_ _ _ _





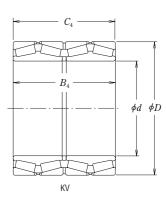


Table 7. 4. 2 Tolerances for Outer Ring Outside Diameter

	Nominal Outs I	side Diameter				Δ	Ds		
over		incl.		CLAS	S 4, 2	CLAS	S 3, 0	CLASS 00	
(mm)	1/25.4	(mm)	1/25.4	high	low	high	low	high	low
_ 266.700 304.800	_ 10.5000 12.0000	266.700 304.800 609.600	10.5000 12.0000 24.0000	+ 25 + 25 + 51	0 0 0	+13 +13 +25	0 0 0	+8 +8 -	0 0 —
609.600 914.400 1 219.200	24.0000 36.0000 48.0000	914.400 1 219.200 —	36.0000 48.0000	+ 76 +102 +127	0 0 0	+38 +51 +76	0 0 0	_ _ _	_ _ _

and Radial Runout of Inner and Outer Rings

Units: µm

_			K_{ia} , K_{ea}		
	CLASS 4	CLASS 2	CLASS 3	CLASS 0	CLASS 00
Ξ	max.	max.	max.	max.	max.
	51 51 51	38 38 38	8 8 18	4 4 —	2 2 —
	76 76 76	51 - -	51 76 76	_ _ _	- - -

Table 7. 4. 3 Tolerances for

		re Diameter d						Δ	Ts				
OV	er	ir	cl.	CL	ASS 4	CLA	SS 2	D≦508.0		SS 3	.000 (mm)	CLAS	S 0, 00
(mm)	1/25.4	(mm)	1/25.4	high	low	high	low	high	low	high	low	high	low
101.600	_ 4.0000	101.600 304.800	4.0000 12.0000	+203 +356	0 -254	+203 +203	0	+203 +203	-203 -203	+203 +203	-203 -203	+203 +203	-203 -203
304.800 609.600	12.0000 24.0000	609.600	24.0000 —	+381 +381	-381 -381	+381	-381 -	+203 +381	-203 -381	+381 +381	-381 -381	_	=

Overall Width and Combined Width

Units: µm

_											UIII	ιs . μm
				Dou		arings (KBE T	ype)				(KV	v Bearings Type) , Δ_{C4s}
_	CLA	SS 4	CLAS	CLASS 2 $\frac{\text{CLASS 3}}{D \le 508.000 \text{ (mm)}} \frac{D > 508.000 \text{ (mm)}}{D > 508.000 \text{ (mm)}}$								SS 4, 3
	high	low	high	low	high low		high	low	high	low	high	low
	+406 +711	0 -508	+406 +406	0 -203	+406 +406	-406 -406	+406 +406	-406 -406	+406 +406	-406 -406	+1 524 +1 524	-1 524 -1 524
	+762 +762	-762 -762	+762 -	-762 -	+406 +762	-406 -762	+762 +762	-762 -762		_	+1 524 +1 524	-1 524 -1 524

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Table 7. 5 Tolerances
Table 7. 5. 1 Tolerances for Inner Rings

	al Bore neter			Δ	dmp				V_{dp}			$V_{d\mathrm{mp}}$			$\it \Delta_{\it Bs}$ (or	△ _{Cs}) (1)
	m)	No	rmal	Cla	ass 6	Cla	ıss 5	Normal	Class 6	Class 5	Normal	Class 6	Class 5		rmal iss 6	Cla	ass 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.

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

Nominal Diam							Δ_{I}	Omp							$V_{D\mathrm{p}}$	
				Bearing S	Series E				I	Bearing Se	eries EN	I				
(mi		Norr							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

Remark 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.

for Magneto Bearings and Width of Outer Rings

							Un	its:μm
$V_{B{ m s}}$ (or	V _{Cs}) (¹)	Δ	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

for Outer Rings

	90					Units : μ	ιm
	$V_{D{ m mp}}$			K_{ea}		S ea	S_D
Normal	Class 6	6 5		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

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Table 7. 6 Tolerances for Thrust Ball Bearings

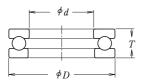
Table 7. 6. 1 Tolerances for Shaft Washer Bore Diameter and Running Accuracy

Units: µm

Nomina Diam $oldsymbol{d}$ or (mr	eter d_2		Δ_{dmp} 0			Normal	r $V_{d2\mathrm{p}}$	N. 1	S_i or	S _e (¹)	Class
,			ss 6 ss 5	Cla	ss 4	Class 6 Class 5	4	Normal	6	5	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	1 000 1 250	0 0	-100 -125	_	_	_	_	45 50	30 35	15 18	

Note (1) For double-direction bearings, the thickness variation doesn't 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, $S_{\rm e}$, applies only to flat-seat thrust bearings.



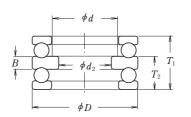
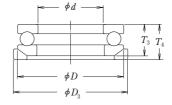


Table 7. 6. 2 Tolerances for Outside Diameter of Housing Washers and Aligning Seat Washers

	ts		

Nominal Outside D Bearing or Ali Seat Wash	igning her			⊿ at Type	<i>D</i> mp	Aligni Wash	ng Seat er Type		Dp	Aligning S Outside Dev	Seat Washer Diameter iation D 3s
D or D (mm)	3	Cla	rmal ss 6 ss 5	Cla	iss 4		rmal ss 6	Normal Class 6 Class 5	Class 4		rmal ss 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 1 250	1 000 1 250 1 600	0 0 0	-100 -125 -160	_ _ _	_ _ _	_ _ _	=	75 — —	_ _ _	_ _ _	=



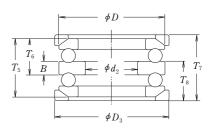




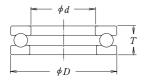
Table 7. 6. 3 Tolerances for Thrust Ball Bearing Height and Central Washer Height

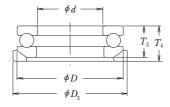
Inits: µm

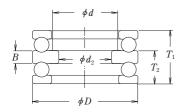
														UIIIIS :	μш
Nominal Bore Diameter d (¹) (mm)		Flat Seat Type				Aligning Seat Washer Type				With Aligning Seat Washer			Height Deviation		
		Δ $T_{ m S}$ or Δ $T_{ m 2S}$		Δ_{Tis}		$\Delta_{T3 ext{S}}$ or $\Delta_{T6 ext{S}}$		Δ_{T5s}		$\Delta_{T_{48}}$ or $\Delta_{T_{88}}$		△ _{T7s}		of Central Washer Δ_{Bs}	
			, Class 6 , Class 4		,		rmal ass 6		rmal ss 6		rmal ss 6	Noi Clas	mal ss 6		l, Class 6 b, Class 4
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low
- 30 50	30 50 80	0 0 0	- 75 -100 -125	+ 50 + 75 +100	-150 -200 -250	0 0 0	- 75 -100 -125	+ 50 + 75 +100	-150 -200 -250	+ 50 + 50 + 75	- 75 -100 -125	+150 +175 +250	-150 -200 -250	0 0 0	- 50 - 75 -100
80 120 180	120 180 250	0 0 0	-150 -175 -200	+125 +150 +175	-300 -350 -400	0 0 0	-150 -175 -200	+125 +150 +175	-300 -350 -400	+ 75 +100 +100	-150 -175 -200	+275 +350 +375	-300 -350 -400	0 0 0	-125 -150 -175
250 315	315 400	0 0	-225 -300	+200 +250	-450 -600	0 0	-225 -300	+200 +250	-450 -600	+125 +150	-225 -275	+450 +550	-450 -550	0	-200 -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.

Remark ΔT_{rs} in the table is the deviation in the respective heights T in figures below.







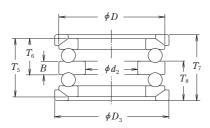


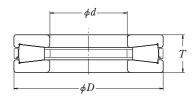
Table 7. 7 Tolerances for Tapered Roller Thrust Bearings

Table 7. 7. 1 Tolerances for Bore Diameters of Shaft Washers and Height (Metric, Class Normal) $$_{\rm Units\,:\,\mu\,m}$$

Nominal Bor d (mr	!	Δ,	dmp	Δ_{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		-160	0	-1 200	

Table 7. 7. 2 Tolerances for Housing washer Outside Diameters (Metric, Class

Normal)		Units : µm			
Nominal Outs <i>I</i> (m)	$\it \Delta \it D_{mp}$			
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		



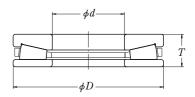




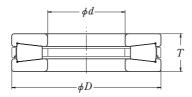
Table 7. 7 Tolerances for Tapered Roller Thrust Bearings

Table 7. 7. 3 Tolerances for Bore Diameters of Shaft Washers and Height (Inch)

	- 3	· · /				Units : L	ım
	Nominal Bo	Δ_{d}	mp	Δ_{Ts}			
0	ver	in	cl				
(mm)	(inch)	(mm)	(inch)	high	low	high	low
304.800	12.0000	304.800 609.600	12.0000 24.0000	+25 +51	0	+381 +381	-381 -381
609.600 914.400	24.0000 36.0000	914.400 1 219.200	36.0000 48.0000	+76 +102	0	+381 +381	-381 -381

Table 7. 7. 4 Tolerances for Housing Washer Outside Diameters (Inch)

	<u> </u>										
OV	Nominal Outside Diameter D over incl										
(mm)	(inch)	(mm)	(inch)	high	low						
304.800 609.600	 12.0000 24.0000	304.800 609.600 914.400	12.0000 24.0000 36.0000	+25 +51 +76	0 0 0						
914.400 1 219.200	36.0000 48.0000	1 219.200	48.0000 —	+102 +127	0						



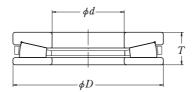


Table 7. 8 Tolerances for Thrust Spherical Roller Bearings

Table 7. 8. 1 Tolerances for Bore Diameters of Shaft Rings and Height (Class Normal)

Units: µm

Nominal Bore					Reference	
Diameter $d \ (ext{mm})$		Δ_{dmp}	V_{dp}	S_d	Δ	Ts
over incl	. high	low	max.	max.	high	low
50 80 80 120 120 180	0	-15 -20 -25	11 15 19	25 25 30	+150 +200 +250	-150 -200 -250
180 250 250 319 315 400	0	-30 -35 -40	23 26 30	30 35 40	+300 +350 +400	-300 -350 -400
400 500	0	- 45	34	45	+450	-450

Remark 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 : μ

		UI	πο. μπ				
1	side Diameter) m)	$\it \Delta_{Dmp}$					
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		-100				

Remark
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.

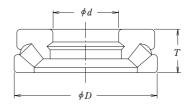




Table 7. 9 Tolerances of

CLASS 5P, CLASS 7P, and CLASS 9P

(1) Tolerances for Inner Rings

Ī	Nominal Bore Diameter d (mm)		Δ_{dmp}			$\it \Delta_{ds}$				V_{dp}		$V_{d\mathrm{mp}}$		_	1_{Bs}	
			CLAS CLAS	SS 5P SS 7P	CLASS 9P		CLASS 5P CLASS 7P		CLASS 9P		CLASS 5P CLASS 7P	CLASS 9P	CLASS 5P CLASS 7P	CLASS 9P	CLA CLA	le Brgs SS 5P SS 7P SS 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.

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

(2) Tolerances for

	Nominal Outside Diameter		Δ_{Dmp}			$\it \Delta_{\it Ds}$				V_{Dp}			$V_{D\mathrm{mp}}$				
Diam			CLASS 5P			CLASS 5P CLASS 7P			CLA	SS 9P	CLASS 5P CLASS 7P		CLASS 9P		SS 5P SS 7P	CLASS 9P	
(mm)		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.

Instrument Ball Bearings (Inch design)

(ANSI/ABMA Equivalent)

and Width of Outer Rings

Units: μm

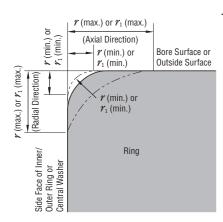
(0)	(or $\Delta_{C_{\rm S}}$) $V_{B_{\rm S}}$		$K_{i\mathrm{a}}$				S_{ia}		S_d				
CI	ASS 5P ASS 7P ASS 9P	CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P	CLASS 5P	CLASS 7P	CLASS 9P
high	n low	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.	max.
0	-400	5.1	2.5	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

Outer Rings

Units: um

_																	πιο . μπ
	V _{Cs} (1)			S_D			K ea				S ea		_	iation of e Outside	Deviation of Flange Width		Flange Backface Runout
	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	LASS CLASS C		CLASS	CLASS				C 1s	with Raceway (²) S_{ea1}
	5P	7P	9P	5P	7P	9P	5P	7P	9P	5P	7P		CLASS 5P CLASS 7P			SS 5P SS 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





r: Chamfer Dimension of Inner/Outer Ring

Remark 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.

Table 7. 10 Chamfer Dimension Limits (for Metric Design Bearings)

Table 7. 10. 1 Chamfer Dimension Limits for Radial Bearings (excluding Tapered Roller Bearings) Units: mm

Permissible			Parmiccih	le Chamfer	Reference	
Chamfer Dimension for Inner/ Outer Rings **(min.) or	Dian	al Bore neter d	Dimens Inner/Ou r (max.) o	sion for ter Rings r γ_1 (max.)	Corner Radius of Shaft or Housing r_a	
\mathcal{V}_1 (min.)	over	incl.	Radial Direction	Axial Direction	max.	
0.05 0.08 0.1	- - -	- - -	0.1 0.16 0.2	0.2 0.3 0.4	0.05 0.08 0.1	
0.15 0.2	_ _	_ _	0.3 0.5	0.6 0.8	0.15 0.2	
0.3	0.3 - 40		0.6 0.8	1 1	0.3	
0.6	- 40	40 —	1 1.3	2 2	0.6	
1	- 50	50 —	1.5 1.9	3 3	1	
1.1	- 120	120 —	2 2.5	3.5 4	1	
1.5	_ 120	120 —	2.3 3	4 5	1.5	
2	- 80 220	80 220 —	3 3.5 3.8	4.5 5 6	2	
2.1	_ 280	280 —	4 4.5	6.5 7	2	
2.5	- 100 280	100 280 —	3.8 4.5 5	6 6 7	2	
3	_ 280	280 —	5 5.5	8 8	2.5	
4 5	_	_	6.5 8	9 10	3 4	
6 7.5 9.5	- - -	- - -	10 12.5 15	13 17 19	5 6 8	
12 15 19	- - -	- - -	18 21 25	24 30 38	10 12 15	

Remark For bearings with nominal widths less than 2mm, 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 Reference Permissible Permissible Chamfer Nominal Bore or Chamfer Corner Nominal Outside Dimension for Inner/ Dimension Radius of Diameter (1) Outer Rings for Inner/ Shaft or d or DOuter (max.) Housing r_a Rings Axial Directio Radial over incl. max. 0.15 0.3 0.6 0.15 40 0.7 1.4 0.3 0.3 40 0.9 1.6 40 1.1 1.7 0.6 0.6 40 1.3 2 50 1.6 2.5 1 50 1.9 3 120 2.3 3 1.5 250 120 2.8 3.5 1.5 250 3.5 4 120 2.8 2 120 250 3.5 4.5 2 250 4 5 120 3.5 2.5 120 250 4 5.5 2 250 4.5 6 _ 120 4 5.5 120 250 4.5 6.5 3 2.5 250 400 5 7.5 400 5.5 120 5 120 250 5.5 7.5 4 3 250 400 6 8 400 8.5 6.5 180 6.5 5 180 7.5 9

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

7.5

10

11

5

180

180

6

Table 7. 10. 3 Chamfer Dimension Limits for Thrust Bearings

Units: mm

		-				
D : 111 01 (Permissible Chamfer	Reference				
Permissible Chamfer Dimension for Shaft (or Central)/Housing Washers γ (min.) or γ (min.)	Dimension for Shaft (or Central)/Housing Washers \mathcal{T} (max.) or \mathcal{T}_1 (max.)	Corner Radius of Shaft or Housing γ_a				
/ (IIIII.) OI / 1 (IIIII.)	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				

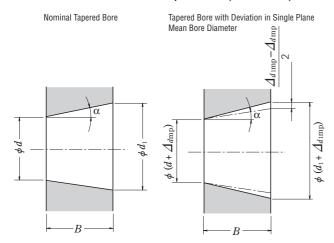
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 r_1 : Chamfer Dimension of Inner/Outer Ring (Front Side) or of Central Washer of Thrust Ball Bearings

Unite : um



Table 7.11 Tolerances for Tapered Bores (Class Normal)



d: Nominal Bore Diameter

 d_1 : Theoretical Diameter of Larger End of Tapered Bore

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

 Δ_{dmp} : Single Plane Mean Bore Diameter Deviation in Theoretical Diameter of Smaller End of Bore $\Delta_{d^{ ext{imp}}}$: Single Plane Mean Bore Diameter Deviation in Theoretical Diameter of Larger End of Bore

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

 \hat{B} : Nominal Inner Ring width

α: Half of Taper Angle of Tapered Bore

Taper 1:12 Taper 1:30 $\alpha = 2^{\circ}23'9.4$ $\alpha = 57'17.4$ =2.38594° =0.95484° =0.041643 rad =0.016665 rad

Taper 1:12

Units: µm

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

Nominal Bo	l	Δ_d	/mp	Δ_{d1mp} -	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	1 250 1 600	+165 +195	0	+105 +125	0	

Notes (1) Applicable to all radial planes of tapered bores.

(2) Not applicable to diameter series 7 and 8.

Taper 1:30

					UI	πιδ. μπ
Nominal Boo	!	Δ_{a}	lmp	Δ_{d1mp} -	V _{dp} (¹) (²)	
over	incl.	high	low	high	low	max.
80 120 180	120 180 250	+20 +25 +30	0 0 0	+35 +40 +46	0 0 0	22 40 46
250 315 400	315 400 500	+35 +40 +45	0 0 0	+52 +57 +63	0 0 0	52 57 63
500	630	+50	0	+70	0	70

(1) Applicable to all radial planes of tapered bores.

(2) Not applicable to diameter series 7 and 8.

Remark For a value exceeding 630 mm, please contact NSK.

7.2 Selection of Accuracy Classes

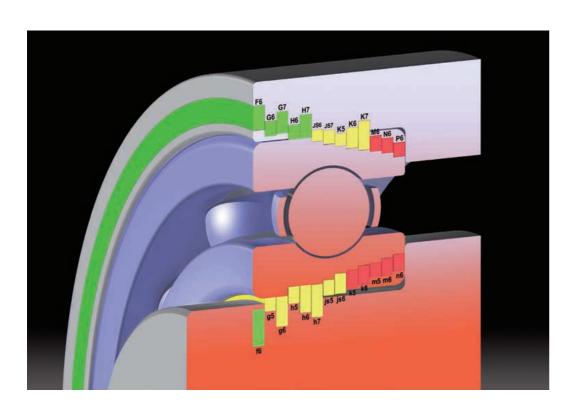
For general applications, Class Normal tolerances are adequate in nearly all cases for satisfactory performance, but for the following applications, bearings having an accuracy class of 5,4 or higher are more suitable.

For reference, in Table 7.12, 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			
	VTR Drum Spindles	P5			
	Magnetic Disk Spindles for Computers	P5, P4, P2			
	Machine-Tool Main Spindles	P5, P4, P2			
High running accuracy	Rotary Printing Presses	P5			
is required	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			
	Dental Drills	CLASS 7P, CLASS 5P			
	Gyroscopes	CLASS 7P, P4			
Extra high speed is	High Frequency Spindles	CLASS 7P, P4			
required	Superchargers	P5, P4			
	Centrifugal Separators	P5, P4			
	Main Shafts of Jet Engines	Higher than P4			
Low torque and low	Gyroscope Gimbals	CLASS 7P, P4			
torque variation are	Servomechanisms	CLASS 7P, CLASS 5P			
required	Potentiometric Controllers	CLASS 7P			

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8. FITS AND INTERNAL CLEARANCES

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8. FITS AND INTERNAL CLEARANCES

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:

$$\Delta d_{\rm F} = 0.08 \sqrt{\frac{d}{B} F_{\rm r}} \times 10^{-3} \dots (N)$$

$$\Delta d_{\rm F} = 0.25 \sqrt{\frac{d}{B} F_{\rm r}} \times 10^{-3} \dots {\rm \{kgf\}}$$

where $\Delta d_{\rm F}$: Interference decrease of inner ring (mm)

d: Bearing bore diameter (mm)
B: Nominal inner ring width (mm)

 $F_{\rm r}$: Radial load applied on bearing

(N), {kgf}

Therefore, the effective interference $\varDelta d$ 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 $C_{\rm or}$, under the operating condition, interference often becomes shortage. Therefore, interference should be estimated using Equation (8.2):

$$\Delta d \ge 0.02 \frac{F_{\rm r}}{B} \times 10^{-3} \dots (N)$$

 $\Delta d \ge 0.2 \frac{F_{\rm r}}{B} \times 10^{-3} \dots {\rm \{kgf\}}$ (8.2)

where Δd : 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 $C_{\rm or}$ 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}

$$\frac{F_{\rm r}}{C_{\rm 0r}} = \frac{98\ 100}{183\ 000} = 0.536 > 0.2$$

Therefore, the required effective interference is calculated using Equation (8.2).

$$\Delta d = 0.02 \times \frac{98\ 100}{32} \times 10^{-3} = 0.061 \ (\text{mm})$$

This result agrees well with Fig. 8.1.



Load Application	Bearing (Operation	Load	Fitting		
	Inner Ring	Outer Ring	Conditions	Inner Ring	Outer Ring	
Load Stationary	Rotating	Stationary	Rotating Inner Ring Load			
Load Rotating O O O O O O O O O O O O O	Stationary	Rotating	Stationary Outer Ring Load	Tight Fit	Loose Fit	
Load Stationary	Stationary	Rotating	Rotating Outer Ring Load	Loose Fit	Tight Fit	
Cod Rotating	Rotating	Stationary	- Stationary Inner Ring Load			
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	

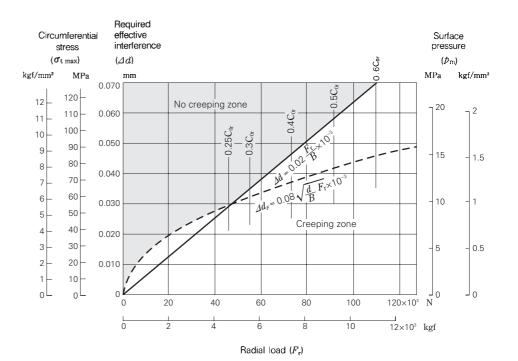


Fig. 8.1 Load and Required Effective Interference for Fit



(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 ΔT (°C), then the temperature difference between the fitted surfaces of the shaft and inner ring is estimated to be about (0.1~0.15) ΔT in case that the shaft is cooled. The decrease in the interference of the inner ring due to this temperature difference $\Delta d_{\rm T}$ may be calculated using Equation (8.3):

$$\Delta d_{\rm T} = (0.10 \text{ to } 0.15) \times \Delta T \cdot \alpha \cdot d$$

 $= 0.0015 \Delta T \cdot d \times 10^{-3} \dots (8.3)$

where $\Delta d_{\rm T}$: Decrease in interference of inner ring due to temperature difference (mm)

 ΔT : Temperature difference between bearing interior and surrounding parts (°C)

 α : Coefficient of linear expansion of bearing steel=12.5×10⁻⁶ (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 ground shafts
$$\Delta d = \frac{d}{d+2} \Delta d_a \dots (8.4)$$

For machined shafts
$$\Delta d = \frac{d}{d+3} \Delta d_a \dots (8.5)$$

where Δd : Effective interference (mm) Δd_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
(MPa) {kgf/mm²}	$\begin{split} & \text{Hollow shaft} \\ & p_{\text{m}} = \frac{2d}{d} \frac{1}{\left[\frac{m_{\text{s}}-1}{m_{\text{s}}E_{\text{s}}} - \frac{m_{i}-1}{m_{i}E_{i}}\right]} + 2\left[\frac{k_{0}^{2}}{E_{\text{s}}(1-k_{0}^{2})} + \frac{1}{E_{i}(1-k^{2})}\right] \\ & \text{Solid shaft} \\ & p_{\text{m}} = \frac{2d}{d} \frac{1}{\left[\frac{m_{\text{s}}-1}{m_{\text{s}}E_{\text{s}}} - \frac{m_{i}-1}{m_{i}E_{i}}\right]} + \frac{2}{E_{i}(1-k^{2})} \end{split}$	Housing outside diameter $p_{\text{m}} = \frac{4D}{D} \frac{1}{\left[\frac{m_{\text{e}}-1}{m_{\text{e}}E_{\text{e}}} - \frac{m_{\text{h}}-1}{m_{\text{b}}E_{\text{h}}}\right]} + 2\left[\frac{h^2}{E_{\text{e}}(1-h^2)} + \frac{1}{E_{\text{h}}(1-h_{\text{e}}^2)}\right]$
Expansion of inner ring raceway ΔD_i (mm) Contraction of outer ring raceway ΔD_e (mm)	$\Delta D_i = 2d \frac{p_m}{E_i} \frac{k}{1 - k^2}$ $= \Delta d \cdot k \frac{1 - k_0^2}{1 - k^2 k_0^2} \text{ (hollow shaft)}$ $= \Delta d \cdot k \text{ (solid shaft)}$	$\Delta D_{\epsilon} = 2D \frac{p_{\text{m}}}{E_{\epsilon}} \frac{h}{1 - h^{2}}$ $= \Delta D \cdot h \frac{1 - h_{0}^{2}}{1 - h^{2}h_{0}^{2}}$
Maximum stress $\sigma_{\rm tmax}$ (MPa) {kgf/mm²}	Circumferential stress at inner ring bore fitting surface is maximum. $\sigma_{\rm tmax} = p_{\rm m} \frac{1+k^2}{1-k^2}$	Circumferential stress at outer ring bore surface is maximum. $\sigma_{\rm tmax} = p_{\rm m} \frac{2}{1-h^2}$
Symbols	d: Shaft diameter, inner ring bore do: Hollow shaft bore Di: Inner ring raceway diameter k = d/Di, ko = do/d Ei: Inner ring Young's modulus, 208 000 MPa {21 200 kgf/mm²} Es: Shaft Young's modulus mi: Inner ring poisson's number, 3.33 ms: Shaft poisson's number	D: Housing bore diameter, outer ring outside diameter Do: Housing outside diameter Do: Outer ring raceway diameter h = Do/D, ho = D/Do Eo: Outer ring Young's modulus, 208 000 MPa {21 200 kgf/mm²} Eh: Housing Young's modulus moe: Outer ring poisson's number, 3.33 mh: 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 $p_{\rm m}$ and maximum stress $\sigma_{\rm t~max}$ 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 $p_{\rm m}$ and maximum stress $\sigma_{\rm t~max}$ when maximum interference occurs.

Fig. 8.4 is convenient for checking whether $\sigma_{\rm t\ max}$ 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 $\sigma_{\rm t}$ and radial stress $\sigma_{\rm r}$ in an inner ring are shown in Fig. 8.2.

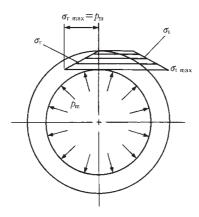


Fig. 8.2 Distribution of Circumferential Stress $\sigma_{\rm t}$ and Radial Stress $\sigma_{\rm r}$

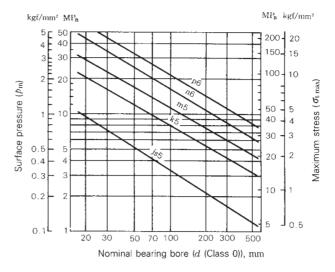


Fig. 8.3 Surface Pressure $p_{\rm m}$ and Maximum Stress $\sigma_{\rm t~max}$ for Mean Interference in Various Tolerance Grades

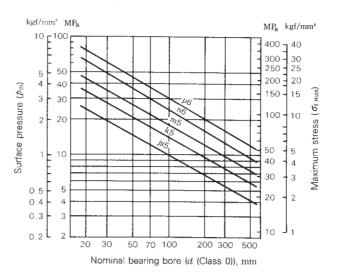


Fig. 8.4 Surface Pressure $p_{\rm m}$ and Maximum Stress $\sigma_{\rm t~max}$ for Maximum Interference in Various Tolerance Grades

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(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).

$$K=\mu p_m \pi d B (N), \{kgf\} \dots (8.6)$$

where μ : Coefficient of friction between fitting surfaces μ =0.12 (for mounting) μ =0.18 (for withdrawal)

p_m: Surface pressure (MPa), {kgf/mm²} For example, inner ring surface pressure can be obtained using Table 8.2.

$$p_{\rm m} = \frac{E}{2} \frac{\Delta d}{d} \frac{(1-k^2)(1-k_0^2)}{1-k^2 k_0^2}$$

- d: Shaft diameter (mm)
- B: Bearing width (mm)
- △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:
- 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:

$$K = 118\ 000\mu\ \Delta d\ B\ (N)$$

= 12\ 000\mu\ \Delta d\ B\ \{kgf\}

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.

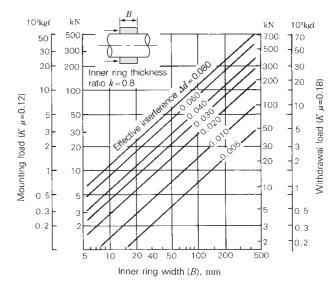


Fig. 8.5 Mounting and Withdrawal Loads for Inner Rings

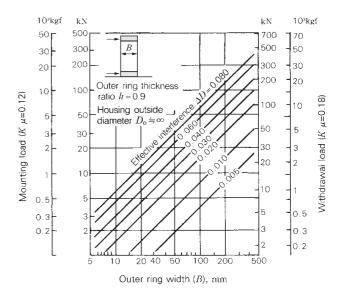


Fig. 8.6 Mounting and Withdrawal Loads for Outer Rings



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).

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Table 8.3 Fits of Radial Bearings with Shafts

			S	Shaft Diameter (mn	1)			
Load	Conditions	Examples	Ball Brgs	Cylindrical Roller Brgs, Tapered Roller Brgs	Spherical Roller Brgs	Tolerance of Shaft	Remarks	
			Radial Bearings	with Cylindrical Bo	ores			
Rotating Outer	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	
Ring Load	Easy axial displacement of inner ring on shaft unnecessary	Tension Pulleys Rope Sheaves		All Shart Diameters		h6	bearings, f6 can be used to allow easy axial movement.	
	Liabtlanda	Electrical Home	<18	_	_	js5		
	Light Loads or Variable Loads $(<0.06C_{\rm r}(^1))$	Appliances Pumps, Blowers, Transport Vehicles, Precision Machinery,	18 to 100	<40	_	js6(j6)		
			100 to 200	40 to 140	_	k6		
		Machine Tools	_	140 to 200	_	m6		
			<18	_	_	js5 or js6 (j5 or j6)		
		Bearings, Gears,	18 to 100	<40	<40	k5 or k6	k6 and m6 can be	
Rotating Inner	Normal Loads (0.06 to $0.13C_{\mathrm{r}}(^{1})$)		100 to 140	40 to 100	40 to 65	m5 or m6	used for single-row	
Ring Load or Direction of			140 to 200	100 to 140	65 to 100	m6	tapered roller bearings and single- row angular contact ball bearings instead of k5 and m5.	
Load			200 to 280	140 to 200	100 to 140	n6		
Indeterminate			_	200 to 400	140 to 280	p6		
		Woodworking Machines	_	_	280 to 500	r6		
		aooo	1	_	over 500	r7		
		Railway Axleboxes,		50 to 140	50 to 100	n6	Manathan ON	
	Heavy Loads or Shock Loads	Industrial Vehicles, Traction Motors,	_	140 to 200	100 to 140	p6	More than CN bearing internal	
	$(>0.13C_{\rm r}(^1))$	Construction Equipment,	_	over 200	140 to 200	r6	clearance is necessary.	
		Crushers	1	_	200 to 500	r7	niccessary.	
Axial	Loads Only			All Shaft Diameters	3	js6 (j6)	_	
		Rad	ial Bearings with	Tapered Bores and	Sleeves			
ΔII Type	es 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.	
ліі Турі	55 of Loauling	Transmission Shafts, Woodworking Spindles		All Ollait Dialifeters	,	h10/IT7(2)		

Notes (¹) C_r represents the basic load rating of the bearing.
(²) Refer to Appendix Table 11 on page E016 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.

Remark 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 A	Axial Load Only	Main Shafts of Lathes	All Shaft Diameters	h6 or js6 (j6)	
Combined	Stationary Inner Ring Load	Cone Crushers	All Shaft Diameters	js6 (j6)	
Radial and Axial Loads	Rotating Inner Ring	Paper Pulp	<200	k6	_
(Spherical Thrust Roller	Load or Direction of Load	Refiners, Plastic	200 to 400	m6	
Bearings)	Indeterminate	Extruders	over 400	n6	

Table 8.5 Fits of Radial Bearings with Housings

	Load Co		Examples	Tolerances for Housing Bores	Axial Displacement of Outer Ring	Remarks	
		Heavy Loads on Bearing in Thin-Walled Housing or Heavy Shock Loads	Automotive Wheel Hubs (Roller Bearings) Crane Travelling Wheels	P7			
	Rotating Outer Ring	Normal or Heavy Loads	Automotive Wheel Hubs (Ball Bearings) Vibrating Screens	N7	- Impossible	_	
Solid Housings	Load	Light or Variable Loads	Conveyor Rollers Rope Sheaves Tension Pulleys	M7	ППроззіліс	_	
		Heavy Shock Loads	Traction Motors				
	Direction of Load Indeterminate	Normal or Heavy Loads	Pumps Crankshaft Main Bearings	K7	Generally Impossible	If axial displacement of the outer ring is not required.	
	muctommato	Normal or Light Loads	Medium and Large Motors(1)	JS7 (J7)	Possible	Axial displacement of outer ring is necessary.	
Solid or Split		Loads of All kinds	General Bearing Applications, Railway Axleboxes	Н7			
Housings		Normal or Light Loads	Plummer Blocks	Н8	Easily possible	_	
	Rotating Inner Ring Load	High Temperature Rise of Inner Ring Through Shaft	Paper Dryers	G7			
	Loau	Accurate Running Desirable under	Grinding Spindle Rear Ball Bearings High Speed Centrifugal Compessor Free Bearings	JS6 (J6)	Possible	_	
Solid Housing	Direction of Load Indeterminate	Normal or Light Loads	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	Accurate Running and High Rigidity Desirable under Variable Loads	Cylindrical Roller Bearings for Machine Tool Main Spindle	M6 or N6	Impossible		
	Inner Ring Load	Minimum noise is required.	Electrical Home Appliances	Electrical Home H6 Easily		_	

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
		Thrust Ball	Clearance over 0.25mm	For General Applications
		Bearings	H8	When precision is required
	Axial Loads Only	Spherical Thrust Roller Bearings Steep Angle Tapered Roller Bearings	Outer ring has radial clearance.	When radial loads are sustained by other bearings.
Combined Radial	Stationary Outer Ring Loads	Spherical Thrust	H7 or JS7 (J7)	_
and Axial	Rotating Outer Ring Loads or	Roller Bearings	K7	Normal Loads
Loads	Direction of Load Indeterminate		M7	Relatively Heavy Radial Loads

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Table 8.7 Fits of Inch Design Tapered Roller Bearings with Shafts

(1) Bearings of Precision Classes 4 and 2

Inits: um

_ '	200go 0									Units : µm
One	rating Conditions		Nominal Bore	e Diameters d	Bore Diameter Tolerances Δ_{ds}		Shaft Diameter Tolerances		- Remarks	
Ope	ating conditions	OV	er	inc	ol.					Hemans
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low	
		_	=	76.200	3.0000	+13	0	+ 38	+ 25	
_	Normal Loads	76.200	3.0000	304.800	12.0000	+25	0	+ 64	+ 38	For bearings with $d \le 152.4$ mm,
s s	NOTHIAI LUAUS	304.800	12.0000	609.600	24.0000	+51	0	+127	+ 76	clearance is usually larger than CN.
glad		609.600	24.0000	914.400	36.0000	+76	0	+190	+114	
Rotating Inner Ring Loads	Heavy Loads	_	_	76.200	3.0000	+13	0	+ 64	+ 38	In general, bearings with a clear-
를	Shock Loads	76.200	3.0000	304.800	12.0000	+25	0	*		ance larger than CN are used.
	High Speeds	304.800	12.0000	609.600	24.0000	+51	0	*		* means that the average
	mg. opecas	609.600	24.0000	914.400	36.0000	+76	0	+381	+305	interference is about 0.0005 d .
		_	_	76.200	3.0000	+13	0	+ 13	0	The inner ring cannot be displaced axially
-		76.200	3.0000	304.800	12.0000	+25	0	+ 25	0	When heavy or shock loads exist, the
S		304.800	12.0000	609.600	24.0000	+51	0	+ 51	0	figures in the above (Rotating inner ring
oad oad	Normal Loads	609.600	24.0000	914.400	36.0000	+76	0	+ 76	0	loads, heavy or shock loads) apply.
atir g L	without Shocks	_		76.200	3.0000	+13	0	0	- 13	
Rotating Outer Ring Loads		76.200	3.0000	304.800	12.0000	+25	0	0	- 25	The inner ring can be displaced
		304.800	12.0000	609.600	24.0000	+51	0	0	- 51	axially.
		609.600	24.0000	914.400	36.0000	+76	0	0	- 76	

(2) Bearings of Precision Classes 3 and 0 (1)

Units: µm

										οιπιο . μπ	
One	rating Conditions	Nominal Bore Diameters $oldsymbol{d}$					$\begin{array}{c} \text{Bore Diameter} \\ \text{Tolerances} \\ \Delta_{d\text{s}} \end{array} \hspace{-0.5cm} \text{Shaft Diameter} \\ \text{Tolerances} \end{array}$			Remarks	
Ope	rating conditions	OV	er	ind	ol.					Hemans	
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low		
	Drasisian	_	_	76.200	3.0000	+13	0	+ 30	+18		
_	Precision Machine-Tool	76.200	3.0000	304.800	12.0000	+13	0	+ 30	+18		
s ne	Main Spindles	304.800	12.0000	609.600	24.0000	+25	0	+ 64	+38	_	
glr	Ividiii Opiiidioo	609.600	24.0000	914.400	36.0000	+38	0	+102	+64		
Rotating Inner Ring Loads	Hansul anda	_		76.200	3.0000	+13	0	_			
3ot	Heavy Loads Shock Loads	76.200	3.0000	304.800	12.0000	+13	0	_	_	A minimum interference of about	
	High Speeds	304.800	12.0000	609.600	24.0000	+25	0	_	_	0.00025 d is used.	
	riigii opoodo	609.600	24.0000	914.400	36.0000	+38	0	_			
nter	Drasisian	_	_	76.200	3.0000	+13	0	+ 30	+18		
g Or	Precision Machine-Tool	76.200	3.0000	304.800	12.0000	+13	0	+ 30	+18		
Rotating Outer Ring Loads	Main Spindles	304.800	12.0000	609.600	24.0000	+25	0	+ 64	+38	_	
쨢둞	iviani opinalos	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

One	rating Conditions	Nominal Outside Diameters D					Outside Diameter Tolerances $\varDelta_{D\mathrm{s}}$		ig Bore neter ances	- Remarks	
Орс	rating conditions	01	ver	ind	l.					Hemarks	
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low		
		-		76.200	3.0000	+25	0	+ 76	+ 51		
	Used either	76.200	3.0000	127.000	5.0000	+25	0	+ 76	+ 51	The outer ring can be easily	
	on free-end or	127.000	5.0000	304.800	12.0000	+25	0	+ 76	+ 51	displaced axially.	
g	fixed-end	304.800	12.0000	609.600	24.0000	+51	0	+152	+102	displaced axially.	
Loads		609.600	24.0000	914.400	36.0000	+76	0	+229	+152		
ω		-	_	76.200	3.0000	+25	0	+ 25	0		
Ring	The outer ring position can be adjusted axially.	76.200	3.0000	127.000	5.0000	+25	0	+ 25	0	The outer ring can be displaced	
ner		127.000	5.0000	304.800	12.0000	+25	0	+ 51	0	axially.	
n n		304.800	12.0000	609.600	24.0000	+51	0	+ 76	+ 25	ariany.	
Rotating Inner		609.600	24.0000	914.400	36.0000	+76	0	+127	+ 51		
ota	The autor sine	=	_	76.200	3.0000	+25	0	- 13	- 38		
<u>~</u>	The outer ring position cannot	76.200	3.0000	127.000	5.0000	+25	0	- 25	- 51	Generally, the outer ring is fixed	
	be adjusted	127.000	5.0000	304.800	12.0000	+25	0	- 25	- 51	axially.	
	axially.	304.800	12.0000	609.600	24.0000	+51	0	- 25	- 76	ariany.	
	,	609.600	24.0000	914.400	36.0000	+76	0	- 25	-102		
ıter	Normal Loads	-	_	76.200	3.0000	+25	0	- 13	- 38		
5 S S	The outer ring	76.200	3.0000	127.000	5.0000	+25	0	- 25	- 51		
Rotating Outer Ring Loads	position cannot	127.000	5.0000	304.800	12.0000	+25	0	- 25	- 51	The outer ring is fixed axially.	
otat ng	be adjusted	304.800	12.0000	609.600	24.0000	+51	0	- 25	- 76		
<u> </u>	axially.	609.600	24.0000	914.400	36.0000	+76	0	- 25	-102		

(2) Bearings of Precision Classes 3 and 0 (1)

Units : μm

One	rating Conditions	ominal Outsid	de Diameters L	e Diameters D			Housing Bore Diameter Tolerances		- Remarks		
Ope	rating conditions	OV	er	incl.						Hemaiks	
		(mm)	1/25.4	(mm)	1/25.4	high	low	high	low		
		_	_	152.400	6.0000	+13	0	+38	+25		
	Used on free-	152.400	6.0000	304.800	12.0000	+13	0	+38	+25	The outer ring can be easily	
	end	304.800	12.0000	609.600	24.0000	+25	0	+64	+38	displaced axially.	
		609.600	24.0000	914.400	36.0000	+38	0	+89	+51		
ads		_	_	152.400	6.0000	+13	0	+25	+13		
2	Used on fixed-	152.400	6.0000	304.800	12.0000	+13	0	+25	+13	The outer ring can be displaced	
ing	end	304.800	12.0000	609.600	24.0000	+25	0	+51	+25	axially.	
r.		609.600	24.0000	914.400	36.0000	+38	0	+76	+38		
Rotating Inner Ring Loads	The autor sine	_		152.400	6.0000	+13	0	+13	0		
l gr	The outer ring position can be	152.400	6.0000	304.800	12.0000	+13	0	+25	0	Generally, the outer ring is fixed	
ati	adjusted axially.	304.800	12.0000	609.600	24.0000	+25	0	+25	0	axially.	
Rot	adjusted analy.	609.600	24.0000	914.400	36.0000	+38	0	+38	0		
	The outer ring	_	_	152.400	6.0000	+13	0	0	-13		
	position cannot	152.400	6.0000	304.800	12.0000	+13	0	0	-25	The outer ring is fixed axially.	
	be adjusted	304.800	12.0000	609.600	24.0000	+25	0	0	-25	The outer fing is fixed axially.	
	axially.	609.600	24.0000	914.400	36.0000	+38	0	0	-38		
ter	Normal Loads	_	-	76.200	3.0000	+13	0	-13	-25		
Rotating Outer Ring Loads	The outer ring	76.200	3.0000	152.400	6.0000	+13	0	-13	-25		
ing	position cannot		6.0000	304.800	12.0000	+13	0	-13	-38	The outer ring is fixed axially.	
otat	be adjusted	304.800	12.0000	609.600	24.0000	+25	0	-13	-38		
<u> </u>	axially.	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.

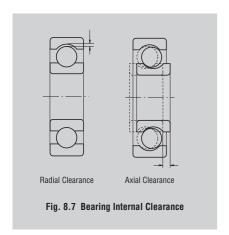
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8.2 Bearing Internal Clearances

8.2.1 Internal Clearances 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 clearances between the inner/outer rings and rolling elements. The radial and axial clearances are defined as the total amount that one ring can be displaced relative to the other in the radial and axial directions respectively (Fig. 8.7).



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

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 Clearances by Bearing Types

Be	earing Types	Table Number	Page Number
Deep Groove Ba	all Bearings	8.10	A169
Extra Small and	Miniature Ball Bearings	8.11	A169
Magneto Bearin	gs	8.12	A169
Self-Aligning Ba	ıll Bearings	8.13	A170
Deep Groove Ball Bearings	Fan Mataur	8.14.1	A170
Cylindrical Roller Bearings	For Motors	8.14.2	A170
Cylindrical Roller Bearings	With Cylindrical Bores With Cylindrical Bores (Matched) With Tapered Bores (Matched)	8.15	A171
Spherical Roller Bearings	With Cylindrical Bores With Tapered Bores	8.16	A172
Double-Row an Roller Bearings	d Combined Tapered	8.17	A173
Combined Angu Bearings (1)	ılar Contact Ball	8.18	A174
Four-Point Cont	act Ball Bearings (1)	8.19	A174

Note (1) Values given are axial clearances.

Table 8.10 Radial Internal Clearances in Deep Groove Ball Bearings

Units: um

Nominal Bo Diameter						Clear	ance				
d (mm)		C	2	С	N	С	3	C	4	С	25
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
10 only 10 18	18 24	0 0 0	7 9 10	2 3 5	13 18 20	8 11 13	23 25 28	14 18 20	29 33 36	20 25 28	37 45 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
120	120	2	20	15	41	36	66	61	97	90	140
	140	2	23	18	48	41	81	71	114	105	160
	160	2	23	18	53	46	91	81	130	120	180
180	180	2	25	20	61	53	102	91	147	135	200
	200	2	30	25	71	63	117	107	163	150	230
	225	2	35	25	85	75	140	125	195	175	265
250	250	2	40	30	95	85	160	145	225	205	300
	280	2	45	35	105	90	170	155	245	225	340
	315	2	55	40	115	100	190	175	270	245	370
355	355	3	60	45	125	110	210	195	300	275	410
	400	3	70	55	145	130	240	225	340	315	460
	450	3	80	60	170	150	270	250	380	350	510
500	500	3	90	70	190	170	300	280	420	390	570
	560	10	100	80	210	190	330	310	470	440	630
	630	10	110	90	230	210	360	340	520	490	690
	710	20	130	110	260	240	400	380	570	540	760
	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 Dia. d (r		Meas Lo			lial Cle ount	arance	Correc	tion
over	incl.	(N)	au {kgf}	C2	CN	СЗ	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

Remark For values exceeding 280 mm, please contact NSK.

Table 8.11 Radial Internal Clearances in Extra **Small and Miniature Ball Bearings**

Units: µm

Clear- ance Symbol	М	C1	M	C2	M	СЗ	М	C4	M	C5	M	C6
	min.	max.										
Clear- ance	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: um

Clearance Symbol	MC1	MC2	мс3	MC4	MC5	MC6
Clearance Correction Value	1	1	1	1	2	2

The measuring loads are as follows:

For miniature ball bearings* 2.5N {0.25kgf}

For extra small ball bearings* 4.4N {0.45kgf}

*For their classification, refer to Table 1 on Page C054.

Table 8.12 Radial Internal Clearances in **Magneto Bearings**

			Offica .	μ 1111
Nomina Diam d (n	eter	Bearing Series	Clea	rance
over	incl.		min.	max.
2.5	20	EN	10	50
2.5	30	Е	30	60

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Table 8.13 Radial Internal Clearances in Self-Aligning Ball Bearings

Units: µm

Nominal			Cl	earanc	e in Be	arings	with C	ylindri	cal Bo	res			(Clearan	ce in B	earing	s with	Tapere	d Bore	IS.	
Dia. d (mm)	C	2	C	N	(3	C	4	C	5	(22	C	N	C	3	C	4	C	25
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 10	6 10 14	1 2 2	8 9 10	5 6 6	15 17 19	10 12 13	20 25 26	15 19 21	25 33 35	21 27 30	33 42 48	=	Ξ	=	=		Ξ		Ξ	=	=
14 18 24	18 24 30	3 4 5	12 14 16	8 10 11	21 23 24	15 17 19	28 30 35	23 25 29	37 39 46	32 34 40	50 52 58	7 9	 17 20	13 15	26 28	20 23	33 39	28 33	42 50	37 44	 55 62
30 40 50	40 50 65	6 6 7	18 19 21	13 14 16	29 31 36	23 25 30	40 44 50	34 37 45	53 57 69	46 50 62	66 71 88	12 14 18	24 27 32	19 22 27	35 39 47	29 33 41	46 52 61	40 45 56	59 65 80	52 58 73	72 79 99
65 80 100	80 100 120	8 9 10	24 27 31	18 22 25	40 48 56	35 42 50	60 70 83	54 64 75	83 96 114	76 89 105	108 124 145	23 29 35	39 47 56	35 42 50	57 68 81	50 62 75	75 90 108	69 84 100	98 116 139	91 109 130	123 144 170
120 140	140 160	10 15	38 44	30 35	68 80	60 70	100 120	90 110	135 161	125 150	175 210	40 45	68 74	60 65	98 110	90 100	130 150	120 140	165 191	155 180	205 240

Table 8.14 Radial Internal Clearances in Bearings for Electric Motors

Table 8.14. 1 Deep Groove Ball Bearings for Electric Motors

				Units	3:μm
Nominal E	Bore	Clea	rance	Ren	narks
Dia. d (m	ım)	С	M	Recomn	nended fit
over	incl.	min.	max.	Shaft	Housing Bore
10 (incl)	18	4	11	js5 (j5)	
18	30	5	12		
30	50	9	17		H6, H7(1)
50	80	12	22	k5	or
50	00	12	22		JS6, JS7
80	100	18	30		(J6, J7)(²)
100	120	18	30		
100	120	10	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.

Remark 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 $\text{Units:} \, \mu m$

Nomina			Clear	rance		F	Remarks
Dia. d	(mm)	Interchan	geable CT	Non-Intercha	angeable CM	Reco	mmended Fit
over	incl.	min.	max.	min.	max.	Shaft	Housing Bore
24	40	15	35	15	30	k5	
40	50	20	40	20	35		
50	65	25	45	25	40		
65	80	30	50	30	45		
80	100	35	60	35	55	m5	JS6, JS7 (J6, J7)(1)
100	120	35	65	35	60		or
120	140	40	70	40	65		K6, K7(2)
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 Clearances in Cylindrical Roller Bearings and Solid-Type Needle Roller Bearings

Units : μm

	ninal e Dia.					ances Cylind									Cleara	nces ir w			angeal I Bores		rings		
d (mm)	C	2	С	N	C	3	C	4	C	5	C	C1	C	CC2	CC	(1)	C	C3	C	C4	C	C5
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 24	10 24 30	0 0 0	25 25 25	20 20 20	45 45 45	35 35 35	60 60 60	50 50 50	75 75 75	65 70	90 95	 5 5	15 15	10 10	 20 25		30 35	35 40	45 50	45 50	55 60	65 70	75 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
200	200	35	90	90	145	140	195	195	250	275	330	15	45	40	80	80	120	140	180	180	220	275	315
	225	45	105	105	165	160	220	220	280	305	365	15	50	45	90	90	135	155	200	200	240	305	350
	250	45	110	110	175	170	235	235	300	330	395	15	50	50	100	100	150	170	215	215	265	330	380
280	280	55	125	125	195	190	260	260	330	370	440	20	55	55	110	110	165	185	240	240	295	370	420
	315	55	130	130	205	200	275	275	350	410	485	20	60	60	120	120	180	205	265	265	325	410	470
	355	65	145	145	225	225	305	305	385	455	535	20	65	65	135	135	200	225	295	295	360	455	520
355		100	190	190	280	280	370	370	460	510	600	25	75	75	150	150	225	255	330	330	405	510	585
400		110	210	210	310	310	410	410	510	565	665	25	85	85	170	170	255	285	370	370	455	565	650
450		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

1	Man	election and															σιπισ . μ	
	Bore	ninal					Clearar	ices in N	on-Inter	changea	ble Bear	ings wit	h Tapere	d Bores				
	<i>d</i> (r		CC	9 (1)	C	C0	С	C1	C	C2	CC	C (2)	C	C3	C	C4	С	C5
	over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
	10 24 30	24 30 40	5 5 5	10 10 12	_ 8 8	— 15 15	10 10 12	20 25 25	20 25 25	30 35 40	35 40 45	45 50 55	45 50 55	55 60 70	55 60 70	65 70 80	75 80 95	85 95 110
	40 50 65	50 65 80	5 5 10	15 15 20	10 10 15	20 20 30	15 15 20	30 35 40	30 35 40	45 50 60	50 55 70	65 75 90	65 75 90	80 90 110	80 90 110	95 110 130	110 130 150	125 150 170
	80 100 120	100 120 140	10 10 15	25 25 30	20 20 25	35 35 40	25 25 30	45 50 60	45 50 60	70 80 90	80 95 105	105 120 135	105 120 135	125 145 160	125 145 160	150 170 190	180 205 230	205 230 260
	140 160 180	160 180 200	15 15 20	35 35 40	30 30 30	50 50 50	35 35 40	65 75 80	65 75 80	100 110 120	115 125 140	150 165 180	150 165 180	180 200 220	180 200 220	215 240 260	260 285 315	295 320 355
	200 225 250	225 250 280	20 25 25	45 50 55	35 40 40	60 65 70	45 50 55	90 100 110	90 100 110	135 150 165	155 170 185	200 215 240	200 215 240	240 265 295	240 265 295	285 315 350	350 380 420	395 430 475
	280 315 355	315 355 400	30 30 35	60 65 75		_	60 65 75	120 135 150	120 135 150	180 200 225	205 225 255	265 295 330	265 295 330	325 360 405	325 360 405	385 430 480	470 520 585	530 585 660
	400 450	450 500	40 45	85 95	_	=	85 95	170 190	170 190	255 285	285 315	370 410	370 410	455 505	455 505	540 600	650 720	735 815

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.

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Table 8.16 Radial Internal Clearances in Spherical Roller Bearings

Units : μm

	ninal Dia.		(Cleara	nce in	Bear	ngs wit	th Cylin	drical B	ores				Cle	arance	in Beari	ngs wit	h Taper	ed Bore	S	
	mm)	(22	С	N	(23	C	4	C	5	C	22	(CN	C	23	С	4	(25
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	1 300	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		1 670	—	—
1 120	1 250	320	580	580	860	860	1 120	1 120	1 460	—	—	570	830	830	1 120	1 120	1 420		1 830	—	—
1 250	1 400	350	640	640	950	950	1 240	1 240	1 620	—	—	620	910	910	1 230	1 230	1 560		2 000	—	—

Table 8.17 Radial Internal Clearances in Double-Row and Combined Tapered Roller Bearings

Units : μm

	ndrical		Clearance										
Bore Tape	red Bore	C	21	C	2	С	N	C	3	C	24	C	5
Nominal Bo Dia. d (mn		-	_	C	1	C	2	С	N	C	23	C	4
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
18 24	18 24 30	0 0 0	10 10 10	10 10 10	20 20 20	20 20 20	30 30 30	35 35 40	45 45 50	50 50 50	60 60 60	65 65 70	75 75 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 1 250	1 120 1 250 1 400	130 150 170	190 210 240	200 220 250	260 280 320	400 450 500	460 510 570	600 670 750	700 770 870		=	_ _ _	

Remark Axial internal clearance $\Delta_a = \Delta_r \cot \alpha = \frac{1.5}{e} \Delta_r$

where Δ_r : Radial internal clearance α : Contact angle e: Constant (Listed in bearing tables)

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Table 8.18 Axial Internal Clearances in Combined Angular Contact Ball Bearings (Measured Clearance)

Units: µm

Nomin	Nominal Bore		Axial Internal Clearance										
Dian	neter.			Contact	Angle 30°					Contact A	Angle 40°		
d (mm)		C	N		3	C	24	C	N	C	3	C	24
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

Remark This table is applicable to bearings in Tolerance Classes Normal and 6. For internal axial clearances 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 Clearances)

Units: µm

			Units : µm								
	al Bore			Axia	I Intern	al Clear	ance				
Dia. d	Dia. d (mm)		2	С	N	C	3	C	24		
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.		
10	18	15	55	45	85	75	125	115	165		
18	40	26	66	56	106	96	146	136	186		
40	60	36	86	76	126	116	166	156	206		
60	80	46	96	86	136	126	176	166	226		
80	100	56	106	96	156	136	196	186	246		
100	140	66	126	116	176	156	216	206	266		
140	180	76	156	136	196	176	246	226	296		
180	220	96	176	156	226	206	276	256	326		
220	260	115	196	175	245	225	305	285	365		
260	300	135	215	195	275	255	335	315	395		
300	350	155	235	215	305	275	365	345	425		
350	400	175	265	245	335	315	405	385	475		
400	500	205	305	285	385	355	455	435	525		

8.2.2 Selection of Bearing Internal Clearances

Among the bearing internal clearances 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 ($P = 0.1C_r$), 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 \varDelta_0 is called the residual clearance, $\varDelta_{\rm f}$.

(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:

$$\delta_t = \alpha \Delta_t D_e$$
.....(8.8)

where δ_t: Decrease in radial clearance due to temperature difference between inner and outer rings (mm)

 α : Coefficient of linear expansion of bearing steel \rightleftharpoons 12.5 \times 10⁻⁶ (1/°C)

 Δ_t : Temperature difference between inner and outer rings (°C)

 $D_{\rm e}$: Outer ring raceway diameter (mm)

For ball bearings

$$D_{\rm e} = \frac{1}{5} (4D + d) \dots (8.9)$$

For roller bearings

$$D_{\rm e} = \frac{1}{4} (3D + d) \dots (8.10)$$

The clearance after substracting this δ_+ from the residual clearance. Δ_f is called the effective clearance. Δ . 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 clearances used in some specific applications are given in Table 8.20. Under special operating conditions, it is advisable to consult NSK.

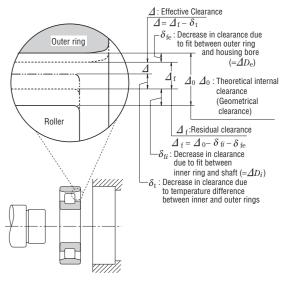


Fig. 8.8 Changes in Radial Internal Clearance of Bearings

Table 8. 20 Examples of Clearances 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	Dryers in paper making machines	C3, C4		
roller shafts are heated.	Table rollers for rolling mills	C3		
When impact loads and	Traction motors for railways	C4		
When impact loads and vibration are severe or	Vibrating screens	C3, C4		
when both the inner and outer rings are tight-	Fluid couplings	C4		
fitted.	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		

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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 Δl due to temperature rise can be expressed as in Equation (8.11) below:

$$\Delta l = \Delta T \alpha l \text{ (mm)} \cdots (8.11)$$

where, Δl : Dimentional change (mm)

 ΔT : temperature rise (°C)

 α : Coefficient of linear expansion for bearing steel α =12.5×10⁻⁶ (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 Δl =0.105 and a horizontal axis l=110 is determined on a diagram. ΔT is located in the temperature range between 70°C and 80°C (ΔT =77°C). Therefore, it is enough to set the inner ring heating temperature to the room temperature +80°C.

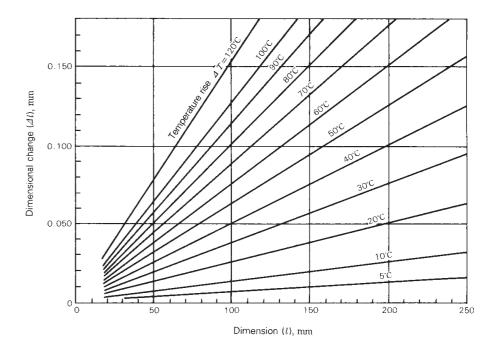


Fig. 8.9 Temperature Rise and Dimensional Change of Bearing Steel

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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 $\varDelta D_{\mathrm{T}}$ of clearance or interference of a fitting surface of a bearing's outer ring due to temperature rise is expressed by the following equation:

$$\Delta D_{\mathrm{T}} = (\alpha_1 \cdot \Delta T_1 - \alpha_2 \cdot \Delta T_2)D \text{ (mm) } \cdots (8.12)$$

where $\Delta D_{\rm T}$: Change of clearance or interference at fitting surface due to temperature rise

Coefficient of linear expansion of housing $(1/^{\circ}C)$

 ΔT_1 : Housing temperature rise near fitting surface ($^{\circ}C$)

Coefficient of linear expansion of bearing outer ring Bearing steel $\alpha_2 = 12.5 \times 10^{-6} (1/^{\circ}C)$

 ΔT_2 : Outer ring temperature rise near fitting surface ($^{\circ}C$)

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, $(\Delta T_1 = \Delta T_2 = \Delta T)$, Equation (8.13) becomes,

$$\Delta D_{\rm T} = (\alpha_1 - \alpha_2) \Delta T \cdot D \text{ (mm)} \cdots (8.13)$$

where ΔT : Temperature rise of outer ring and housing near fitting surfaces (${}^{\circ}C$)

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 9×10^{-5} . Equation (8.13) can be shown as in Fig. 8.11.

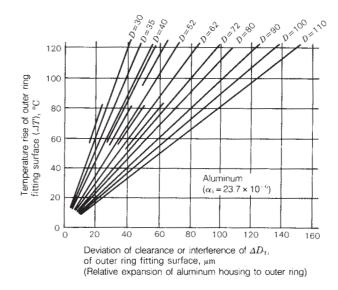
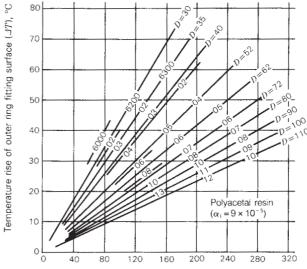


Fig. 8.10 Aluminum Housing



Deviation of clearance or interference $\Delta D_{\rm T}$ of outer ring fitting surface, um (Relative expansion of polyacetal resin housing to outer ring)

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_{st}) and standard deviation (σ_{st}) of the internal clearance after mounting (residual clearance) can be calculated. Measurements are given in units of millimeters (mm).

$$\sigma_{\rm s} = \frac{R_{\rm s}/2}{3} = 0.0018$$

$$\sigma_i = \frac{R_i/2}{3} = 0.0020$$

$$\sigma_{\Delta_0} = \frac{R_{\Delta_0}/2}{3} = 0.0028$$

$$\sigma_{\rm f}^{2} = \sigma_{\rm s}^{2} + \sigma_{i}^{2}$$

 $m_{\Delta f} = m_{\Delta 0} - \lambda_i \ (m_s - m_i) = 0.0035$

$$\sigma_{\Delta f} = \sqrt{\sigma_{\Delta 0}^2 + \lambda_i^2 \sigma_f^2} = 0.0035$$

where, σ_s : Standard deviation of shaft diameter

 σ_i : Standard deviation of bore diameter

 σ_{i} : Standard deviation of interference

 σ_{a_0} : Standard deviation of radial clearance (before mounting)

 σ_{a_i} : 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_{a_0} : Mean value of radial clearance (before mounting) (0.014)

 $m_{\Delta_{\rm f}}$: Mean value of residual clearance (after mounting)

 $R_{\rm s}$: Shaft tolerance (0.011)

 R_i : Bearing bore tolèrance (0.012)

 $\vec{R}_{\perp 0}$: Range in radial clearance (before mounting) (0.017)

 λ_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 λ_i ($m_{\rm m}$ - m_i).

To determine, wihtin a 99.7% probability, the variation in internal clearance after mounting (R_{Af}) , 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 $(m_{\it sf})$ is +0.0035, and the range is from -0.007 to +0.014 for a 6310 bearing.

Hr	าเา	S	•	m	ır

Shaft diameter	ϕ 50 $^{+0.013}_{+0.002}$
Bearing bore diameter, (d)	ϕ 50 $\begin{array}{c} 0 \\ -0.012 \end{array}$
Radial internal clearance	0.006 to 0.023(1)

Note (1) Standard internal clearance, unmounted

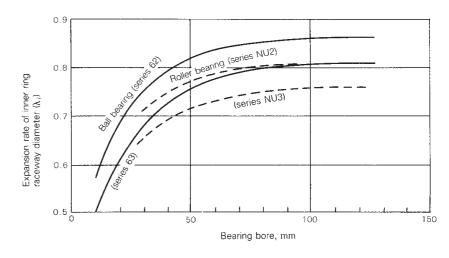


Fig. 8.12 Rate of Inner Ring Raceway Expansion (λ_i) from Apparent Interference

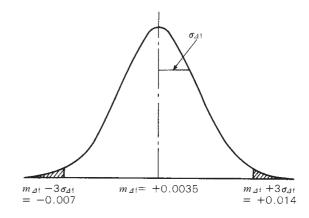


Fig. 8.13 Distribution of Residual Internal Clearance

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 (ΔD_i) is given in Equation (8.14).

$$\Delta D_i = \Delta d \ k \frac{1 - k_0^2}{1 - k^2 k_0^2} \cdots (8.14)$$

where, Δd : Effective interference (mm)

k: Ratio of bore to inner raceway diameter; k=d/D:

 k_0 : Ratio of inside to outside diameter of hollow shaft: $k_0 = d_0/D$:

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 d_0 =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

 $30~\mu m$, the amount of raceway expansion, or, the amount of decrease in the radial clearance from the fit is $0.73{\times}30{=}22~\mu m$.

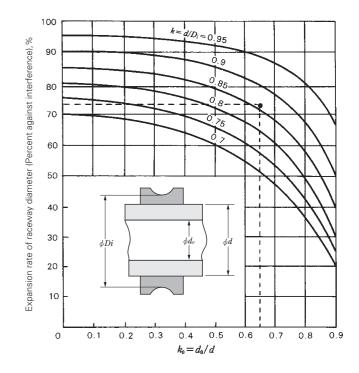


Fig. 8.14 Raceway Expansion in Relation to Bearing Fit (Inner Ring Fit upon Steel Shaft)

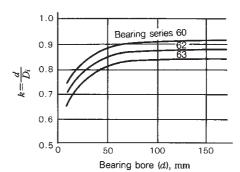


Fig. 8.15 Ratio of Bore Size to Raceway Diameter for Single Row Deep Groove Ball Bearings

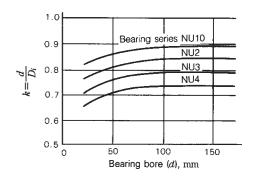


Fig. 8.16 Ratio of Bore Size to Raceway Diameter for Cylindrical Roller Bearings

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 $\Delta D_{\rm e}$ is calculated using Equation (8.15).

$$\Delta D_{\rm e} = \Delta D \cdot h \cdot \frac{1 - h_0^2}{1 - h^2 h_0^2} \cdots (8.15)$$

where, ΔD : Effective interference (mm)

h: Ratio between raceway dia. and outside dia. of outer ring, $h=D_o/D$

 h_0 : Housing thickness ratio, h_0 = D/D_0

D: Bearing outside diameter (housing bore diameter) (mm)

D_a: 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 $0.71\!\times\!18\!=\!13\,\mu m$.

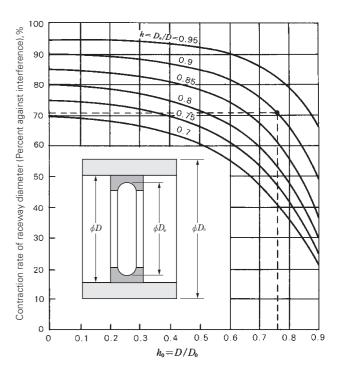


Fig. 8.17 Raceway Contraction in Relation to Bearing Fit (Outer Ring Fit in Steel Housing)

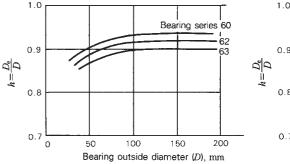


Fig. 8.18 Ratio of Outside Diameter to Raceway
Diameter for Single Row Deep Groove
Ball Bearings

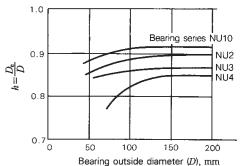


Fig. 8.19 Ratio of Outside Diameter to Raceway Diameter for Cylindrical Roller Bearings

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 $f_{\rm A} = T_{\rm A} B_{\rm A}$.
- (2) Next, as shown in Fig. 8.23, use the same procedure to measure the other bearing B for its offset $f_0 = T_0 B_0$.
- (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 Δ_n 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):

$$\Delta_{a} = (L-K)-(f_{A}+f_{B})$$
(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 Δ_r =110 to 140 μ m.

To compare this specification with the offset measurement results, convert it into an axial clearance Δ , by using Equation (8.17):

$$\Delta_{\mathbf{a}} = \Delta_{\mathbf{r}} \cot \alpha = \Delta_{\mathbf{r}} \frac{1.5}{e}$$
(8.17)

where, e: Constant determined for each bearing No. (Listed in the Bearing Tables of NSK Rolling Bearings Catalog)

referring to the said catalog (Page C205), with use of e=0.44, the following is obtained:

$$\Delta_{a}$$
=(110 to 140)× $\frac{1.5}{e}$
= 380 to 480 μ m

It is possible to confirm that the bearing clearance is C3, by verifying that the axial clearance Δ_a of Equation (8.16) (obtained by the bearing offset measurement) is within the above mentioned range.

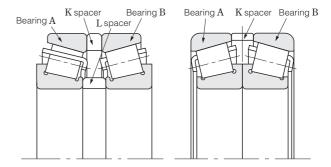


Fig. 8.20 DB Arrangement

Fig. 8.21 DF Arrangement

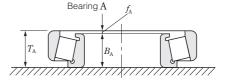


Fig. 8.22

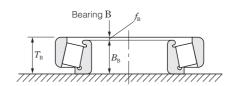


Fig. 8.23

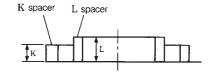


Fig. 8.24

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 Δ , and axial clearance Δ , is as follows:

$$\Delta_{a} = \Delta_{r} \cot \alpha = \Delta_{r} \frac{1.5}{e}$$

where, α : 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.

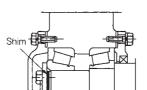


Fig. 8.25 DB Arrangement whose Clearance is Adjusted by Inner Rings.

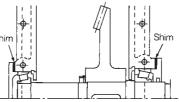


Fig. 8.26 DF Arrangement
whose Clearance is
Adjusted by Outer
Rings.



Fig. 8.27 Examples of Clearance Adjusted by Shim Thickness of Outer Ring Cover

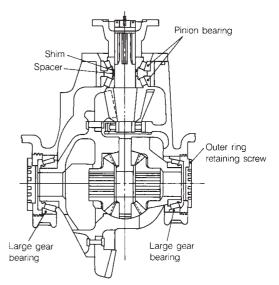


Fig. 8.28 Automotive Final Reduction Gear

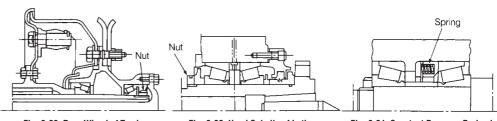
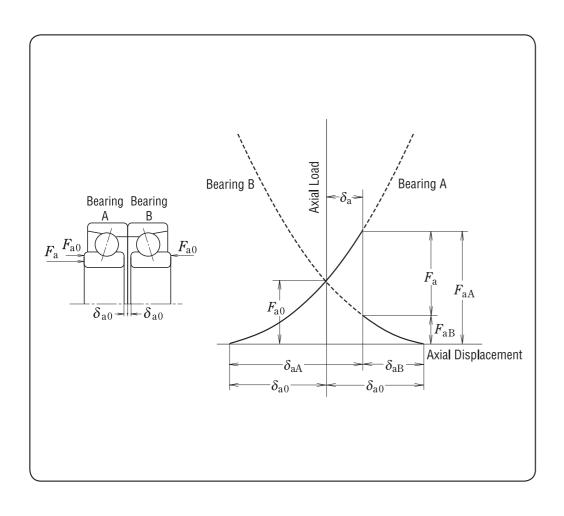


Fig. 8.29 Rear Wheel of Truck

Fig. 8.30 Head Spindle of Lathe

Fig. 8.31 Constant Pressure Preload
Applied by Spring



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9. PRELOAD

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 faceto-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

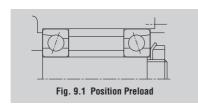
A position preload is achieved by fixing two axially opposed bearings in such a way that a preload is imposed on them. Their position, once fixed, remain unchanged while in operation.

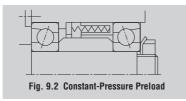
In practice, the following three methods are generally used to obtain a position preload.

- (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)

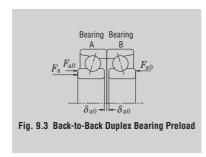




9.3 Preload and Rigidity

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 δ_{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.



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 $F_{\rm a0}$ 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.

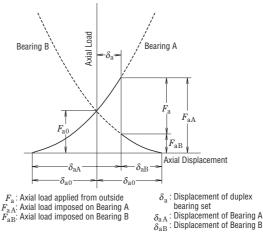


Fig. 9.4 Axial Displacement with Position Preload

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.

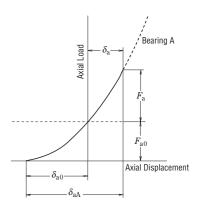


Fig. 9.5 Axial Displacement with Constant-Pressure Preload

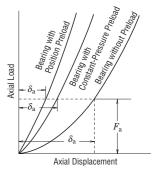


Fig. 9.6 Comparison of Rigidities and Preloading Methods

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 $D_{\mathrm{pw}} \times n$ ($d_{\mathrm{m}} n$ 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 b		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 outs	side diameter	Shaft and	Housing and		
			•		
$d ext{ or } I$) (mm)	inner ring	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

	Extra l	ight EL	Lig	ht L	Medi	um M	Hea	vy H
Bearing No.	Preload	Axial clearance						
	(N)	(µm)	(N)	(µm)	(N)	(µm)	(N)	(µm)
7900C	7	5	16	2	29	-1	58	-6
7901C	8.6	4	16	2	41	-3	77	-8
7902C	12	3	25	0	47	-4	104	-11
7903C	11	3	25	0	56	-5	119	-12
7904C	20	1	42	-3	80	-8	152	-15
7905C	19	1	37	-2	99	-9	203	-17
7906C	25	0	46	-3	95	-8	204	-16
7907C	33	2	67	-2	149	-9	297	-18
7908C	41	1	78	-3	196	-12	384	-22
7909C	49	0	104	-5	192	-11	391	-21
7910C	49	0	95	-4	240	-13	499	-24
7911C	60	-1	111	-5	296	-15	593	-26
7912C	60	-1	113	-5	305	-15	581	-25
7913C	74	-2	151	-7	348	-16	690	-27
7914C	101	-4	205	-10	503	-22	1 004	-36
7915C	103	-4	190	-9	489	-21	997	-35
7916C	104	-4	195	-9	503	-21	986	-34
7917C	138	-6	307	-14	629	-25	1 281	-41
7918C	153	-3	289	-9	740	-23	1 488	-39
7919C	154	-3	294	-9	800	-24	1 588	-40
7920C	191	-5	387	-13	905	-28	1 790	-46
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Remark In the axial clearance column, the measured value is given.

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Table 9.4 Average Preloads and Axial Clearance for Bearing Series 70C

	Extra I	ight EL	Ligl	nt L	Medi	um M	Hea	vy H
Bearing No.	Preload	Axial clearance						
	(N)	(µm)	(N)	(µm)	(N)	(µm)	(N)	(µm)
7000C	13	3	25	0	49	-5	96	-12
7001C	13	3	25	0	57	-6	120	-14
7002C	12	3	29	-1	66	- 7	147	-16
7003C	15	2	30	-1	69	-7	156	-16
7004C	25	0	49	-4	119	-12	244	-22
7005C	30	-1	58	-5	148	-14	292	-24
7006C	41	1	75	-3	195	-13	386	-24
7007C	58	-1	121	-7	251	-16	493	-28
7008C	58	-1	114	-6	291	-17	594	-30
7009C	80	-3	144	-8	338	-19	695	-33
7010C	70	-2	152	-8	388	-20	791	-34
7011C	95	-4	200	-11	479	-24	971	-40
7012C	96	-4	189	-10	526	-25	1 092	-42
7013C	130	-6	260	-13	537	-24	1 062	-39
7014C	148	-7	285	-14	732	-30	1 460	-48
7015C	151	-7	294	-14	796	-31	1 573	-49
7016C	202	-6	382	-14	921	-31	1 880	-52
7017C	205	-6	393	-14	995	-32	1 956	-52
7018C	247	-8	502	-18	1 187	-37	2 373	-60
7019C	275	-9	549	-19	1 188	-36	2 348	-58
7020C	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

	Extra l	ight EL	Ligi	ht L	Medi	um M	Hea	vy H
Bearing No.	Preload	Axial clearance						
	(N)	(µm)	(N)	(µm)	(N)	(µm)	(N)	(µm)
7200C	13	3	29	-1	68	-8	150	-18
7201C	20	1	39	-3	99	-12	197	-22
7202C	20	1	40	-3	97	-11	199	-21
7203C	25	0	46	-4	146	-16	296	-28
7204C	35	-2	68	-7	196	-20	384	-33
7205C	42	1	82	-4	193	-14	402	-27
7206C	57	-1	114	-7	292	-20	591	-35
7207C	75	-3	151	-10	385	-25	794	-43
7208C	98	-5	202	-13	501	-29	985	-47
7209C	123	-7	254	-16	534	-30	1 067	-49
7210C	127	- 7	248	-15	590	-31	1 171	-50
7211C	142	-8	289	-17	788	-38	1 554	-60
7212C	190	-11	397	-22	928	-42	1 878	-67
7213C	219	-12	448	-23	1 069	-44	2 175	-70
7214C	243	-9	484	-20	1 164	-42	2 368	-69
7215C	270	-10	530	-21	1 224	-42	2 445	-68
7216C	305	-12	595	-24	1 367	-47	2 752	-76
7217C	355	-14	697	-27	1 658	-53	3 358	-85
7218C	384	-15	771	-29	1 865	-57	3 713	-90
7219C	448	-18	876	-33	2 081	-63	4 153	-99
7220C	503	-20	984	-36	2 337	-68	4 700	-107

Remark In the axial clearance column, the measured value is given.

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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

$$F_{\text{a min}} = \frac{C_{0\text{a}}}{100} \left(\frac{n}{N_{\text{max}}} \right)^2 \dots$$
 (9.1)

$$F_{\rm a\,min} = \frac{C_{0a}}{1000}$$
 (9.2)

where $F_{
m a\,min}$: Minimum axial load (N), {kgf} n: Speed (min⁻¹) C_{0a} : Basic static load rating (N), {kgf} $N_{
m max}$: 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 $F_{\rm a \; min}$ necessary to prevent such sliding is obtained from the following equation:

$$F_{\rm a\,min} = \frac{C_{0\,\rm a}}{1000}$$
(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, δ_{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 δ_a under an axial load F_a for single-row angular contact ball bearings is calculated as follows.

$$\delta_a = c F_a^{2/3}$$
 (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 δ_{a0A} and δ_{a0B} respectively and the clearance (between the inner rings), δ_{a0} , becomes zero. This condition means that the preload F_{a0} is applied on the bearing set. If an external axial load F_a is applied on the preloaded bearing set from the A-side, then the A-side bearing will be deformed δ_{a1} additionally and the displacement of B-side bearing will be reduced to the same amount as the A-side bearing displacement δ_{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 $(F_{a0} - F_a')$.

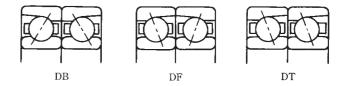


Fig. 9.7 Duplex Bearing Arrangements

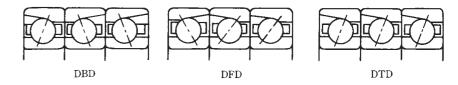


Fig. 9.8 Triplex Bearing Arrangements

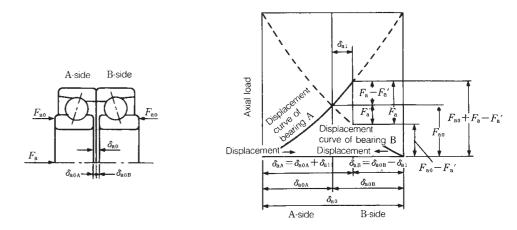


Fig. 9.9 Preload Graph of DB Arrangement Duplex Bearings

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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 δ_{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.

AA-side

 δ_{aoA}

B-side

 δ_{aob}

Table 9.6

Direction	Displacement	Axial load
AA-side	$\delta_{\scriptscriptstyle a0A} + \delta_{\scriptscriptstyle a1}$	$F_{\mathrm{a}0} + F_{\mathrm{a}} - F_{\mathrm{a}}{}^{\prime}$
B-side	$\delta_{\scriptscriptstyle a0B} - \delta_{\scriptscriptstyle a1}$	$F_{\mathrm{a0}}{-}F_{\mathrm{a}^{'}}$

Table 9.7

Direction	Displacement	Axial load
A-side	$\delta_{\scriptscriptstyle a0A} + \delta_{\scriptscriptstyle a1}$	$F_{\mathrm{a}0}\!+\!F_{\mathrm{a}}\!-\!F_{\mathrm{a}}{}^{\prime}$
BB-side	$\delta_{\scriptscriptstyle{ ext{a}0 ext{B}}} - \delta_{\scriptscriptstyle{ ext{a}1}}$	$F_{\mathrm{a0}}{-}F_{\mathrm{a}}{'}$

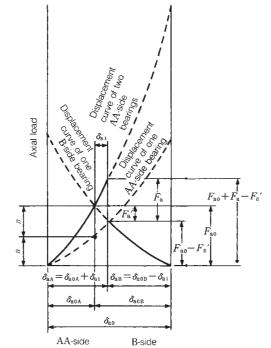


Fig. 9.10 Preload Graph of Triplex DBD Bearing Set (Axial load is applied from AA-side)

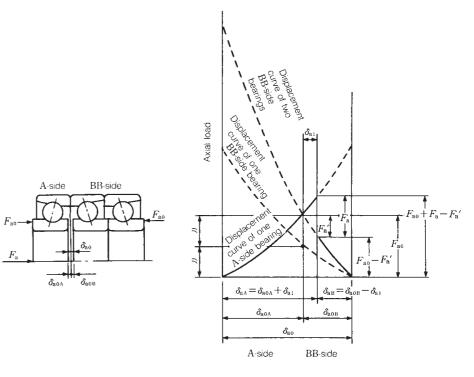
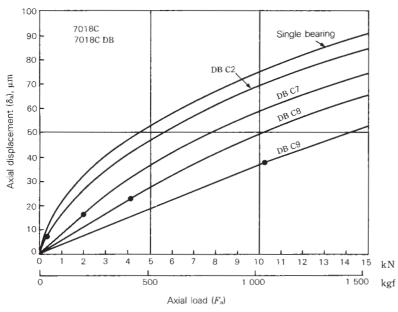


Fig. 9.11 Preload Graph of Triplex DBD Bearing set (Axial load is applied from A-side)





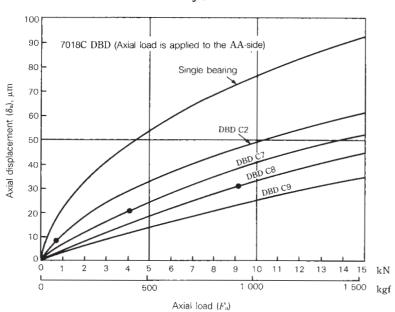


Fig. 9.13

100 7018C DBD (Axiat load is applied to the A-side) 80 Single bearing DBD C2 Axial displacement (δ_a) , 60 50 40 30 10 11 12 13 14 15 kN 3 9 8 500 1 000 1 500 kgf Axial load (F_a)

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.

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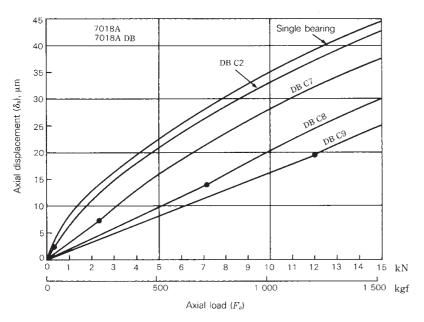


Fig. 9.15

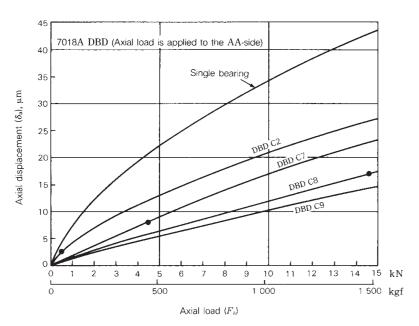


Fig. 9.16

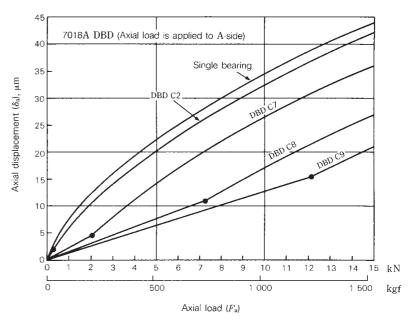


Fig. 9.17

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.

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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 α_0 and the inner ring is displaced δ_a , the center Oi of the inner ring raceway radius is also moved to Oi' resulting in the contact angle α as shown in Fig. 9.18. If $\delta_{\rm N}$ 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.

$$(m_0+\delta_N)^2=(m_0\cdot\sin\alpha_0+\delta_a)^2+(m_0\cdot\cos\alpha_0)^2$$

$$\therefore \delta_{\rm N} = m_0 \left\{ \sqrt{\left(\sin \alpha_0 + \frac{\delta_a}{m_0} \right)^2 + \cos^2 \alpha_0} - 1 \right\} \dots (9.5)$$

Also there is the following relationship between the rolling element load Q and elastic deformation $\delta_{\rm N}$.

$$Q=K_{\rm N}\cdot\delta_{\rm N}^{3/2}$$
 (9.6)

where, $K_{\rm N}$: Constant depending on bearing material, type, and dimension .. If we introduce the relation of

$$m_0 = \left(\frac{r_{\rm e}}{D_{\rm w}} + \frac{r_i}{D_{\rm w}} - 1\right) D_{\rm w} = B \cdot D_{\rm w}$$

Equations (9.5) and (9.6) are,

$$Q=K_{\rm N} (B \cdot D_{\rm w})^{3/2} \left\{ \sqrt{(\sin \alpha_0 + h)^2 + \cos^2 \alpha_0} - 1 \right\}^{3/2}$$

where,
$$h = \frac{\delta_a}{m_0} = \frac{\delta_a}{R \cdot D_a}$$

where, $h=\frac{\delta_{\rm a}}{m_{\rm 0}}=\frac{\delta_{\rm a}}{B\cdot D_{\rm w}}$ If we introduce the relation of $K_{\rm N}$ = $K\cdot \frac{\sqrt{D_{\rm w}}}{B^{3/2}}$

$$Q=K\cdot D_{\rm w}^{\ 2}\left\{\sqrt{(\sin\alpha_0+h)^2+\cos^2\alpha_0}-1\right\}^{3/2}$$
..... (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:

$$F_a = Z \cdot Q \cdot \sin \alpha$$
 (9.8)

Based on Fig. 9.18, we obtain,

$$(m_0+\delta_N) \sin\alpha=m_0\cdot\sin\alpha_0+\delta_n$$

$$\therefore \sin\alpha = \frac{m_0 \cdot \sin\alpha_0 + \delta_a}{m_0 + \delta_N} = \frac{\sin\alpha_0 + h}{1 + \frac{\delta_N}{m_0}}$$

If we substitute Equation (9.5).

$$\sin\alpha = \frac{\sin\alpha_0 + h}{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0}}$$
 (9.9)

That is, the relation between the bearing axial load F_a and axial displacement δ_a can be obtained by substituting Equations (9.7) and (9.9) for Equation

$$F_a = K \cdot Z \cdot D_w^2$$

$$\frac{\left\{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0 - 1}\right\}^{3/2} \times (\sin\alpha_0 + h)}{\sqrt{(\sin\alpha_0 + h)^2 + \cos^2\alpha_0}}$$
......(9.10)

where, K: Constant depending on the bearing material and design

 $D_{\rm w}$: Ball diameter

Z: Number of balls

Initial contact angle In case of single-row deep groove ball bearings, the initial contact angle can be obtained using Equation (5) of Page C012

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.

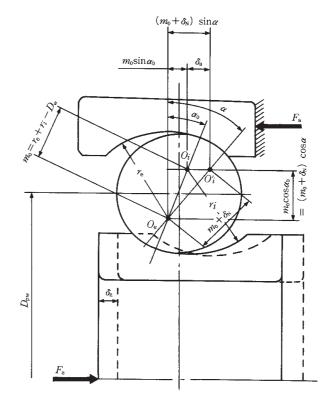


Fig. 9.18

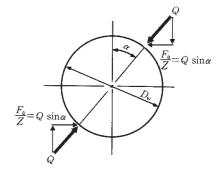


Fig. 9.19

the radial clearance.

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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 α_0 =0°, 10°, 15°. The larger the initial contact angle α_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 α_0 depends upon the groove radius and

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 $F_a \propto \delta_a^{3/2}$ or $\delta_a \propto F_a^{2/3}$. That is, the axial displacement δ_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.

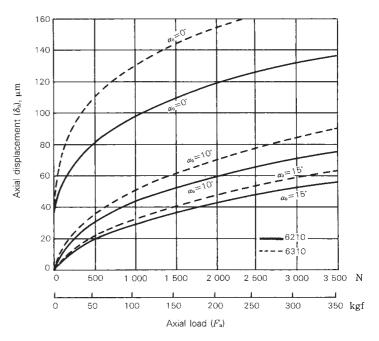


Fig. 9.20 Axial Load and Axial Displacement of Deep Groove Ball Bearings

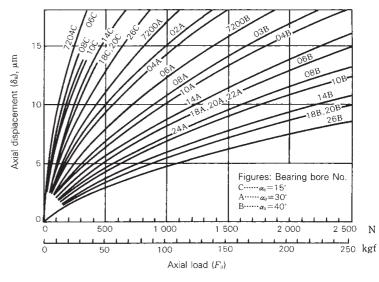


Fig. 9.21 Axial Load and Axial Displacement of Angular Contact Ball Bearings

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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.

$$\begin{array}{ll} \delta_{\rm a} = & \frac{0.000077}{\sin\alpha} \cdot \frac{Q^{0.9}}{L_{\rm we}^{0.8}} & & (\rm N) \\ \\ = & \frac{0.0006}{\sin\alpha} \cdot \frac{Q^{0.9}}{L_{\rm we}^{0.8}} & & \{\rm kgf\} \\ \end{array} \right\} \qquad \cdots \quad \textbf{(9.11)}$$

where, δ_a : Axial displacement of inner, outer ring (mm)

α: Contact angle...1/2 the cup angle (°) (Refer to Fig. 9.22)

Q: Load on rolling elements (N), {kgf}

$$Q = \frac{F_{\rm a}}{Z {\rm sin}\alpha}$$

 $L_{
m we}$: 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).

$$\delta_a = K_a \cdot F_a^{0.9}$$
 (9.12)

where, $K_{\rm a} = \frac{0.000077}{(\sin\!\alpha)^{1.9}\; Z^{0.9}\; L_{\rm we}^{0.8}} \;\; \dots \eqno (N)$

$$= \frac{0.0006}{(\sin \alpha)^{1.9} Z^{0.9} L_{we}^{0.8}}$$
 (kgf)

Here, $K_{\rm a}$: 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.

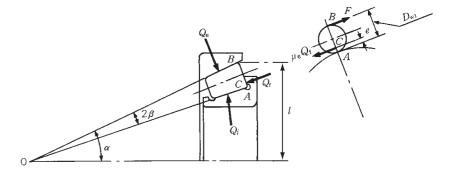


Fig. 9.22

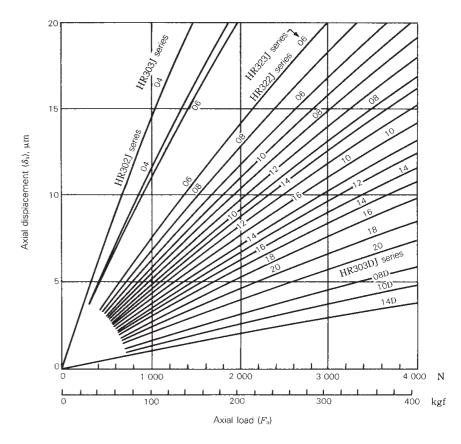
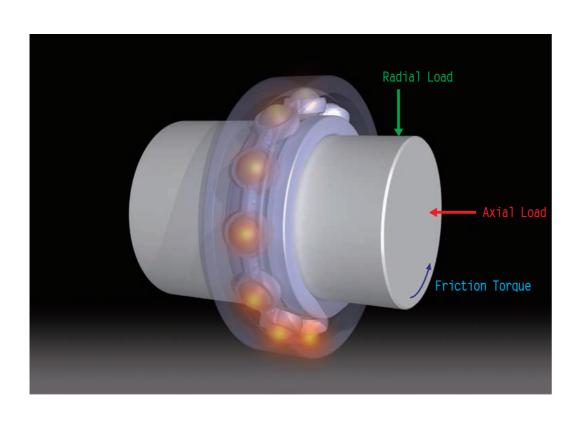


Fig. 9.23 Axial Load and Axial Displacement for Tapered Roller Bearings



10. FRICTION

10.1 Coe	officients of Dynamic Friction A 216
10.1.1	Bearing Types and Their Coefficients of Dynamic Friction μ
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10. FRICTION

10.1 Coefficients of Dynamic Friction

10.1.1 Bearing Types and Their Coefficients of Dynamic Friction μ

$$\mu = \frac{M}{P \cdot \frac{d}{2}} \quad (10.1)$$

M: Dynamic friction torque (N·mm), {kgf·mm}

P: Load on a bearing (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 μ
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 Tapered Roller Bearings Spherical Roller Bearings	0.0010 0.0022 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)

 $M_l=f_1Fd_m$

where f_1 : Coefficient determined by bearing type and load

F: Load

 $d_{\scriptscriptstyle \mathrm{m}}$: Pitch circle diameter of rolling element

Speed term (Determined by oil viscosity, amount, speed)

 $M_v = f_0 (v_0 n)^{2/3} dm^3$

where f_0 : Coefficient determined by bearing and lubricating

method

 v_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,

$$M=M_s\cdot Z\sin\alpha$$
 (mN·m), {kgf·mm} ······ (10.2)

where, $M_{\rm s}$: Spin friction for contact angle α centered on the shaft.

$$M_{\rm s} = \frac{3}{8} \mu_{\rm s} \cdot Q \cdot a \cdot E(k)$$

(mN⋅m), {kgf⋅mm} Contact-surface slip friction coefficient

Q: Load on rolling elements (N), {kgf}

a: (1/2) of contact-ellipse major axis (mm)

$$E(k)$$
: With $k = \sqrt{1 - \left(\frac{b}{a}\right)}$

as the population parameter, second class complete ellipsoidal integration

b: (1/2) of contact-ellipse minor axis (mm)

Z: Number of balls

 α : Contact angle (°)

Actual measurements with 15° angular contact ball bearings correlate well with calculated results using μ_s =0.15 in Equation (10.2). Fig. 10.1 shows the calculated friction torque for 70C and 72C series bearings.

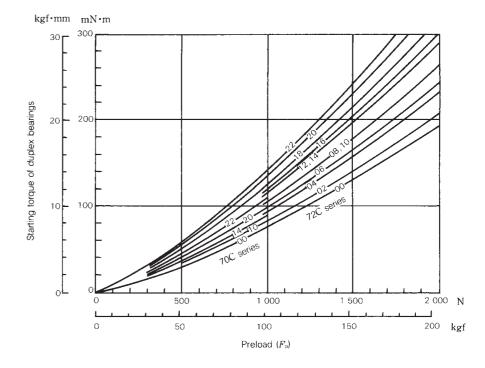


Fig. 10.1 Preload and Starting Torque for Angular Contact Ball Bearings (lpha=15°) of DF and DB Duplex Sets

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:

$$M=M_l+M_v \text{ (mN}\cdot\text{m)}, \{\text{kgf}\cdot\text{mm}\} \cdots (10.3)$$

The load term M_l 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.

$$\frac{M_{l}=0.672\times10^{-3}D_{pw}^{0.7}F_{a}^{1.2} (\text{mN}\cdot\text{m})}{=1.06\times10^{-3}D_{pw}^{0.7}F_{a}^{1.2} \{\text{kgf}\cdot\text{mm}\}} \right\} \cdots (10.4)$$

where, D_{pw} : Pitch diameter of rolling elements (mm) F_a : Axial load (N), {kgf}

The speed term M_v is that for fluid friction, which depends on angular speed, and is expressed by Equation (10.5).

$$M_v = 3.47 \times 10^{-10} D_{pw}^{3} n_i^{1.4} Z_B^{a} Q^{b} \text{ (mN \cdot m)}$$

= $3.54 \times 10^{-11} D_{pw}^{3} n_i^{1.4} Z_B^{a} Q^{b} \text{ (kgf \cdot mm)}$
.......(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:

$$a=24n_i^{-0.37}$$
 (10.6)

$$b=4\times10^{-9}n_i^{1.6}+0.03$$
 (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 (ϕ 20× ϕ 47×14) 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), M_i =0.672×10⁻³ $D_{pw}^{07}F_a^{1.2}$ =0.672×10⁻³×33.5^{0.7}×590^{1.2} =16.6 (mN·m) M_i =1.06×10⁻³×33.5^{0.7}×60^{1.2} =1.7 {kgf·mm}

From Equations (10.6) and (10.7), $a=24n_i^{-0.37}$ $=24\times70\ 000^{-0.37}=0.39$ $b=4\times10^{-9}n_i^{1.6}+0.03$ $=4\times10^{-9}\times70\ 000^{1.6}+0.03=0.26$

From Equation (10.5), M_v =3.47×10⁻¹⁰ $D_{pv}^{3}n_i^{1.4}Z_B^{a}Q^b$ =3.47×10⁻¹⁰×33.5³×70 000^{1.4}×10^{0.39}×1.5^{0.26} =216 (mN·m)

 M_v =3.54×10⁻¹¹×33.5³×70 000^{1.4}×10^{0.39}×1.5^{0.26} =22.0 {kgf·mm}

 $M=M_l+M_v=16.6+216=232.6 \text{ (mN}\cdot\text{m)}$ $M=M_l+M_v=1.7+22=23.7 \text{ {kgf}\cdot\text{mm}}$

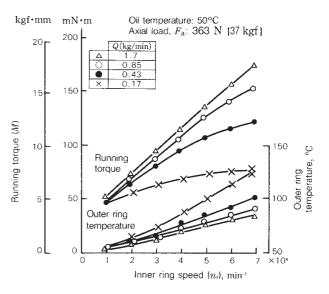


Fig. 10.2 Typical Test Example

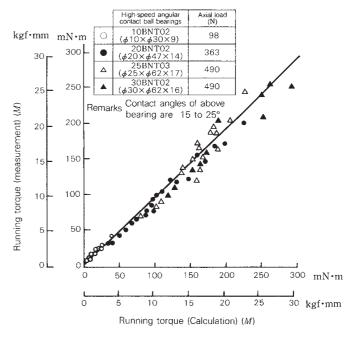


Fig. 10.3 Comparison of Actual Measurements and Calculated Values

NSK

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):

$$Q_e$$
= $\frac{F_a}{Z \sin \alpha}$(10.8)

$$Q_{i}=Q_{c}\cos 2\beta = \frac{\cos 2\beta}{Z\sin \alpha}F_{a}$$
 (10.9)

$$Q_{i}=Q_{e}\sin 2\beta = \frac{\sin 2\beta}{Z \sin \alpha}F_{a} \qquad (10.10)$$

where, $Q_{\rm e}$: Rolling element load on outer ring (N), $\{kgf\}$

 Q_i : Rolling element load on inner ring (N), $\{kgf\}$

 $Q_{\rm f}$: Rolling element load on inner-ring large end rib, (N), {kgf} (assume $Q_{\rm f} \perp Q_{\rm i}$)

Z: Number of rollers

 α : Contact angle...(1/2) of the cup angle (°)

 β : (1/2) of tapered roller angle (°)

 $D_{\rm w1}^{'}$: 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 $e u_c Q_t$.

Therefore, the balance of frictional torque is,

$$D_{\text{wl}}F = e \mu_{\text{e}}Q_{\text{f}} \text{ (mN \cdot m)}, \{\text{kgf} \cdot \text{mm}\} \cdot \cdots \cdot (10.11)$$

where, μ_e : Friction coefficient between inner ring large rib and roller endface

The starting torque M for one bearing is given by, $M=FZ\ l$

$$= \frac{e \ \mu_e \ l \ \sin \ 2\beta}{D_{\text{w1}} \ \sin \ \alpha} F_a$$

$$(\text{mN} \cdot \text{m}), \{\text{kgf} \cdot \text{mm}\} \cdots \cdots (\textbf{10.12})$$

because, $D_{\text{w1}} = 2\ \overline{OB}\ \sin\beta$, and $l = \overline{OB}\ \sin\alpha$. If we substitute these into Equation (10.12) we obtain, $M = e\ \mu_{\text{e}}\ \cos\!\beta\ F_{\text{a}}\ (\text{mN}\cdot\text{m}), \ \{\text{kgf}\cdot\text{mm}\}$ (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 β in Equation (10.12) are determined by the bearing design. Consequently, assuming a value for μ_e , the starting torque can be calculated.

The values for μ_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 μ_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.

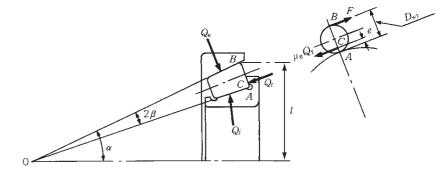


Fig. 10.4

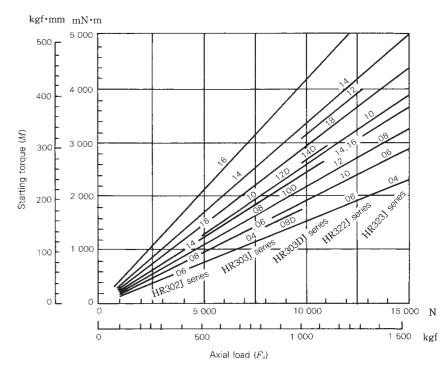


Fig. 10.5 Axial Load and Starting Torque for Tapered Roller Bearings

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 $F_{\rm a}$ is applied on tapered roller bearings, the loads shown in Fig. 10.6 are applied on the rollers.

$$Q_{\rm e} = Q_{\rm i} = \frac{F_{\rm a}}{Z \sin \alpha}$$
 (10.14)

$$Q_{t} = \frac{F_{a} \sin 2\beta}{Z \sin \alpha} \dots (10.15)$$

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
- α : Contact angle...(1/2) of the cup angle
- β : (1/2) of tapered roller angle

For simplification, a model using the average diameter $D_{\rm wc}$ as shows in Fig. 10.7 can be used.

Where, M_i , M_e : F_{si} , F_{se} , F_{sf} :

Rolling resistance (moment) 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:

$$M_{\rm f} + M_{\rm e} = \frac{D_{\rm w}}{2} F_{\rm se} + \frac{D_{\rm w}}{2} F_{\rm sf} + \left(\frac{D_{\rm w}}{2} - e\right) F_{\rm sf}$$
(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:

$$M=Z (R_e F_{sc}-M_e)$$

$$= \frac{Z}{D_w} (R_e M_i + R_i M_e) + \frac{Z}{D_w} R_e e F_{sf}$$

$$= M_e + M_e$$

Therefore, the friction on the raceway surface $M_{\rm R}$ and that on the ribs $M_{\rm S}$ are separately obtained. Additionally, $M_{\rm R}$ and $M_{\rm S}$ are rolling friction and sliding friction respectively.

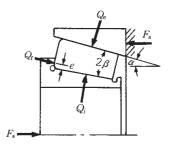


Fig. 10.6 Loads Applied on Roller

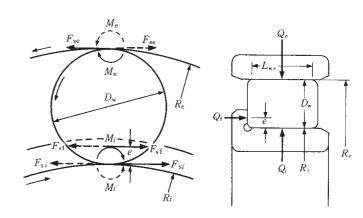


Fig. 10.7 Model of Parts where Friction is Generated

The running torque M of a tapered roller bearing can be obtained from the rolling friction on the raceway $M_{\rm R}$ and sliding friction on the ribs $M_{\rm S}$.

Sliding Friction on Rib $M_{ m S}$

As a part of $M_{\rm S}$, $F_{\rm sf}$ is the tangential load caused by sliding, so we can write $F_{\rm sf} = \mu Q_{\rm f}$ using the coefficient of dynamic friction μ . Further, by substitution of the axial load $F_{\rm a}$,

the following equation is obtained:

$$M_{\rm S} = e \,\mu \, {\rm cos}\beta \, F_{\rm a} \, \cdots$$
 (10.19)

This is the same as the equation for starting torque, but μ is not constant and it decreases depending on the conditions or running in. For this reason, Equation (10.19) can be rewritten as follows:

$$M_{\rm S}=e \mu_0 \cos\beta F_{\rm a} f'(\Lambda, t, \sigma) \cdots (10.20)$$

Where μ_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 $M_{ m R}$

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:

$$M_{i, e} = \left[f(w) \left(\frac{1}{1 + 0.29L^{0.78}} \right) \frac{4.318}{\alpha_0} \right]$$

$$(G \cdot U)^{0.658} W^{0.0126} R^2 L_{we} \Big]_{i, e} \cdots \cdots \cdots (10.21)$$

$$f(w) = \left(\frac{kF_a}{E' D_w L_{we} Z \sin \alpha}\right)^{0.3} \dots (10.22)$$

Therefore, M_R can be obtained using Equations (10. 21) and (10.22) together with the following equation:

$$M_{\rm R} = \frac{Z}{D_{\rm or}} (R_{\rm e} M_i + R_i M_{\rm e})$$

Running Torque of Bearings M

From these, the running torque of tapered roller bearings M is given by Equation (10.23)

$$M = \frac{Z}{D_{w}} (R_{e}M_{i} + R_{i}M_{e}) + e \,\mu_{0} \cos\beta \,F_{a}f' \,(A, t, \sigma)$$
.....(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

 α_0 : Pressure coefficient of lubricating oil

viscosity

R: Equivalent radius

k: Constant

E': Equivalent elastic modulus α : Contact angle (Half of cup angle)

lpha: Contact angle (Half of cup angle) $R_i,\,R_{\rm e}$: Inner and outer ring raceway radii

(center)

: Half angle of roller

i, e: Indicate inner ring or outer ring

respectively

 $L_{\rm we}$: Effective roller length

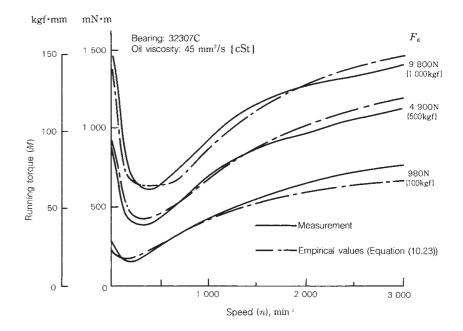


Fig. 10.8 Comparison of Empirical Values with Actual Measurements

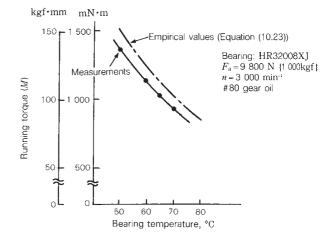


Fig. 10.9 Viscosity Variation and Running Torque



11. LUBRICATION

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11. LUBRICATION

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 transter is possible using forced oil circulation.
Fluidity	Poor	Good
Full Lubricant Replacement	Sometimes difficult	Easy
Removal of Foreign Matter	Removal of particles from grese 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 need not 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

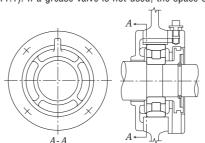


Fig. 11.1 Combination of Partitioned Grease Reservoir and Grease Valve

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.

(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 soapsynthetic 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.)

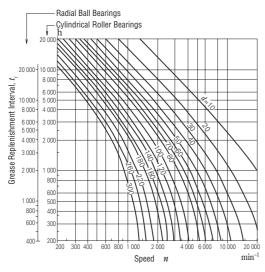
It is advisable to consult NSK.

· Load

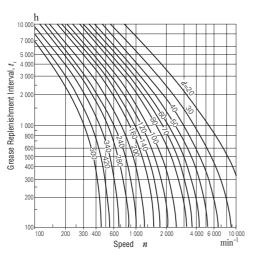
The replenishing time interval depends on the magnitude of the bearing load.

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 facto

r	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))

$$log \ t = 6.54 - 2.6 \frac{n}{N_{\text{max}}} - \left(0.025 - 0.012 \frac{n}{N_{\text{max}}}\right) T$$

(Wide-range grease (2))

$$log t = 6.12 - 1.4 \frac{n}{N_{\text{max}}} - \left(0.018 - 0.006 \frac{n}{N_{\text{max}}}\right) T$$
(11.2)

where t: Average grease life, (h)

n: Speed (min⁻¹)

 $N_{
m max}$: Limiting speed with grease lubrication $({
m min^{-1}})$ (values for ZZ and VV types listed in the bearing tables)

T: Operating temperature °C

Equations (11.1) and (11.2) and Fig. 11.3 apply under the following conditions:

(a) Speed, n

$$0.25 \le \frac{n}{N_{\text{max}}} \le 1$$

when
$$\frac{n}{N_{\rm max}}$$
 < 0.25, assume $\frac{n}{N_{\rm max}}$ = 0.25

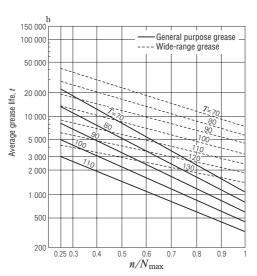


Fig. 11.3 Grease Life of Sealed Ball Bearings

(b) Operating Temperature, *T* For general purpose grease (1)

70 °C ≤ *T* ≤ 110 °C

For wide-range grease (2)

70 °C ≤ *T* ≤ 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 bearings without submerging the bearings in oil. It is commonly used in automobile transmissions and final drive gears. Fig. 11.6 shows this lubricating method used on a reduction gear.

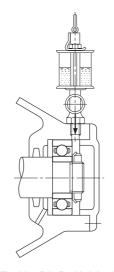


Fig. 11.5 Drip Feed Lubrication

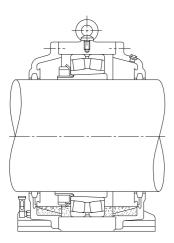


Fig. 11.4 Oil Bath Lubrication

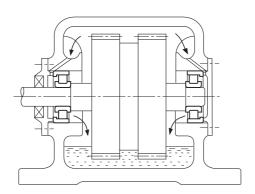
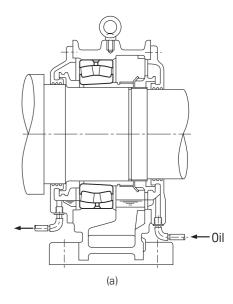


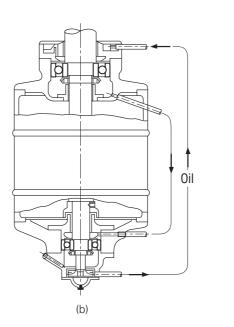
Fig. 11.6 Splash Lubrication

(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.





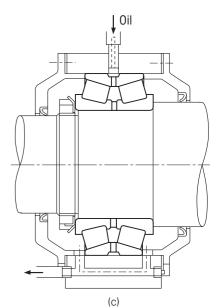


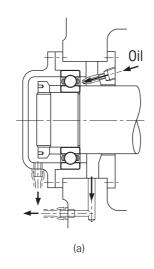
Fig. 11.7 Circulating Lubrication

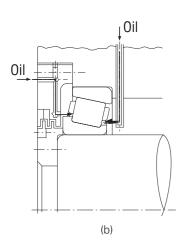
(5) Jet Lubrication

Jet lubrication is often used for ultra high speed bearings, such as the bearings in jet engines with a $d_{\rm m}n$ valve ($d_{\rm m}$: 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.





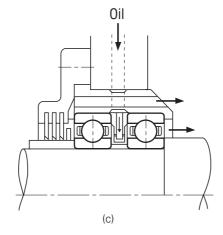


Fig. 11.8 Jet Lubrication

(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.

(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.

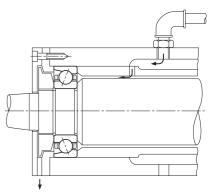


Fig. 11.9 Oil Mist Lubrication

- (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.
- For these reasons, this method is used in the main spindles of machine tools and other high speed applications (Fig. 11.10).

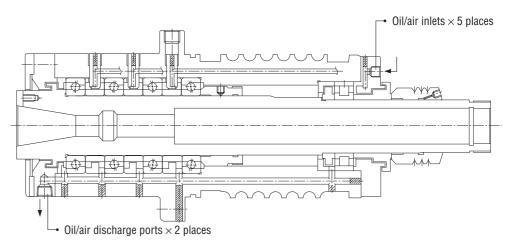


Fig. 11.10 Oil/Air Lubrication

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			Calcium Grease (Cup Grease)	Mixed Base Grease	Complex Base Grease (Complex Grease)	Non-S (Nor	oap Base Grease -Soap Grease)
Thickener	Li Soap			Na Soap	Ca Soap	Na + Ca Soap, Li + Ca Soap, etc.	Ca Complex Soap, Al Complex Soap, Li Complex Soap, etc.		te, Carbon Black, Fluoric Heat Resistant Organic tc.
Base Oil Properties	Mineral Oil	Diester Oil, Polyatomic Ester Oil	Silicone Oil	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)
Dropping Point, °C	170 to 195	170 to 195	200 to 210	170 to 210	70 to 90	160 to 190	180 to 300	> 230	> 230
Working Temperatures, °C	-20 to +110	-50 to +130	-50 to +160	-20 to +130	-20 to +60	-20 to +80	-20 to +130	-10 to +130	< +220
Working Speed, %(1)	70	100	60	70	40	70	70	70	40 to 100
Mechanical Stability	Good	Good	Good	Good	Poor	Good	Good	Good	Good
Pressure Resistance	Fair	Fair	Poor	Fair	Poor	Fair to Good	Fair to Good	Fair	Fair
Water Resistance	Good	Good	Good	Poor	Good	Poor for Na Soap Grease	Good	Good	Good
Rust Prevention	Good	Good	Poor	Poor to Good	Good	Fair to Good	Fair to Good	Fair to Good	Fair to Good
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.)	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	and high tem lubricant. Syn is recommend temperature.	se grease is middle perature purpose thetic oil base grease led for low or high Some silicone and ed grease have poor n and noise.

Note (1) The values listed are percentages of the limiting speeds given in the bearing tables.

Remark The grease properties shown here can vary between brands.

(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.

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 When fretting is likely to occur	For centralized oiling When fretting is likely to occur For low temperatures	-For general use -For sealed ball bearings	For general use For sealed ball bearings For high temperatures	·For high temperatures ·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 1/10mm. 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 13mm²/s
Tapered Roller Bearings and Spherical Roller Bearings	Higher than 20mm²/s
Spherical Thrust Roller Bearings	Higher than $32 mm^2/s$

Remark 1mm²/s=1cSt (centistokes)

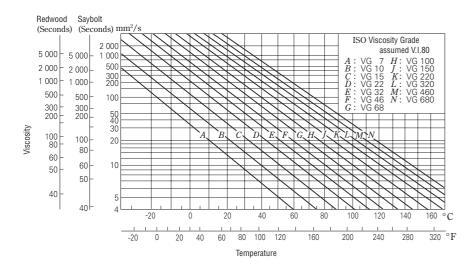


Fig. 11.11 Temperature-Viscosity Chart

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 °C	Less than limiting speed ISO VG 15, 22, 32 (refrigerating machine oil)		_
	Less than 50% of limiting speed	ISO VG 32, 46, 68 (bearing oil, turbine oil)	ISO VG 46, 68, 100 (bearing oil, turbine oil)
0 to 50 °C	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)	-
	Less than 50% of limiting speed	ISO VG 100, 150, 220 (bearings oil)	ISO VG 150, 220, 320 (bearing oil)
50 to 80 °C	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)	_
	Less than 50% of limiting speed	ISO VG 320, 460 (bearing oil)	ISO VG 460, 680 (bearing oil, gear oil)
80 to 110 °C	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 (IIS K 2211), Bearing Oils (IIS K 2239), Turbine Oils (IIS 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.

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11.4 Technical Data

11. 4. 1 Brands and Properties of Lubricating Greases

Table 11. 6 Brands of

Lubricating Greases

Brands	Thickeners	Base Oils	Dropping Point (°C)	Consistency	Working Temperature Range(¹)(°C)	Pressure Resistance	Usable Limit Compared to Listed Limiting Speed(Grease)(2)(%)
EA3 GREASE	Urea (3)	Poly-α-olefin oil	≧260	230	-40 to +150	Fair	100
EA5 GREASE	Urea (3)	Poly-α-olefin oil	≧260	251	-40 to +160	Good	60
EA6 GREASE	Urea (3)	Poly-α-olefin oil	≧260	220	-40 to + 160	Fair	70
EA7 GREASE	Urea (3)	Poly-α-olefin oil	≧260	243	-40 to +160	Fair	100
EA9 GREASE	Urea (3)	Poly-α-olefin oil	≧260	314	-40 to +140	Fair	100
ENS GREASE	Urea (3)	Polyol ester oil (4)	≧260	264	-40 to +160	Poor	100
ECE GREASE	Lithium	Poly-α-olefin oil	≧260	235	-10 to +120	Poor	100
DOW CORNING(R) SH 44 M GREASE	Lithium	Silicone oil (5)	210	260	-30 to +130	Poor	60
NS HI-LUBE	Lithium	Ester oil + Diester oil (4)	192	250	-40 to +130	poor	100
LG2 GREASE	Lithium	Poly-α-olefin oil + Mineral oil	201	199	-20 to +70	Poor	100
LGU GREASE	Urea (3)	Poly-α-olefin oil	≧260	201	-40 to +120	Fair	70
EMALUBE 8030	Urea (3)	Mineral oil	≧260	280	0 to +130	Good	60
KP1 GREASE	PTFE	Perfluoropolyether oil	Not applicable	290	-30 to +200	Fair	60
SHELL ALVANIA GREASE S2	Lithium	Mineral oil	181	275	-10 to +110	Fair	70
SHELL ALVANIA GREASE S3	Lithium	Mineral oil	182	242	-10 to +110	Fair	70
SHELL SUNLIGHT GREASE 2	Lithium	Mineral oil	200	274	-10 to +110	Fair	70
WPH GREASE	Urea (3)	Poly-α-olefin oil	259	240	-40 to +150	Fair	70
NIGLUBE RSH	Sodium Complex	Glycol oil	≧260	270	-20 to +140	Fair	60
PALMAX RBG	Lithium Complex	Mineral oil	216	300	-10 to +130	Good	70
MULTEMP PS No.2	Lithium	Poly-α-olefin oil + Diester oil (4)	190	275	-50 to +110	Poor	100
MOLYKOTE(R) FS-3451GREASE	PTFE	Fluorosilicone oil (5)	Not applicable	285	0 to +180	Fair	70
UME GREASE	Urea (3)	Mineral oil	≧260	272	-10 to +130	Fair	70
RW1 GREASE	Urea (3)	Mineral oil	≧260	300	-10 to +130	Fair	70
HA1 GREASE	Urea (3)	Ether oil	≧260	290	-40 to +160	Fair	70
HA2 GREASE	Urea (3)	Ether + Poly-α-olefin oil	≧260	295	-30 to +170	Fair	70
KLUBERSYNTH HB 72-52	Urea (3)	Ester oil (4)	250	295	-30 to +160	Fair	70
NOXLUB KF0921	PTFE	Perfluoropolyether oil	Not applicable	280	-40 to +200	Fair	70
ECH GREASE	Carbon Brack	Perfluoropolyether oil	Not applicable	205	-30 to +260	Fair	60
FWG GREASE	Urea (3)	Mineral oil + Poly-α-olefin oil	≧260	268	-30 to +150	Fair	70
HT1 GREASE	Urea (3)	Poly-α-olefin oil	≧260	236	-40 to +150	Fair	100
ARAPEN RB320	Lithium-Calcium	Mineral oil	177	305	-10 to +80	Fair	70
SHELL GADUSRAIL S4 HIGH SPEED EUFR	Lithium	Mineral oil	188	266	-10 to +110	Fair	100

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Notes (1) If grease will be used at the upper or lower limit sufficient 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 grease may be used at speeds exceeding the above limits provided the supply of grease is appropriate.

(3) Urea-based grease causes fluorine-based material to deteriorate.

(4) Ester-based grease causes acrylic rubber material to swell.

(5) Silicone-based grease causes silicone-based material to swell.



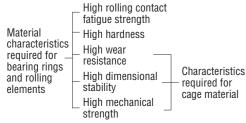
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12. BEARING MATERIALS

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 England.

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 (%)								
		С	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 (%)							
Standard	Syllibols	С	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	Cumbala		Chemical Composition (%)											
	Syllinois	С	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 (%)										
Stanuaru		С	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		Chem	ical Composition	al Composition (%)			
Glassification	Statiuatu	Syllibuis	С	Si	Mn	P	S		
Steel sheet and	JIS G 3141	SPCC	Less than 0.12	_	Less than 0.50	Less than 0.04	Less than 0.045		
strip for pressed	BAS 361	BAS 361 SPB 2		Less than 0.30	0.25 to 0.60	Less than 0.03	Less than 0.030		
cages	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

		Chemical Composition (%)										
Standard	Symbols	Cu	Zn	Ma	Fe	Λ1	Sn	Ni	Impurities			
		Cu	ZII	Mn	ге	Al	SII	INI	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.

Table 12.7 Physical and Mechanical Properties of Bearing and Shaft/Housing Materials

	Material	Heat treatment	Density g/cm ³	Specific heat kJ/(kg·K)	Thermal conductivity W/(m·K)	Electric resistance μΩ·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}	Elong- ation %	Hardness HB	Remarks
	SUJ2	Quenching, tempering	7.83		46	22	12.5		1 370 {140}	1 570 to 1 960 {160 to 200}	0.5 Max.	650 to 740	High carbon chrome bearing steel No. 2
	SUJ2	Spheroidizing annealing	7.86	0.47			11.9	208 000	420 {43}	647 {66}	27	180	steel No. 2
	SCr420	Quenching, low temp tempering	7.83	0.47	48	21	12.8	{21 200}	882 {90}	1 225 {125}	15	370	Chrome steel
g	SAE4320 (SNCM420)	Quenching, low temp tempering	7.00		44	20	11.7		902 {92}	1 009 {103}	16	**293 to 375	Nickel chrome
Bearing	SNCM815	Quenching, low temp tempering	7.89		40	35	_		_	*1 080 {110} Min.	*12 Min.	*311 to 375	molybde- num steel
Ш	SUS440C	Quenching, low temp tempering	7.68	0.46	24	60	10.1	200 000 {20 400}	1 860 {190}	1 960 {200}	_	**580	Martensitic stainless steel
	SPCC	Annealing		0.47	59	15	11.6	206 000	_	*275 {28} Min.	*32 Min.	_	Cold rolled steel plate
	S25C	Annealing	7.86	0.48	50	17	11.8	{21 000}	323 {33}	431 {44}	33	120	Carbon steel for machine structure
	CAC301 (HB _s C1)	_	8.5	0.38	123	6.2	19.1	103 000 {10 500}	_	*431 {44} Min.	*20 Min.	_	High-tension brass
	S45C	Quenching, 650°C tempering			47	18	12.8	207 000 {21 100}	440 {45}	735 {75}	25	217	Carbon steel for machine structure
	SCr430	Quenching, 520 to 620°C fast cooling		0.48		22	12.5		*637 {65} Min.	*784 {80} Min.	*18 Min.	*229 to 293	Chrome
	SCr440	Quenching, 520 to 620°C fast cooling	7.83	0.47	45	23	12.5	208 000 {21 100}	*784 {80} Min.	*930 {95} Min.	*13 Min.	*269 to 331	steel
Shaft	SCM420	Quenching, 150 to 200°C air cooling	7.03		48	21	12.8	(21 100)	_	*930 {95} Min.	*14 Min.	*262 to 352	Chrome molybde- num steel
S	SNCM439	Quenching, 650°C tempering			38	30	11.3	207 000 {21 100}	920 {94}	1 030 {105}	18	320	Nickel chrome molybde- num steel
	SC46	Normalizing	_	_	_	_	_	206 000 {21 000}	294 {30}	520 {53}	27	143	Low carbon cast steel
	SUS420J2	1 038°C oil cooling, 400°C air cooling	7.75	0.46	22	55	10.4	200 000 {20 400}	1 440 {147}	1 650 {168}	10	400	Martensitic stainless steel
	FC200	Casting	7.3	0.50	43	_		98 000 {10 000}	_	*200 {20} Min.	_	*217 Max.	Gray cast iron
	FCD400	Casting	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
βι	A1100	Annealing	2.69	0.90	222	3.0	23.7	70 600 {7 200}	34 {3.5}	78 {8}	35	_	Pure aluminum
Housing	AC4C	Casting	2.68	0.88	151	4.2	21.5	72 000 {7 350}	88 {9}	167 {17}	7	_	Aluminum alloy for sand casting
	ADC10	Casting	2.74	0.96	96	7.5	22.0	71 000 {7 240}	167 {17}	323 {33}	4	_	Aluminum alloy for die casting
	SUS304	Annealing	8.03	0.50	15	72	15.7 to 16.8	193 000 {19 700}	245 {25}	588 {60}	60	150	Austenitic stainless steel

Note * JIS standard or reference value.

** Though Rockwell C scale is generally
Remark Proportional limits of SUJ2 and SCr420

used, Brinel hardness is shown for comparison.

are 833 MPa (85 kgf/mm²) and 440 MPa (45 kgf/mm²) respectively as reference.

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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.

Table 12.8

Applicable National Standards and Chemical Composition of High-Carbon Chrome Bearing Steel

JIS	ASTM	Other major			Chemical cor	mposition (%)			Application	Remarks	
G 4805	ASTW	national standards	С	Si	Mn	Cr	Mo	Others	Application	nemarks	
SUJ1	_	_	0.95 to 1.10	0.15 to 0.35	≦0.50	0.90 to 1.20	_	*1	Not used	Equivalent to each	
_	51100	_	0.98 to 1.10	0.15 to 0.35	0.25 to 0.45	0.90 to 1.15	≦0.10	*1	generally	other though there are slight differences in the ranges.	
SUJ2	_	_	0.95 to 1.10	0.15 to 0.35	≦0.50	1.30 to 1.60	_	*1	Typical steel	Equivalent to each	
_	A 295-89 52100	_	0.93 to 1.05	0.15 to 0.35	0.25 to 0.45	1.35 to 1.60	≦ 0.10	P≦0.025 S≦0.015	type for small and medium size bearings	other though there are slight differences in the ranges.	
_	_	100Cr6 (DIN)	0.90 to 1.05	0.15 to 0.35	0.25 to 0.40	1.40 to 1.65	_	_	Sizo boarings	the ranges.	
_	_	100C6 (NF)	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 S≦0.025			
_	_	535A99 (BS)	0.95 to 1.10	0.10 to 0.35	0.40 to 0.70	1.20 to 1.60	_	*1			
SUJ3	_	_	0.95 to 1.10	0.40 to 0.70	0.90 to 1.15	0.90 to 1.20	_	*1	For large size	SUJ3 is equivalent to	
_	A 485-03 Grade 1	_	0.90 to 1.05	0.45 to 0.75	0.90 to 1.20	0.90 to 1.20	≦0.10	P≦0.025 S≦0.015	bearings	Grade 1. Grade 2 has better quenching	
_	A 485-03 Grade 2	_	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 S≦0.015		capability	
SUJ4	_	_	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	
SUJ5	_	_	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	Though Grade 3 is	
_	A 485-03 Grade 3	_	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 S≦0.015	size bearings	equivalent to SUJ5, quenching capability of Grade 3 is better than SUJ5.	

Note *1: $P \le 0.025$, $S \le 0.025$

Remark ASTM: Standard of American Society

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

JIS CAMED	ASTM				Chemical cor	nposition (%)			Application	Damanica
G 4052 G 4053	A 534-90	С	Si	Mn	Ni	Cr	Mo	Others	Application	Remarks
SCr420H	_	0.17 to 0.23	0.15 to 0.35	0.55 to 0.95	≦0.25	0.85 to 1.25	_	*2	For small	Similar steel type
_	5120H	0.17 to 0.23	0.15 to 0.35	0.60 to 1.00	_	0.60 to 1.00	_	*3	bearings	
SCM420H	_	0.17 to 0.23	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	Similar steel type,
_	4118H	0.17 to 0.23	0.15 to 0.35	0.60 to 1.00	_	0.30 to 0.70	0.08 to 0.15	*3	bearings	though quenching capability of 4118H is inferior to SCM420H
SNCM220H	_	0.17 to 0.23	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	Equivalent, though
_	8620H	0.17 to 0.23	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	bearings	there are slight differences
SNCM420H	_	0.17 to 0.23	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	Equivalent, though
_	4320H	0.17 to 0.23	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	bearings	there are slight differences
SNCM815	_	0.12 to 0.18	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	Similar steel type
_	9310H	0.07 to 0.13	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	bearings	

Note *2: $P \le 0.030$, $S \le 0.030$ *3: $P \le 0.025$, $S \le 0.015$

12.4.2 Long Life Bearing Steel (NSK Z Steel)

It is well known that the rolling fatigue life of high-carbon 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

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.

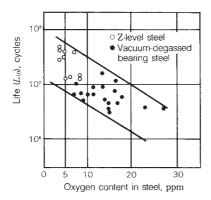


Fig. 12.1 Oxygen Content in Steel and Life of Bearing Steel

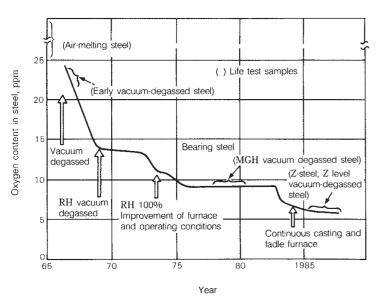
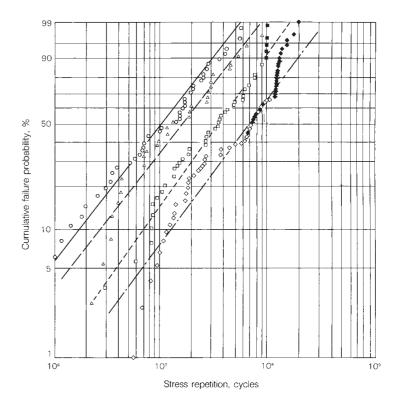


Fig. 12.2 Transition of Oxygen Content in NSK Bearing Steels



Classification	Test quantity	Failured quantity	Weibull slope	L_{10}	L_{50}
O Air-melting steel	44	44	1.02	1.67×10 ⁶	1.06×10 ⁷
$\overset{\triangle}{\text{ Vacuum degassed}}$ steel	30	30	1.10	2.82×10 ⁶	1.55×10 ⁷
☐ MGH vacuum degassed steel	46	41	1.16	6.92×10 ⁶	3.47×10 ⁷
	70	39	1.11	1.26×10 ⁷	6.89×10 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

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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.

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.

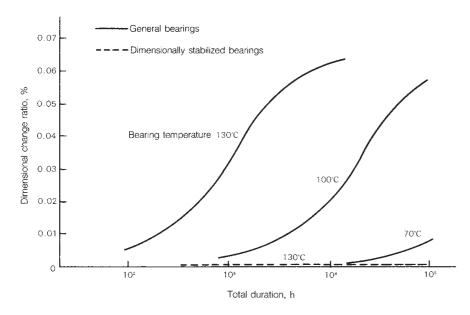
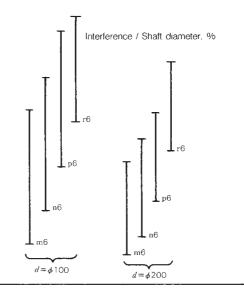


Fig. 12.4 Bearing Temperature and Dimensional Change Ratio



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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.

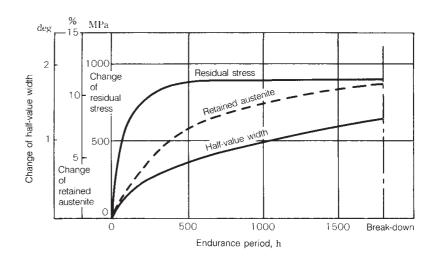


Fig. 12.5 Change in X-ray Measurements

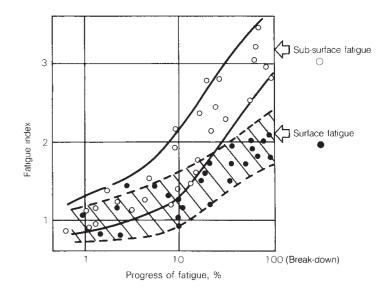


Fig. 12.6 Fatigue Progress and Fatigue Index

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(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.

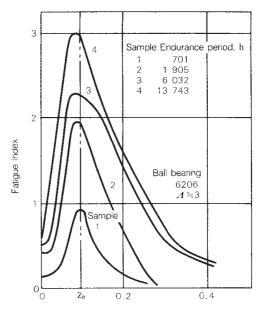
The fatigue pattern shown in Fig. 12.7 occurs mostly when lubrication conditions are satisfactory and oil film of sufficient thickness is formed in rolling contact points. The basic dynamic load rating described in the bearing catalog is determined using data of bearing failures according to the above 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.



Depth below surface, mm

- ∠1: Oil film parameter
- Z_0 : Depth position of maximum shearing stress

Fig. 12.7 Progress of Sub-Surface Fatigue

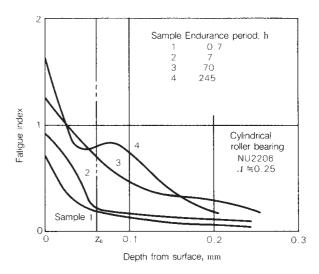


Fig. 12.8 Progress of Surface Fatigue

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 surface-originating flaking.

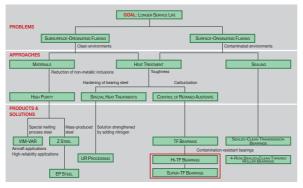
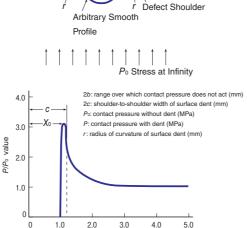


Fig. 12.9 Approaches to Achieving Longer Service Life in Bearings

(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.



2b

Fig. 12.10 Concentration of Stress around a Surface Dent

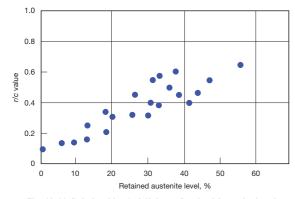


Fig. 12.11 Relationship of r/c Value to Retained Austenite Level

(3) Material Properties of Hi-TF Bearings and Super-TF Bearings

 \dot{NSK} has developed the Hi-TF Bearings and Super- \dot{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, which has a specific amount of chrome added to it. Super-TF Bearings adopt a new type of steel, which has a specific amount of chrome and molybdenum added to it. 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)

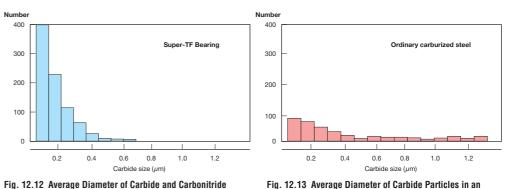


Fig. 12.12 Average Diameter of Carbide and Carbonitride Particles in a Super-TF Bearing

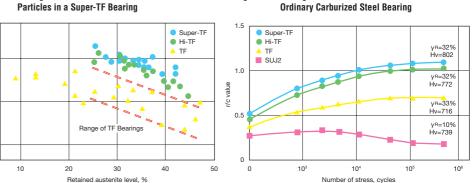


Fig. 12.14 Relationship of Material Hardness and Retained Austenite Level

Fig. 12.15 Change of r/c Value under Repeated Stress

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800

600

(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.

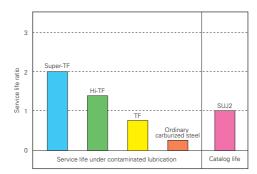


Fig. 12.16 Comparison of Service Life under Contaminated Lubrication

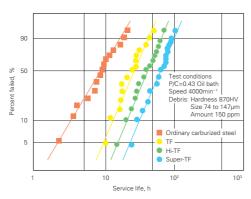


Fig. 12.17 Service Life of L44649/10 Bearings under Contaminated Lubrication

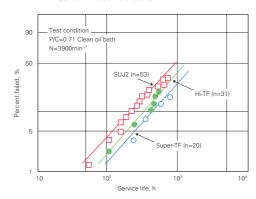


Fig. 12.18 Service Life Tests of 6206 Bearings under Clean Lubrication

(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 Λ , which represents the ratio of the thickness of the oil film to the roughness of the surface, is very small (Λ =0.3). When Λ 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.

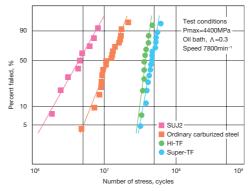


Fig. 12.19 Service Life Tests under Boundary Lubrication Conditions

(7) Wear and Seizure Resistance

Bésides 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.

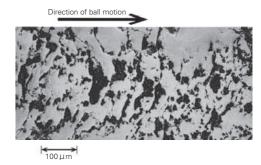


Fig. 12.20 Peeling Damage

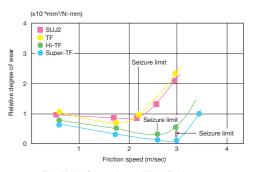


Fig. 12.21 Comparison of Wear Resistance

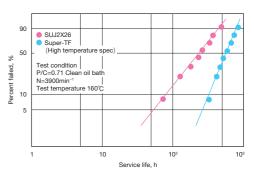


Fig. 12.22 Service Life Test of 6206 under High Temperature

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.

Table 12.11 Characteristics of Representative Polymers

Plastics	Elastic modulus (GPa) (¹)	Strength GPa (1)	Density g/cm ³	Specific elastic modulus ×10 ⁴ mm	Specific strength ×10 ⁴ mm	Melting point °C	Glass transition temp °C	Thermal deformation temperature °C (²)	Continuous operating temperature °C	Remarks
Polyethylene HDPE UHMWPE	0.115 0.5	0.03 0.025	0.96 0.94	12.6 53.2	3.3 2.7	132 136	-20 -20	75/50 75/50	=	High creep and toughness, softening
Polyamide Nylon 6 Nylon 66	2.5 3.0	0.07 0.08	1.13 1.14	221.2 263.2	6.2 7.0	215 264	50 60	150/57 180/60	80 to 120 80 to 120	High water absorption and toughness
Nylon 11	1.25	0.04	1.04	120.2	3.8	180	_	150/55	Lower than nylon 6 or 66	Low water absorption
Polytetra fluoroethylene PTFE	0.40	0.028	2.16	18.5	1.3	327	115	120/—	260	High creep, sintering,low friction and adhesion, inert. Stable at 290°C
Poly buthylene terephthalate PBT	2.7	0.06	1.31	206.1	4.6	225	30	230/215	155	
Polyacetal POM Homo-polymer Co-polymer	3.2 2.9	0.07 0.06	1.42 1.41	225.3 205.7	4.9 4.3	175 165	-13 -	170/120 155/110	 104	High hardness and toughness, low water absorption
Polyether sulfon PES	2.46	0.086	1.37	179.6	6.3	_	225	210/203	180	Usable up to 200°C Chemically stable
Polysulfon PSf	2.5	0.07	1.24	201.6	5.6	_	190	181/175	150	
Polyallylate (Aromatic polyester)	1.3 3.0	0.07 0.075	1.35 1.40	96.3 214.3	5.2 5.4	350 350	_	293 293	300 260 to 300	Inert, high hardness, Used as filler for PTFE Stable up to 320°C
Polyphenylene sulfide PPS (GF 40%)	4.2	0.14	1.64	256.1	8.5	275	94	>260	220	Hot cured at 360°C
Polyether ether keton PEEK	1.7	0.093	1.30	130.8	7.2	335	144	152	240	
Poly-meta-phenylene isophthalic amide	10 (fiber) 7.7 (mold)	0.7 0.18	1.38 1.33	724.6 579	50.7 13.5	375 415 (decomposition)	>230 >230	280 280	220 220	Fire retardant, heat resistance fiber
Polypromellitic imide	3 (film)	0.17	1.43	203	7.0	Heat de- composition	417 decomposition	360/250	300 (³)	No change in inert gas up to 350°C
(Aromatic polyimide) PI	2.5 to 3.2 (mold)	0.1	1.43	203	7.0	Heat de- composition	417 decomposition	360/250	260	Usable up to 300°C for bearing. Sintering, no fusion (molded products)
Polyamide imide PAI	4.7	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
Polyether imide (Aromatic polyimide) PI	3.6	0.107	1.27	240.9	_	_	215	210/200	170	Improved polyimide of melting forming
Polyamino bis-maleimide	_	0.35	1.6	_	21.9	_	_	330 (³)	260	

Notes (1) $GPa = 10^4 \text{ kgf/cm}^2 = 10^2 \text{ kgf/mm}^2$

(2) If there is a slash mark "/" in the thermal

(3) Reference value

deformation temperature column, then the value to the left of the "/" applies to 451 kPa, If there, the value relates to 1.82 MPa.



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 démonstrates 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

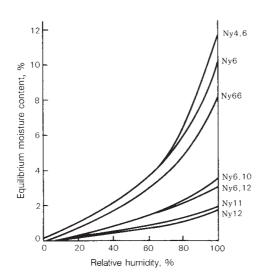


Fig. 12.23 Equilibrium Moisture Content and Relative Humidity of Various Nylons

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		
D	Miniature ball bearings	VCR, IC cooling fans			
3all bearing	Deep groove ball bearings	Alternators, fan motors for air conditioners	Nylon 66 (Glass fiber content: 0 to 10%)		
Ball	Angular contact ball bearings	Magnetic clutches, automotive wheels	(diago nosi content. o to 1070)		
Bu	Needle roller bearings	Automotive transmissions			
Roller bearing	Tapered roller bearings	Automotive wheels	Nylon 66		
ller t	ET-type cylindrical roller bearings	General	(Glass fiber content: 10 to 25%)		
Rol	H-type spherical roller bearings	General			

Table 12.13 Environmental Resistance of Nylon 66 Resin

En	vironment	Temper- ature, °C	Glass content	Hours for the phy	sical property v	alue to drop to 5	50%, h 2000	Remarks
		120	0 D		<u> </u>	<u> </u>	→	Contains an extreme
	Gear oil	140	0 A D				— →	pressure additive
		100	A				→	Contains an
		120	A					extreme pressure
	Synthetic lubricating oil	130	0 A C			_		additive
Oil		150	0 B D				→	
UII		80	0 D				—	Contains an extreme
	Hydraulic oil	120	0 D				─	pressure additive
		150	0 D					
		120	0 D				→	
	ATF oil	140	0 A D				─	
	Engine oil	120	0 D				—	
		80	0 D				→	
	Grease	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.

Table 12.14 Properties of Typical Super-Engineering Plastic Materials for Cages

Classification	Polyether sulfone (PES)	Polyether imide (PEI)	Polyamide imide (PAI)	Polyether etherketon (PEEK)	Branch type polyphenylene sulfide (PPS)	Linear type polyphenylene sulfide (L-PPS)
Resin	Amorphous resin	Amorphous resin	Amorphous resin	Crystalline resin	Crystalline resin	Crystalline resin
Continuous temp	180°C	170℃	210℃	240°C	220°C	220℃
Physical properties	Poor toughness (Pay attention to cage shape) Low weld strength Small fatigue resistance	Poor toughness Small weld strength Small fatigue resistance	•Very brittle (No forced-removal molding) •Special heat treatment before use •High rigidity, after heat treatment	Excellent toughness, wear and fatigue resistance Small weld strength	Excellent mechanical properties Slightly low toughness	Excellent mechanical properties Good toughness Good dimensional stability (No water absorption)
Environmental properties	Water absorption (Poor dimensional stability) Good aging resistance Poor stress cracking resistance	Good aging resistance 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).
Material cost (Superiority)	3	2	5	4	1	1
Cage application	Many performance problems High material price	Many performance problems High material cost	Good performance High material and molding cost (For special applications)	Excellent performance High material cost (For special applications)	Problems with toughness Cost is high compared to its performance	Reasonable cost for its performance (For general applications)

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13. DESIGN OF SHAFTS AND HOUSINGS

13.1	Accuracy and Surface Finish of Shafts and Housings
13.2	Shoulder and Fillet Dimensions A 27
13.3	Bearing Seals A 27
13.	3.1 Non-Contact Types Seals A 27:
(1) Oil Groove Seals A 27:
(2) Flinger (Slinger) Type Seals A 27:
(3) Labyrinth Seals A 27
13.	3.2 Contact Type Seals A 27
(1) Oil Seals
(2) Felt Seals A 27

13. DESIGN OF SHAFTS AND HOUSINGS

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 13.1 for normal operating conditions.

Table 13. 1 Accuracy and Roughness of Shaft and Housing

Item	Class of Bearings	Shaft	Housing Bore
Tolerance for	Normal, Class 6	$\frac{\text{IT3}}{2}$ to $\frac{\text{IT4}}{2}$	$\frac{\text{IT4}}{2}$ to $\frac{\text{IT5}}{2}$
Out-of-roundness	Class 5, Class 4	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$
Tolerance for	Normal, Class 6	$\frac{\text{IT3}}{2}$ to $\frac{\text{IT4}}{2}$	$\frac{\text{IT4}}{2}$ to $\frac{\text{IT5}}{2}$
Cylindricality	Class 5, Class 4	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$	$\frac{\text{IT2}}{2}$ to $\frac{\text{IT3}}{2}$
Tolerance for	Normal, Class 6	IT3	IT3 to IT4
Shoulder Runout	Class 5, Class 4	IT3	IT3
Roughness of Fitting Surfaces Ra Small Bearings Large Bearings		0.8 1.6	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

> In cases that the outer ring is mounted in the housing bore with interference or that a thin crosssection 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_2 must be smaller than the minimum bearing chamfer dimension r or r_1 .

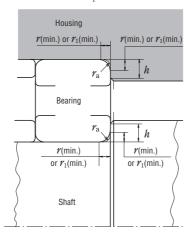


Fig. 13.1 Chamfer Dimensions, Fillet Radius of Shaft and Housing, and Shoulder Height

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

			UIIII . IIIIII	
Nominal	Shaft or Housing			
Chamfer Dimensions	Fillet	Minimun Shoulder Heights h (min.)		
r (min.) or r_1 (min.)	Radius $r_{\rm a}$ (max.)	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.



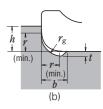


Fig. 13. 2 Chamfer Dimensions, Fillet Radius, and Shoulder Height

Table 13, 3 Shaft Undercut

Unite : mm

			UIIIIS . IIIIII	
Chamfer Dimensions of Inner and	Undercut Dimensions			
Outer Rings r (min.) or r 1(min.)	t	$\gamma_{ m g}$	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	

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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 $D_{\rm a}$ should be less than the pitch circle diameter of the balls, and the shaft shoulder diameter $d_{\rm a}$ 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.

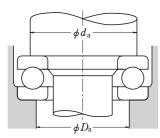


Fig. 13.3 Face Supporting Diameters for Thrust Ball Bearings

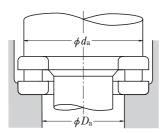


Fig. 13.4 Face Supporting Diameters for Thrust Roller Bearings

13.3 Bearing SealsTo insure the longest p

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 5mm, with a depth of about 4 to 5mm. In the case of sealing methods using grooves only, there should be three or more 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).

Table 13. 4 Gaps between Shafts and Housings for Oil-Groove Type Seals

	Ullis : mm	
Nominal Shaft Diameter	Radial Gap	
Under 50	0.25 to 0.4	
50-200	0.5 to 1.5	

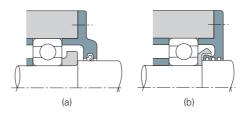
(3) Labyrinth Seals

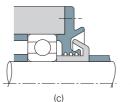
Labyrinth seals are formed by interdigitated segments attached to the shaft and housing that are separated by a very small gap. They are particularly suitable for preventing oil leakage from the shaft at high speeds. The type shown in Fig. 13.7 (a) is widely used because of its ease of assembly, but those shown in Fig. 13.7 (b), (c) have better seal effectiveness.

Table 13. 5 Labyrinth Seal Gaps

Units: mm

Nominal Shaft Diameter	Labyrinth Gaps		
Nominal Shart Diameter	Radial Gap	Axiall Gap	
Under 50	0.25 to 0.4	1 to 2	
50-200	0.5 to 1.5	2 to 5	





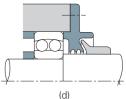
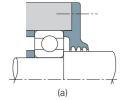
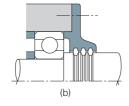


Fig. 13.6 Examples of Flinger Configurations





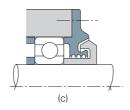
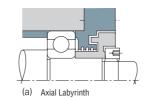


Fig. 13.5 Examples of Oil Grooves



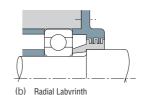




Fig. 13.7 Examples of Labyrinth Designs

rig. 10.7 Examples of Eabyrillin 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. 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 HRC40 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.

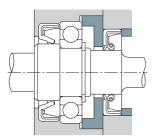


Fig. 13.8 Example of Application of Oil Seal (1)

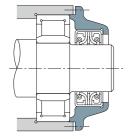


Fig. 13.9 Example of Application of Oil Seal (2)

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)
	Nitrile Rubber	Under 16	-25 to +100
Synthetic Rubber	Acrylic Rubber	Under 25	-15 to +130
	Silicone Rubber	Under 32	−70 to + 200
	Fluorine- containes 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 being used for transmission shafts, etc.

However, since oil permeation and leakage are

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 4m/sec; therefore, it is preferable to replace them with synthetic rubber seals depending on the application.

BEARING HANDLING AND MAINTENANCE



Part B

BEARING HANDLING AND	MAINTENANCE
1. BEARING HANDLING	В 005

2.	BEARING DAMAGE AND	
	MEASURES (Bearing Doctor)	В 02





1.	BEA	RING	HAN	DLING
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1.1 Pre	cautions for Proper Handling of Bearings	В 00
1.2 Bea	aring Storage	В 00
1.2.1	Bearing Storage Location	В 00
1.2.2	How to Store Bearings	В 00
1.3 Mo	unting	В 00
1.3.1	Mounting of Bearings with Cylindrical Bores	В 00
1.3.2	Mounting of Bearings with Tapered Bores	В 00
1.4 Ope	eration Inspection	В 00
1.5 Dis	mounting	В 01
1.5.1	Dismounting of Outer Rings	В 01
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1.8 Ma	intenance and Inspection	В 01
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1.8.2	Diagnosis with Sound and Vibration	В 01

1. BEARING HANDLING

1.1 Precautions for Proper Handling of Bearings

Since rolling bearings are high precision machine parts, they must be handled accordingly. Even if high quality bearings are used, their expected performance cannot be achieved if they are not handled properly. The main precautions to be observed are as follows:

(1) Keep Bearings and Surrounding Area Clean

Dust and dirt, even if invisible to the naked eye, have harmful effects on bearings. It is necessary to prevent the entry of dust and dirt by keeping the bearings and their environment as clean as possible.

(2) Careful Handling

Heavy shocks during handling may cause bearings to be scratched or otherwise damaged possibly resulting in their failure. Excessively strong impacts may cause brinelling, breaking, or cracking,

(3) Use Proper Tools

Always use the proper equipment when handling bearings and avoid general purpose tools.

(4) Prevent Corrosion

Since perspiration on the hands and various other contaminants may cause corrosion, keep the hands clean when handling bearings. Wear gloves if possible. Pay attention to rust of bearing caused by corrosive gasses.

1.2 Bearing Storage

To prevent rusting, each bearing is treated and packed with an anticorrosive agent, but depending on the environment of the storing place, the effectiveness of the corrosion countermeasures varies greatly. Careful attention is necessary to select a suitable place to keep and stock replacement bearings.

1.2.1 Bearing Storage Location

Bearings shall be stocked indoors in a place that is not exposed to wind or rain. Also, an indoor environment where temperature and/or humidity is high would be unsuitable for storage, because such a place would deteriorate the anticorrosion effect. Be sure to stock the bearings in a place where environmental temperature variation is small.

1.2.2 How to Store Bearings

After considering the size and weight of bearing to be stocked, secure enough space and proper carrying equipment to transport the bearing safely. It is recommended to provide proper storing shelves to stock bearings. The lowest tray of the storing shelves shall be at least 30 cm above the floor. Please avoid putting bearings directly on the floor.

The anticorrosive effectiveness of the package varies depending on the storing environment, but

it is generally effective for about one to three years. Due to some special reason, if storing of the bearing for a longer time, or even up to nearly ten years is necessary, then a special storage method must be used. One such method is to immerse the bearing in a turbine oil which prevents corrosion.

1.3 Mounting

The method of mounting rolling bearings strongly affects their accuracy, life, and performance, so their mounting deserves careful attention. Their characteristics should first be thoroughly studied, and then they should be mounted in the proper manner. It is recommended that the handling procedures for bearings be fully investigated by the design engineers and that standards be established with respect to the following items:

- (1) Cleaning the bearings and related parts.
- (2) Checking the dimensions and finish of related parts.
- (3) Mounting
- (4) Inspection after mounting.
- (5) Supply of lubricants.

Bearings should not be unpacked until immediately before mounting. When using ordinary grease lubrication, the grease should be packed in the bearings without first cleaning them. Even in the case of ordinary oil lubrication, cleaning the bearings is not required. However, bearings for instruments or for high speed operation must first be cleaned with clean filtered oil in order to remove the anti-corrosion agent. After the bearings are cleaned with filtered oil, they should be protected to prevent corrosion.

Prelubricated bearings must be used without cleaning. Bearing mounting methods depend on the bearing type and type of fit. As bearings are usually used on rotating shafts, the inner rings require a tight fit.

Bearings with cylindrical bores are usually mounted by pressing them on the shafts (press fit) or heating them to expand their diameter (shrink fit). Bearings with tapered bores can be mounted directly on tapered shafts or cylindrical shafts using tapered sleeves.

Bearings are usually mounted in housings with a loose fit. However, in cases where the outer ring has an interference fit, a press may be used. Bearings can be interference-fitted by cooling them before mounting using dry ice. In this case, a rust preventive treatment must be applied to the bearing because moisture in the air condenses on its surface.

1.3.1 Mounting of Bearings with Cylindrical Bores

(1) Press Fits

Fitting with a press is widely used for small bearings. A mounting tool is placed on the inner ring as shown in Fig. 1.1 and the bearing is slowly pressed on the shaft with a press until the side of the inner ring rests against the shoulder of the shaft. The mounting tool must not be placed on the outer ring for press

mounting, since the bearing may be damaged. Before mounting, applying oil to the fitted shaft surface is recommended for smooth insertion. The mounting method using a hammer should only be used for small ball bearings with minimally tight fits and when a press is not available. In the case of tight interference fits or for medium and large bearings, this method should not be used. Any time a hammer is used, a mounting tool must be placed on the inner ring.

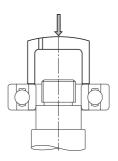


Fig. 1.1 Press Fitting Inner Ring

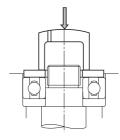
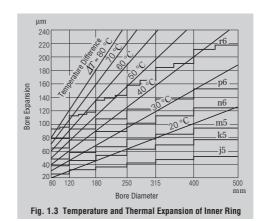


Fig. 1.2 Simultaneous Press Fitting of Inner and Outer Rings



When both the inner and outer rings of non-separable bearings, such as deep groove ball bearings, require tight-fit, a mounting tool is placed on both rings as shown in Fig. 1.2, and both rings are fitted at the same time using a screw or hydraulic press. Since the outer ring of self-aligning ball bearings may deflect a mounting tool such as that shown in Fig. 1.2 should always be used for mounting them.

In the case of separable bearings, such as cylindrical roller bearings and tapered roller bearings, the inner and outer rings may be mounted separately. Assembly of the inner and outer rings, which were previously mounted separately, should be done carefully to align the inner and outer rings correctly. Careless or forced assembly may cause scratches on the rolling contact surfaces.

(2) Shrink Fits

Since press fitting large bearings requires a large force, a shrink fit is widely used. The bearings are first heated in oil to expand them before mounting.

This method prevents an excessive force from being imposed on the bearings and allows mounting them in a short time.

The expansion of the inner ring for various temperature differences and bearing sizes is shown in Fig. 1.3.

The precautions to follow when making shrink fits are as follows:

- (a) Do not heat bearings to more than 120°C.
- (b) Put the bearings on a wire net or suspend them in an oil tank in order to prevent them from touching the tank's bottom directly.
- (c) Heat the bearings to a temperature 20 to 30°C higher than the lowest temperature required for mounting without interference since the inner ring will cool a little during mounting.
- (d) After mounting, the bearings will shrink in the axial direction as well as the radial direction while cooling. Therefore, press the bearing firmly against the shaft shoulder using locating methods to avoid a clearance between the bearing and shoulder.

NSK Bearing Induction Heaters

Besides heating in oil. NSK Bearing Heaters, which use electromagnetic induction to heat bearings, are widely used.

In NSK Bearing Heaters, electricity (AC) in a coil produces a magnetic field that induces a current inside the bearing that generates heat. Consequently, without using flames or oil uniform heating in a short time is possible, making bearing shrink fitting efficient and

In the case of relatively frequent mounting and dismounting such as cylindrical roller bearings for roll necks of rolling mills and for railway journal boxes, induction heating should be used for mounting and dismounting inner rings.

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1.3.2 Mounting of Bearings with Tapered Bores

Bearings with tapered bores are mounted on tapered shafts directly or on cylindrical shafts with adapters or withdrawal sleeves (Figs. 1.4 and 1.5). Large spherical roller bearings are often mounted using hydraulic pressure. Fig. 1.6 shows a bearing mounting utilizing a sleeve and hydraulic nut. Fig. 1.7 shows another mounting method. Holes are drilled in the sleeve which are used to feed oil under pressure to the bearing seat. As the bearing expands radially, the sleeve is inserted axially with adjusting bolts.

Spherical roller bearings should be mounted while checking their radial-clearance reduction and referring to the push-in amounts listed in Table 1.1. The radial clearance must be measured using clearance gauges.

In this measurement, as shown in Fig. 1.8, the clearance for both rows of rollers must be measured simultaneously, and these two values should be kept roughly the same by adjusting the relative position of the outer and inner rings.

When a large bearing is mounted on a shaft, the outer ring may be deformed into an oval shape by its own weight. If the clearance is measured at the lowest part of the deformed bearing, the measured value may be bigger than the true value. If an incorrect radial internal clearance is obtained in this manner and the values in Table 1.1 are used, then the interference fit may

become too tight and the true residual clearance may become too small. In this case, as shown in Fig. 1.9. one half of the total clearance at points a and b (which are on a horizontal line passing through the bearing center) and c (which is at the lowest position of the bearing) may be used as the residual clearance. When a self-aligning ball bearing is mounted on a shaft with an adapter, be sure that the residual clearance does not become too small. Sufficient clearance for easy alignment of the outer ring must be allowed.

1.4 Operation Inspection

After the mounting has been completed, a running test should be conducted to determine if the bearing has been mounted correctly. Small machines may be manually operated to assure that they rotate smoothly. Items to be checked include sticking due to foreign matter or visible flaws, uneven torque caused by improper mounting or an improper mounting surface, and excessive torque caused by an inadequate clearance, mounting error, or seal friction. If there are no abnormalities, powered operation may be started.

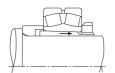


Fig. 1.4 Mounting with Adapter



Fig. 1.6 Mounting with Hvdraulic Nut

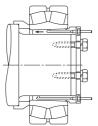


Fig. 1.5 Mounting with Withdrawal Sleeve

Fig. 1.7 Mounting with Special Sleeve and Hydraulic Pressure

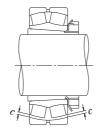


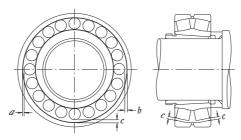
Fig. 1.8 Clearance Measurement of Spherical Roller Bearing



Units: mm

Ullits : mr									
Bearing Bore Diameter		Reduction in Radial		Push-in amount in axial direction				Minimum Permissible Residual Clearance	
d		Clearance		Taper 1 : 12		Taper 1 : 30		an.	G0
over	incl.	min.	max.	min.	max.	min.	max.	CN	C3
30 40 50 65	40 50 65 80	0.025 0.030 0.030 0.040	0.030 0.035 0.035 0.045	0.40 0.45 0.45 0.60	0.45 0.55 0.55 0.70	=		0.010 0.015 0.025 0.030	0.025 0.030 0.035 0.040
80	100	0.045	0.055	0.70	0.85	1.75	2.15	0.035	0.050
100	120	0.050	0.060	0.75	0.90	1.9	2.25	0.045	0.065
120	140	0.060	0.070	0.90	1.10	2.25	2.75	0.055	0.080
140	160	0.065	0.080	1.0	1.3	2.5	3.25	0.060	0.100
160	180	0.070	0.090	1.1	1.4	2.75	3.5	0.070	0.110
180	200	0.080	0.100	1.3	1.6	3.25	4.0	0.070	0.110
200	225	0.090	0.110	1.4	1.7	3.5	4.25	0.080	0.130
225	250	0.100	0.120	1.6	1.9	4	4.75	0.090	0.140
250	280	0.110	0.140	1.7	2.2	4.25	5.5	0.100	0.150
280	315	0.120	0.150	1.9	2.4	4.75	6.0	0.110	0.160
315	355	0.140	0.170	2.2	2.7	5.5	6.75	0.120	0.180
355	400	0.150	0.190	2.4	3.0	6	7.5	0.130	0.200
400	450	0.170	0.210	2.7	3.3	6.75	8.25	0.140	0.220
450	500	0.190	0.240	3.0	3.7	7.5	9.25	0.160	0.240
500	560	0.210	0.270	3.4	4.3	8.5	11.0	0.170	0.270
560	630	0.230	0.300	3.7	4.8	9.25	12.0	0.200	0.310
630	710	0.260	0.330	4.2	5.3	10.5	13.0	0.220	0.330
710	800	0.280	0.370	4.5	5.9	11.5	15.0	0.240	0.390
800	900	0.310	0.410	5.0	6.6	12.5	16.5	0.280	0.430
900	1 000	0.340	0.460	5.5	7.4	14.0	18.5	0.310	0.470
1 000	1 120	0.370	0.500	5.9	8.0	15.0	20.0	0.360	0.530
Pamark. The values for reduction in radial internal clearance are for hearings with CN clearance. For hearing with C									

Remark The values for reduction in radial internal clearance are for bearings with CN clearance. For bearing with C3 Clearance the maximum values listed should be used for the reduction in radial internal clearance.



Measuring Clearance in Large Spherical Roller Bearing

Large machines, which cannot be turned by hand, can be started after examination with no load, and the power immediately cutoff and the machine allowed to coast to a stop. Confirm that there is no abnormality such as vibration, noise, contact of rotating parts, etc. Powered operation should be started slowly without load and the operation should be observed carefully until it is determined that no abnormalities exist, then gradually increase the speed, load, etc. to their normal levels. Items to be checked during the test operation include the existence of abnormal noise, excessive rise of bearing temperature, leakage and contamination of lubricants, etc. If any abnormality is found during the test operation, it must be stopped immediately and the machine should be inspected. If necessary, the bearing should be dismounted for examination.

Although the bearing temperature can generally be estimated by the temperature of the outside surface of the housing, it is more desirable to directly measure the temperature of the outer ring using oil holes for

The bearing temperature should rise gradually to the steady state level within one to two hours after the operation starts. If the bearing or its mounting is improper, the bearing temperature may increase rapidly and become abnormally high. The cause of this abnormal temperature may be an excessive amount of lubricant, insufficient bearing clearance, incorrect mounting, or excessive friction of the seals.

In the case of high speed operation, an incorrect selection of bearing type or lubricating method may also cause an abnormal temperature rise.

The sound of a bearing may be checked with a noise locater or other instruments. Abnormal conditions are indicated by a loud metallic sound, or other irregular noise, and the possible cause may include incorrect lubrication, poor alignment of the shaft and housing, or the entry of foreign matter into the bearing. The possible causes and measures for irregularities are listed in Table 1.2.

Table 1. 2 Causes of and Measures for Operating Irregularities

Table 1. 2 Causes of and measures for Operating Inegularities							
Irregularities		Possible Causes	Measures				
	Loud Metallic Sound (¹)	Abnormal Load	Improve the fit, internal clearance, preload, position of housing shoulder, etc.				
		Incorrect mounting	Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting method.				
		Insufficient or improper Lubricant	Replenish the lubricant or select another lubricant.				
		Contact of rotating parts	Modify the labyrinth seal, etc.				
Noise	Loud Regular Sound	Flaws,corrosion,or scratches on raceways	Replace or clean the bearing, improve the seals, and use clean lubricant.				
		Brinelling	Replace the bearing and use care when handling bearings.				
		Flaking on raceway	Replace the bearing.				
	Irregular Sound	Excessive clearance	Improve the fit, clearance and preload.				
		Penetration of foreign particles	Replace or clean the bearing, improve the seals, and use clean lubricant.				
		Flaws or flaking on balls	Replace the bearing.				
		Excessive amount of lubricant	Reduce amount of lubricant, select stiffer grease.				
		Insufficient or improper lubricant	Replenish lubricant or select a better one.				
Abnorn	nal Tamparatura	Abnormal load	Improve the fit, internal clearance, preload, position of housing shoulder.				
Abnormal Temperature Rise		Incorrect mounting	Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting, or mounting method.				
		Creep on fitted surface, excessive seal friction	3, 1 11				
		Seal Hiction	Correct the seals, replace the bearing, correct the fitting or mounting.				
Vibration (Axial runout)		Brinelling	Replace the bearing and use care when handling bearings.				
		Flaking	Replace the bearing.				
		Incorrect mounting	Correct the squareness between the shaft and housing shoulder or side of spacer.				
		Penetration of foreign particles	Replace or clean the bearing, improve the seals.				
Leakage or Discoloration of Lubricant		Too much lubricant, Penetration by foreign matter or abrasion chips	Reduce the amount of lubricant, select a stiffer grease. Replace the bearing or lubricant. Clean the housing and adjacent parts.				

Note (1) Intermittent squeal or high-pitch noise may be heard in medium- to large-sized cylindrical roller bearings or ball bearings that are operating under grease lubrication in low-temperature environments. Under such low-temperature conditions, bearing temperature will not rise resulting in fatigue nor is grease performance affected. Although intermittent squeal or high-pitch noise may occur under these conditions, the bearing is fully functional and can continue to be used. In the event that greater noise reduction or quieter running properties are needed, please contact your nearest NSK branch office.

1.5 Dismounting

A bearing may be removed for periodic inspection or for other reasons. If the removed bearing is to be used again or it is removed only for inspection, it should be dismounted as carefully as when it was mounted. If the bearing has a tight fit. its removal may be difficult. The means for removal should be considered in the original design of the adjacent parts of the machine. When dismounting, the procedure and sequence of removal should first be studied using the machine drawing and considering the type of mounting fit in order to perform the operation properly.

1.5.1 Dismounting of Outer Rings

In order to remove an outer ring that is tightly fitted, first place bolts in the push-out holes in the housing at several locations on its circumference as shown in Fig. 1.10, and remove the outer ring by uniformly tightening the bolts. These bolt holes should always be fitted with blank plugs when not being used for dismounting. In the case of separable bearings, such as tapered roller bearings, some notches should be made at several positions in the housing shoulder, as shown in Fig. 1.11, so the outer ring may be pressed out using a dismounting tool or by tapping it.

1.5.2 Dismounting of Bearings with Cylindrical

If the mounting design allows space to press out the inner ring, this is an easy and fast method. In this case, the withdrawal force should be imposed only on the inner ring (Fig. 1.12). Withdrawal tools like those shown in Figs. 1.13 and 1.14 are often used.

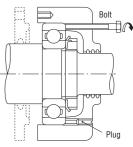


Fig. 1.10 Removal of Outer Ring with Dismounting Bolts

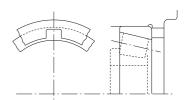


Fig. 1.11 Removal Notches

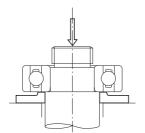


Fig. 1.12 Removal of Inner Ring Using a Press

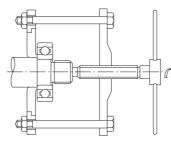


Fig. 1.13 Removal of Inner Ring Using Withdrawal Tool (1)

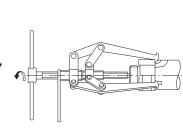


Fig. 1.14 Removal of Inner Ring Using Withdrawal Tool (2)

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In both cases, the claws of the tools must substantially engage the face of the inner ring; therefore, it is advisable to consider the size of the shaft shoulder or to cut grooves in the shoulder to accommodate the withdrawal tools (Fig. 1.14).

The oil injection method is usually used for the withdrawal of large bearings. The withdrawal is achieved easily by mean of oil pressure applied through holes in the shaft. In the case of extra wide bearings, the oil injection method is used together with a withdrawal tool.

Induction heating is used to remove the inner rings of NU and NJ types of cylindrical roller bearings. The inner rings are expanded by brief local heating, and then withdrawn (Fig. 1.15). Induction heating is also used to mount several bearings of these types on a shaft.

1.5.3 Dismounting of Bearings with Tapered Bores

When dismounting relatively small bearings with adapters, the inner ring is held by a stop fastened to the shaft and the nut is loosened several turns. This is followed by hammering on the sleeve using a suitable tool as shown in Fig. 1.18. Fig. 1.16 shows one procedure for dismounting a withdrawal sleeve by tightening the removal nut. If this procedure is difficult, it may be possible to drill and tap bolt holes in the nut and withdraw the sleeve by tightening the bolts as shown in Fig. 1.17.

Large bearings may be withdrawn easily using oil pressure. Fig. 1.19 illustrates the removal of a bearing by forcing oil under pressure through a hole and groove in a tapered shaft to expand the inner ring. The bearing may suddenly move axially when the interference is relieved during this procedure so a stop nut is recommended for protection. Fig. 1.20 shows a withdrawal using a hydraulic nut.

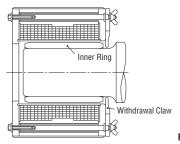


Fig. 1.15 Removal of Inner Ring Using **Induction Heater**

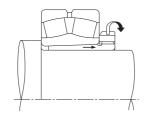


Fig. 1.16 Removal of Withdrawal Sleeve Using Withdrawal Nut (1)

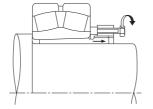


Fig. 1.17 Removal of Withdrawal Sleeve Using Withdrawal Nut (2)

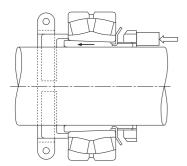


Fig. 1.18 Removal of Adapter with Stop and Axial Pressure

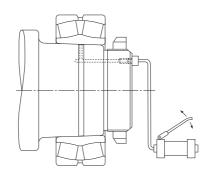


Fig. 1.19 Removal Using Oil Injection Hydraulic Pump

1.6 Inspection of Bearings

1.6.1 Bearing Cleaning

When bearings are inspected, the appearance of the bearings should first be recorded and the amount and condition of the residual lubricant should be checked. After the lubricant has been sampled for examination, the bearings should be cleaned. In general, light oil or kerosene may be used as a cleaning solution.

Dismounted bearings should first be given a preliminary cleaning followed by a finishing rinse. Each bath should be provided with a metal net to support the bearings in the oil without touching the sides or bottom of the tank. If the bearings are rotated with foreign matter in them during preliminary cleaning, the raceways may be damaged. The lubricant and other deposits should be removed in the oil bath during the initial rough cleaning with a brush or other means. After the bearing is relatively clean, it is given the finishing rinse. The finishing rinse should be done carefully with the bearing being rotated while immersed in the rinsing oil. It is necessary to always keep the rinsing oil clean.

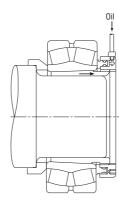


Fig. 1.20 Removal Using Hydraulic Nut

1.6.2 Inspection and Evaluation of Bearings

After being thoroughly cleaned, bearings should be examined for the condition of their raceways and external surfaces, the amount of cage wear, the increase in internal clearance, and degradation of tolerances. These should be carefully checked, in addition to examination for possible damage or other abnormalities, in order to determine the possibility for

In the case of small non-separable ball bearings, hold the bearing horizontally in one hand, and then rotate the outer ring to confirm that it turns smoothly.

Separable bearings such as tapered roller bearings may be checked by individually examining their rolling elements and the outer ring raceway.

Large bearings cannot be rotated manually; however, the rolling elements, raceway surfaces, cages, and contact surface of the ribs should be carefully examined visually. The more important a bearing is, the more carefully it should be inspected.

The determination to reuse a bearing should be made only after considering the degree of bearing wear, the function of the machine, the importance of the bearings in the machine, operating conditions, and the time until the next inspection. However, if any of the following defects exist, reuse is impossible and replacement is necessary.

- (a) When there are cracks in the inner or outer rings, rolling elements, or cage.
- (b) When there is flaking of the raceway or rolling elements.
- (c) When there is significant smearing of the raceway surfaces, ribs, or rolling elements.
- (d) When the cage is significantly worn or rivets are
- (e) When there is rust or scoring on the raceway surfaces or rolling elements.
- (f) When there are any significant impact or brinell traces on the raceway surfaces or rolling elements.
- (g) When there is significant evidence of creep on the bore or the periphery of the outer ring.
- (h) When discoloration by heat is evident.
- (i) When significant damage to the seals or shields of grease sealed bearings has occurred.

B 012 B 013

1.7 Checking of Shaft and Housing

1.7.1 Checking of Shaft

(a) Cylindrical Shaft

- (1) Dimensional check of shaft Measure the shaft size at the place where the bearing will be mounted to confirm that the bearing size is correct. The measurement positions are shown in Fig. 1.21. Use an outside micrometer.
- (2) Observation of the shaft outside surface Observe the surface of shaft where the bearing was mounted to check whether there are scratches, dents, rust or stepped wearing.
 - When there are scratches, dents Round edge with oil stone and/or sand paper to smoothen the surface.

- . When there is rust Remove rust with oil stone and/or sand paper to smoothen the surface.
- When there is stepped wearing After the dimensional measurement of the shaft, decide whether correction is possible.
- (3) Anticorrosive agent After completion of check, apply an anticorrosive agent.

(b) Tapered Shaft

(1) Check of shaft shape

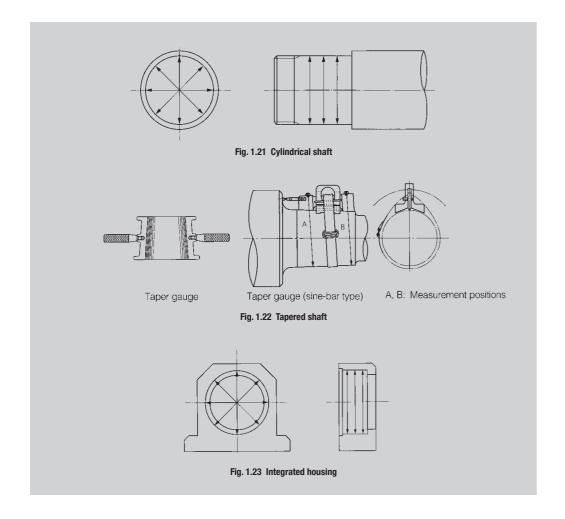
Measure the shape of shaft where the bearing will be mounted to confirm that its shape is correct. The measurement positions are shown in Fig. 1.22. As for the measurement instrument, use a taper gauge (sine bar system). (Fig. 2.2 and Fig. 1.22)

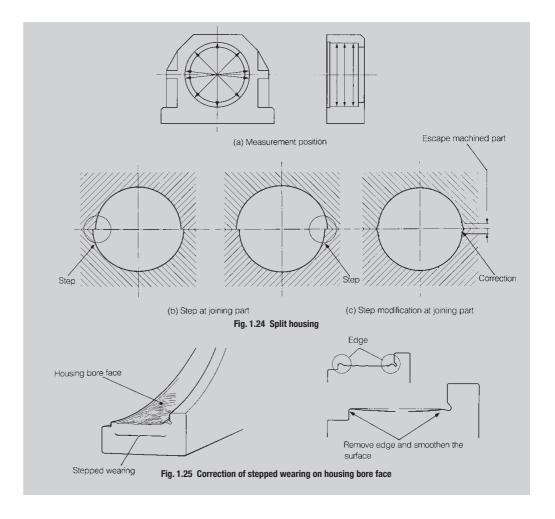
- (2) Observation of the shaft outside surface Observe the shaft surface where the bearing was mounted to check whether there are scratches. dents, rust or stepped wearing.
 - . When there are scratches, dents Round edge with oil stone and/or sand paper to smoothen the surface.
 - When there is rust Remove rust with oil stone and/or sand paper to smoothen the surface. (In this case if the zone to be corrected is wide, it

is necessary to inspect the shape of the tapered part by using a taper gauge. The inspection method is: apply a thin coat of bluing over the entire surface of taper gauge bore face, insert it slowly after adjusting the taper gauge to the shaft center tapered shaft, then, do a run-in by moving back-and-forth. Then, pull the taper gauge out slowly when adjusting to the shaft center. Observe where blue dve is attached to the surface of tapered shaft.

If the blue ares is bigger than 80%, the shaft may be reused. When using a taper gauge (sinebar type), follow the instructions given in the Operation Manual issued by the manufacturer).

- When there is stepped wearing After the dimensional measurement of the shaft, decide whether correction is possible.
- (3) Anticorrosive agent After completion of check, apply an anticorrosive agent.





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1.7.2 Checking of Housing

(a) Integrated Type Housing

(1) Check of bore size of housing Measure the housing bore size where the bearing will be mounted to confirm that the size is correct. The measurement position is shown in Fig. 1.23.

As for the measurement instrument, use an inside micrometer.

(2) Observation of housing bore face

Observe the surface of the housing bore where the bearing was mounted to check whether there are scratches, dents, rust or stepped wearing.

 When there are scratches, dents Round edge with oil stone and/or sand paper to smoothen the surface.

· When there is rust Remove rust with oil stone and/or sand paper to smoothen the surface.

 When there is stepped wearing (Fig. 1.25) After the dimensional measurement of the housing bore, decide whether correction and reuse is possible. In this case, if the measured value of the housing bore is within its tolerance, remove the stepped worn part with oil stone and/or sand paper, etc. and smoothen the surface, then, reuse. If the stepped wearing is severe, either plate or apply thermal spraying to reconstitute to the correct housing size before reusina.

(3) Anticorrosive agent After completion of check, apply an anticorrosive agent.

(b) Split Housing

(1) Check of the housing bore size

In case of a split housing, assemble correctly the housing without bearing, and measure its bore dimension at the place where the bearing will be mounted to confirm that the dimension is correct. The measurement position is shown in Fig. 1.24 (a). As for the measurement instrument, an inside micrometer shall be used.

(2) Observation of housing bore face Observe the surface of the housing bore where the bearing was mounted to check whether there are scratches, dents, rust or stepped wearing.

• When there are scratches, dents Round edge with oil stone and/or sand paper to smoothen the surface.

 When there is rust Remove rust with oil stone and/or sand paper to smoothen the surface.

• When there is stepped wearing (Fig. 1.25) After the dimensional measurement of the housing bore, decide whether correction is possible.

In this case, if the measured value of housing bore is within its tolerance, remove the stepped worn portion with oil stone and/or sand paper, etc. and smoothen the surface, then, reuse.

• When the stepped wearing is severe If the stepped wearing is severe, either plate or apply thermal spraying to reconstitute to the correct housing size and reuse.

 When there is a step As step may occur at the joining part of the split halves housing, confirm whether there is a step. If a step is found, correct it in the way as shown in Fig. 1.24 (c).

(3) Anticorrosive agent After completion of check, apply an anticorrosive

1.8 Maintenance and Inspection

1.8.1 Detecting and Correcting Irregularities

In order to maintain the original performance of a bearing for as long as possible, proper maintenance and inspection should be performed. If proper procedures are used, many bearing problems can be avoided and the reliability, productivity, and operating costs of the equipment containing the bearings are all improved. It is suggested that periodic maintenance be done following the procedure specified. This periodic maintenance encompasses the supervision of operating conditions, the supply or replacement of lubricants, and regular periodic inspection, Items that should be regularly checked during operation include bearing noise, vibration, temperature, and lubrication. If an irregularity is found during operation, the cause should be determined and the proper corrective actions should be taken after referring to Table 1.2. If necessary, the bearing should be dismounted and examined in detail. As for the procedure for dismounting and inspection, refer to Section 1.6, Inspection of Bearings.

1.8.2 Diagnosis with Sound and Vibration Classification of sounds and vibrations

Sound and vibration accompany the rotation of rolling bearings. The tone and amplitude of such sound and vibration vary depending on the type of bearing, mounting conditions, operational conditions, etc. The sound and vibration of a rolling bearing can be classified under the following four chief categories and each category can be further classified into several sub-categories, as described in Table 1.3 below. Boundaries between groups are, however, not definite. Even if some types of sounds or vibrations are inherent in the bearings, the volume might be related to the manufacturing process, while some types of sounds or vibrations, even if they arise due to manufacturing, cannot be eliminated even in normal conditions.

By recording sounds and vibrations of a rotating machine and analyzing them, it is possible to infer the cause. As can be seen from figures on the next page, a mechanically normal bearing shows a stable waveform. However, a bearing with a scratch, for example, shows a waveform with wide swings indicating large-amplitude sounds at regular intervals. (Refer to Figs. 1.26 and 1.27)



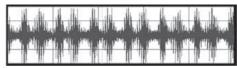
	lable 1.3 Classification of Sounds and Vibrations in a Rolling Bearing					
	SC	ound	Vibration		Features	
	Race noise		Free vibration of raceway ring		Continuous noise, basic unavoidable noise which all bearings generate	
	Click noise		Free vibration of raceway ring, free vibration of cage		Regular noise at a certain interval, large bearings and horizontal shaft, radial load and low rpm	
	Squeal no	ise	Free vibration of raceway		Intermittent or continuous, mostly large cylindrical roller bearings, radial load, grease lubrication, at particular speed	
Structural		"CK" noise	Free vibration	of cage	Regular noise at a certain interval, all bearing types generate it	
	Cage noise	"CG" noise	Vibration of ca	age	Intermittent or continuous, lubrication with particular grease	
		Tapping noise	Free vibration	of cage	Certain interval, but a little irregular under radial load and during initial stage	
	_		Rolling element passage vibration		Continuous, all bearing types under radial load	
	Waviness noise		Vibration due to waviness	Inner ring	Continuous noise	
Manufacturing				Outer ring	Continuous noise	
				Rolling element	Continuous with rollers, occasional with balls	
				Inner ring	Regular noise at a certain interval	
Handling	Flaw noise		Vibration due to flaw	Outer ring		
			naw	Rolling element		
	Contamination noise		Vibration due to contamination		Irregular	
Seal noise		9	Free vibration of a seal		Contact seal	
	Lubricant noise		_		Irregular	
Others				f_{r}	Continuous	
		_	Runout	f_{c}	Continuous	
				$f_{\rm r}-2f_{\rm c}$	Continuous	



Number of rolling elements



Sound waveform of a normal bearing



Sound waveform of a scratched bearing

Fig. 1.26

When there is damage on an inner-ring raceway surface Bore diameter: 100 mm Recording and analysis method: Envelope analysis result of sounds of a test machine recorded by a microphone Number of rotations: 50 min⁻¹

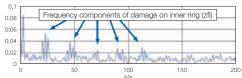


Fig. 1.27

Generated frequency (frequency analysis)					
FFT of original wave		FFT after	Source	Measures	
Radial (angular) direction Axial direction		envelope (basic No.)			
f_{RiN}, f_{MI}	f_{AIN} , f_{AM}	_	Selective resonance of waviness (rolling friction)	Improve rigidity around the bearings, appropriate radial clearance, high-viscosity lubricant, high-quality bearings	
$f_{\it RiN}, f_{\it MI}$ Natural frequen	f_{AiN}, f_{AM} icy of cage	Zf _c	Collision of rolling elements with inner ring or cage	Reduce radial clearance, apply preload, high-viscosity oil	
$(\approx f_{R2N}, f_{R3N})$	_	?	Self-induced vibration caused by sliding friction at rolling surface	Reduce radial clearance, apply preload, change the grease, replace with countermeasured bearings	
Natural frequen	cy of cage	fc	Collision of cage with rolling elements or rings	Apply preload, high-viscosity lubricant, reduce mounting error	
Natural frequen	cy of cage	?	Self-induced vibration caused by friction at cage guide surface	Change of grease brand, replace with countermeasured cage	
Natural frequen	cy of cage	Zf _c	Collision of cage and rolling element caused by grease resistance	Reduce radial clearance, apply preload, low-viscosity lubricant	
Zf _c	_	_	Displacement of inner ring due to rolling element passage	Reduce radial clearance, apply preload	
$nZf_i \pm f_r (nZ \pm 1 \text{ peaks})$	<i>nZ_{fi} (nZ</i> peaks)	_	Inner ring raceway waviness, irregularity of shaft exterior	High-quality bearings, improve shaft accuracy	
nZf_c ($nZ\pm 1$ peaks)	nZfc (nZ peaks)	_	Outer ring raceway waviness, irregular bore of housing	High-quality bearings, improve housing bore accuracy	
$2nf_b \pm f_c$ (2n peaks) $2nf_b$ (2n peaks)		_	Rolling element waviness	High-quality bearings	
		Z _f	Nicks, dents, rust, flaking on inner ring raceway	Replacement and careful bearing handling	
f_{RiN} , f_{MI}	f_{AIN} , f_{AM}	Zfc	Nicks, dents, rust, flaking on inner ring raceway	Replacement and careful bearing handling	
		2f _b	Nicks, dents, rust, flaking on rolling elements	Replacement and careful bearing handling	
f_{RiN} , f_{MI}	f_{AiN}, f_{AM}	Irregular	Entry of dirt and debris	Washing, improve sealing	
Natural frequency of seal		(f_r)	Self-induced vibration due to friction at seal contact area	Change the seal, change the grease	
?	?	Irregular	Lubricant or lubricant bubbles crushed between rolling elements and raceways	Change the grease	
fr	_	_	Irregular inner ring cross-section	High-quality bearings	
f_{c}	_	_	Ball variation in bearing, rolling elements non-equidistant	High-quality bearings	
$f_{r}-2f_{c}$	_	_	Non-linear vibration due to rigid variation by ball variation	High-quality bearings	

Orbital revolution frequency of rolling elements, Hz

 f_{RIN} : Ring natural frequency in radial bending mode, Hz

Natural frequency in the mode of angular vibration in inertia of outer ring-spring system, Hz

Rotation frequency of inner ring, Hz

Ring natural frequency in axial bending mode, Hz

Natural frequency in the mode of axial vibration in mass of outer ring-spring system, Hz

 $f_i = f_r - f_c$, Hz

Rotation frequency of rolling element around its center, Hz



2. BEARING DAMAGE AND MEASURES (Bearing Doctor)				
2.1 Bea	ring Damage B 022			
2.2 Rur	ning Traces and Applied Loads B 022			
2.3 Bea	ring Damage and Measures B 024			
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2.3.2	Peeling B 029			
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2. BEARING DAMAGE AND MEASURES (Bearing Doctor)

2.1 Bearing Damage

In general, if rolling bearings are used correctly they will survive to their predicted fatigue life. However, they often fail prematurely due to avoidable mistakes. In contrast to fatigue life, this premature failure is caused by improper mounting, handling, or lubrication, entry of foreign matter, or abnormal heat generation.

For instance, the causes of rib scoring, as one example of premature failure, may include insufficient lubrication, use of improper lubricant, faulty lubrication system, entry of foreign matter, bearing mounting error, excessive deflection of the shaft, or any combination of these. Thus, it is difficult to determine the real cause of some premature failures.

If all the conditions at the time of failure and previous to the time of failure are known, including the application, the operating conditions, and environment; then by studying the nature of the failure and its probable causes, the possibility of similar future failures can be reduced.

2.2 Running Traces and Applied Loads

As the bearing rotates, the raceways of the inner ring and outer ring make contact with the rolling elements. This results in a wear path on both the rolling elements and raceways. Running traces are useful, since they indicate the loading conditions, and should be carefully observed when the bearing is disassembled.

If the running traces are clearly defined, it is possible to determine whether the bearing is carrying a radial load, axial load or moment load. Also, the roundness condition of the bearing can be determined. Check whether unexpected bearing loads or large mounting errors occurred. Also, determine the probable cause of the bearing damage.

Fig. 2.2 shows the running traces generated in deep groove bearings under various load conditions. Fig. 2.2 (a) shows the most common running trace generated when the inner ring rotates under a radial load only. Figs. 2.2 (e) through (h) show several different running traces that result in a shortened life due to their adverse effect on the bearings.

Similarly, Fig. 2.2 shows different roller bearing running traces: Fig. 2.2 (i) shows the outer ring running trace when a radial load is properly applied to a cylindrical roller bearing which has a load on a rotating inner ring. Fig. 2.2 (j) shows the running trace in the case of shaft bending or relative inclination

between the inner and outer rings. This misalignment leads to the generation of slightly shaded (dull) bands in the width direction. Traces are diagonal at the beginning and end of the loading zone. For double-row tapered roller bearings where a single load is applied to the rotating inner ring, Fig. 2.2 (k) shows the running trace on the outer ring under radial load while Fig. 2.2 (l) shows the running trace on the outer ring under axial load. When misalignment exists between the inner and the outer rings, then the application of a radial load causes running traces to appear on the outer ring as shown in Fig. 2.2 (m).

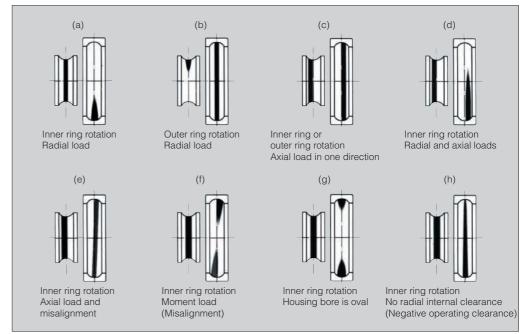


Fig. 2.2 Typical Running Traces of Deep Groove Ball Bearings

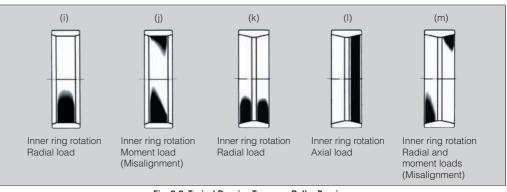


Fig. 2.2 Typical Running Traces on Roller Bearings

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2.3 Bearing Damage and Measures

In general, if rolling bearings are used correctly, they will survive to their predicted fatigue life. Bearings. however, often fail prematurely due to avoidable mistakes. In contrast to fatigue life, this premature failure is caused by improper mounting, mishandling, poor lubrication, entry of foreign matter or abnormal heat generation.

For example, one cause of premature failure is rib scoring which is due to insufficient lubrication, use of improper lubricant, faulty lubrication system, entry of foreign matter, bearing mounting error, excessive deflection of the shaft or some combination of these. If all conditions are known for the times both before and after the failure, including the application. the operating conditions, and environment, then a measure can be determined by studying the nature of the failure and its probable causes. A successful measure will reduce similar failures or prevent them from happening again.

Sections 2.3.1 through 2.3.18 give various type of bearing damage and measures. Please consult these sections when trying to determine the cause of bearing damage. By the way, the bearing diagnostic chart in the Appendix may be useful as a quick reference guide.

2.3.1 Flaking

Damage Condition	Possible Cause	Measures
Flaking occurs when small pieces of bearing material are split off from the smooth surface of the raceway or rolling elements due to rolling fatigue, thereby creating regions having rough and coarse texture.	Excessive load Poor mounting (misalignment) Moment load Entry of foreign debris, water penetration Poor lubrication, Improper lubricant Unsuitable bearing clearance Improper precision for shaft or housing, unevenness in housing rigidity, large shaft bending Progression from rust, corrosion pits, smearing, dents (Brinelling)	Reconfirm the bearing application and check the load conditions Improve the mounting method Improve the sealing mechanism, prevent rusting during non-running Use a lubricant with a proper viscosity, improve the lubrication method Check the precision of shaft and housing Check the bearing internal clearance





Symptom:

Inner ring of an angular contact ball bearing Flaking occurs around half of the circumference

of the raceway surface

Cause: Poor lubrication due to entry of cutting coolant

into bearing



Photo 1-2

Part: Symptom: Cause:

Inner ring of an angular contact ball bearing Flaking occurs diagonally along raceway Poor alignment between shaft and housing

during mounting



Part: Symptom: Outer ring of Photo 1-4

Dents due to shock load while stationary Cause:



Photo 1-4

Part: Balls of Photo 1-3 Symptom: Flaking of ball surface

Dents due to shock load while stationary Cause:

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Photo 1-3

Flaking of raceway surface at ball pitch



Photo 1-5

Part: Inner ring of a spherical roller bearing Flaking of only one raceway over its entire Symptom:

circumference

Excessive axial load Cause:



Photo 1-6

Part: Outer ring of Photo 1-5 Symptom:

Flaking of only one raceway over its entire

circumference Excessive axial load Cause:



Photo 1-11

Part: Outer ring of a spherical roller bearing Discoloration and flaking occur on outer ring Symptom:

raceway surface

Poor lubrication under high temperatures Cause:



Photo 1-12

Cause:

Part: Outer ring of a cylindrical roller bearing

for sendzimir Mills

Flaking occurs on outside surface Symptom:

Progression of fatigue in outer ring material (Long period of grinding on outer ring outside

surface)



Photo 1-7

Part: Inner ring of a spherical roller bearing Symptom: Flaking of only one row of raceway Cause: Poor lubrication



Photo 1-8

Part: Rollers of a cylindrical roller bearing Symptom: Premature flaking occurs axially on the rolling

Cause: Scratches caused during improper mounting



Photo 1-13

Part: Inner ring of a cylindrical roller bearing for

sendzimir Mills

Symptom: Flaking occurs on the raceway surface Cause: Severe operating conditions and oil lubrication

of low viscosity

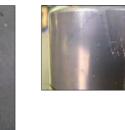
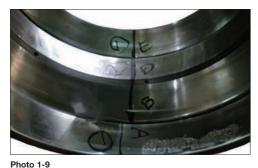


Photo 1-14

Part: Roller of a cylindrical roller bearing Flaking of rolling surfaces

Symptom: Cause:

Origin from flaw or crack in roller during mounting of outer ring and roller



Part:

Outer ring of a four-row tapered roller bearing Flaking of raceway(Loading area) Symptom: Excessive moment load Cause:



Photo 1-10

Part: Symptom: Cause:

Enlargement of raceway surface in Photo 1-9 Flaking of one-side of the raceway Excessive pressure due to be misalignment



Photo 1-15

Part: Inner ring of deep groove ball bearing Symptom:

Flaking of raceway at ball pitch Dents due to shock load during mounting Cause:



Photo 1-16

Part: Inner ring of an angular contact ball bearing Symptom: Flaking of raceway at ball pitch

Dents due to shock load while stationary Cause:



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—Example of flaking and other damage combined 1—



Photo 1-15

Outer ring of a cylindrical roller bearing Symptom: Rust, flaking and crack occur on raceway

Rust at the pitch interval leads to flaking during Cause: operation⇒ Further operation results in cracking

—Example of flaking and other damage combined 2—



Photo 1-16

Outer ring of a spherical roller bearing Symptom: Example of flaking, cracking, and wear

combined on the outer ring raceway Cause: Wear in two places due to poor lubrication

(primary damage) progresses to flaking in one spot (secondary damage) that later becomes a

crack (tertiary damage)

2.3.2 Peeling

Damage Condition	Possible Cause	Measures
Dull or cloudy spots appear on surface along with light wear. From such dull spots, tiny cracks are generated downward to a depth of 5 to 10 µm. Small particles fall off and minor flaking occurs widely.	Entry of debris into lubricant Rough surface due to poor lubrication Surface roughness of mating rolling	Select a proper lubricant Improve the sealing mechanism Improve the surface finish of the rolling mating parts



Photo 2-1

Inner ring of a spherical roller bearing Round shaped peeling pattern occurs Symptom: on the center of the raceway surface

Cause: Poor lubrication

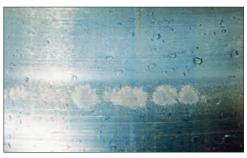


Photo 2-2

Enlargement of pattern in Photo 2-1



Convex rollers of Photo 2-1 Symptom: Round shaped peeling pattern occurs on the center of the rolling surfaces

Poor lubrication



Photo 2-4 Part:

Outer ring of a spherical roller bearing Symptom: Peeling occurs near the shoulder of the raceway

over the entire circumference

Cause: Poor lubrication

Photo 2-3

Cause:

2.3.3 Scoring

Damage Condition	Possible Cause	Measures
Scoring is surface damage due to accumulated small seizures caused by sliding under improper lubrication or under severe operating conditions. Linear damage appears circumferentially on the raceway surface and rolling surface. Cycloidal shaped damage on the roller end. Scoring on rib surface contacting roller end.	Particles are caught in the surface Inclination of inner and outer rings Shaft bending Poor precision of the shaft and housing	Check the size of the load Adjust the preload Improve the lubricant and the lubrication method Check the precision of the shaft and housing



Photo 3-1 Part: Symptom: Cause:

Inner ring of a spherical roller bearing Scoring on large rib face of inner ring Roller slipping due to sudden acceleration and deceleration



Photo 3-2 Part: Symptom: Cause:

Convex rollers of Photo 3-1 Scoring on roller end face Roller slipping due to sudden acceleration and deceleration



Photo 3-5 Part: Symptom: Cause:

Inner ring of a spherical thrust roller bearing Scoring on the rib face of inner ring Debris, which is caught in surface, and excessive axial loading



Photo 3-6 Part: Symptom: Cause:

Convex rollers of Photo 3-5 Scoring on the roller end face Debris, which is caught in surface, and excessive axial loading



Photo 3-3 Part: Symptom: Cause:

Inner ring of a tapered roller thrust bearing Scoring on the face of inner ring rib Worn particles become mixed with lubricant, and breakdown of oil film occurs due to excessive load



Photo 3-4 Part: Symptom: Cause:

Rollers of a double-row cylindrical roller bearing Scoring on the roller end face Poor lubrication and excessive axial load

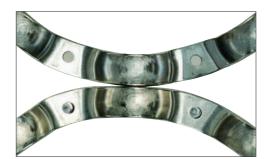


Photo 3-7 Part: Symptom: Cause:

Cage of a deep groove ball bearing Scoring on the pressed-steel cage pockets Entry of debris



Photo 3-8 Part: Symptom: Cause:

Outer ring a double-row cylindrical roller bearing Notable scoring on the face of outer ring rib Excessive axial loading

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2.3.4 Smearing

Damage Condition	Possible Cause	Measures
Smearing is surface damage which occurs from a collection of small seizures between bearing components caused by oil film rupture and/or sliding. Surface roughening occurs along with melting.	High speed and light load Sudden acceleration/deceleration Improper lubricant Entry of water	Improve the preload Improve the bearing clearance Use a lubricant with good oil film formation ability Improve the lubrication method Improve the sealing mechanism

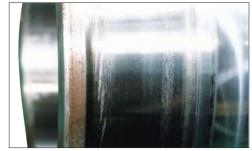


Photo 4-5

Part: Inner ring of a spherical roller bearing Symptom: Partial smearing occurs circumferentially on

raceway surface Poor lubrication Cause:

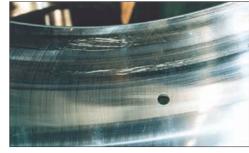


Photo 4-6

Cause:

Part: Outer ring of Photo 4-5

Symptom: Partial smearing occurs circumferentially on

raceway surface Poor lubrication

Photo 4-1

Part: Inner ring of a cylindrical roller bearing Smearing occurs circumferentially on raceway Symptom:

Cause: Roller slipping due to excessive grease filling



Photo 4-2 Symptom:

Part: Outer ring of Photo 4-1

Smearing occurs circumferentially on raceway

surface

Cause: Roller slipping due to excessive grease filling



Photo 4-7

Part: Convex rollers of Photo 4-5 Symptom:

Smearing occurs at the center of the rolling surface

Cause: Poor lubrication



Photo 4-8

Part: Symptom: Cause:

Rollers of a large cylindrical roller bearing Smearing occurs on rolling surface Light load and poor lubrication



Photo 4-3

Part: Inner ring of a spherical roller bearing Symptom: Smearing occurs circumferentially on raceway

surface

Poor lubrication Cause:



Photo 4-4

Part: Outer ring of Photo 4-3 Symptom: Smearing occurs circumferentially on raceway

surface

Cause: Poor lubrication



Photo 4-9

Part: Symptom: Cause:

Outer ring of a large tapered roller bearing Smearing occurs on outer ring raceway surface High speed, light load and poor lubrication

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2.3.5 Fracture

Damage Condition	Possible Cause	Measures
Fracture refers to small pieces which were broken off due to excessive load or shock load acting locally on a part of the roller corner or rib of a raceway ring.	Poor handling such as dropping	 Improve the mounting method (Shrink fit, use of proper tools) Reconsider the loading conditions Provide enough back-up and support for the bearing rib

2.3.6 Cracks

Damage Condition	Possible Cause	Measures
Cracks in the raceway ring and rolling elements. Continued use under this condition leads to larger cracks or fractures.	Excessive interference Excessive load, shock load Progression of flaking Heat generation and fretting caused by contact between mounting parts and raceway ring Heat generation due to creep Poor taper angle of tapered shaft Poor cylindricality of shaft Interference with bearing chamfer due to a large shaft corner radius	 Correct the interference Check the load conditions Improve the mounting method Use an appropriate shaft shape



Photo 5-1

Part: Inner ring of a double-row cylindrical roller bearing Symptom: Chipping occurs at the center rib Cause: Excessive load during mounting



Photo 5-2 Part:

Inner ring of a tapered roller bearing Symptom: Fracture occurs at the cone back face rib Cause: Large shock during mounting



Photo 6-1 Part:

Outer ring of a double-row cylindrical roller bearing Symptom: Thermal cracks occur on the outer ring side face Cause: Abnormal heat generation due to contact sliding between mating part and face of outer ring



Photo 6-2 Part: Symptom:

Cause:

Roller of a tapered roller thrust bearing Thermal cracks occur at large end face of roller Heat generation due to sliding with the inner ring rib under poor lubrication



Photo 5-3

Part: Inner ring of a spherical thrust roller bearing Symptom: Fracture occurs at the large rib Cause: Repeated load



Photo 5-4 Part: Symptom: Cause:

Outer ring of a solid type needle roller bearing Fracture occurs at the outer ring rib Roller inclination due to excessive loading (Needle rollers are long compared to their diameter. Under excessive or uneven loading, rollers become inclined and push against the ribs.)



Photo 6-3

Part: Outer ring of a double-row cylindrical roller

Cracks propageted outward in the axial and Symptom: circumferential directions from the flaking origin

on the raceway surface

Cause: Flaking from a flaw due to shock

Possible Cause

Poor mounting (Bearing misalignment)

Excessive rotation speed, sudden

acceleration and deceleration

Poor handling

Poor lubrication

Temperature rise

Large moment load

Shock and large vibration

Measures

Check the mounting method

and load conditions

Reduce the vibration

Select a cage type

lubricant

Check the temperature, rotation,

Select a lubrication method and



Photo 6-4 Part:

Outer ring of a double-row cylindrical roller bearing used for outer ring rolling (Outer ring rotation) Cracks occur on outside surface

Symptom: Cause:

Flat wear and heat generation due to nonrotation of the outer ring



Photo 6-5

Part: Outer ring of a cylindrical roller bearing for

sendzimir Mills

Symptom: Fatigue crack occurs on outer ring raceway

surface

Bending stress (Large rotating outer ring load) Cause:



Photo 6-6 Part: Symptom: Cause:

Inner ring of a spherical roller bearing Axial cracks occur on raceway surface Large fitting stress due to temperature difference between shaft and inner ring



Cross section of a fractured inner ring in Photo 6-6 Origin is directly beneath the raceway surface Symptom:



2.3.7 Cage Damage

Fracture of cage pillar

Deformation of side face

Wear of pocket surface

Wear of guide surface

Cage damage includes cage deformation, fracture, and wear

Damage Condition

Photo 7-1 Part:

Cage of a deep groove ball bearing Symptom: Fracture of pressed-steel cage-pocket



Photo 7-2

Cause:

Part: Cage of an angular contact ball bearing Symptom: Pocket pillar fractures from a cast iron machined

Abnormal load action on cage due to misaligned

mounting between inner and outer rings



Photo 6-8 Part: Symptom:

Roller of a spherical roller bearing Axial cracks occur on rolling surface



Photo 6-9 Part: Symptom:

Outer ring of four-row tapered roller bearing Secondary damage after flaking occurs on outer ring raceway surface

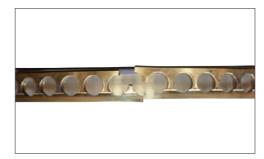


Photo 7-3 Part:

Cage of an angular contact ball bearing Fracture of machined high-tension brass cage Symptom:



Photo 7-4 Part:

Cage of a tapered roller bearing Symptom: Pillar fractures of pressed-steel cage

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2.3.8 Denting

Damage Condition	Possible Cause	Measures
When debris such as small metallic particles are caught in the rolling contact zone, denting occurs on the raceway surface or rolling element surface. Denting can occur at the rolling element pitch interval if there is a shock during the mounting (Brinell dents).	Debris such as metallic particles are caught in the surface Excessive load Shock during transport or mounting	Wash the housing Improve the sealing mechanism Filter the lubrication oil Improve the mounting and handling methods



Photo 7-5 Part: Symptom: Cause:

Cage of an angular contact ball bearing Pressed-steel cage deformation Shock load due to poor handling



Photo 7-6 Part: Symptom:

Cage of a cylindrical roller bearing Deformation of the side face of a machined high-tension brass cage

Cause: Large shock during mounting



Photo 8-1 Part: Symptom:

Cause:

Inner ring of a double-row tapered roller bearing Frosted raceway surface Debris caught in the surface



Photo 8-2 Part:

Outer ring of a double-row tapered roller bearing Indentations on raceway surface Symptom: Cause: Debris caught in the surface



Photo 7-7 Part: Symptom:

Cage of a cylindrical roller bearing Deformation and wear of a machined hightension brass cage



Photo 7-8 Part: Symptom:

Cage of an angular contact ball bearing Stepped wear on the outside surface and pocket surface of a machined high-tension brass cage



Photo 8-3 Part:

Inner ring of a tapered roller bearing Small and large indentations occur over entire Symptom: raceway surface

Debris caught in the surface Cause:



Photo 8-4

Part: Tapered rollers of Photo 8-3 Symptom: Small and large indentations occur over the rolling

Cause: Debris caught in the surface

2.3.9 Pitting

Damage Condition	Possible Cause	Measures
The pitted surface has a dull luster which appears on the rolling element surface or raceway surface.	Debris becomes caught in the lubricant Exposure to moisture in the atmosphere Poor lubrication	 Improve the sealing mechanism Filter the lubrication oil thoroughly Use a proper lubricant

2.3.10 Wear

faces, rib face, cage pockets, etc. Poor lubrication Sliding due to irregular motion of method Check the lubricant and lubrication method	Damage Condition	Possible Cause	Measures
Tolling contents	sliding friction at the surface of the raceway, rolling elements, roller end	Progression from rust and electrical corrosion Poor lubrication	 Clean the housing Filter the lubrication oil thoroughly Check the lubricant and lubrication



Photo 9-1 Part: Symptom: Cause:

Outer ring of a slewing bearing Pitting occurs on the raceway surface Rust at bottoms of indentations



Photo 9-2 Part: Symptom:

rt: Ball of Photo 9-1
mptom: Pitting occurs on the rolling element surface



Photo 10-1

Part: Inner ring of a cylindrical roller bearing

Symptom: Many pits occur due to electrical corrosion and wave-shaped wear on raceway surface

Cause: Electrical corrosion



Photo 10-2

Part: Outer ring of a spherical roller bearing

Symptom: Wear having a wavy or concave-and-convex texture on loaded side of raceway surface

Cause: Entry of debris under repeated vibration while

stationary



Photo 10-3 Part: Symptom: Cause:

Outer ring of a spherical roller bearing Wear occurs on loaded side of raceway surface Low speed, heavy load and poor lubrication(No oil film)



Photo 10-4

Part: Outer ring of a spherical roller bearing

(enlargement)

Symptom: Example of small flaking and wear combined on

the raceway

Cause: Insufficient oil film due to poor lubrication leads to wear (primary damage) that progresses to

flaking (secondary damage)

2.3.11 Fretting

Damage Condition	Possible Cause	Measures						
Wear occurs due to repeated sliding between the two surfaces. Fretting occurs at fitting surface and also at contact area between raceway ring and rolling elements. Fretting corrosion is another term used to describe the reddish brown or black worn particles.	Poor lubrication Vibration with a small amplitude Insufficient interference	 Use a proper lubricant Apply a preload Check the interference fit Apply a film of lubricant to the fitting surface 						



Photo 10-5 Part: Symptom: Cause:

Outer ring of a tapered roller bearing Wear occurs on outer ring raceway surface Insufficient oil film and wear due to poor lubrication



Photo 10-6 Symptom:

Inner ring of a double-row tapered roller bearing Fretting wear of raceway and stepped wear on the rib face Fretting progression due to excessive load while

Cause:

stationary



Photo 11-1

Part: Inner ring of a deep groove ball bearing Symptom: Fretting occurs on the bore surface Cause: Vibration



Photo 11-2

Inner ring of an angular contact ball bearing Notable fretting occurs over entire Part: Symptom: circumference of bore surface

Insufficient interference fit

Cause:



Photo 11-3 Symptom:

Outer ring of a double-row cylindrical roller bearing Fretting occurs on the raceway surface at roller pitch intervals



Photo 10-7 Part: Symptom: Cause:

Tapered rollers of Photo 10-6 Stepped wear on the roller head and face Fretting progression due to excessive load while stationary

2.3.12 False Brinelling

Damage Condition	Possible Cause	Measures
Among the different types of fretting, false brinelling is the occurrence of hollow spots that resemble brinell dents, and are due to wear caused by vibration and swaying at the contact points between the rolling elements and raceway.	Oscillation and vibration of a stationary bearing during such times as transporting Oscillating motion with a small amplitude Poor lubrication	 Secure the shaft and housing during transporting Transport with the inner and outer rings packed separately Reduce the vibration by preloading Use a proper lubricant

2.3.13 Seizure

Damage Condition	Possible Cause	Measures					
When sudden overheating occurs during rotation, the bearing becomes discolored. Next, raceway rings, rolling elements, and cage will soften, melt and deform as damage accumulates.	Poor lubrication Excessive load (Excessive preload) Excessive rotational speed Excessively small internal clearance Entry of water and debris Poor precision of shaft and housing, excessive shaft bending	 Study the lubricant and lubrication method Reinvestigate the suitability of the bearing type selected Study the preload, bearing clearance, and fitting Improve the sealing mechanism Check the precision of the shaft and housing Improve the mounting method 					



Photo 12-1 Part: Symptom: Cause:

Inner ring of a deep groove ball bearing False brinelling occurs on the raceway Vibration from an external source while stationary



Part: Symptom: Cause:

False brinelling occurs on the raceway Vibration from an external source while stationary



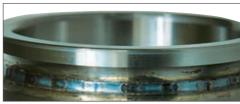


Photo 13-3 Part:

Photo 13-1

Symptom:

Part:

Cause:

Inner ring of an angular contact ball bearing Raceway discoloration, melting occurs at ball pitch

intervals

raceway

Insufficient lubrication

Excessive preload Cause:





Photo 13-2

Convex rollers of Photo 13-1 Part: Symptom:

Discoloration and melting of roller rolling surface,

adhesion of worn particles from cage

Cause: Insufficient lubrication



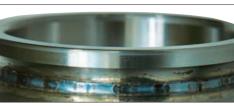
Photo 12-3 Part: Symptom: Cause:

Outer ring of a thrust ball bearing False brinelling of raceway surface at ball pitch Repeated vibration with a small oscillating angle



Photo 12-4 Part: Symptom: Cause:

Rollers of a cylindrical roller bearing False brinelling occurs on rolling surface Vibration from an external source while stationary



Inner ring of a spherical roller bearing

Raceway is discolored and melted. Worn particles

from the cage were rolled and attached to the

Symptom:



Photo 13-4

Part: Outer ring in Photo 13-3

Raceway discoloration, melting occurs at ball pitch Symptom:

intervals

Cause: Excessive preload

2.3.14 Creep

Damage Condition	Possible Cause	Measures
Creep is the phenomenon in bearings where relative slipping occurs at the fitting surfaces and thereby creates a clearance at the fitting surface. Creep causes a shiny appearance, occasionally with scoring or wear.	Insufficient interference or loose fit Insufficient sleeve tightening	 Check the interference, and prevent rotation Correct the sleeve tightening Study the shaft and housing precision Preload in the axial direction Tighten the raceway ring side face Apply adhesive to the fitting surface Apply a film of lubricant to the fitting surafce



Photo 13-5 Part:

Balls and cage of Photo 13-3 Cage is damaged by melting, balls become

Symptom: discolored and melted Cause: Excessive preload



Photo 13-6 Part: Symptom: Cause:

Rollers of a large tapered roller bearing Seizure occur at large end face of roller Poor lubrication and excessive axial load



Photo 14-1 Part: Symptom:

Cause:

Inner ring of a spherical roller bearing Creep accompanied by scoring of bore surface Insufficient interference



Photo 14-2

Part: Outer ring of a spherical roller bearing Creep occurs over entire circumference of outside Symptom: surface

Cause: Loose fit between outer ring and housing



Photo 13-7

Cylindrical roller bearing

Symptom: Seizure occurs on ring raceway surface and

Cause: Excessively small internal clearance causes

heat generation by sliding of the inner ring and rollers under high speed and light load

2.3.15 Electrical Corrosion

Damage Condition	Possible Cause	Measures
When electric current passes through a bearing, arcing and burning occur through the thin oil film at points of contact between the race and rolling elements. The points of contact are melted locally to form "fluting" or groove-like corrugations which are seen by the naked eye. The magnification of these grooves will reveal crater-like depressions which indicate melting by arcing.	Electrical potential difference between inner and outer rings Electrical potential difference of a high frequency that is generated by instruments or substrates when used near a bearing.	 Design electric circuits which prevent current flow through the bearings Insulation of the bearing



Photo 15-1

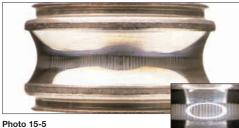
Part: Inner ring of a tapered roller bearing Symptom: Striped pattern of corrosion occurs on the raceway surface



Photo 15-3

Part: Symptom:

Inner ring of a cylindrical roller bearing Belt pattern of electrical corrosion accompanied by pits on the raceway surface



Part:

Inner ring of a deep groove ball bearing

Symptom: Fluting occurs on the raceway surface (High frequency)



Tapered rollers in Photo 15-1 Symptom: Striped pattern of corrosion occurs on the rolling surface



Photo 15-4

Part: Symptom:

Balls of a groove ball bearing Electrical corrosion has a dark color that covers the

entire ball surface



Photo 15-6 Part:

Enlargement

Outer ring of a deep groove ball bearing Fluting occurs on the raceway surface (High frequency)

2.3.16 Rust and Corrosion

Damage Condition	Possible Cause	Measures
Bearing rust and corrosion are pits on the surface of rings and rolling elements and may occur at the rolling element pitch on the rings or over the entire bearing surfaces.	Entry of corrosive gas or water Improper lubricant Formation of water droplets due to condensation of moisture High temperature and high humidity while stationary Poor rust preventive treatment during transporting Improper storage conditions Improper handling	Improve the sealing mechanism Study the lubrication method Anti-rust treatment for periods of non-running Improve the storage methods Improve the handling method



Photo 16-1

Part: Outer ring of a cylindrical roller bearing Rust on the rib face and raceway surface Symptom: Cause: Poor lubrication due to water entry

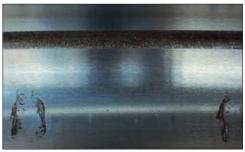


Photo 16-2

Part: Outer ring of a slewing ring Rust on raceway surface at ball pitch Symptom: Cause: Moisture condensation during stationary periods



Photo 16-3

Part: Symptom: Cause:

Inner ring of a spherical roller bearing Rust on raceway surface at roller pitch Entry of water into lubricant



Photo 16-4 Part:

Cause:

Symptom:

Rollers of a spherical roller bearing Pit-shaped rust on rolling contact surface. Corroded

portions.

Moisture condensation during storage

2.3.17 Mounting Flaws

Damage Condition	Possible Cause	Measures
Straight line scratches on surface of raceways or rolling elements caused during mounting or dismounting of bearing.	Inclination of inner and outer rings during mounting or dismounting. Shock load during mounting or dismounting.	 Use appropriate jig and tool Avoid a shock load by use of a press machine Center the relative mating parts during mounting

2.3.18 Discoloration

Damage Condition	Possible Cause	Measures
Discoloration of cage, rolling elements, and raceway ring occurs due to a reaction with lubricant and high temperature.	Poor lubrication Oil stain due to a reaction with lubricant High temperature	Improve the lubrication method



Photo 17-1

Part: Symptom: Cause:

Inner ring of a cylindrical roller bearing Axial scratches on raceway surface Inclination of inner and outer rings during

mounting



Photo 17-2

Part: Outer ring of a double-row cylindrical roller

bearing

Axial scratches at roller pitch intervals on Symptom:

raceway surface

Inclination of inner and outer rings during Cause:

mounting

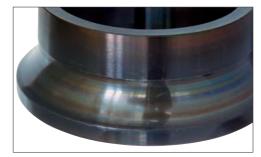


Photo 18-1

Part: Inner ring of an angular contact ball bearing Bluish or purplish discoloration on raceway Symptom:

surface

Cause: Heat generation due to poor lubrication



Photo 18-2

Part: Inner ring of a 4-point contact ball bearing Bluish or purplish discoloration on raceway Symptom: surface

Cause: Heat generation due to poor lubrication

Photo 17-3

Rollers of a cylindrical roller bearing Part: Symptom: Axial scratches on rolling surface Inclination of inner and outer rings during Cause:

mounting

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Appendix Bearing Diagnostic Chart

	_							Cause	9						
		Hand	dling		earin round			bri- ion		Load		Sp	eed		
Damage name	Location (Phenomenon)	Stock-Shipping	Mounting	Shaft Housing	Sealed device Water-Debris	Temperature	Lubricant	Lubrication method	Excessive load Impact load	Moment	Ultra small load	High speed, High acceleration & deceleration	Shaking-Vibration Stationary	Bearing Selection	Remarks
2.3.1 Flaking	Raceway, Rolling surface	0,	_	0,	0,	'	_	_		_			0,		Hemarks
2.3.1 Flakilly	, ,														
2.3.2 Peeling	Raceway, Rolling surface Bearing outside surface			<u>*</u>			0	0				\cup			*Mating rolling
	(Rolling contact) Roller end face surface,			0	0		0	0							part
2.3.3 Scoring	Rib surface		0	0	0		0	0	0	0		0			
	Cage guide surface, Pocket surface		0		0		0	0							
2.3.4 Smearing	Raceway, Rolling surface				0		0	0			0	0			
2.3.5 Fracture	Raceway collar, Rollers	0	0	0					0	0					
0.0.0.0	Raceway rings, Rolling elements		0	0		0			0	0					
2.3.6 Cracks	Rib surface, Roller end face, Cage guide surface (Thermal crack)			0				0	0	0					
2.3.7 Cage damage	(Deformation), (Fracture)		0	0					0	0					
2.5.7 Gaye damaye	(Wear)		0		0		0	0	0	0		0			
2.3.8 Denting	Raceway, Rolling surface, (Innumerable small dents)				0			0							
2.0.0 Denting	Raceway (Debris on the rolling element pitch)	0	0						0				0		
2.3.9 Pitting	Raceway, Rolling surface				0		0	0							
2.3.10 Wear	Raceway, Rolling surface, Rib surface, Roller end face		0		0		0	0							
	Raceway, Rolling surface	0	0	0			0	0	0			0	0		
2.3.11 Fretting	Bearing outside & bore, side surface (Contact with housing and shaft)		0	0					0						
2.3.12 False brinelling	Raceway, Rolling surface	0					0	0					0		
2.3.13 Seizure	Raceway ring, Rolling element, Cage		0	0	0		0	0	0	0		0		0	
2.3.14 Creep	Fitting surface		\bigcirc	0		0	o*	o*	0			0			*Clearance fit
2.3.15 Electrical corrosion	Raceway, Rolling surface		*	o*											*Electricity passing through the rolling element
2.3.16 Rust and corrosion	Raceway ring, Rolling element, Cage	0	0		0	0	0	0							
2.3.17 Mounting flaws	Raceway, Rolling surface		0	0											
2.3.18 Discoloration	Raceway ring, Rolling element, Cage					0	0	0							

Remark This chart is not comprehensive. It lists only the more commonly occurring damages, causes, and locations.

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Note



BEARINGS TABLE



















Part C

BEARINGS TABLE

1.	DEEP GROOVE BALL BEARINGS C 000
2.	EXTRA SMALL BALL BEARINGS AND MINIATURE BALL BEARINGS
3.	ANGULAR CONTACT BALL BEARINGSc 07
4.	SELF-ALIGNING BALL BEARINGSC 11:
5 .	CYLINDRICAL ROLLER BEARINGSC 12:
6.	TAPERED ROLLER BEARINGSC 18
7.	SPHERICAL ROLLER BEARINGSc 25
8.	THRUST BALL BEARINGS C 29
9.	THRUST CYLINDRICAL ROLLER BEARINGS C 31:
10.	THRUST TAPERED ROLLER BEARINGS C 32
11.	THRUST SPHERICAL ROLLER BEARINGSc 33
12.	NEEDLE ROLLER BEARINGS C 34
13.	BALL BEARING UNITS C 34
14.	PLUMMER BLOCKS C 34
15.	ACCESSORIES FOR ROLLING BEARINGS







1. DEEP GROOVE BALL BEARINGS

INTRODUCTION		C 00	0
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TECHNICAL DATA

Radial and Axial Internal Clearances and Contac Single-Row Deep Groove Ball Bearings	•
Features and Operating Temperature Range of B Seal Material	•
Free Space and Grease Filling Amount for Deep Ball Bearings	

BEARINGS TABLE

Single-Row Deep Groove Ball Bearings Open Type, Shielded Type, Sealed Type

	Bore Diameter 10 – 240 mm C 020
Open Type	Bore Diameter 260 – 800 mm C 040
Creep-Free Bearings™	Bore Diameter 10 – 100 mm C 046
Maximum Type Ball Bearings	Bore Diameter 25 – 110 mm C 048
Magneto Bearings	Bore Diameter 4 – 20 mm ····· C 050



C 004 C 005

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

Туре	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





Non-Contact

Rubber Sealed

Type (VV Type)



Shielded Type (ZZ 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.

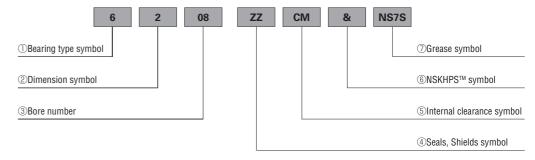
Table 2 Standard Cages for Deep Groove Ball Bearings

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

☐ Formulation of Bearing Numbers

Single-Row Deep Groove Ball Bearings

Bearing number example



①Bearing type symbol 6 : Single-Row Deep Groove 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

Over 04, Bearing bore Bore number X 5 (mm)

(4) Seals, Shields symbol ZZ: Shield on Both Side, DDU: Contact Rubber Seal on Both Side, VV: Non-Contact Rubber Sealed on

Both Side

⑤Internal clearance symbol Omitted: CN clearance*1, C3: Clearance greater than CN, C4: Clearance greater than C3, CM: For

Electric Motors*1

⑥NSKHPS™ symbol & : NSKHPS™ Bearings ⑦Grease symbol NS7 : NS HI-LUBE

*1 The CM clearance can be used in substitute of the CN clearance. (The opposite is not available.)

NSKHPS™ Deep Groove Ball Bearings

Features Compared to the conventional bearing



- Improved reliability
- Bearing life has increased by a maximum of 2 times compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology. As a result, the NSKHPSTM bearings contribute to reducing maintenance cost and facilitate the downscaling of related equipment.
- New product line-up

The standard dimensions are the same as for the standardsize bearings. NSK has expanded the line-up of NSKHPS™ bearings focusing on a wide range of sizes offering a high degree of versatility for various general-purpose applications



C 006

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.

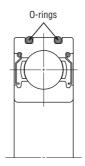
Easy to assemble

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.

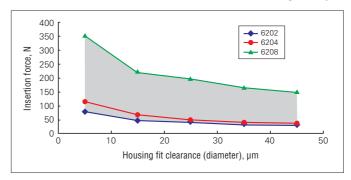




600 • Creep-Free Bearing Z resistance, l 000 000 000 ▲ Conventional bearing (without O-ring) 200 100 Housing clearance (diameter), µm

Fig. 1 Structure of Creep-Free Bearings

Fig. 2 Creep limit load test (example: 6204)



700

Fig. 3 Fit and insertion force

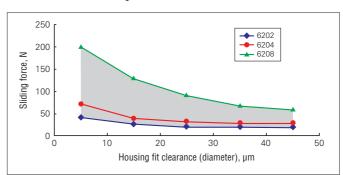
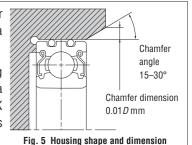


Fig. 4 Fit and sliding force



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.



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 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

SINGLE-ROW DEEP GROOVE BALL BEARINGSTable 7.2 (Pages A128 to A131) NSKHPS DEEP GROOVE BALL BEARINGS Tolerance for Dimensions : ISO Normal Running Accuracy : ISO Normal
MAXIMUM TYPE BALL BEARINGSTable 7.2 (Pages A128 to A131)
MAGNETO BEARINGSTable 7.5 (Pages A138 and A139

RECOMMENDED FITS

·Table 8.3 (Page A164)
Table 8.5 (Page A165)
·Table 8.3 (Page A164)
Table 8.5 (Page A165)
-Table 8.3 (Page A164)
Table 8.5 (Page A165)

INTERNAL CLEARANCES

BEARINGS	·Table 8.10 (Page A169
NSKHPS DEEP GROOVE BALL BEARINGS	
INTERNAL CLEARANCE SYMBOL: CN, C3,	C4, CM
MAXIMUM TYPE BALL BEARINGS	-Table 8.10 (Page A169
MAGNETO BEARINGS	-Table 8.12 (Page A169

LIMITING SPEEDS (GREASE/OIL)

CINCLE DOW DEED CDOOVE DALL

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.



C 010

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.

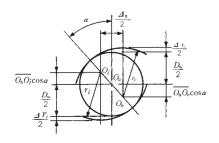


Fig. 1 Relationship Between Δ_r and Δ_a

Symbols used in Fig. 1

- O_a : Ball center
- O_e : Center of groove curvature, outer ring
- $O_{\rm i}$: Center of groove curvature, inner ring
- $D_{\rm w}$: Ball diameter (mm)
- re: Radius of outer ring groove (mm) re: Radius of inner ring groove (mm)
- r_i : Radius of inner rin α : Contact angle (°)
- ∠_r: Radial clearance (mm)
- Δ_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.

$$\Delta_r=2 (1-\cos\alpha) (r_o+r_i-D_w) \cdots (1)$$

$$\frac{\Delta_{\rm a}}{\Delta_{\rm r}} = \cot \frac{\alpha}{2} \qquad (3)$$

$$\Delta_a \stackrel{.}{=} 2 (r_e + r_i - D_w)^{1/2} \Delta_r^{1/2} \dots$$
 (4)

$$\alpha = \cos^{-1}\left(\frac{r_e + r_i - D_w - \frac{\Delta_r}{2}}{r_e + r_i - D_w}\right) \dots (5)$$

$$=\sin^{-1}\left(\frac{\Delta_{a}/2}{r_{c}+r_{i}-D_{w}}\right)$$
 (6)

Because $(r_{\rm c}+r_{\rm i}-D_{\rm w})$ is a constant, it is apparent why fixed relationships between $\Delta_{\rm r}$, $\Delta_{\rm a}$ and α 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 $\Delta_{\rm l}$ and axial clearance $\Delta_{\rm l}$ is given in Equation (4). To simplify,

$$\Delta_{a} \stackrel{:}{=} K \Delta_{r}^{1/2} \dots (7)$$

where K : Constant depending on bearing design $K = 2 \; (r_{\rm e} + r_{\it i} - D_{\rm w})^{1/2}$

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 Δ_a is: $\Delta=2.09\times\sqrt{0.017}=2.09\times0.13=0.27$ (mm)

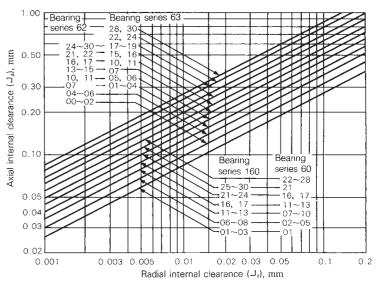


Fig. 2 Radial Clearance, Δ_r and Axial Clearance, Δ_s of Deep Groove Ball Bearings

Table 1 Constant Values of K for Radial and Axial Clearance Conversion

Bearing		I	K	
bore No.	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 04	0.80 0.90	0.93 0.96	0.99 1.06	1.11 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 10	1.01 1.01	1.11 1.11	1.29 1.33	1.57 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 16	1.16 1.20	1.29 1.37	1.57 1.64	1.95 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 22	1.37 1.40	1.54 1.64	1.95 2.01	2.32 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	1.57	1.76	2.11	2.59



C 012 C 013



(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, α_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 α_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 angle 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, α_0 , with C3 and C4 Clearances

Bearing No.	$lpha_{\scriptscriptstyle 0}$ with C3	$lpha_{\scriptscriptstyle 0}$ 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°

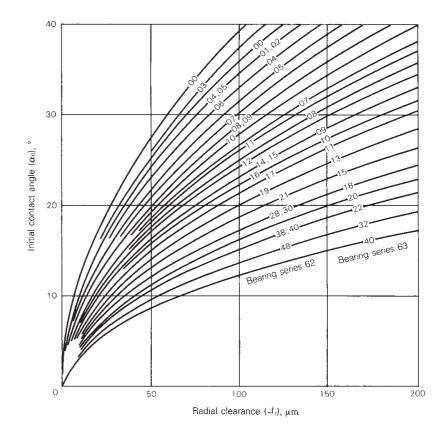


Fig. 3 Radial Clearance and Contact Angle

C 014

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.

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)



Contact rubber seal (DDU)

Fig. 1

Fig. 2

Table 1 Features and Operating Temperature Range of Rubber Materials

Mat	erial	Nitrile rubber	Polyacrylic rubber	Silicon rubber	Fluorine rubber
	atures	oMost popular seal material Superior in oil and wear resistances and mechanical properties Readily ages under direct sunrays Less expensive than other rubbers	Superior in heat and oil resistances Large compression causes permanent deformation Inferior in cold resistance One of the less expensive materials among the high temperature materials Attention is neces-	oHigh heat and cold resistances Inferior in mechanical properties other than permanent deformation by compression. Pay attention to tear strength OPay attention so as to avoid swell caused by low aniline point mineral oil, silicone grease, and	High heat resistance Superior in oil and chemical resistances Cold resistance similar to nitrile rubber Attention is necessary because it deteriorates the urea grease
Operating	Non- contact seal -50 to +130		sary because it swells the ester oil based grease -30 to +170	silicone oil -100 to +250	-50 to +220
temperature range (1) (°C)	Contact seal	-30 to +110	-15 to +150	-70 to +200	-30 to +200

 $\textbf{Note} \ (^{\scriptscriptstyle 1}) \quad \text{This operating temperature is the temperature of seal rubber materials}.$

C 016 C 017

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.

when the bearing speed is 50% or 1/3 to 1/2 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.

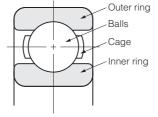
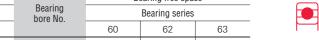


Table 1 Free Space of Open Type Deep Groove Ball Bearing

Units: cm3

	В	earing free spa	се		Bearing free space							
Bearing bore No.		Bearing series		Bearing bore No.								
20.0.10.	60	62	63	20.0.120.	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.

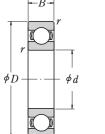


C 019 C 018



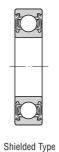
SINGLE-ROW DEEP GROOVE BALL BEARINGS

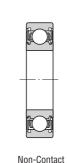
Bore Diameter 10 - 17 mm



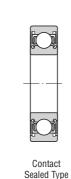
Open Type

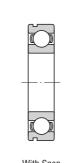


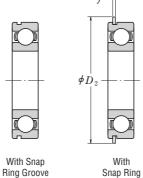


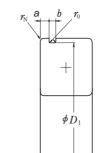


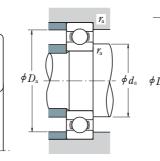
Sealed Type

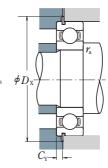












Dynamic Equivalent Load $P = XF_r + YF_a$

1 –21	$I_{T} + I I_{2}$	l					
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{\rm a}}{F_{ m r}}$	>e		
U _{0r}		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

$$\frac{F_a}{F_r} > 0.8, P_0 = 0.6F_r + 0.5F_a$$

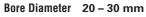
 $\frac{F_a}{F_r} \le 0.8, P_0 = F_r$

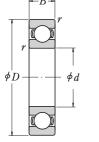
				VV		· DDU	N	J0 V C	NF		$\frac{1}{F_r} \leq 0.8, P_0 = F_r$																																
Boundary Dimens	isions	Basic Loa	Ü	Factor		ing Speeds	(min ⁻¹)	Beari	Bearing Numbers		Bearing Numbers		Bearing Numbers		Bearing Numbers		Bearing Numbers		Bearing Numbers		Bearing Numbers		Bearing Numbers		Bearing Numbers		Bearing Numbers		With With	Sna	p Ring G	roove Din (mm)	nensions	S (1)	Snap F Dimer	nsions		Abutmen	nt and Fill (mm		nsions		Mass (kg)
d D B	γ min.	$C_{\rm r}$	C_{0r}	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open Shielde	ed Sea	aled	Snap Snap Ring Ring Groove	a max.	$b \atop { m min.}$	$D_{\scriptscriptstyle 1} \atop {\rm max.}$	r_0 max.	$ m \emph{r}_{N}$ min.	$D_2^{(m m}$ max.	m) f max.	min.	$d_{ m a}$ (2) max.	$D_{ m a}^{(2)}$ max.	${\pmb \gamma}_{\rm a}$ max.	$D_{\mathbf{x}}_{\text{min.}}$	$C_{\scriptscriptstyle \mathrm{Y}}$ max.	approx.																		
10 19 5 22 6 26 8	0.3	1 720 2 700 4 550	840 1 270 1 970	14.8 14.0 12.4	34 000 32 000 30 000	24 000 22 000 22 000	40 000 38 000 36 000	6800 ZZ 6900 ZZ 6000 ZZ	VV		N(3) NR(3) N(4) NR(4)	1.05 1.35	— 0.8 0.87	20.8 24.5	0.2 0.2	0.2 0.3	— 24.8 28.7	— 0.7 0.84	12 12 12	12 12.5 13	17 20 24	0.3 0.3 0.3	25.5 29.4	— 1.5 1.9	0.005 0.009 0.018																		
30 9 30 9 35 11 35 11	0.6 0.6 0.6 0.6	5 350 5 100 8 500 8 100	2 390 2 390 3 450 3 450	13.2 13.2 11.2 11.2	28 000 24 000 26 000 22 000	18 000 18 000 17 000 17 000	34 000 30 000 30 000 26 000	* 6200 ZZ 6200 ZZ * 6300 ZZ 6300 ZZ	VV VV	DDU DDU DDU DDU	 N NR N NR	2.06 — 2.06	1.35 — 1.35	28.17 — 33.17	0.4 0.4	0.5 - 0.5	34.7 — 39.7	1.12 — 1.12	14 14 14 14	16 16 16.5 16.5	26 26 31 31	0.6 0.6 0.6 0.6	35.5 — 40.5	2.9 - 2.9	0.032 0.032 0.052 0.052																		
12 21 5 24 6 28 7	0.3 0.3 0.3	1 920 2 890 5 100	1 040 1 460 2 370	15.3 14.5 13.0	32 000 30 000 28 000	20 000 20 000 —	38 000 36 000 32 000	6801 ZZ 6901 ZZ 16001 —			N(3) NR(3)	1.05 —	0.8	22.8 —	0.2	0.2 —	26.8 —	0.7 —	14 14 14	14 14.5 —	19 22 26	0.3 0.3 0.3	27.5 —	1.5 —	0.006 0.010 0.019																		
28 8 28 8 32 10	0.3 0.3 0.6	5 350 5 100 7 150	2 370 2 370 3 050	13.0 13.0 12.3	32 000 28 000 26 000	18 000 18 000 17 000	38 000 32 000 32 000	* 6001 ZZ 6001 ZZ * 6201 ZZ	VV	DDU DDU DDU	N(4) NR(4)	1.35 —	0.87 —	26.5 —	0.2	0.3 —	30.7 —	0.84 —	14 14 16	15.5 15.5 17	26 26 28	0.3 0.3 0.6	31 <u>.4</u>	1.9 —	0.022 0.022 0.037																		
32 10 37 12 37 12	0.6 1 1	6 800 10 200 9 700	3 050 4 200 4 200	12.3 11.1 11.1	22 000 24 000 20 000	17 000 16 000 16 000	28 000 28 000 24 000	* 6201 ZZ * 6301 ZZ 6301 ZZ	VV	DDU DDU DDU	N NR N NR	2.06 — 2.06	1.35 — 1.35	30.15 — 34.77	0.4 0.4	0.5 — 0.5	36.7 — 41.3	1.12 — 1.12	16 17 17	17 18 18	28 32 32	0.6 1 1	37.5 — 42	2.9 — 2.9	0.037 0.060 0.060																		
15 24 5 28 7 32 8	0.3 0.3 0.3	2 070 4 350 5 600	1 260 2 260 2 830	15.8 14.3 13.9	28 000 26 000 24 000	17 000 17 000 —	34 000 30 000 28 000	6802 ZZ 6902 ZZ 16002 —			N(3) NR(3)	1.30 —	0.95 —	26 <u>.7</u>	0.25 —	0.3 —	30.8	0.85 —	17 17 17	17 17 —	22 26 30	0.3 0.3 0.3	31.5	1.8 —	0.007 0.015 0.027																		
32 9 32 9 35 11	0.3 0.3 0.6	5 850 5 600 8 000	2 830 2 830 3 750	13.9 13.9 13.2	26 000 24 000 22 000	15 000 15 000 14 000	32 000 28 000 28 000	* 6002 ZZ 6002 ZZ * 6202 ZZ	VV	DDU DDU DDU	 N NR 	2.06 —	1.35 —	30.15 —	0.4	0.3 —	36.7 —	1.12 —	17 17 19	19 19 20.5	30 30 31	0.3 0.3 0.6	37 <u>.5</u>	2.9 —	0.031 0.031 0.045																		
35 11 42 13 42 13	0.6 1 1	7 650 12 000 11 400	3 750 5 450 5 450	13.2 12.3 12.3	20 000 19 000 17 000	14 000 13 000 13 000	24 000 24 000 20 000	* 6202 ZZ * 6302 ZZ 6302 ZZ	VV	DDU DDU DDU	N NR N NR	2.06 — 2.06	1.35 — 1.35	33.17 — 39.75	0.4 0.4	0.5 — 0.5	39.7 — 46.3	1.12 — 1.12	19 20 20	20.5 22.5 22.5	31 37 37	0.6 1 1	40.5 — 47	2.9 2.9	0.045 0.083 0.083																		
17 26 5 30 7 35 8	0.3 0.3 0.3	2 630 4 600 6 000	1 570 2 550 3 250	15.7 14.7 14.4	26 000 24 000 22 000	15 000 15 000 —	30 000 28 000 26 000	6803 ZZ 6903 ZZ 16003 —		DD DDU	N(3) NR(3)	1.30 —	0.95 —	28 <u>.7</u>	0.25 —	0.3 —	32.8 —	0.85 —	19 19 19	19 19.5 —	24 28 33	0.3 0.3 0.3	33.5	1.8 —	0.007 0.017 0.033																		
35 10 35 10 40 12	0.3 0.3 0.6	6 300 6 000 10 100	3 250 3 250 4 800	14.4 14.4 13.2	24 000 22 000 20 000	13 000 13 000 12 000	28 000 26 000 24 000	* 6003 ZZ 6003 ZZ * 6203 ZZ	VV	DDU DDU DDU	 N NR 	2.06 —	1.35 —	33 <u>.17</u>	0.4	0.3 —	39.7 —	1.12 —	19 19 21	21.5 21.5 23.5	33 33 36	0.3 0.3 0.6	40.5	2.9 —	0.041 0.041 0.067																		
40 12 47 14 47 14	0.6 1 1	9 550 14 300 13 600	4 800 6 650 6 650	13.2 12.4 12.4	17 000 17 000 15 000	12 000 11 000 11 000	20 000 20 000 18 000	* 6203 ZZ * 6303 ZZ 6303 ZZ	VV	DDU DDU DDU	N NR — — N NR	2.06 — 2.46	1.35 — 1.35	38.1 — 44.6	0.4	0.5 — 0.5	44.6 — 52.7	1.12 — 1.12	21 22 22	23.5 25.5 25.5	36 42 42	0.6 1 1	45.5 — 53.5	2.9 — 3.3	0.067 0.113 0.113																		

- **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.

- **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.

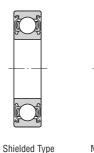
SINGLE-ROW DEEP GROOVE BALL BEARINGS

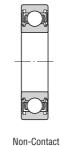


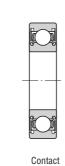


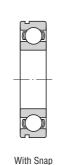
Open Type

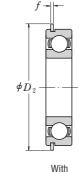


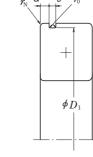


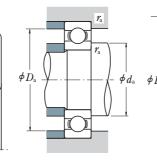


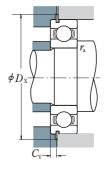












Dynamic Equivalent Load D VE VE

P = X	$F_{\rm r} + YF_{\rm z}$	ı								
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\frac{F_{\rm a}}{F_{\rm r}} > e$							
U _{0r}		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

$$\frac{F_a}{F_r} > 0.8, P_0 = 0.6F_r + 0.5F_a$$

$$\frac{F_a}{F_r} \le 0.8, P_0 = F_r$$

	Opei	ZZ Sealed Type Sealed Type Ring Groove Snap Ring VV DD · DDU N NR										ı						C	y -= =-		$\frac{F_{ m a}}{F_{ m r}}$	≦0.8, <i>P</i>	$F_0 = F_r$							
Bou	ndary (m	Dimer m)	nsions	Basic Loa	d Ratings	Factor		ng Speeds			Bearing	g Num	bers		With With								ling (¹) Isions			Mass (kg)				
d	D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Oil Open Z	Open	Shielded	Sea	ıled		Snar Ring Groo		а max.	$b \atop { m min.}$	$D_{\scriptscriptstyle 1} \atop {\sf max.}$	$ ho_0$ max.	$ m \emph{r}_{N}$ min.	$D_2^{(m)}$ max.	m) f max.	min.	$d_{ m a}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	${\it r}_{\rm a}$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.
20	32 37 42	7 9 8		4 000 6 400 7 900	2 470 3 700 4 450	15.5 14.7 14.5	22 000 19 000 18 000	13 000 12 000 —	26 000 22 000 20 000		ZZ ZZ —				N N	NR NR —	1.30 1.70 —	0.95 0.95 —	30.7 35.7 —	0.25 0.25 —	0.3 0.3 —	34.8 39.8 —	0.85 0.85 —	22 22 22	22 24 —	30 35 40	0.3 0.3 0.3	35.5 40.5 —	1.8 2.3 —	0.017 0.037 0.048
	42 42 47	12 12 14	0.6	9 850 9 400 13 400	5 000 5 000 6 600	13.8 13.8 13.1	20 000 18 000 17 000	11 000 11 000 11 000	24 000 20 000 20 000	* 6004 6004 * 6204	ZZ	VV VV VV	DDU		N —	NR —	2.06 —	1.35 —	39.75 —	0.4	0.5 —	46.3 —	1.12 —	24 24 25	25.5 25.5 26.5	38 38 42	0.6 0.6 1	47_ —	2.9	0.068 0.068 0.107
	47 52 52	14 15 15	1.1	12 800 16 700 15 900	6 600 7 900 7 900	13.1 12.4 12.4	15 000 16 000 14 000	11 000 10 000 10 000	18 000 19 000 17 000	* 6304	ZZ	VV VV VV	DDU		N N	NR — NR	2.46 — 2.46	1.35 — 1.35	44.6 — 49.73	0.4 0.4	0.5 — 0.5	52.7 — 57.9	1.12 — 1.12	25 26.5 26.5	26.5 28 28	42 45.5 45.5	1 1 1	53.5 — 58.5	3.3 — 3.3	0.107 0.145 0.145
22	44 50 56	12 14 16	1	9 400 12 900 18 400	5 050 6 800 9 250	14.0 13.5 12.4	17 000 14 000 13 000	11 000 9 500 9 500	20 000 16 000 16 000	60/22 62/22 63/22	ZZ	VV VV VV	DDU		N N N	NR NR NR	2.06 2.46 2.46	1.35 1.35 1.35	41.75 47.6 53.6	0.4 0.4 0.4	0.5 0.5 0.5	48.3 55.7 61.7	1.12 1.12 1.12	26 27 28.5	26.5 29.5 30.5	40 45 49.5	0.6 1 1	49 56.5 62.5	2.9 3.3 3.3	0.074 0.119 0.179
25	37 42 47	7 9 8		4 500 7 050 8 850	3 150 4 550 5 600	16.1 15.4 15.1	18 000 16 000 15 000	10 000 10 000 —	22 000 19 000 18 000		ZZ ZZ —				N N(3)	NR NR(3)	1.30 1.70 —	0.95 0.95 —	35.7 40.7 —	0.25 0.25 —	0.3 0.3 —	39.8 44.8 —	0.85 0.85 —	27 27 27	27 28.5 —	35 40 45	0.3 0.3 0.3	40.5 45.5 —	1.8 2.3 —	0.021 0.042 0.059
	47 47 52	12 12 15	0.6	10 600 10 100 14 700	5 850 5 850 7 850	14.5 14.5 13.9	18 000 15 000 15 000	9 500 9 500 9 000	22 000 18 000 18 000	* 6005 6005 * 6205	ZZ	VV VV VV	DDU		N —	NR —	2.06 —	1.35 —	44.6 —	0.4	0.5 —	52.7 —	1.12 —	29 29 30	30 30 32	43 43 47	0.6 0.6 1	53.5	2.9	0.079 0.079 0.129
	52 62 62	15 17 17	1.1	14 000 21 600 20 600	7 850 11 200 11 200	13.9 13.2 13.2	13 000 13 000 11 000	9 000 8 000 8 000	15 000 16 000 13 000	* 6305	ZZ	VV VV VV	DDU		N N	NR — NR	2.46 — 3.28	1.35 — 1.9	49.73 — 59.61	0.4 0.6	0.5 — 0.5	57.9 — 67.7	1.12 1.7	30 31.5 31.5	32 36 36	47 55.5 55.5	1 1 1	58.5 — 68.5	3.3 - 4.6	0.129 0.235 0.235
28	52 58 68	12 16 18	1	12 500 16 600 26 700	7 400 9 500 14 000	14.5 13.9 12.4	14 000 12 000 10 000	8 500 8 000 7 500	16 000 14 000 13 000	60/28 62/28 63/28	ZZ	VV VV VV	DDU		N N N	NR NR NR	2.06 2.46 3.28	1.35 1.35 1.9	49.73 55.6 64.82	0.4 0.4 0.6	0.5 0.5 0.5	57.9 63.7 74.6	1.12 1.12 1.7	32 33 34.5	34 35.5 38	48 53 61.5	0.6 1 1	58.5 64.5 76	2.9 3.3 4.6	0.096 0.175 0.287
30	42 47 55	7 9 9		4 700 7 250 11 200	3 650 5 000 7 350	16.4 15.8 15.2	15 000 14 000 13 000	9 000 8 500 —	18 000 17 000 15 000		ZZ	VV VV			N N	NR NR —	1.30 1.70 —	0.95 0.95 —	40.7 45.7 —	0.25 0.25 —	0.3 0.3 —	44.8 49.8 —	0.85 0.85 —	32 32 32	32 34 —	40 45 53	0.3 0.3 0.3	45.5 50.5	1.8 2.3 —	0.024 0.052 0.087
	55 55 62	13 13 16	1	13 900 13 200 20 400	8 300 8 300 11 300	14.7 14.7 13.8	15 000 13 000 12 000	8 000 8 000 7 500	18 000 15 000 15 000	* 6006 6006 * 6206	ZZ	VV VV VV	DDU		_ N _	NR —	2.08 —	 1.35 	52.6 —	0.4	0.5 —	60 <u>.7</u>	1.12 —	35 35 35	36.5 36.5 38.5	50 50 57	1 1 1	61.5 —	2.9 —	0.116 0.116 0.199
	62 72 72	16 19 19	1.1	19 500 28 000 26 700	11 300 15 000 15 000	13.8 13.3 13.3	11 000 11 000 9 500	7 500 6 700 6 700	13 000 13 000 12 000	* 6306			DDU		N N	NR — NR	3.28 — 3.28	1.9 — 1.9	59.61 — 68.81	0.6 0.6	0.5 — 0.5	67.7 — 78.6	1.7 - 1.7	35 36.5 36.5	38.5 42.5 42.5	57 65.5 65.5	1 1 1	68.5 — 80	4.6 - 4.6	0.199 0.345 0.345

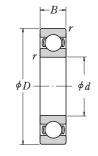
- **Notes** (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A116 to A119.
 - (2) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.
 - (3) Ring types N and NR applicable only to open-type bearings. Please consult NSK about the snap ring groove dimensions of sealed or shielded bearings.

- **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.

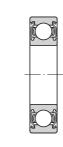
Dynamic Equivalent Load



Bore Diameter 32 - 45 mm



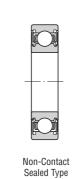
Open Type

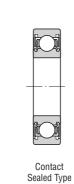


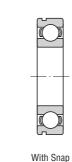
Shielded Type

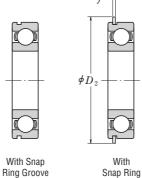
ZZ

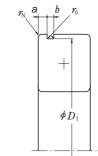
SINGLE-ROW DEEP GROOVE BALL BEARINGS

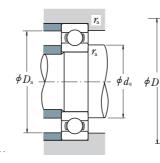


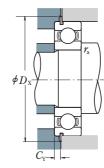


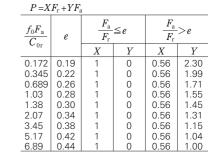












Static Equivalent Load

$$\frac{F_a}{F_r}$$
 > 0.8, P_0 = 0.6 F_r + 0.5 F_a

$F_{\rm a}$	< 0 0	D = F
$F_{\rm r}$	≅0.0,	$P_0 = F_r$

						VV	DD	· DDU	N			NR										$F_{\rm r} \stackrel{\text{defo}, I_0 - I_{\rm r}}{=}$								
Воц		Dimension m)	S	Basic Load Ratings (N)		Factor	Limiting Speeds Grease		(min ⁻¹)		Bearing	Numb	ers		h With	Sna	Ring G	roove Dir (mm)	nensions	S (1)	Dimer			Abutmer	nt and Fill (mm		nsions		Mass (kg)	
d	D	B r	- 1	$C_{\rm r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open	Shielded	Seale	d	Sna Rin Groo		а max.	$b \atop ext{min.}$	$D_{1\atop \text{max.}}$	$ ho_0$ max.	$oldsymbol{\gamma}_{ m N}$ min.	$D_2^{(m m}$ max.	m) max.	min.	$d_{ m a}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	${m \gamma}_{\rm a}$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.	
32	58 65 75	13 1 17 1 20 1.	1	15 100 20 700 29 900	9 150 11 600 17 000	14.5 13.6 13.2	12 000 10 000 9 000	7 500 7 100 6 300	14 000 12 000 11 000	60/32 62/32 63/32	ZZ	VV D VV D	DÜ	N N N	NR NR NR	2.08 3.28 3.28	1.35 1.9 1.9	55.6 62.6 71.83	0.4 0.6 0.6	0.5 0.5 0.5	63.7 70.7 81.6	1.12 1.7 1.7	37 37 38.5	38.5 40 44.5	53 60 68.5	1 1 1	64.5 71.5 83	2.9 4.6 4.6	0.122 0.225 0.389	
35	47 55 62	7 0. 10 0. 9 0.	6	4 900 10 600 11 700	4 100 7 250 8 200	16.7 15.5 15.6	14 000 12 000 11 000	7 500 7 500 —	16 000 15 000 13 000	6807 6907 16007	ZZ ZZ			N N	NR NR —	1.30 1.70 —	0.95 0.95 —	45.7 53.7 —	0.25 0.25 —	0.3 0.5 —	49.8 57.8	0.85 0.85 —	37 39 37	37 39 —	45 51 60	0.3 0.6 0.3	50.5 58.5 —	1.8 2.3 —	0.027 0.075 0.107	
	62 62 72	14 1 14 1 17 1.	1	16 800 16 000 27 000	10 300 10 300 15 300	14.8 14.8 13.8	13 000 11 000 11 000	6 700 6 700 6 300	15 000 13 000 13 000	* 6007 6007 * 6207		VV D VV D	DÜ	_ N _	NR	2.08 —	1.9	59.61 —	0.6	0.5	67.7 —	1.7 —	40 40 41.5	41.5 41.5 44.5	57 57 65.5	1 1 1	68.5 —	3.4	0.151 0.151 0.284	
	72 80 80	17 1. 21 1. 21 1.	5	25 700 35 000 33 500	15 300 19 200 19 200	13.8 13.2 13.2	9 500 10 000 8 500	6 300 6 000 6 000	11 000 12 000 10 000	* 6207 * 6307 6307	ZZ	VV D VV D	DÜ	N N	NR — NR	3.28 — 3.28	1.9 1.9	68.81 — 76.81	0.6	0.5 0.5	78.6 — 86.6	1.7 — 1.7	41.5 43 43	44.5 47 47	65.5 72 72	1 1.5 1.5	80_ 88	4.6 4.6	0.284 0.464 0.464	
40	52 62 68	7 0. 12 0. 9 0.	6	6 350 13 700 12 600	5 550 10 000 9 650	17.0 15.7 16.0	12 000 11 000 10 000	6 700 6 300 —	14 000 13 000 12 000	6808 6908 16008	ZZ '	VV D		N N —	NR NR	1.30 1.70 —	0.95 0.95 —	50.7 60.7 —	0.25 0.25 —	0.3 0.5 —	54.8 64.8 —	0.85 0.85 —	42 44 42	42 46 —	50 58 66	0.3 0.6 0.3	55.5 65.5 —	1.8 2.3 —	0.031 0.112 0.13	
	68 68 80	15 1 15 1 18 1.	1	17 600 16 800 30 500	11 500 11 500 17 900	15.3 15.3 14.0	12 000 10 000 9 500	6 000 6 000 5 600	14 000 12 000 12 000	* 6008 6008 * 6208	ZZ	VV D VV D	DÜ	_ N _	NR	2.49 —	1.9	64.82 —	0.6	0.5	74.6 —	1.7 —	45 45 46.5	47.5 47.5 50.5	63 63 73.5	1 1 1	76 —	3.8	0.19 0.19 0.366	
	80 90 90	18 1. 23 1. 23 1.		29 100 43 000 40 500	17 900 24 000 24 000	14.0 13.2 13.2	8 500 9 000 7 500	5 600 5 300 5 300	10 000 11 000 9 000	* 6208 * 6308 6308	ZZ	VV D VV D	DÜ	N N	NR — NR	3.28 - 3.28	1.9 2.7	76.81 — 86.79	0.6	0.5	86.6 — 96.5	1.7 	46.5 48 48	50.5 53 53	73.5 82 82	1 1.5 1.5	88_ 98	4.6 5.4	0.366 0.636 0.636	
45	58 68 75	7 0. 12 0. 10 0.	6	6 600 14 100 14 900	6 150 10 900 11 400	17.2 15.9 15.9	11 000 9 500 9 000	6 000 5 600 —	13 000 12 000 11 000	6809 6909 16009		VV D		N N	NR NR —	1.30 1.70 —	0.95 0.95 —	56.7 66.7	0.25 0.25 —	0.3 0.3(³)	60.8 70.8	0.85 0.85 —	47 49 49	47.5 50 —	56 64 71	0.3 0.6 0.6	61.5 72 —	1.8 2.3 —	0.038 0.126 0.167	
	75 75 85	16 1 16 1 19 1.	1	22 000 20 900 33 000	15 200 15 200 20 400	15.3 15.3 14.4	10 000 9 000 9 000	5 300 5 300 5 300	12 000 11 000 11 000	* 6009 6009 * 6209	ZZ	VV D VV D	DÜ	_ N _	NR	2.49 —	1.9	71.83 —	0.6	0.5 —	81.6 —	1.7 —	50 50 51.5	53.5 53.5 55.5	70 70 78.5	1 1 1	83_ _	3.8	0.241 0.241 0.42	
	85 100 100	19 1. 25 1. 25 1.	5	31 500 55 500 53 000	20 400 32 000 32 000	14.4 13.1 13.1	7 500 7 500 6 700	5 300 4 800 4 800	9 000 9 500 8 000	* 6309			DÜ	N N	NR — NR	3.28 — 3.28	1.9 	81.81 — 96.8	0.6 — 0.6	0.5 — 0.5	91.6 — 106.5	1.7 — 2.46	51.5 53 53	55.5 61.5 61.5	78.5 92 92	1 1.5 1.5	93 108	4.6 — 5.4	0.42 0.829 0.829	

- 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) Not Conformed to ISO15.

- **Remarks** 1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
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 - 3. The bearings denoted by an asterisk(*) are NSKHPS™ Deep groove ball bearings.

Dynamic Equivalent Load

 $P = XF_r + YF_a$

NSK

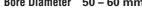
0.56

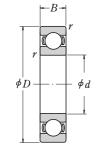
0.56

1.04

1.00

Bore Diameter 50 - 60 mm



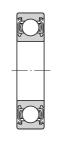


Open Type

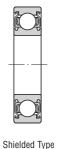
C 026

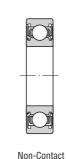


SINGLE-ROW DEEP GROOVE BALL BEARINGS

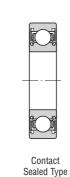


ZZ

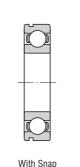




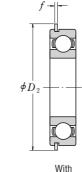
Sealed Type



DD · DDU

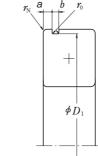


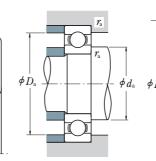
Ring Groove

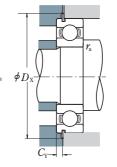


Snap Ring

NR







$\frac{F_{\rm a}}{F_{\rm r}} > e$ $\frac{F_{\rm a}}{F_{\rm r}} \leq e$ C_{0r} 0.172 0.19 0.56 2.30 0.56 1.99 0.345 0.22 0 1.71 1.55 1.45 0.689 0.26 0 0.56 0.56 0.56 1.03 0.28 0.30 0 1.38 2.07 0.34 0.56 1.31 3.45 0.38 0.56 1.15

Static Equivalent Load

5.17

6.89

0.42 0.44

$$\frac{F_{\rm a}}{F_{\rm r}} > 0.8, P_0 = 0.6F_{\rm r} + 0.5F_{\rm a}$$

$$\frac{F_{\rm a}}{F_{\rm r}} \le 0.8, P_0 = F_{\rm r}$$

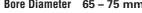
Boundary Dimensions (mm)					ad Ratings	Factor		ng Speeds (Beari	ng Number		With With Snan Snan		Snap Ring Groove Dimensions (1) Snap Ring (1) Abutment and Fillet Dimen (mm)								nsions	sions Mass			
d	D	B	γ min.	C_{r}	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Oil Open Z	Open Shielder	d Sealed	S R Gr	Snap Snap Ring Ring roove	а max.	$b \atop ext{min.}$	$D_{ m 1} \atop { m max.}$	$oldsymbol{r}_0$ max.	$ m \emph{r}_{N}$ min.	$D_2^{(\mathrm{mi})}$	m) max.	min.	$d_{ m a}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	${m \gamma}_{\rm a}$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.
50	65 72 80			6 400 14 500 15 400	6 200 11 700 12 400	17.2 16.1 16.1	9 500 9 000 8 500	5 300 5 300 —	11 000 11 000 10 000	6810 ZZ 6910 ZZ 16010 —	VV DD VV DD			1.30 1.70 —	0.95 0.95 —	63.7 70.7 —	0.25 0.25 —	0.3 0.5 —	67.8 74.8 —	0.85 0.85 —	52 54 54	52.5 55 —	63 68 76	0.3 0.6 0.6	68.5 76 —	1.8 2.3 —	0.050 0.135 0.175
	80 80 90	16	1	22 900 21 800 37 000	16 600 16 600 23 200	15.6 15.6 14.4	9 500 8 500 8 000	4 800 4 800 4 800	11 000 10 000 10 000	* 6010 ZZ 6010 ZZ * 6210 ZZ	VV DD VV DD VV DD	N	NR	 2.49 	1.9 —	76.81 —	0.6	0.5 —	86.6 —	1.7 —	55 55 56.5	58.5 58.5 60	75 75 83.5	1 1 1	88 _	3.8 —	0.261 0.261 0.459
	90 110 110	27	2	35 000 65 000 62 000	23 200 38 500 38 500	14.4 13.2 13.2	7 100 7 100 6 000	4 800 4 300 4 300	8 500 8 500 7 500	* 6210 ZZ * 6310 ZZ 6310 ZZ	VV DD VV DD VV DD	_		3.28 — 3.28	2.7 	86.79 106.81	0.6 0.6	0. <u>5</u> 0.5	96.5 116.6	2.46 	56.5 59 59	60 68 68	83.5 101 101	1 2 2	98_ 118	5.4 5.4	0.459 1.06 1.06
55	72 80 90	9 13 11		8 800 16 000 19 400	8 500 13 300 16 300	17.0 16.2 16.2	8 500 8 000 7 500	4 800 4 500 —	10 000 9 500 9 000	6811 ZZ 6911 ZZ 16011 —				1.70 2.10 —	0.95 1.3 —	70.7 77.9 —	0.25 0.4 —	0.3 0.5 —	74.8 84.4 —	0.85 1.12 —	57 60 59	59 61.5 —	70 75 86	0.3 1 0.6	76 86 —	2.3 2.9 —	0.081 0.189 0.257
	90 90 100	18	1.1	29 700 28 300 45 500	21 200 21 200 29 300	15.3 15.3 14.3	8 500 7 500 7 500	4 500 4 500 4 300	10 000 9 000 9 000	* 6011 ZZ 6011 ZZ * 6211 ZZ	VV DD VV DD VV DD	N	- — I NR - —	 2.87 	2.7 —	86.79 —	0.6	0.5 —	96.5 —	 2.46 	61.5 61.5 63	64 64 66.5	83.5 83.5 92	1 1 1.5	98_ _	_ 5	0.381 0.381 0.619
	100 120 120	29	2	43 500 75 000 71 500	29 300 44 500 44 500	14.3 13.1 13.1	6 300 6 700 5 600	4 300 4 000 4 000	7 500 8 000 6 700	6211 ZZ * 6311 ZZ 6311 ZZ	VV DD VV DD VV DD	_		3.28 — 4.06	2.7 	96.8 — 115.21	0.6 0.6	0.5 — 0.5	106.5 — 129.7	2.46 — 2.82	63 64 64	66.5 72.5 72.5	92 111 111	1.5 2 2	108_ 131.5	5.4 — 6.5	0.619 1.37 1.37
60	78 85 95	13	1	11 500 19 400 20 000	10 900 16 300 17 500	16.9 16.2 16.3	8 000 7 500 7 100	4 500 4 300 —	9 500 9 000 8 500	6812 ZZ 6912 ZZ 16012 —	VV DD VV DD	N N		1.70 2.10 —	1.3 1.3	76.2 82.9	0.4 0.4 —	0.3 0.5 —	82.7 89.4 —	1.12 1.12 —	62 65 64	64 66 —	76 80 91	0.3 1 0.6	84 91 —	2.5 2.9 —	0.103 0.192 0.281
	95 95 110	18	1.1	31 000 29 500 55 000	23 200 23 200 36 000	15.6 15.6 14.3	8 000 7 100 6 700	4 000 4 000 3 800	9 500 8 500 8 000	* 6012 ZZ 6012 ZZ * 6212 ZZ	VV DD VV DD VV DD	N	NR	 2.87 	2.7 —	91.82 —	0.6	0.5 —	101.6	2 <u>.46</u>	66.5 66.5 68	69 69 74.5	88.5 88.5 102	1 1 1.5	103_	_ 5	0.412 0.412 0.783
	110 130 130		2.1	52 500 86 000 82 000	36 000 52 000 52 000	14.3 13.1 13.1	5 600 6 000 5 300	3 800 3 600 3 600	7 100 7 100 6 300	* 6212 ZZ * 6312 ZZ 6312 ZZ	VV DD VV DD VV DD	_		3.28 — 4.06	2.7 	106.81 — 125.22	0.6	0.5 — 0.5	116.6 — 139.7	2.46 — 2.82	68 71 71	74.5 79 79	102 119 119	2	118 	5.4 — 6.5	0.783 1.72 1.72

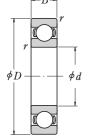
Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A116 to A119.

(2) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.

- **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.

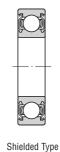
Bore Diameter 65 - 75 mm

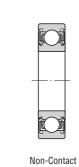


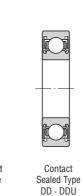


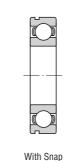
Open Type

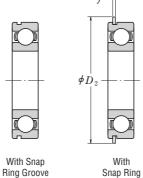


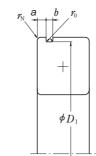


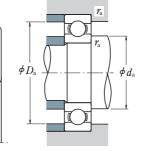


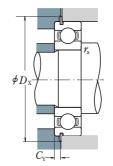












Dynamic Equivalent Load

P = X	$F_{\rm r} + YF_{\rm a}$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{ m a}}{F_{ m r}}$	$\leq e$	$\frac{F_{\rm a}}{F_{ m r}}$	>e
C _{0r}		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

$$\frac{F_{\rm a}}{F_{\rm r}} > 0.8, P_0 = 0.6F_{\rm r} + 0.5F_{\rm a}$$

$$\frac{F_{\rm a}}{F_{\rm r}} \le 0.8, P_0 = F_{\rm r}$$

$$\frac{F_{\rm a}}{F_{\rm r}} \le 0.8, P_0 = F_{\rm r}$$

	U	pen i	γpe	Z	zu Type Z	Sealed Type VV	Seale	ed Type · DDU	Ring Gro N			Snap Rir NR	g		ļ						C	γ—н —		$rac{F_{ m a}}{F_{ m r}}$	-≦0.8, <i>P</i>	$P_0 = F_r$			
В	ounda	ry Din (mm)	ensions		ad Ratings N)	Factor	Limitir	ng Speeds ((min ⁻¹)		Bearin	ng Numbe	rs		h With	Snap	Ring G	Groove Din (mm)	nensions	S (1)	Snap F Dimer	nsions		Abutme	nt and Fill (mn		ensions		Mass (kg)
ĺ	d i	D.	B r min.	$C_{\rm r}$	C_{0r}	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open	Shielded	l Seale	i	Rin Groo	p Snap g Ring ove	а max.	$b \atop {\rm min.}$	$D_{1} \\ \text{max.}$	r_0 max.	$ m \emph{r}_{N}$ min.	$D_2^{(m m}$ max.	f max.	min.	$d_{ m a}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	$ m \emph{r}_a$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.
6	ç	90 1	0 0.6 3 1 1 0.6	11 900 17 400 20 500	12 100 16 100 18 700	17.0 16.6 16.5	7 500 7 100 6 700	4 000 4 000 —	8 500 8 500 8 000		ZZ	VV DI		N N —	NR NR	1.70 2.10 —	1.3 1.3	82.9 87.9 —	0.4 0.4 —	0.5 0.5 —	89.4 94.4 —	1.12 1.12 —	69 70 69	69 71.5 —	81 85 96	0.6 1 0.6	91 96 —	2.5 2.9 —	0.128 0.218 0.30
	10	00 1	8 1.1 8 1.1 3 1.5	32 000 30 500 60 000	25 200 25 200 40 000	15.8 15.8 14.4	7 500 6 700 6 300	4 000 4 000 3 600	9 000 8 000 7 500	6013	ZZ	VV DI VV DI	DÚ	_ N _	NR —	 2.87 	2.7 —	96.8 —	0.6	0.5 —	106.5 —	2.46 —	71.5 71.5 73	73 73 80	93.5 93.5 112	1 1 1.5	108_ _	5 —	0.439 0.439 1.0
	14	20 2 10 3 10 3	1.5 13 2.1 13 2.1	57 500 97 500 92 500	40 000 60 000 60 000	14.4 13.2 13.2	5 300 5 600 4 800	3 600 3 400 3 400	6 300 6 700 6 000	* 6313	ZZ	VV DI VV DI	DÚ	N N	NR — NR	_	3 <u>.1</u> 3.1	115.21 — 135.23	0.6 0.6	0.5 — 0.5	129.7 — 149.7	2.82 — 2.82	73 76 76	80 85.5 85.5	112 129 129	1.5 2 2	131 <u>.5</u> 152	6.5 7.3	1.0 2.11 2.11
7	10	00 1	0 0.6 6 1 3 0.6	12 100 23 700 26 800	12 700 21 200 23 600	17.2 16.3 16.3	6 700 6 300 6 000	3 800 3 600 —	8 000 7 500 7 100		ZZ	VV DI		N N	NR NR —		1.3 1.3	87.9 97.9 —	0.4 0.4 —	0.5 0.5 —	94.4 104.4 —	1.12 1.12 —	74 75 74	74.5 77.5 —	86 95 106	0.6 1 0.6	96 106 —	2.5 3.3 —	0.134 0.349 0.441
	11		10 1.1 10 1.1 14 1.5	40 000 38 000 65 500	31 000 31 000 44 000	15.6 15.6 14.5	7 100 6 000 6 000	3 600 3 600 3 400	8 500 7 100 7 100		ZZ	VV DI VV DI	DÚ	_ N	NR —	 2.87 	2 <u>.7</u>	106.81 —	0.6	0.5 —	116.6 —	2.46 —	76.5 76.5 78	80.5 80.5 84	103.5 103.5 117	1 1 1.5	118 —	5 —	0.608 0.608 1.09
	12 15 15	50 3	14 1.5 15 2.1 15 2.1	62 000 109 000 104 000	44 000 68 000 68 000	14.5 13.2 13.2	5 000 5 300 4 500	3 400 3 200 3 200	6 300 6 300 5 300	* 6314	ZZ	VV DI VV DI	DÚ	N N	NR — NR	4.06 — 4.90	3.1 3.1	120.22 — 145.24	0.6	0.5 — 0.5	134.7 — 159.7	2.82 — 2.82	78 81 81	84 92 92	117 139 139	1.5 2 2	136.5 — 162	6.5 7.3	1.09 2.57 2.57
7!	10)5 1	0 0.6 6 1 3 0.6	12 500 24 400 27 600	13 900 22 600 25 300	17.3 16.5 16.4	6 300 6 000 5 600	3 600 3 400 —	7 500 7 100 6 700		ZZ	VV DI		N N —	NR NR —		1.3 1.3	92.9 102.6 —	0.4 0.4 —	0.5 0.5 —	99.4 110.7	1.12 1.12 —	79 80 79	79.5 82 —	91 100 111	0.6 1 0.6	101 112 —	2.5 3.3 —	0.149 0.364 0.463
	11 11 13	5 2 5 2 80 2	10 1.1 10 1.1 15 1.5	41 500 39 500 69 500	33 500 33 500 49 500	15.8 15.8 14.7	6 700 5 600 5 600	3 400 3 400 3 200	8 000 6 700 6 700	6015	ZZ	VV DI VV DI	DU	_ N _	NR —	 2.87 	2 <u>.7</u>	_ 111.81 _	0.6	0.5 —	121.6	2.46 —	81.5 81.5 83	85.5 85.5 90	108.5 108.5 122	1 1 1.5	123 —	_ 5	0.649 0.649 1.19
_	16	30 3	25 1.5 37 2.1 37 2.1	66 000 119 000 113 000	49 500 77 000 77 000	14.7 13.2 13.2	4 800 4 800 4 300	3 200 2 800 2 800	5 600 6 000 5 000	* 6315	ZZ	VV DI VV DI	υ	_	NR — NR	4.06 — 4.90	3.1 3.1	125.22 — 155.22	0.6 0.6	0.5 — 0.5	139.7 — 169.7	2.82 — 2.82	83 86 86	90 98.5 98.5	122 149 149	1.5 2 2	141.5 — 172	6.5 — 7.3	1.19 3.08 3.08

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A116 to A119.

- **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 80 - 90 mm

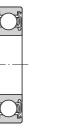


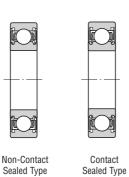
Open Type



Shielded Type

ZZ

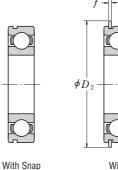


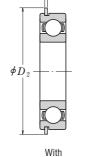


DD · DDU



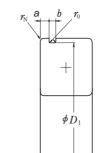
Ring Groove

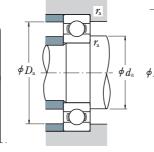


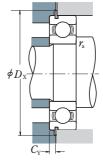


Snap Ring

NR







Dynamic Equivalent Load

 $P = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{ m a}}{F_{ m r}}$	$\leq e$	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	>e
C _{0r}		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

$$\frac{F_{\rm a}}{F_{\rm r}} > 0.8, P_0 = 0.6F_{\rm r} + 0.5F_{\rm a}$$

$$\frac{F_{\rm a}}{F_{\rm r}} \le 0.8, P_0 = F_{\rm r}$$

$$\frac{F_a}{F_a} \le 0.8, P_0 = F_1$$

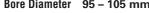
Boundary Dimensions	Basic Load Ratings	Factor	Limiting Speeds (r		Bearing Numbers	With With	Snap	Ring G	roove Dim	ensions	(1)	Snap R Dimen			Abutme	nt and Fill		ensions		Mass (kg)
d D B r min.	$C_{ m r}$ $C_{ m 0r}$	f_0	Grease Open Z · ZZ DU V · VV DDU	Oil Open Z	Open Shielded Sealed	Snap Snap Ring Ring Groove	a max.	$b \atop { m min.}$	$D_{ m 1}$ max.		$r_{ m N}$ min.	$D_2^{(m)}_{max.}$	f max.	min.	$d_{ m a}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	${m r}_{ m a}$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.
	12 700	17.4 16.6 16.4	6 000 3 400 5 600 3 200 5 300 —	7 100 6 700 6 300	6816 ZZ VV DDU 6916 ZZ VV DDU 16016 — — —	N NR N NR — —	1.7 2.5 —	1.3 1.3 —	97.9 107.6 —	0.4 0.4 —	0.5 0.5 —	104.4 115.7 —	1.12 1.12 —	84 85 84	84.5 87.5 —	96 105 121	0.6 1 0.6	106 117 —	2.5 3.3 —	0.151 0.391 0.621
	50 000	15.6 15.6 14.6	6 300 3 200 5 300 3 200 5 300 3 000	7 100 6 300 6 300	* 6016 ZZ VV DDU 6016 ZZ VV DDU * 6216 ZZ VV DDU	 N NR 	 2.87 	3.1	120.22 —	0.6	0.5 —	134.7 —	2.82 —	86.5 86.5 89	91 91 95.5	118.5 118.5 131	1 1 2	136.5	5.3	0.872 0.872 1.42
170 39 2.1 1	72 500 53 000 129 000 86 500 123 000 86 500	14.6 13.3 13.3	4 500 3 000 4 500 2 800 4 000 2 800	5 300 5 600 4 800	* 6216 ZZ VV DDU * 6316 ZZ VV DDU 6316 ZZ VV DDU	N NR N NR	4.90 — 5.69	3.1 3.5	135.23 — 163.65	0.6	0.5 - 0.5	149 <u>.7</u> 182.9	2.82 — 3.1	89 91 91	95.5 104.5 104.5	131 159 159	2 2 2	152 — 185	7.3 — 8.4	1.42 3.67 3.67
	18 700 20 000 32 000 29 600 33 000 31 500	17.1 16.4 16.5	5 600 3 200 5 300 3 000 5 000 —	6 700 6 300 6 000	6817 ZZ VV DDU 6917 ZZ VV DDU 16017 — — —	N NR N NR — —	2.10 3.30 —	1.3 1.3	107.6 117.6	0.4 0.4 —	0.5 0.5 —	115.7 125.7 —	1.12 1.12 —	90 91.5 89	90.5 94.5 —	105 113.5 126	1 1 0.6	117 127 —	2.9 4.1 —	0.263 0.55 0.652
130 22 1.1 130 22 1.1 150 28 2	52 000	15.8 15.8 14.5	6 000 3 000 5 000 3 000 4 800 2 800	7 100 6 000 6 000	* 6017 ZZ VV DDU 6017 ZZ VV DDU * 6217 ZZ VV DDU	 N NR 	 2.87 	3 <u>.1</u>	 125.22 	0.6	0.5 —	139.7 —	 2.82 	91.5 91.5 94	96 96 102	123.5 123.5 141	1 1 2	141. <u>5</u>	5.3 —	0.918 0.918 1.76
180 41 3 1	84 000 62 000 139 000 97 000 133 000 97 000	14.5 13.3 13.3	4 300 2 800 4 300 2 600 3 800 2 600	5 000 5 000 4 500	6217 ZZ VV DDU * 6317 ZZ VV DDU 6317 ZZ VV DDU	N NR N NR	4.90 — 5.69	3.1 3.5	_	0.6	0.5 	159.7 — 192.9	2.82 — 3.1	94 98 98	102 110.5 110.5	141 167 167	2 2.5 2.5	162 — 195	7.3 — 8.4	1.76 4.28 4.28
	19 000 21 000 33 000 31 500 41 500 39 500	17.2 16.5 16.3	5 300 3 000 5 000 2 800 4 800 —	6 300 6 000 5 600	6818 ZZ VV DDU 6918 ZZ VV DDU 16018 — — —	N NR N NR — —		1.3 1.3	112.6 122.6	0.4 0.4 —	0.5 0.5 —	120.7 130.7	1.12 1.12 —	95 96.5 95	95.5 98.5 —	110 118.5 135	1 1 1	122 132 —	2.9 4.1 —	0.276 0.585 0.873
140 24 1.5	61 000 50 000 58 000 50 000 101 000 71 500	15.6 15.6 14.5	5 600 2 800 4 800 2 800 4 500 2 600	6 300 5 600 5 600	* 6018 ZZ VV DDU 6018 ZZ VV DDU * 6218 ZZ VV DDU	 N NR 	3.71 —	3.1 —	 135.23 	0.6	0.5 —	149 <u>.7</u>	 2.82 	98 98 99	103 103 107.5	132 132 151	1.5 1.5 2	 152	6.1 —	1.19 1.19 2.18
190 43 3	96 000 71 500 150 000 107 000 143 000 107 000	14.5 13.3 13.3	4 000 2 600 4 000 2 400 3 600 2 400	4 800 4 800 4 300	6218 ZZ VV DDU * 6318 ZZ VV DDU 6318 ZZ VV DDU	N NR NR NR	4.90 — 5.69	3.1 — 3.5	_	0.6 — 0.6	0.5 — 0.5	169.7 — 202.9	2.82 — 3.1	99 103 103	107.5 117 117	151 177 177	2 2.5 2.5	172 	7.3 — 8.4	2.18 4.98 4.98

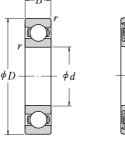
Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A116 to A119.

- **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

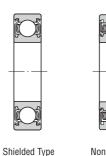




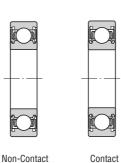
Open Type



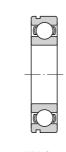
ZZ



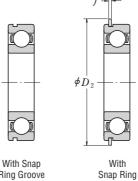
Sealed Type

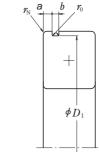


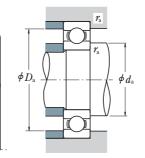
Sealed Type

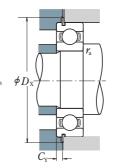


Ring Groove









Dynamic Equivalent Load

 $P = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	>e
C _{0r}		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

$$\frac{F_{\rm a}}{F_{\rm r}}$$
>0.8, P_0 =0.6 $F_{\rm r}$ +0.5 $F_{\rm a}$

$$\frac{F_a}{F_a} \leq 0.8, P_0 = F_r$$

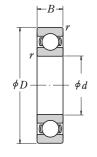
						VV	DD	· DĎÚ	N			NR											$F_{\rm r}$	⊒0.0, 1	0 –1 ′r			
В	oundary (r	Dime	nsions	1	ad Ratings N)	Factor	Limitir	ng Speeds (min ⁻¹)	Ве	aring N	lumbers		h With	Snap	Ring (Groove Din	nension	S (1)	Snap R Dimen	nsions		Abutme	nt and Fil (mn		ensions		Mass (kg)
a	! D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open Shie	lded	Sealed	Sna Ring Groo	p Snap g Ring ove	а max.	$_{\min .}^{\textit{b}}$	$D_1 \atop { m max.}$	$ ho_0$ max.	${m r}_{ m N}$ min.	$D_2^{(\mathrm{m})}_{\mathrm{max.}}$	m) f max.	min.	$d_{ m a}$ (2) max.	$D_{\mathrm{a}^{(2)}}$ max.	${\it r}_{\rm a}$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.
95	130		1.1	19 300 33 500 43 000	22 000 33 500 42 000	17.2 16.6 16.4	5 000 4 800 4 500	2 800 2 800 —	6 000 5 600 5 300	6819 Z 6919 Z 16019 —	Z V	V DDU	N N	NR NR —		1.3 1.3	117.6 127.6	0.4 0.4 —	0.5 0.5 —	125.7 135.7 —	1.12 1.12 —	100 101.5 100	101.5 103.5	115 123.5 140	1 1 1	127 137 —	2.9 4.1 —	0.297 0.601 0.904
	145		1.5 1.5 2.1	63 500 60 500 114 000	54 000 54 000 82 000	15.8 15.8 14.4	5 300 4 500 4 300	2 600 2 600 2 600	6 000 5 300 5 000	* 6019 Z 6019 Z * 6219 Z	Z V	V DDU	_ N _	NR —	_ 3.71 _	3.1	140.23 —	0.6	0.5	154.7 —	 2.82 	103 103 106	108.5 108.5 114	137 137 159	1.5 1.5 2	157 —	6.1 —	1.23 1.23 2.64
	170 200 200	45	2.1	109 000 160 000 153 000	82 000 119 000 119 000	14.4 13.3 13.3	3 800 3 400 3 000	2 600 2 400 2 400	4 500 4 300 3 600	6219 Z * 6319 Z 6319 Z	Z V	V DDU V DDU V DDU	N N	NR — NR	5.69 - 5.69	3.5 3.5	163.65 — 193.65	0.6	0.5 0.5	182.9 212.9	3.1 3.1	106 108 108	114 123.5 123.5	159 187 187	2 2.5 2.5	185 215	8.4 — 8.4	2.64 5.76 5.76
100	140		1.1	19 600 43 000 42 500	23 000 42 000 42 000	17.3 16.4 16.5	4 800 4 500 4 300	2 800 2 600 —	5 600 5 300 5 300	6820 Z 6920 Z 16020 —			N N	NR NR —		1.3 1.9	122.6 137.6 —	0.4 0.6 —	0.5 0.5 —	130.7 145.7	1.12 1.7 —	105 106.5 105	105.5 111 —	120 133.5 145	1 1 1	132 147 —	2.9 4.7 —	0.31 0.828 0.945
	150 150 180	24	1.5 1.5 2.1	63 000 60 000 128 000	54 000 54 000 93 000	15.9 15.9 14.4	5 000 4 300 4 000	2 600 2 600 2 400	6 000 5 300 4 800	* 6020 Z 6020 Z * 6220 Z	Z V	V DDU	_ N _	NR —	3.71 —	3.1 —	 145.24 	0.6	0.5 —	159.7	 2.82 	108 108 111	112.5 112.5 121.5	142 142 169	1.5 1.5 2	162 —	6.1 —	1.29 1.29 3.17
	180 215	34 47	2.1	122 000 173 000	93 000 141 000	14.4 13.2	3 600 2 800	2 400 2 200	4 300 3 400	6220 Z 6320 Z			<u>N</u>	NR —	5.69	3.5	173.66 —	0.6	0.5	192.9	3.1	111 113	121.5 133	169 202	2 2.5	195 —	8.4	3.17 7.04
105	145	13 20 18	1.1	19 800 42 500 52 000	23 900 42 000 50 500	17.4 16.5 16.3	4 800 4 300 4 000	2 600 — —	5 600 5 300 4 800	6821 Z 6921 Z 16021 —	Z V	V —	N N	NR NR —		1.3 1.9	127.6 142.6 —	0.4 0.6 —	0.5 0.5 —	135.7 150.7 —	1.12 1.7 —	110 111.5 110	110.5 116 —	125 138.5 155	1 1 1	137 152 —	2.9 4.7 —	0.324 0.856 1.24
	160 160 190	26	3 2 3 2 3 2.1	76 000 72 500 140 000	66 000 66 000 105 000	15.8 15.8 14.4	4 500 4 000 3 800	2 400 2 400 2 200	5 600 4 800 4 500	* 6021 Z 6021 Z * 6221 Z	Z V	V DDU V DDU V DDU	_ N _	NR —	3.71 —	3.1 —	 155.22 	0.6	0.5	169.7 —	 2.82 	114 114 116	120 120 127.5	151 151 179	2 2 2	172 —	6.1 —	1.58 1.58 3.79
	190 225		3 2.1	133 000 184 000	105 000 154 000	14.4 13.2	3 400 2 600	2 200 2 000	4 000 3 200	6221 Z 6321 Z				NR —	5.69 —	3.5	183.64	0.6	0.5	202.9	3.1	116 118	127.5 138	179 212	2 2.5	205_	8.4	3.79 8.09

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A116 to A119.

- **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.







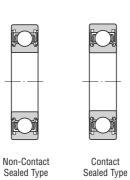
Open Type

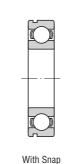


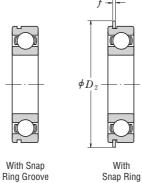
Shielded Type

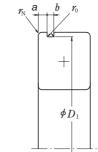
ZZ · ZZŚ

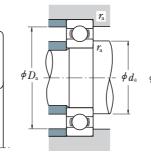


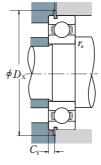












Dynamic Equivalent Load

 $P = XF_r + YF_a$

		•			
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{\rm a}}{F_{ m r}}$	>e
∪ _{0r}		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

$$\frac{F_{\rm a}}{F_{\rm r}}$$
>0.8, P_0 =0.6 $F_{\rm r}$ +0.5 $F_{\rm a}$

$$\frac{F_a}{F_r} \leq 0.8, P_0 = F_r$$

					VV	DD -	DDU	N	NR										$F_{\rm r}$	⊒0.0,1() —I' _I			
Вс	undary [(m	imensions n)		ad Ratings N)	Factor	Limitin	ig Speeds (i	min ⁻¹)	Bearing Numbers	With With	Sna	ıp Ring (Groove Dir	nensions	(1)	Snap R Dimen	isions		Abutme	nt and Fill (mm		nsions		Mass (kg)
d	D	$B \underset{\text{min.}}{\pmb{r}}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open Shielded Sealed	Snap Snap Ring Ring Groove	a max.	$b \atop { m min.}$	$D_{ m 1}$ max.	${m \gamma}_0$ max.	$ m \emph{r}_N$ min.	$D_2^{(\mathrm{mi})}$	f max.	min.	$d_{ m a}^{(2)}$ max.	$D_{\mathrm{a}^{(2)}}$ max.	${\pmb{\gamma}}_a$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.
110	140 150 170	20 1.1	28 100 43 500 57 500	32 500 44 500 56 500	17.1 16.6 16.3	4 300 4 300 3 800	2 400 2 400 —	5 300 5 000 4 500	6822 ZZ VV DDU 6922 ZZ VV DDU 16022 — —	N NR N NR — —	2.50 3.30 —	1.9 1.9 —	137.6 147.6 —	0.6 0.6	0.5 0.5 —	145.7 155.7 —	1.7 1.7 —	115 116.5 115	117 121 —	135 143.5 165		147 157 —	3.9 4.7 —	0.497 0.893 1.51
	170 170 200 240	28 2 28 2 38 2.1 50 3	89 000 85 000 144 000 205 000	73 000 73 000 117 000 179 000	15.5 15.5 14.3 13.2	4 500 3 800 2 800 2 400	2 200 2 200 2 200 —	5 300 4 500 3 400 3 000	* 6022 ZZ VV DDU 6022 ZZ VV DDU 6222 ZZ VV DDU 6322 ZZ — —	 N NR N NR 	3.71 5.69	3.5 3.5 —	163.65 193.65 —	0.6 0.6 —	0.5 0.5 —	182.9 212.9	3.1 3.1 —	119 119 121 123	124.5 124.5 134 147	161 161 189 227	2 2 2 2.5	185 215 —	6.4 8.4 —	1.94 1.94 4.45 9.51
120	150 165 180	16 1 22 1.1 19 1	28 900 53 000 56 500	35 500 54 000 57 500	17.3 16.5 16.5	4 000 3 800 3 600	2 200	4 800 4 500 4 300	6824 ZZ VV DD 6924 ZZ — — 16024 — —	N NR N NR — —	2.50 3.70 —	1.9 1.9 —	147.6 161.8	0.6 0.6 —	0.5 0.5 —	155.7 171.5 —	1.7 1.7 —	125 126.5 125	127 132 —	145 158.5 175		157 173 —	3.9 5.1 —	0.537 1.21 1.6
	180 180 215 260	28 2 28 2 40 2.1 55 3	92 500 88 000 155 000 207 000	80 000 80 000 131 000 185 000	15.7 15.7 14.4 13.5	4 000 3 600 2 600 2 200	2 200 2 200 2 000 1 800	4 800 4 300 3 200 2 800	* 6024 ZZ VV DDU 6024 ZZ VV DDU 6224 ZZ VV DDU 6324 ZZS — DDU	N NR 	3.71 — —	3.5 —	173.66 — —	0.6	0.5 —	192.9 —	3.1 —	129 129 131 133	134.5 134.5 146 161	171 171 204 247	2 2 2 2.5	195 — —	6.4 —	2.08 2.08 5.29 12.5
130	165 180 200	18 1.1 24 1.5 22 1.1	37 000 65 000 75 500	44 000 67 500 77 500	17.1 16.5 16.4	3 600 3 400 3 000	2 000	4 300 4 000 3 600	6826 ZZS VV DD 6926 ZZ — — 16026 — — —	N NR N NR — —	3.30 3.70 —	1.9 1.9 —	161.8 176.8	0.6 0.6 —	0.5 0.5 —	171.5 186.5 —	1.7 1.7 —	136.5 138 136.5	138 144 —	158.5 172 193.5		173 188 —	4.7 5.1 —	0.758 1.57 2.4
	200 230 280	33 2 40 3 58 4	106 000 167 000 229 000	101 000 146 000 214 000	15.8 14.5 13.6	3 000 2 400 2 200	1 900	3 600 3 000 2 600	6026 ZZ — DDU 6226 ZZ — — 6326 ZZS — —	N NR — — — —	5.69 —	3.5	193.65 — —	0.6 —	0.5 —	212.9	3.1 	139 143 146	148.5 157 175	191 217 264	2 2.5 3	215 —	8.4 —	3.26 5.96 15.2
140	190	18 1.1 24 1.5 22 1.1	38 500 66 500 77 500	48 000 72 000 82 500	17.3 16.6 16.5	3 400 3 200 2 800	1 900	4 000 3 800 3 400	6828 ZZ VV DDU 6928 ZZS VV — 16028 — — —	N NR N NR — —	3.30 3.70 —	1.9 1.9 —	171.8 186.8 —	0.6 0.6 —	0.5 0.5 —	181.5 196.5 —	1.7 1.7 —	146.5 148 146.5	148.5 153.5 —	168.5 182 203.5		183 198 —	4.7 5.1 —	0.832 1.67 2.84
	210 250 300	33 2 42 3 62 4	110 000 166 000 253 000	109 000 150 000 246 000	16.0 14.9 13.6	2 800 2 200 2 000	1 800 1 700 —	3 400 2 800 2 400	6028 ZZ — DDU 6228 ZZS — DDU 6328 ZZS — —	ΞΞ	=	_	=	_ _ _	_	_ _ _	_ _ _	149 153 156	158.5 171.5 187	201 237 284	2 2.5 3	_ _ _	_ _ _	3.48 7.68 18.5
150	210	20 1.1 28 2 24 1.1	47 500 85 000 84 000	58 500 90 500 91 000	17.1 16.5 16.6	3 200 2 600 2 600	1 800 1 700 —	3 800 3 200 3 000	6830 ZZ VV DDU 6930 ZZS — DDU 16030 — — —	N NR — — — —	3.30 —	1.9	186.8 — —	0.6 —	0.5 —	196.5 —	1.7 	156.5 159 156.5	160 166 —	183.5 201 218.5	1 2 1	198 _ _	4.7 —	1.15 3.01 3.62
	225 270 320	35 2.1 45 3 65 4	126 000 176 000 274 000	126 000 168 000 284 000	15.9 15.1 13.9	2 600 2 000 1 800	1 700 — —	3 000 2 600 2 200	6030 ZZ VV DDU 6230 ZZS — — 6330 ZZS — —	ΞΞ	=	=		_ _ _	_ _ _	_	_ _ _	161 163 166	170 186 203	214 257 304	2 2.5 3	_ _ _	_	4.24 10 22.7

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A116 to A119.

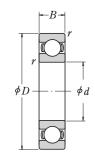
(2) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.

- 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.



C 034

Bore Diameter 160 mm



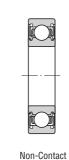
Open Type



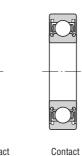


Shielded Type

ZZ · ZZS

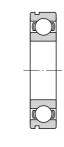


Sealed Type

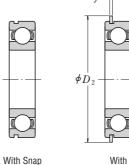


Sealed Type

DD · DDU

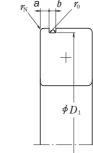


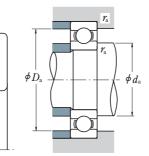
Ring Groove

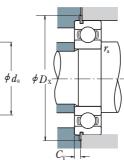


Snap Ring

NR







Dynamic Equivalent Load D VE VE

P = X	$F_{\rm r} + YF_{\rm z}$	ı			
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{ m a}}{F_{ m r}}$	$\leq e$	$\frac{F_{\rm a}}{F_{\rm r}}$	>e
∪ _{0r}		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

$$\frac{F_a}{F_r} > 0.8, P_0 = 0.6F_r + 0.5F_a$$

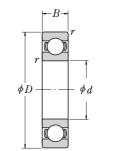
$$\frac{F_a}{F_r} \le 0.8, P_0 = F_r$$

Bou	ndary C		sions		ad Ratings N)	Factor	Limitin Grea	g Speeds (i	min ⁻¹)	Bearing	Numbers	With With	Sna	p Ring G	roove Dim (mm)	nensions	(1)	Snap R Dimen	sions		Abutmei	nt and Fill (mm		nsions		Mass (kg)
d	D	В	γ min.	$C_{ m r}$	C_{0r}	f_0	Open Z · ZZ V · VV	DU DDU	Open Z	Open Shielded	Sealed	Snap Snap Ring Ring Groove	а max.	$b \atop { m min.}$	$D_{ m 1}$ max.	$oldsymbol{\gamma}_0$ max.	$ m \emph{r}_{N}$ min.	$D_2^{(m mr}$ max.	f max.	min.	$d_{ m a}^{(2)}$ max.	$D_{ m a}^{(2)}$ max.	${m \gamma}_{\rm a}$ max.	$D_{\rm x} \atop {\rm min.}$	$C_{ m Y}$ max.	approx.
160	200 220 240	20 28 25	1.1 2 1.5	48 500 87 000 99 000	61 000 96 000 108 000	17.2 16.6 16.5	2 600 2 600 2 400	1 700 1 600 —	3 200 3 000 2 800	6832 ZZS 6932 ZZS 16032 —	VV DDU — DDU — —	N NR — — — —	3.30 —	1.9 —	196.8	0.6	0.5 —	206.5	1.7 —	166.5 169 168	170.5 176 —	193.5 211 232	1 2 1.5	208_	4.7 —	1.23 2.71 4.2
	240 290 340	38 48 68	2.1 3 4	137 000 185 000 278 000	135 000 186 000 287 000	15.9 15.4 13.9	2 400 1 900 1 700	1 600 —	2 800 2 400 2 000	6032 ZZ 6232 ZZS 6332 ZZS	— DDU — — — —	= =	_	_	=		_	_ _ _	_	171 173 176	181.5 202 215.5	229 277 324	2 2.5 3	_ _ _	_	5.15 12.8 26.2

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A116 to A119.

- 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.

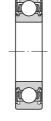
Bore Diameter 170 – 240 mm















Dynamic Equivalent Load

 $P = XF_r + YF_a$

	1 r 1 1 1 2	1			
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{ m a}}{F_{ m r}}$	>e
C _{0r}		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 =0.6 F_r +0.5 F_a

$$\frac{F_{\rm a}}{F_{\rm r}}$$
 \leq 0.8, P_0 = $F_{\rm r}$

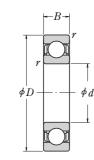
Open Type ZZS Seale

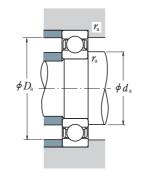
								VV							
Bou	ındary [m	Dimen: im)	sions	1	ad Ratings N)	Factor		g Speeds (r		Bearing Numbers		Abutment Dimensio			Mass (kg)
d	D	В	γ min.	$C_{\rm r}$	C_{0r}	f_0	Grea Open Z · ZZ V · VV	DU DDU	Oil Open Z	Open Shielded Sealed	min.	$d_{ m a}$ (1) max.	$D_{ m a}^{(1)}$ max.	$ m \emph{r}_a$ max.	approx.
170	215 230 260	22 28 28	1.1 2 1.5	60 000 86 000 114 000	75 000 97 000 126 000	17.1 16.7 16.5	2 600 2 400 2 200	1 600	3 000 2 800 2 600	6834 ZZS VV DDU 6934 ZZS — — 16034 — —	176.5 179 178	182 186	208.5 221 252	1 2 1.5	1.86 3.34 5.71
	260 310 360	42 52 72	2.1 4 4	161 000 212 000 325 000	161 000 224 000 355 000	15.8 15.3 13.6	2 200 1 800 1 600	_	2 600 2 200 2 000	6034 ZZS VV — 6234 ZZS — — 6334 — — —	181 186 186	194.5 215 —	249 294 344	2 3 3	6.89 15.8 36.6
180	225 250 280	22 33 31	1.1 2 2	60 500 119 000 145 000	78 500 128 000 157 000	17.2 16.4 16.3	2 400 2 200 2 000	=	2 800 2 600 2 400	6836 — VV — 6936 ZZS — — 16036 — — —	186.5 189 189	192 198.5 —	218.5 241 271	1 2 2	1.98 4.16 7.5
	280 320 380	46 52 75	2.1 4 4	180 000 227 000 355 000	185 000 241 000 405 000	15.6 15.1 13.9	2 000 1 700 1 500	_	2 400 2 000 1 800	6036 ZZS VV — 6236 ZZS — — 6336 — — —	191 196 196	208 223 —	269 304 364	2 3 3	8.88 15.9 43.1
190	240 260 290	24 33 31	1.5 2 2	73 000 113 000 149 000	93 500 127 000 168 000	17.1 16.6 16.4	2 200 2 200 2 000	_	2 600 2 600 2 400	6838 — VV — 6938 — — — 16038 — — —	198 199 199	202.5 — —	232 251 281	1.5 2 2	2.53 5.18 7.78
	290 340 400	46 55 78	2.1 4 5	188 000 255 000 355 000	201 000 282 000 415 000	15.8 15.0 14.1	2 000 1 600 1 400	_	2 400 2 000 1 700	6038 ZZS — — 6238 ZZS — — 6338 — — —	201 206 210	218 236 —	279 324 380	2 3 4	9.39 22.3 49.7
200	250 280 310	24 38 34	1.5 2.1 2	74 000 143 000 161 000	98 000 158 000 180 000	17.2 16.4 16.4	2 200 2 000 1 900	_	2 600 2 400 2 200	6840 — — — 6940 ZZS — — 16040 — — —	208 211 209	222_	242 269 301	1.5 2 2	2.67 7.28 10
	310 360 420	51 58 80	2.1 4 5	207 000 269 000 380 000	226 000 310 000 445 000	15.6 15.2 13.8	1 900 1 500 1 300	_	2 200 1 800 1 600	6040 ZZS — — 6240 ZZS — — 6340 — — —	211 216 220	231.5 252 —	299 344 400	2 3 4	12 26.7 55.3
220	270 300 340	24 38 37	1.5 2.1 2.1	76 500 146 000 180 000	107 000 169 000 217 000	17.4 16.6 16.5	1 900 1 800 1 600		2 400 2 200 2 000	6844 ZZS — — 6944 ZZS — — 16044 — — —	228 231 231	233.5 242 —	262 289 329	1.5 2 2	2.9 7.88 13.1
	340 400 460	56 65 88	3 4 5	235 000 310 000 410 000	271 000 375 000 520 000	15.6 15.1 14.3	1 700 1 300 1 200	_	2 000 1 600 1 500	6044 ZZS — — 6244 — — — 6344 — — —	233 236 240	254.5 — —	327 384 440	2.5 3 4	18.6 37.4 73.9
240	300 320 360	28 38 37	2 2.1 2.1	98 500 154 000 196 000	137 000 190 000 243 000	17.3 16.8 16.5	1 700 1 700 1 500	_	2 000 2 000 1 900	6848 — — — 6948 ZZS — — 16048 — — —	249 251 251	262 _	291 309 349	2 2 2	4.48 8.49 13.9
	360 440 500	56 72 95	3 4 5	244 000 340 000 470 000	296 000 430 000 625 000	15.9 15.2 14.2	1 500 1 200 1 100		1 900 1 500 1 300	6048 — — — 6248 — — — 6348 — — —	253 256 260	=	347 424 480	2.5 3 4	19.9 50.5 94.4

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.

Bore Diameter 260 - 360 mm





nen	Type	

E	Boundary Dimensions (mm)		Basic Load Ratings Fact		Factor	Limiting (mi	•	Bearing Numbers		ment and I ensions (m		Mass (kg)	
d	D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	Open	$d_{ m a}^{(1)}$ min.	$D_{ m a}^{(1)}$ max.	$ m \emph{r}_a$ max.	approx.
260	320	28	2	101 000	148 000	17.4	1 600	1 900	6852	269	311	2	4.84
	360	46	2.1	204 000	255 000	16.5	1 500	1 800	6952	271	349	2	14
	400	44	3	237 000	310 000	16.4	1 400	1 700	16052	273	387	2.5	21.1
	400	65	4	291 000	375 000	15.8	1 400	1 700	6052	276	384	3	29.4
	480	80	5	400 000	540 000	15.1	1 100	1 300	6252	280	460	4	67
	540	102	6	505 000	710 000	14.6	1 000	1 200	6352	286	514	5	118
280	350	33	2	133 000	191 000	17.3	1 500	1 700	6856	289	341	2	7.2
	380	46	2.1	209 000	272 000	16.6	1 400	1 700	6956	291	369	2	15.1
	420	44	3	243 000	330 000	16.5	1 300	1 600	16056	293	407	2.5	22.7
	420	65	4	300 000	410 000	16.0	1 300	1 600	6056	296	404	3	31.2
	500	80	5	400 000	550 000	15.2	1 000	1 300	6256	300	480	4	70.4
	580	108	6	570 000	840 000	14.5	900	1 100	6356	306	554	5	144
300	380	38	2.1	166 000	233 000	17.1	1 300	1 600	6860	311	369	2	10.3
	420	56	3	269 000	370 000	16.4	1 300	1 500	6960	313	407	2.5	23.9
	460	50	4	285 000	405 000	16.4	1 200	1 400	16060	316	444	3	31.5
	460	74	4	355 000	500 000	15.8	1 200	1 400	6060	316	444	3	44.2
	540	85	5	465 000	670 000	15.1	950	1 200	6260	320	520	4	87.8
320	400	38	2.1	168 000	244 000	17.2	1 300	1 500	6864	331	389	2	10.8
	440	56	3	266 000	375 000	16.5	1 200	1 400	6964	333	427	2.5	25.3
	480	50	4	293 000	430 000	16.5	1 100	1 300	16064	336	464	3	33.2
	480	74	4	390 000	570 000	15.7	1 100	1 300	6064	336	464	3	46.5
	580	92	5	530 000	805 000	15.0	850	1 100	6264	340	560	4	111
340	420	38	2.1	175 000	265 000	17.3	1 200	1 400	6868	351	409	2	11.5
	460	56	3	273 000	400 000	16.6	1 100	1 300	6968	353	447	2.5	26.6
	520	82	5	440 000	660 000	15.6	1 000	1 200	6068	360	500	4	62.3
	620	92	6	530 000	820 000	15.3	800	1 000	6268	366	594	5	129
360	440	38	2.1	192 000	290 000	17.3	1 100	1 300	6872	371	429	2	11.8
	480	56	3	280 000	425 000	16.7	1 100	1 300	6972	373	467	2.5	27.9
	540	82	5	460 000	720 000	15.7	950	1 200	6072	380	520	4	65.3
	650	95	6	555 000	905 000	15.4	750	950	6272	386	624	5	145

Note (1) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.

Dynamic Equivalent Load

 $P = XF_r + YF_a$

	1 6	•				
$\frac{f_0 F_a}{C_{0r}}$ e		$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{\rm a}}{F_{\rm r}} > e$		
C _{0r}		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	

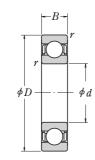
Static Equivalent Load

$$\frac{F_{\rm a}}{F_{\rm r}} \leq 0.8$$
, $P_0 = F_{\rm r}$

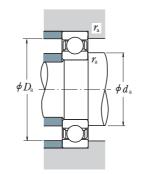




Bore Diameter 380 - 600 mm



Open Type



E	Boundary I	Dimension nm)	18		ad Ratings N)	Factor	Limiting (mi		Bearing Numbers			nent and Fi nsions (m		Mass (kg)
d	D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	Open	$d_{\scriptscriptstyle m a}$	(¹) in.	$D_{ m a}^{(1)}$ max.	$\emph{\textbf{r}}_a$ max.	approx.
380	480 520 560	46 65 82	2.1 4 5	238 000 325 000 455 000	375 000 510 000 725 000	17.1 16.6 15.9	1 000 950 900	1 200 1 200 1 100	6876 6976 6076	39 39 40	96	469 504 540	2 3 4	19.5 40 68
400	500 540 600	46 65 90	2.1 4 5	241 000 335 000 510 000	390 000 540 000 825 000	17.2 16.7 15.7	950 900 850	1 200 1 100 1 000	6880 6980 6080	41 41 42	16	489 524 580	2 3 4	20.5 42 88.4
420	520 560 620	46 65 90	2.1 4 5	245 000 340 000 530 000	410 000 570 000 895 000	17.3 16.8 15.8	900 900 800	1 100 1 100 1 000	6884 6984 6084	43 43 44	36	509 544 600	2 3 4	21.4 43.6 92.2
440	540 600 650	46 74 94	2.1 4 6	248 000 395 000 550 000	425 000 680 000 965 000	17.4 16.6 16.0	900 800 750	1 100 1 000 900	6888 6988 6088	45 45 46	56	529 584 624	2 3 5	22.3 60.2 106
460	580 620 680	56 74 100	3 4 6	310 000 405 000 605 000	550 000 720 000 1 080 000	17.1 16.7 15.8	800 800 710	1 000 950 850	6892 6992 6092	47 47 48	76	567 604 654	2.5 3 5	34.3 62.6 123
480	600 650 700	56 78 100	3 5 6	315 000 450 000 605 000	575 000 815 000 1 090 000	17.2 16.6 15.9	800 750 710	950 900 850	6896 6996 6096	49 50 50	00	587 630 674	2.5 4 5	35.4 73.5 127
500	620 670 720	56 78 100	3 5 6	320 000 460 000 630 000	600 000 865 000 1 170 000	17.3 16.7 16.0	750 710 670	900 850 800	68/500 69/500 60/500	51 52 52	20	607 650 694	2.5 4 5	37.2 82 131
530	650 710 780	56 82 112	3 5 6	325 000 455 000 680 000	625 000 870 000 1 300 000	17.4 16.8 16.0	710 670 600	850 800 750	68/530 69/530 60/530	54 55 55	50	637 690 754	2.5 4 5	39.8 89.8 184

670

600 560

600 560

530

800

750 670

710

670

630

68/560

69/560 60/560

68/600

69/600

60/600

573 580 586

613 620

626

667 730 793.5

717

780

844

2.5

4 5

2.5

5

41.5

50.9 120

236

105

Note (1) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.

330 000 525 000 735 000

355 000

550 000

790 000

650 000 1 040 000 1 500 000

735 000

1 160 000

1 640 000

17.4

16.7 16.2

17.5 16.9

16.1

Dynamic Equivalent Load

 $P = XF_r + YF_a$

		-			
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{ m a}}{F_{ m r}}$	>e
C _{0r}		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

$$\frac{F_a}{F_r} > 0.8$$
, $P_0 = 0.6F_r + 0.5F_a$

$$\frac{F_{\rm a}}{F_{\rm r}} \leq 0.8, P_0 = F_{\rm r}$$





680

750 820

730 800

870

560

600

56

85 115

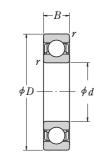
60

90

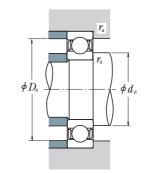
118

5 6

Bore Diameter 630 – 800 mm







Boundary Dimensions (mm)		Basic Load Ratings (N)			Limiting (mir		Bearing Numbers	Abu Din	Mass (kg)				
d	D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	f_0	Grease	Oil	Open	$d_{ m a}^{(1)}$ min.	$D_{ m a}^{(1)}$ max.	\emph{r}_{a} max.	approx.
630	780	69	4	420 000	890 000	17.3	560	670	68/630	646	764	3	71.3
	850	100	6	625 000	1 350 000	16.7	530	630	69/630	656	824	5	163
	920	128	7.5	750 000	1 620 000	16.4	480	600	60/630	662	888	6	285
670	820	69	4	435 000	965 000	17.4	500	630	68/670	686	804	3	75.4
	900	103	6	675 000	1 460 000	16.7	480	560	69/670	696	874	5	181
	980	136	7.5	765 000	1 730 000	16.6	450	530	60/670	702	948	6	351
710	870	74	4	480 000	1 100 000	17.4	480	560	68/710	726	854	3	92.6
	950	106	6	715 000	1 640 000	16.8	450	530	69/710	736	924	5	208
750	920	78	5	525 000	1 260 000	17.4	430	530	68/750	770	900	4	110
	1 000	112	6	785 000	1 840 000	16.7	400	500	69/750	776	974	5	245
800	980	82	5	530 000	1 310 000	17.5	400	480	68/800	820	960	4	132
	1 060	115	6	825 000	2 050 000	16.8	380	450	69/800	826	1 034	5	275

Note (1) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.

Dynamic Equivalent Load

 $P = XF_r + YF_a$

	1 6	1			
$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_{\mathrm{a}}}{F_{\mathrm{r}}}$	$\leq e$	$\frac{F_{ m a}}{F_{ m r}}$	>e
C _{0r}		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

$$\frac{F_a}{F_r} > 0.8$$
, $P_0 = 0.6F_r + 0.5F_a$

$$\frac{F_{\rm a}}{F_{\rm r}} \le 0.8, P_0 = F_{\rm r}$$







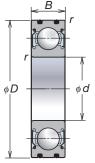
Bore Diameter 10 – 100 mm

	Bearing outer diameter	Bearing width	Basic loa	nd ratings	Recommended
$d \atop ext{(mm)}$	(mm)	$B \atop ext{(mm)}$	$C_{\rm r}({ m N})$	$C_{0\mathrm{r}}(\mathrm{N})$	fits (1)
	26	8	4 550	1 970	
10	30 35	9 11	5 100 8 100	2 390 3 450	
	28	8	5 100	2 370	-
12	32	10	6 800	3 050	
	37	12	9 700	4 200	
	32	9	5 600	2 830	
15	35 42	11 13	7 650 11 400	3 750 5 450	
	35	10	6 000	3 250	_
17	40	12	9 550	4 800	
	47	14	13 600	6 650	
20	42 47	12 14	9 400 12 800	5 000 6 600	
20	52	15	15 900	7 900	
	47	12	10 100	5 850	1
25	52	15	14 000	7 850	
	62	17	20 600	11 200	_
30	55 62	13 16	13 200 19 500	8 300 11 300	
30	72	19	26 700	15 000	
	62	14	16 000	10 300	
35	72	17	25 700	15 300	
	80	21	33 500	19 200	-
40	68 80	15 18	16 800 29 100	11 500 17 900	
40	90	23	40 500	24 000	H7 or
	75	16	20 900	15 200	G6
45	85 100	19 25	31 500 53 000	20 400 32 000	
	80	16	21 800	16 600	-
50	90	20	35 000	23 200	
	110	27	62 000	38 500	
	90	18	28 300	21 200	
55	100 120	21 29	43 500 71 500	29 300 44 500	
	95	18	29 500	23 200	-
60	110	22	52 500	36 000	
	130	31	82 000	52 000	_
65	100 120	18 23	30 500 57 500	25 200 40 000	
00	140	33	92 500	60 000	
	110	20	38 000	31 000	1
70	125	24	62 000	44 000	
	150	35	104 000	68 000	-
75	115 130	20 25	39 500 66 000	33 500 49 500	
	125	22	47 500	40 000	1
80	140	26	72 500	53 000	
85	130	22	49 500	43 000	
	150	28	84 000	62 000	4
90	140	24	58 000	50 000	4
95	145	24	60 500	54 000	4
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 pre-load.

⁽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 6200 6300	ZZ	DDU	vv						
6001 6201 6301	ZZ	DDU	vv						
6002 6202 6302	ZZ	DDU	VV						
6003 6203 6303	ZZ	DDU	vv						
6004 6204 6304	ZZ	DDU	VV						
6005 6205 6305	ZZ	DDU	VV						
6006 6206 6306	ZZ	DDU	VV						
6007 6207 6307	ZZ	DDU	VV						
6008 6208 6308	ZZ	DDU	vv						
6009 6209 6309	ZZ	DDU	vv						
6010 6210 6310	ZZ	DDU	vv						
6011 6211 6311	ZZ	DDU	vv						
6012 6212 6312	ZZ	DDU	vv						
6013 6213 6313	zz	DDU	vv						
6014 6214 6314	ZZ	DDU	vv						
6015 6215	ZZ	DDU	VV						
6016 6216	ZZ	DDU	VV						
6017 6217	ZZ	DDU	vv						
6018	ZZ	DDU	VV						
6019	ZZ	DDU	VV						
6020	ZZ	DDU	VV						



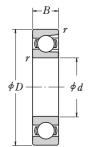




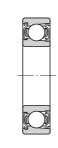
C 046

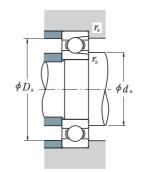
BEARINGS TABLE **NSK**

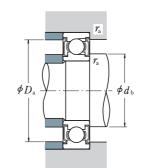
MAXIMUM TYPE BALL BEARINGS Bore Diameter 25 – 110 mm











Open Type

Shielded Type (One Shield) Z

Shielded Type (Two Shields) ZZ

	Boundary I	Dimension	s	Basic Load	d Ratings	Limitino	Speeds		Bearing Number	ers	Abu	tment and Fil	let Dimensio	ns	Mass
	(m			(N		(mi						(mr			(kg)
d	D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease Open Z · ZZ	Open Z	Open	With One Shielded	With Two Shields	$d_{ m a}$ min.	$d_{ m b}$ max.	$D_{ m a}$ max.	$m{\gamma}_a$ max.	approx.
25	52	15	1	14 400	10 500	12 000	15 000	BL 205	BL 205 Z	BL 205 ZZ	30	32	47	1	0.133
	62	17	1.1	21 500	15 500	11 000	13 000	BL 305	BL 305 Z	BL 305 ZZ	31.5	36	55.5	1	0.246
30	62	16	1	21 000	16 300	10 000	12 000	BL 206	BL 206 Z	BL 206 ZZ	35	38.5	57	1	0.215
	72	19	1.1	27 900	20 700	9 000	11 000	BL 306	BL 306 Z	BL 306 ZZ	36.5	42	65.5	1	0.364
35	72	17	1.1	27 800	22 100	9 000	11 000	BL 207	BL 207 Z	BL 207 ZZ	41.5	44.5	65.5	1	0.307
	80	21	1.5	37 000	29 100	8 000	9 500	BL 307	BL 307 Z	BL 307 ZZ	43	44.5	72	1.5	0.486
40	80	18	1.1	35 500	28 800	8 000	9 500	BL 208	BL 208 Z	BL 208 ZZ	46.5	50	73.5	1	0.394
	90	23	1.5	46 500	36 000	7 500	9 000	BL 308	BL 308 Z	BL 308 ZZ	48	52.5	82	1.5	0.685
45	85	19	1.1	37 000	32 000	7 500	9 000	BL 209	BL 209 Z	BL 209 ZZ	51.5	55.5	78.5	1	0.449
	100	25	1.5	55 500	44 000	6 300	8 000	BL 309	BL 309 Z	BL 309 ZZ	53	61.5	92	1.5	0.883
50	90 110	20 27	1.1 2	39 000 65 000	35 000 52 500	6 700 6 000	8 500 7 100	BL 210 BL 310	BL 210 Z BL 310 Z	BL 210 ZZ BL 310 ZZ	56.5 59	60 68	83.5 101	1 2	0.504 1.16
55	100	21	1.5	48 000	44 000	6 300	7 500	BL 211	BL 211 Z	BL 211 ZZ	63	66.5	92	1.5	0.667
	120	29	2	75 000	61 500	5 600	6 700	BL 311	BL 311 Z	BL 311 ZZ	64	72.5	111	2	1.49
60	110	22	1.5	58 000	54 000	5 600	6 700	BL 212	BL 212 Z	BL 212 ZZ	68	74.5	102	1.5	0.856
	130	31	2.1	85 500	71 500	5 000	6 000	BL 312	BL 312 Z	BL 312 ZZ	71	79	119	2	1.88
65	120	23	1.5	63 500	60 000	5 300	6 300	BL 213	BL 213 Z	BL 213 ZZ	73	80	112	1.5	1.09
	140	33	2.1	103 000	89 500	4 800	5 600	BL 313	BL 313 Z	BL 313 ZZ	76	85.5	129	2	2.36
70	125	24	1.5	69 000	66 000	5 000	6 000	BL 214	BL 214 Z	BL 214 ZZ	78	84	117	1.5	1.19
	150	35	2.1	115 000	102 000	4 300	5 300	BL 314	BL 314 Z	BL 314 ZZ	81	92	139	2	2.87
75	130	25	1.5	72 000	72 000	4 500	5 600	BL 215	BL 215 Z	BL 215 ZZ	83	90	122	1.5	1.29
	160	37	2.1	126 000	116 000	4 000	5 000	BL 315	BL 315 Z	BL 315 ZZ	86	98.5	149	2	3.43
80	140 170	26 39	2 2.1	84 000 136 000	85 000 130 000	4 300 3 800	5 300 4 500	BL 216 BL 316	BL 216 Z BL 316 Z	BL 216 ZZ BL 316 ZZ	89 91	95.5 104.5	131 159	2 2	1.61 4.08
85	150 180	28 41	2	93 000 147 000	93 000 145 000	4 000 3 600	5 000 4 300	BL 217 BL 317	BL 217 Z BL 317 Z	BL 217 ZZ BL 317 ZZ	94 98	102 110.5	141 167	2 2.5	1.97 4.77
90	160 190	30 43	2	107 000 158 000	107 000 161 000	3 800 3 400	4 500 4 000	BL 218 BL 318	BL 218 Z BL 318 Z	BL 218 ZZ BL 318 ZZ	99 103	107.5 117	151 177	2 2.5	2.43 5.45
95	170	32	2.1	121 000	123 000	3 600	4 300	BL 219	BL 219 Z	BL 219 ZZ	106	114	159	2	2.95
	200	45	3	169 000	178 000	2 800	3 600	BL 319	BL 319 Z	BL 319 ZZ	108	124	187	2.5	6.4
100	180	34	2.1	136 000	140 000	3 400	4 000	BL 220	BL 220 Z	BL 220 ZZ	111	121.5	169	2	3.54
105	190	36	2.1	148 000	157 000	3 200	3 800	BL 221	BL 221 Z	BL 221 ZZ	116	127.5	179	2	4.23
110	200	38	2.1	160 000	176 000	2 800	3 400	BL 222	—	—	121	—	189	2	4.84

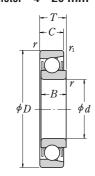
Remark When using Maximum Type Ball Bearings, please contact NSK.



C 048

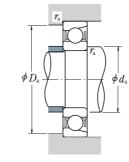
Bore Diameter 4 – 20 mm

MAGNETO BEARINGS



Outside Diameter Tolerance (Class N)

				Ur	iits : µn						
Nom Outs Diam	side	Sing	Single Plane Mean Outside Diameter $\Delta D_{ m mp}$								
D (n		E Se	eries	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						



Dynamic Equivalent Load

 $P = XF_r + YF_o$

1	AI'r T	L I a		
$F_{\rm a}/I$	$G_{r} \leq e$	$F_{\rm a}/I$		
X	Y	X	Y	е
1	0	0.5	2.5	0.2

	Воц	undary Dim (mm)	ensions		Basic Loa		Limiting (mi	•	Bearing	Numbers			ment and F ensions (m		Mass (kg)
d	D	B,C,T	γ min.	$oldsymbol{\gamma}_1$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	E Series EN Series		ı	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{\gamma}_{\mathrm{a}}$ max.	approx.
4 5 6	16 16 21	5 5 7	0.15 0.15 0.3	0.1 0.1 0.15	1 650 1 650 2 490	288 288 445	34 000 34 000 30 000	40 000 40 000 36 000	E 4 E 5 E 6	EN 4 EN 5 EN 6		5.2 6.2 8	14.8 14.8 19	0.15 0.15 0.3	0.005 0.004 0.011
7 8 9	22 24 28	7 7 8	0.3 0.3 0.3	0.15 0.15 0.15	2 490 3 450 4 550	445 650 880	30 000 28 000 24 000	36 000 34 000 30 000	E 7 E 8 E 9	EN 7 EN 8 EN 9	1	9 10 11	20 22 26	0.3 0.3 0.3	0.013 0.014 0.022
10 11 12	28 32 32	8 7 7	0.3 0.3 0.3	0.15 0.15 0.15	4 550 4 400 4 400	880 845 845	24 000 22 000 22 000	30 000 26 000 26 000	E 10 E 11 E 12	EN 10 EN 11 EN 12	1	12 13 14	26 30 30	0.3 0.3 0.3	0.021 0.029 0.028
13 14	30 35	7 8	0.3 0.3	0.15 0.15	4 400 5 800	845 1 150	22 000 19 000	26 000 22 000	E 13 —	EN 13 EN 14	1	15 16	28 33	0.3 0.3	0.021 0.035
15 16	35 40 38	8 10 10	0.3 0.6 0.6	0.15 0.3 0.2	5 800 7 400 6 900	1 150 1 500 1 380	19 000 17 000 17 000	22 000 20 000 22 000	E 15 BO 15	EN 15 — EN 16	1	17 19 20	33 36 34	0.3 0.6 0.6	0.034 0.055 0.049
17	40 44 44	10 11 11	0.6 0.6 0.6	0.3 0.3 0.3	7 400 7 350 7 350	1 500 1 500 1 500	17 000 16 000 16 000	20 000 19 000 19 000	L 17 BO 17	EN 17 —	2 2 2 2	21 21 21	36 40 40	0.6 0.6 0.6	0.051 0.080 0.080
18 19	40 40	9	0.6 0.6	0.2 0.2	5 050 5 050	1 030 1 030	17 000 17 000	20 000 20 000	E 19	EN 18 EN 19	2 2	22 23	36 36	0.6 0.6	0.051 0.049
20	47 47	12 14	1 1	0.6 0.6	11 000 11 000	2 380 2 380	14 000 14 000	17 000 17 000	E 20 L 20	EN 20 —	2 2 2	25 25	42 42	1	0.089 0.101

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.

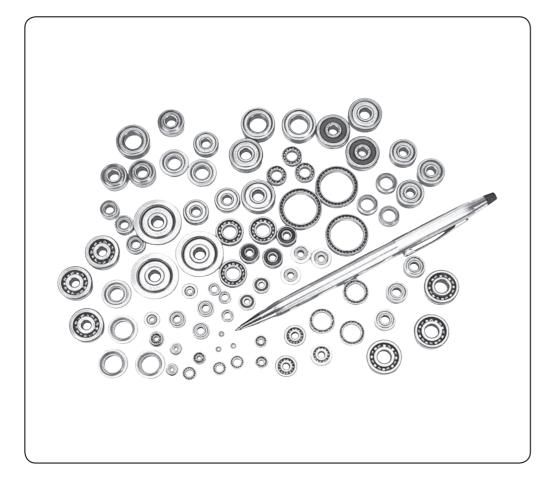




INTRODUCTION C 054
BEARINGS TABLE

EXTRA SMALL BALL BEARINGS · MINIATURE BALL BEARINGS

Metric Desig	n	Bore Diameter 1 – 9mm·····	C 058
	With Flange	Bore Diameter 1 – 9mm·····	C 062
Inch Design		Bore Diameter 1.016 – 9.525mm ·····	C 066
	With Flange	Bore Diameter 1.191 – 9.525mm	C 068







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

	ì	ì
Design	Extra Small Ball Bearings	Miniature Ball Bearings
Metric	Outside diameter $D \ge 9$ Bore diameter $d < 10$	Outside diameter $D<9$
Inch	Outside diameter $D \ge 9.525$ Bore diameter $d < 10$	Outside diameter $D<9.525$

Please refer to NSK Miniature Ball Bearings (CAT. No. E126) for details.









Table 2 Design, Types, and Type Symbols

			Type S	ymbols		
D	Design · Types	Metric	Inch	Spe	cial	Remarks
		Wetric	IIICII	Metric	Inch	
		600	R	MR	_	Shielded · sealed bearings are available.
	Thin section	_	_	SMT	_	
Single-Row Deep Groove Ball Bearings	With flange	F6 0 0	FR	MF	_	Shielded · sealed bearings are available.
	Extended inner ring	_	_	_	RW	Shielded bearings are available.
Singl	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	_	
F	Remark Single	-row angula	r contact ba	all bearings	are available	besides those shown

above.



TOLERANCES AND RUNNING ACCURACY

METRIC DESIGN BEARINGSTable 7.2(Pages A128 to A131)

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	de Diameter
----------------------------------	-------------

Units : µm

	Nominal F Outside Dia	•	Deviation of Flange Outside Diameter ${\it extit{ extit{$d$}}}_{D_{1{ m S}}}$									
	D_1 (mr	n)	(1)	2							
0	ver	incl.	high	low	high	low						
	10		+220	-36	0	-36						
1	10	18	+270	-43	0	-43						
1	18	30	+330	- 52	0	- 52						

Remarks ②is applied when the flange outside diameter is used for positioning.

(2) Flange Width Tolerances and Running Accuracies Related to Flange

Units : µm

Nom Bearing (Diam	Outside eter	Flange	ation of e Width C_{18}	Va Flange	Outside Genera	on of Bea e Surface trix Inclir ange Bac S_{D1}	nation	Flange Backface Runout with Raceway S_{ea1}					
(1111)	(mm)		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 ΔB_S		Use the $\varDelta V_{ m BS}$		2.5	1.5	8	4	1.5	11	7	3
6	18	of the same		tolerance for d of the same bearing		2.5	1.5	8	4	1.5	11	7	3
18	30	same class		of the same class	5	2.5	1.5	8	4	1.5	11	7	3

Notes (1) 2.5 mm is included

INCH DESIGN BEARINGSTable 7.2 (Pages A128 to A131)

The flange tolerances for inch design flanged bearings are listed in Table 7.9(2) (Pages A146 and A147).

INSTRUMENT BALL BEARINGSTable 7.9 (Pages A146 and A147)

RECOMMENDED FITS

Please refer to NSK Miniature Ball Bearings (CAT.No.E126).

INTERNAL CLEARANCESTable 8.11 (Page A169)

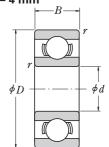
LIMITING SPEEDS

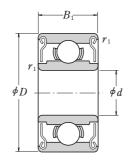
The limiting speeds listed in the bearing tables should be adjusted depending on the bearing toad conditions. Also, higher speeds are attainable by making changes in the lubrication method, cage design, etc. Refer to Page A098 for detailed information.

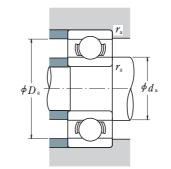


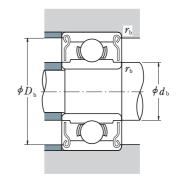
Metric Design

Bore Diameter 1 – 4 mm









Open Type

Shielded Type ZZ · ZZ1

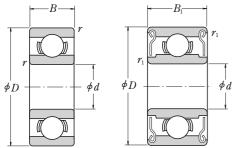
		Bounda	ry Dimen (mm)	sions		Basic Load		Limiting (mi	Speeds n ⁻¹)		Bearing Numbers			Abutn	nent and F (m		nsions		Mass (g)		
<i>d</i>	D	В	B_1	γ (¹) min.	r_1 (1) min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease Open Z ZZ	Oil Open Z	Open	Shielded	Shielded Sealed		$d_{ m b}$ max.	$D_{\rm a} \atop {\rm max.}$	$D_{ m b}$ min.	${\pmb r}_{\rm a}$ max.	$r_{ m a}$ $r_{ m b}$ ax. max. 0		approx. Open Shielded	
1	3 3 4	1 1.5 1.6	_	0.05 0.05 0.1		80 80 138	23 23 35	130 000 130 000 100 000	150 000 150 000 120 000	681 MR 31 691		= =	1.4 1.4 1.8	_	2.6 2.6 3.2	=	0.05 0.05 0.1	_	0.03 0.04 0.09		
1.2	4	1.8	2.5	0.1	0.1	138	35	110 000	130 000	MR 41 X	MR 41 XZZ		2.0	1.9	3.2	3.5	0.1	0.1	0.10	0.14	
1.5	4 5 6	1.2 2 2.5	2 2.6 3	0.05 0.15 0.15	0.05 0.15 0.15	112 237 330	33 69 98	100 000 85 000 75 000	120 000 100 000 90 000	681 X 691 X 601 X	681 XZZ 691 XZZ 601 XZZ	= =	1.9 2.7 2.7	2.1 2.5 3.0	3.6 3.8 4.8	3.6 4.3 5.4	0.05 0.15 0.15	0.05 0.15 0.15	0.07 0.17 0.33	0.11 0.20 0.38	
2	5 5 6	1.5 2 2.3	2.3 2.5 3	0.08 0.1 0.15	0.08 0.1 0.15	169 187 330	50 58 98	85 000 85 000 75 000	100 000 100 000 90 000	682 MR 52 B 692	682 ZZ MR 52 BZZ 692 ZZ	ΞΞ	2.6 2.8 3.2	2.7 2.7 3.0	4.4 4.2 4.8	4.2 4.4 5.4	0.08 0.1 0.15	0.08 0.1 0.15	0.12 0.16 0.28	0.17 0.23 0.38	
	6 7 7	2.5 2.5 2.8	2.5 3 3.5	0.15 0.15 0.15	0.15 0.15 0.15	330 385 385	98 127 127	75 000 63 000 63 000	90 000 75 000 75 000	MR 62 MR 72 602	MR 62 ZZ MR 72 ZZ 602 ZZ	ΞΞ	3.2 3.2 3.2	3.0 3.8 3.8	4.8 5.8 5.8	5.2 6.2 6.2	0.15 0.15 0.15	0.15 0.15 0.15	0.30 0.45 0.51	0.29 0.49 0.58	
2.5	6 7 8 8	1.8 2.5 2.5 2.8	2.6 3.5 — 4	0.08 0.15 0.2 0.15	0.08 0.15 — 0.15	208 385 560 550	74 127 179 175	71 000 63 000 60 000 60 000	80 000 75 000 67 000 71 000	682 X 692 X MR 82 X 602 X	682 XZZ 692 XZZ — 602 XZZ		3.1 3.7 4.1 3.7	3.7 3.8 — 4.1	5.4 5.8 6.4 6.8	5.4 6.2 — 7.0	0.08 0.15 0.2 0.15	0.08 0.15 — 0.15	0.23 0.41 0.56 0.63	0.29 0.55 — 0.83	
3	6 7 8	2 2 2.5	2.5 3 —	0.1 0.1 0.15	0.1 0.1 —	208 390 560	74 130 179	71 000 63 000 60 000	80 000 75 000 67 000	MR 63 683 A MR 83	MR 63 ZZ 683 AZZ —	= =	3.8 3.8 4.2	3.7 4.0 —	5.2 6.2 6.8	5.4 6.4 —	0.1 0.1 0.15	0.1 0.1 —	0.20 0.32 0.54	0.27 0.45 —	
	8 9 9	3 2.5 3	4 4 5	0.15 0.2 0.15	0.15 0.15 0.15	560 570 570	179 187 187	60 000 56 000 56 000	67 000 67 000 67 000	693 MR 93 603	693 ZZ MR 93 ZZ 603 ZZ	ΞΞ	4.2 4.6 4.2	4.3 4.3 4.3	6.8 7.4 7.8	7.3 7.9 7.9	0.15 0.2 0.15	0.15 0.15 0.15	0.61 0.73 0.87	0.83 1.18 1.45	
	10 13	4 5	4 5	0.15 0.2	0.15 0.2	630 1 300	218 485	50 000 40 000	60 000 48 000	623 633	623 ZZ 633 ZZ	= =	4.2 4.6	4.3 6.0	8.8 11.4	8.0 11.3	0.15 0.2	0.15 0.2	1.65 3.38	1.66 3.33	
4	7 7 8 9	2 — 2 2.5	2.5 3 4	0.1 — 0.15 (0.15)	0.1 0.1 (0.15)	310 255 395 640	115 107 139 225	60 000 60 000 56 000 53 000	67 000 71 000 67 000 63 000	MR 74 MR 84 684 A	MR 74 ZZ MR 84 ZZ 684 AZZ		4.8 — 5.2 4.8	 4.8 5.0 5.2	6.2 — 6.8 8.2	 6.3 7.4 8.1	0.1 — 0.15 0.1	0.1 0.1 0.1	0.22 — 0.36 0.63	0.29 0.56 1.01	
	10 11 12	3 4 4	4 4 4	0.2 0.15 0.2	0.15 0.15 0.2	710 960 960	270 345 345	50 000 48 000 48 000	60 000 56 000 56 000	MR 104 B 694 604	MR 104 BZZ 694 ZZ 604 ZZ	= =	5.6 5.2 5.6	5.9 5.6 5.6	8.4 9.8 10.4	8.8 9.9 9.9	0.2 0.15 0.2	0.15 0.15 0.2	1.04 1.7 2.25	1.42 1.75 2.29	
	13 16	5 5	5 5	0.2 0.3	0.2 0.3	1 300 1 730	485 670	40 000 36 000	48 000 43 000	624 634	624 ZZ 634 ZZ1	= =	5.6 6.0	6.0 7.5	11.4 14.0	11.3 13.8	0.2 0.3	0.2 0.3	3.03 5.24	3.04 5.21	

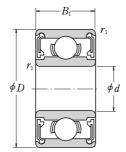
Remark When using bearings with a rotating outer ring, please contact NSK if they are shielded.

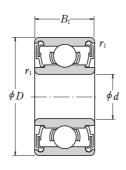
C 058 C 059

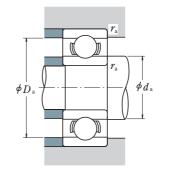
Metric Design

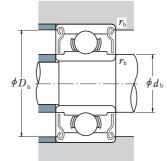
Bore Diameter 5 - 9 mm











Shielded Type ZZ · ZZ1

Non-Contact Sealed Type

Contact Sealed Type

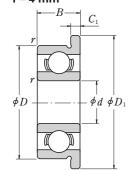
								VV		DD									
	ı	Boundary (1	Dimens	ions		Basic Loa	•		ng Speeds (ase	min ⁻¹) Oil		Bearing Numbers		Abut	ment and F (m	Fillet Dime	nsions		Mass (g)
d	D	В	B_1	γ (¹) min.	$ _1^{(1)}$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Open Z · ZZ V · VV	D · DD	Open Z	Open	Shielded Seale	d d min		$D_{ m a}$ max.	$D_{ m b}$ min.	${\it r}_{\rm a}$ max.	$ m \emph{r}_{b}$ max.	approx. Open Shielded
5	8 8 9 10 11	2 2.5 3 3	2.5 3 4 4 5	0.1 0.15 0.15 0.15 	0.1 0.15 0.15 0.15 0.15	310 278 430 430 715 715	120 131 168 168 276 281	53 000 53 000 50 000 50 000 48 000 45 000	_ _ _ _ _	63 000 63 000 60 000 60 000 56 000 53 000	MR 85 — MR 95 MR 105 — 685	MR 85 ZZ —	- 6 6	5.8 2 6.0 2 6.0 6.3 2 6.2	7.2 — 7.8 8.8 — 9.8	7.4 8.2 8.4 9.8	0.1 0.15 0.15 - 0.15	0.1 0.15 0.15 0.15 0.15	0.26 — 0.34 0.50 0.58 0.95 1.29 — 1.49 1.2 1.96
	13 14	4 5	4 5	0.2 0.2	0.2 0.2	1 080 1 330	430 505	43 000 40 000	40 000 38 000	50 000 50 000	695 605	695 ZZ VV D 605 ZZ — D			11.4 12.4	11.2 12.2	0.2 0.2	0.2	2.45 2.5 3.54 3.48
	16 19	5	5	0.3 0.3	0.3 0.3	1 730 2 340	670 885	36 000 32 000	32 000 30 000	43 000 40 000	625 635	625 ZZ1 VV D 635 ZZ1 VV D	D 7	0 7.5	14.0 17.0	13.8 16.5	0.3 0.3	0.3 0.3	4.95 4.86 8.56 8.34
6	10 12 13	2.5 3 3.5	3 4 5	0.15 0.2 0.15	0.1 0.15 0.15	495 715 1 080	218 292 440	45 000 43 000 40 000	40 000 38 000	53 000 50 000 50 000	MR 106 MR 126 686 A	MR 106 ZZ1 — - MR 126 ZZ — D 686 AZZ VV D		6 7.2	8.8 10.4 11.8	9.3 10.9 11.7	0.15 0.2 0.15	0.1 0.15 0.15	0.56 0.68 1.27 1.74 1.91 2.69
	15 17 19 22	5 6 6 7	5 6 6 7	0.2 0.3 0.3 0.3	0.2 0.3 0.3 0.3	1 730 2 260 2 340 3 300	670 835 885 1 370	40 000 38 000 32 000 30 000	36 000 34 000 30 000 28 000	45 000 45 000 40 000 36 000	696 606 626 636	696 ZZ1 VV D 606 ZZ VV D 626 ZZ1 VV D 636 ZZ VV D	D 8	0 8.2 0 8.5	13.4 15.0 17.0 20.0	13.3 14.8 16.5 19.0	0.2 0.3 0.3 0.3	0.2 0.3 0.3 0.3	3.88 3.72 5.97 6.08 8.15 7.94 14 14
7	11 13 14	2.5 3 3.5	3 4 5	0.15 0.2 0.15	0.1 0.15 0.15	455 540 1 170	201 276 510	43 000 40 000 40 000	_ 34 000	50 000 48 000 45 000	MR 117 MR 137 687	MR 117 ZZ — - MR 137 ZZ — - 687 ZZ1 VV D	- 8 - 8 D 8	6 9.0	9.8 11.4 12.8	10.5 11.6 12.7	0.15 0.2 0.15	0.1 0.15 0.15	0.62 0.72 1.58 2.02 2.13 2.97
	17 19 22 26	5 6 7 9	5 6 7 9	0.3 0.3 0.3 0.3	0.3 0.3 0.3 0.3	1 610 2 340 3 300 4 550	710 885 1 370 1 970	36 000 36 000 30 000 28 000	28 000 32 000 28 000 22 000	43 000 43 000 36 000 34 000	697 607 627 637	697 ZZ1 VV D 607 ZZ1 VV D 627 ZZ VV D 637 ZZ1 VV D	D 9 9 9	0 9.1 0 10.5	15.0 17.0 20.0 24.0	14.8 16.5 19.0 22.8	0.3 0.3 0.3 0.3	0.3 0.3 0.3 0.3	5.26 5.12 7.67 7.51 12.7 12.9 24 25
8	12 14 16	2.5 3.5 4	3.5 4 5	0.15 0.2 0.2	0.1 0.15 0.2	545 820 1 610	274 385 710	40 000 38 000 36 000	— 32 000 28 000	48 000 45 000 43 000	MR 128 MR 148 688 A	MR 128 ZZ1 — - MR 148 ZZ VV D 688 AZZ1 VV D		6 9.2	10.8 12.4 14.4	11.3 12.8 14.2	0.15 0.2 0.2	0.1 0.15 0.2	0.71 0.97 1.86 2.16 3.12 4.02
	19 22 24 28	6 7 8 9	6 7 8 9	0.3 0.3 0.3 0.3	0.3 0.3 0.3 0.3	2 240 3 300 3 350 4 550	910 1 370 1 430 1 970	36 000 34 000 28 000 28 000	28 000 28 000 24 000 22 000	43 000 40 000 34 000 34 000	698 608 628 638	698 ZZ VV D 608 ZZ VV D 628 ZZ VV D 638 ZZ1 VV D	D 10 D 10 D 10	0 10.5 0 12.0	17.0 20.0 22.0 26.0	16.5 19.0 20.5 22.8	0.3 0.3 0.3 0.3	0.3 0.3 0.3 0.3	7.23 7.18 12.1 12.2 17.2 17.4 28.3 28.6
9	17 20 24	4 6 7	5 6 7	0.2 0.3 0.3	0.2 0.3 0.3	1 330 1 720 3 350	665 840 1 430	36 000 34 000 32 000	24 000 24 000 24 000	43 000 40 000 38 000	689 699 609	689 ZZ1 VV D 699 ZZ1 VV D 609 ZZ VV D	D 11	0 12.0	15.4 18.0 22.8	15.2 17.2 20.5	0.2 0.3 0.3	0.2 0.3 0.3	3.53 4.43 8.45 8.33 14.5 14.7
	26 30	8 10	8 10	(0.6) 0.6	(0.6) 0.6	4 550 5 100	1 970 2 390	28 000 24 000	22 000 —	34 000 30 000	629 639	629 ZZ VV D 639 ZZ VV -	D 11		24.0 26.0	22.8 25.6	0.3 0.6	0.3 0.6	19.5 19.3 36.5 36

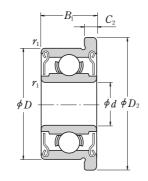
Note (1) The values in parentheses are not based on ISO 15.

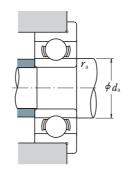
Remarks 1. When using bearings with a rotating outer ring, please contact NSK if they are sealed or shielded.

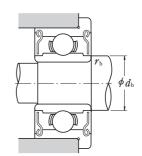
2. Bearings with snap rings are also available, please contact NSK.

Metric Design With Flange Bore Diameter 1 – 4 mm









Open Type

Shielded Type ZZ · ZZ1

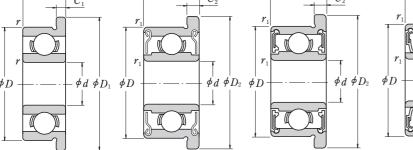
			Во	undary (n	Dimens	sions				Basic Load	Ü	Limiting (mi	'		Bearing Numbers		Abutme		illet Dim	ensions	Ma (g	ass g)
<i>d</i>	D	D_1	D_2	В	B_1	C_1	C_2	γ (¹) min.	$ m \emph{r}_{1}(^{1})$ min.	$C_{ m r}$	C_{0r}	Grease Open Z · ZZ	Oil Open Z	Open	Shielded	Sealed	$d_{ m a}$ min.	$d_{ m b}$ max.	${m \gamma}_{\rm a}$ max.	$ m \emph{r}_{b}$ max.	app Open	rox. Shielded
1	3 4	3.8 5	_	1 1.6	_	0.3 0.5	_	0.05 0.1	_	80 140	23 36	130 000 100 000	150 000 120 000	F 681 F 691	=	= =	1.4 1.8	_	0.05 0.1	_	0.04 0.14	_
1.2	4	4.8	_	1.8	_	0.4	_	0.1	_	138	35	110 000	130 000	MF 41 X	_		2.0	_	0.1	_	0.12	_
1.5	4 5 6	5 6.5 7.5	5 6.5 7.5	1.2 2 2.5	2 2.6 3	0.4 0.6 0.6	0.6 0.8 0.8	0.05 0.15 0.15	0.05 0.15 0.15	112 237 330	33 69 98	100 000 85 000 75 000	120 000 100 000 90 000	F 681 X F 691 X F 601 X	F 681 XZZ F 691 XZZ F 601 XZZ	= =	1.9 2.7 2.7	2.1 2.5 3.0	0.05 0.15 0.15	0.05 0.15 0.15	0.09 0.23 0.42	0.14 0.28 0.52
2	5 5 6	6.1 6.2 7.5	6.1 6.2 7.5	1.5 2 2.3	2.3 2.5 3	0.5 0.6 0.6	0.6 0.6 0.8	0.08 0.1 0.15	0.08 0.1 0.15	169 187 330	50 58 98	85 000 85 000 75 000	100 000 100 000 90 000	F 682 MF 52 B F 692	F 682 ZZ MF 52 BZZ F 692 ZZ	= =	2.6 2.8 3.2	2.7 2.7 3.0	0.08 0.1 0.15	0.08 0.1 0.15	0.16 0.21 0.35	0.22 0.27 0.48
	6 7 7	7.2 8.2 8.5	— 8.2 8.5	2.5 2.5 2.8	— 3 3.5	0.6 0.6 0.7	0.6 0.9	0.15 0.15 0.15	— 0.15 0.15	330 385 385	98 127 127	75 000 63 000 63 000	90 000 75 000 75 000	MF 62 MF 72 F 602	MF 72 ZZ F 602 ZZ	= =	3.2 3.2 3.2	3.8 3.1	0.15 0.15 0.15	0.15 0.15	0.36 0.52 0.60	— 0.56 0.71
2.5	6 7 8 8	7.1 8.5 9.2 9.5	7.1 8.5 — 9.5	1.8 2.5 2.5 2.8	2.6 3.5 — 4	0.5 0.7 0.6 0.7	0.8 0.9 — 0.9	0.08 0.15 0.2 0.15	0.08 0.15 — 0.15	208 385 560 550	74 127 179 175	71 000 63 000 60 000 60 000	80 000 75 000 67 000 71 000	F 682 X F 692 X MF 82 X F 602 X	F 682 XZZ F 692 XZZ — F 602 XZZ	$\equiv \equiv$	3.1 3.7 4.1 3.7	3.7 3.8 — 3.5	0.08 0.15 0.2 0.15	0.08 0.15 — 0.15	0.25 0.51 0.62 0.74	0.36 0.68 — 0.98
3	6 7 8	7.2 8.1 9.2	7.2 8.1 —	2 2 2.5	2.5 3 —	0.6 0.5 0.6	0.6 0.8 —	0.1 0.1 0.15	0.1 0.1 —	208 390 560	74 130 179	71 000 63 000 60 000	80 000 75 000 67 000	MF 63 F 683 A MF 83	MF 63 ZZ F 683 AZZ —	ΞΞ	3.8 3.8 4.2	3.7 4.0 —	0.1 0.1 0.15	0.1 0.1 —	0.27 0.37 0.56	0.33 0.53 —
	8 9 9 10 13	9.5 10.2 10.5 11.5 15	9.5 10.6 10.5 11.5 15	3 2.5 3 4 5	4 4 5 4 5	0.7 0.6 0.7 1	0.9 0.8 1 1	0.15 0.2 0.15 0.15 0.2	0.15 0.15 0.15 0.15 0.2	560 570 570 630 1 300	179 187 187 218 485	60 000 56 000 56 000 50 000 36 000	67 000 67 000 67 000 60 000 43 000	F 693 MF 93 F 603 F 623 F 633	F 693 ZZ MF 93 ZZ F 603 ZZ F 623 ZZ F 633 ZZ		4.2 4.6 4.2 4.2 4.6	4.3 4.3 4.3 4.3 6.0	0.15 0.2 0.15 0.15 0.2	0.15 0.15 0.15 0.15 0.2	0.70 0.81 1.0 1.85 3.73	0.97 1.34 1.63 1.86 3.59
4	7 7 8 9	8.2 — 9.2 10.3	8.2 9.2 10.3	2 2 2.5	2.5 3 4	0.6 0.6 0.6	 0.6 0.6 1	0.1 0.15 (0.15)	0.1 0.1 (0.15)	310 255 395 640	115 107 139 225	60 000 60 000 56 000 53 000	67 000 71 000 67 000 63 000	MF 74 MF 84 F 684	MF 74 ZZ MF 84 ZZ F 684 ZZ		4.8 — 5.2 4.8	 4.8 5.0 5.2	0.1 0.15 0.1	0.1 0.1 0.1	0.29 — 0.44 0.70	 0.35 0.63 1.14
	10 11 12	11.2 12.5 13.5	11.6 12.5 13.5	3 4 4	4 4 4	0.6 1 1	0.8 1 1	0.2 0.15 0.2	0.15 0.15 0.2	710 960 960	270 345 345	50 000 48 000 48 000	60 000 56 000 56 000	MF 104 B F 694 F 604	MF 104 BZZ F 694 ZZ F 604 ZZ	= =	5.6 5.2 5.6	5.9 5.6 5.6	0.2 0.15 0.2	0.15 0.15 0.2	1.13 1.91 2.53	1.59 1.96 2.53
	13 16	15 18	15 18	5 5	5 5	1 1	1 1	0.2 0.3	0.2 0.3	1 300 1 730	485 670	40 000 36 000	48 000 43 000	F 624 F 634	F 624 ZZ F 634 ZZ1	= =	5.6 6.0	6.0 7.5	0.2 0.3	0.2 0.3	3.38 5.73	3.53 5.62

Remark When using bearings with a rotating outer ring, please contact NSK if they are shielded.

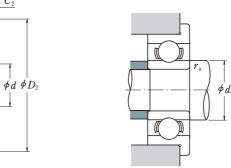
C 062 C 063

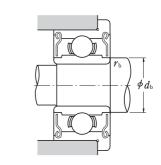
Metric Design With Flange

Bore Diameter 5 - 9 mm



■EXTRA SMALL BALL BEARINGS · MINIATURE BALL BEARINGS



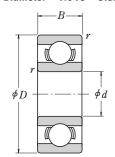


	Op	oen Type	,	_			ded Typ · ZZ1	е		Non-Cor Sealed 7 VV			Contac Sealed Ty DD			Γ								
			Воц		Dimen: nm)	sions				Basic Load	3	Grease	g Speeds (min ⁻¹) Oil		Bearing Numbers					and Fille ns (mm		Ma (g	
<i>d</i>	D	D_1	D_2	В	B_1	C_1	C_2	γ min.	${m r}_1$ min.	$C_{\rm r}$	C_{0r}	Open Z · ZZ V · VV	D · DD	Open Z	Open	Shielded	Sea	led	$d_{ m a}$ min.	$d_{ m b}$ max.	$m{\gamma}_{\mathrm{a}}$ max.	$ m \emph{r}_b$ max.	app Open	rox. Shielded
5	8 8 9 10	9.2 — 10.2 11.2	9.2 10.2 11.6	2 2.5 3	 2.5 3 4	0.6 0.6 0.6	0.6 0.6 0.8	0.1 0.15 0.15	0.1 0.15 0.15	310 278 430 430	120 131 168 168	53 000 53 000 50 000 50 000	_ _ _	63 000 63 000 60 000 60 000	MF 85 MF 95 MF 105	MF 85 ZZ MF 95 ZZ1 MF 105 ZZ	=		5.8 — 6.2 6.2	5.8 6.0 6.0	0.1 0.15 0.15	0.1 0.15 0.15	0.33 — 0.59 1.05	— 0.41 0.66 1.46
	11 13 14	12.5 15 16	12.5 15 16	3 4 5	5 4 5	0.8 1 1	1 1 1	0.15 0.2 0.2	0.15 0.2 0.2	715 1 080 1 330	281 430 505	45 000 43 000 40 000	40 000 38 000	53 000 50 000 50 000	F 685 F 695 F 605	F 685 ZZ F 695 ZZ F 605 ZZ	vv –	DD DD	6.2 6.6 6.6	6.2 6.6 6.9	0.15 0.2 0.2	0.15 0.2 0.2	1.37 2.79 3.9	2.18 2.84 3.85
	16 19	18 22	18 22	5 6	5 6	1 1.5	1 1.5	0.3 0.3	0.3 0.3	1 730 2 340	670 885	36 000 32 000	32 000 30 000	43 000 40 000	F 625 F 635	F 625 ZZ1 F 635 ZZ1	VV VV	DD DD	7.0 7.0	7.5 8.5	0.3 0.3	0.3 0.3	5.37 9.49	5.27 9.49
6	10 12 13	11.2 13.2 15	11.2 13.6 15	2.5 3 3.5	3 4 5	0.6 0.6 1	0.6 0.8 1.1	0.15 0.2 0.15	0.1 0.15 0.15	495 715 1 080	218 292 440	45 000 43 000 40 000	40 000 38 000	53 000 50 000 50 000	MF 106 MF 126 F 686 A	MF 106 ZZ1 MF 126 ZZ F 686 AZZ	_ _ vv	DD DD	7.2 7.6 7.2	7.2	0.15 0.2 0.15	0.1 0.15 0.15	0.65 1.38 2.25	0.77 1.94 3.04
	15 17 19 22	17 19 22 25	17 19 22 25	5 6 6 7	5 6 6 7	1.2 1.2 1.5 1.5	1.2 1.2 1.5 1.5	0.2 0.3 0.3 0.3	0.2 0.3 0.3 0.3	1 730 2 260 2 340 3 300	670 835 885 1 370	40 000 38 000 32 000 30 000	36 000 34 000 30 000 28 000	45 000 45 000 40 000 36 000	F 696 F 606 F 626 F 636	F 696 ZZ1 F 606 ZZ F 626 ZZ1 F 636 ZZ	VV VV VV	DD DD DD DD	7.6 8.0 8.0 8.0	7.9 8.2 8.5 10.5	0.2 0.3 0.3 0.3	0.2 0.3 0.3 0.3	4.34 6.58 9.09 14.6	4.26 6.61 9.09 14.7
7	11 13 14	12.2 14.2 16	12.2 14.6 16	2.5 3 3.5	3 4 5	0.6 0.6 1	0.6 0.8 1.1	0.15 0.2 0.15	0.1 0.15 0.15	455 540 1 170	201 276 510	43 000 40 000 40 000	 34 000	50 000 48 000 45 000	MF 117 MF 137 F 687	MF 117 ZZ MF 137 ZZ F 687 ZZ1	_ _ VV	_ DD	8.2 8.6 8.2	8.0 9.0 8.5	0.15 0.2 0.15	0.1 0.15 0.15	0.72 1.7 2.48	0.82 2.23 3.37
	17 19 22	19 22 25	19 22 25	5 6 7	5 6 7	1.2 1.5 1.5	1.2 1.5 1.5	0.3 0.3 0.3	0.3 0.3 0.3	1 610 2 340 3 300	715 885 1 370	36 000 36 000 30 000	28 000 32 000 28 000	43 000 43 000 36 000	F 697 F 607 F 627	F 697 ZZ1 F 607 ZZ1 F 627 ZZ	VV VV VV	DD DD DD	9.0 9.0 9.0	9.1	0.3 0.3 0.3	0.3 0.3 0.3	5.65 8.66 14.2	5.65 8.66 14.2
8	12 14 16	13.2 15.6 18	13.6 15.6 18	2.5 3.5 4	3.5 4 5	0.6 0.8 1	0.8 0.8 1.1	0.15 0.2 0.2	0.1 0.15 0.2	545 820 1 610	274 385 710	40 000 38 000 36 000	32 000 30 000	48 000 45 000 43 000	MF 128 MF 148 F 688 A	MF 128 ZZ1 MF 148 ZZ F 688 AZZ	VV VV	DD DD	9.2 9.6 9.6	9.0 9.2 10.2	0.15 0.2 0.2	0.1 0.15 0.2	0.82 2.09 3.54	1.15 2.39 4.47
	19 22	22 25	22 25	6 7	6 7	1.5 1.5	1.5 1.5	0.3 0.3	0.3 0.3	2 240 3 300	910 1 370	36 000 34 000	28 000 28 000	43 000 40 000	F 698 F 608	F 698 ZZ F 608 ZZ	VV VV	DD DD	10.0 10.0		0.3 0.3	0.3 0.3	8.35 13.4	8.3 13.5
9	17 20	19 23	19 23	4 6	5 6	1 1.5	1.1 1.5	0.2 0.3	0.2 0.3	1 330 1 720	665 840	36 000 34 000	24 000 24 000	43 000 40 000	F 689 F 699	F 689 ZZ1 F 699 ZZ1	VV VV	DD DD	10.6 11.0		0.2 0.3	0.2 0.3	3.97 9.51	4.91 9.51

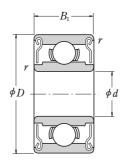
Remark When using bearings with a rotating outer ring, please contact NSK if they are shielded.

Inch Design

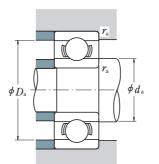
Bore Diameter 1.016 – 9.525 mm

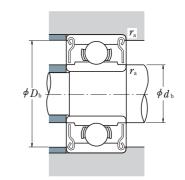


Open Type











	Bound	lary Dimens (mm)	ions		Basic Loa	d Ratings		g Speeds	Bearing	Numbers	A	butment a	and Fillet D	imension	S		lass (g)
d	D	В	B_1	γ min.	C_{r}	C_{0r}	Grease Open Z · ZZ	Oil Open Z	Open	Shielded	$d_{ m a}$ min.	$d_{ m b}$ max.	$D_{ m a}$ max.	$D_{ m b}$ min.	${\pmb{\gamma}}_a$ max.		prox. Shielded
1.016	3.175	1.191	_	0.1	80	23	130 000	150 000	R 09	_	1.9	_	2.3	_	0.1	0.04	_
1.191	3.967	1.588	2.380	0.1	138	35	110 000	130 000	R 0	R 0 ZZ	2.0	1.9	3.1	3.5	0.1	0.09	0.11
1.397	4.762	1.984	2.779	0.1	231	66	90 000	110 000	R 1	R 1 ZZ	2.2	2.3	3.9	4.1	0.1	0.15	0.19
1.984	6.350	2.380	3.571	0.1	310	108	67 000	80 000	R 1-4	R 1-4 ZZ	2.8	3.9	5.5	5.9	0.1	0.35	0.50
2.380	4.762 4.762 7.938	1.588 — 2.779	2.380 3.571	0.1 0.1 0.15	188 143 550	60 52 175	80 000 80 000 60 000	95 000 95 000 71 000	R 133 — R 1-5	R 133 ZZS R 1-5 ZZ	3.2 — 3.6	3.0 4.1	3.9 - 6.7	4.2 7.0	0.1 0.1 0.15	0.10 — 0.60	— 0.13 0.72
3.175	6.350 7.938 9.525	2.380 2.779 2.779	2.779 3.571 3.571	0.1 0.1 0.15	283 560 640	95 179 225	67 000 60 000 53 000	80 000 67 000 63 000	R 144 R 2-5 R 2-6	R 144 ZZ R 2-5 ZZ R 2-6 ZZS	4.0 4.0 4.4	3.9 4.3 4.6	5.5 7.1 8.3	5.9 7.3 8.2	0.1 0.1 0.15	0.25 0.55 0.96	0.27 0.72 1.13
	9.525 12.700	3.967 4.366	3.967 4.366	0.3 0.3	630 640	218 225	56 000 53 000	67 000 63 000	R 2 R 2A	R 2 ZZ R 2A ZZ	5.2 5.2	4.8 4.6	7.5 10.7	8.0 8.2	0.3 0.3	1.36 3.3	1.39 3.23
3.967	7.938	2.779	3.175	0.1	360	149	53 000	63 000	R 155	R 155 ZZS	4.8	5.5	7.1	7.3	0.1	0.51	0.56
4.762	7.938 9.525 12.700	2.779 3.175 3.967	3.175 3.175 4.978	0.1 0.1 0.3	360 710 1 300	149 270 485	53 000 50 000 43 000	63 000 60 000 53 000	R 156 R 166 R 3	R 156 ZZS R 166 ZZ R 3 ZZ	5.6 5.6 6.8	5.5 5.9 6.5	7.1 8.7 10.7	7.3 8.8 11.2	0.1 0.1 0.3	0.39 0.81 2.21	0.42 0.85 2.79
6.350	9.525 12.700	3.175 3.175	3.175 4.762	0.1 0.15	420 1 080	204 440	48 000 40 000	56 000 50 000	R 168B R 188	R 168 BZZ R 188 ZZ	7.2 7.6	7.0 7.4	8.7 11.5	8.9 11.6	0.1 0.15	0.58 1.53	0.62 2.21
	15.875 19.050	4.978 5.558	4.978 7.142	0.3 0.4	1 610 2 620	660 1 060	38 000 36 000	45 000 43 000	R 4B R 4AA	R 4B ZZ R 4AA ZZ	8.4 9.4	8.4 9.0	13.8 16.0	13.8 16.6	0.3 0.4	4.5 7.48	4.43 9.17
7.938	12.700	3.967	3.967	0.15	540	276	40 000	48 000	R 1810	R 1810 ZZ	9.2	9.0	11.5	11.6	0.15	1.56	1.48
9.525	22.225	5.558	7.142	0.4	3 350	1 410	32 000	38 000	R 6	R 6 ZZ	12.6	11.9	19.2	20.0	0.4	9.02	11

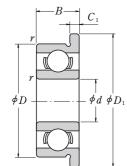
Remarks 1. When using bearings with a rotating outer ring, please contact NSK if they are shielded.

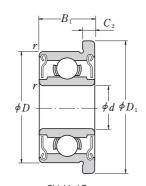
2. Bearings with double shields (ZZ, ZZS) are also available with single shields (Z, ZS).

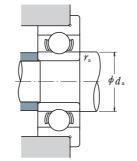
C 066

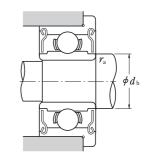
Inch Design With Flange

Bore Diameter 1.191 – 9.525 mm









Open Type

Shielded Type ZZ · ZZS

			Boundary D						d Ratings	Lim	niting S	Speeds ⁻¹)	Beari	ing Numbers		ment and ensions (r		Ma (ç	ass g)
<i>d</i>	D	D_1	В	B_1	C_1	C_2	r min.	$C_{ m r}$	C_{0r}	Greasi Open Z · ZZ	1	Oil Open Z	Open	Shielded	$d_{ m a}$ min.	$d_{ m b}$ max.	${\it r}_{\rm a}$ max.	app Open	rox. Shielded
1.191	3.967	5.156	1.588	2.380	0.330	0.790	0.1	138	35	110 0	00	130 000	FR 0	FR 0 ZZ	2.0	1.9	0.1	0.11	0.16
1.397	4.762	5.944	1.984	2.779	0.580	0.790	0.1	231	66	90 00	00	110 000	FR 1	FR 1 ZZ	2.2	2.3	0.1	0.20	0.25
1.984	6.350	7.518	2.380	3.571	0.580	0.790	0.1	310	108	67 0	00	80 000	FR 1-4	FR 1-4 ZZ	2.8	3.9	0.1	0.41	0.58
2.380	4.762 4.762 7.938	5.944 5.944 9.119	1.588 — 2.779	 2.380 3.571	0.460 — 0.580	 0.790 0.790	0.1 0.1 0.15	188 143 550	60 52 175	80 00 80 00 60 00	00	95 000 95 000 71 000	FR 133 — FR 1-5	FR 133 ZZS FR 1-5 ZZ	3.2 — 3.6	3.0 4.1	0.1 0.1 0.15	0.13 — 0.68	0.19 0.82
3.175	6.350 7.938 9.525 9.525	7.518 9.119 10.719 11.176	2.380 2.779 2.779 3.967	2.779 3.571 3.571 3.967	0.580 0.580 0.580 0.760	0.790 0.790 0.790 0.760	0.1 0.1 0.15 0.3	283 560 640 630	95 179 225 218	67 00 60 00 53 00 56 00	00 00	80 000 67 000 63 000 67 000	FR 144 FR 2-5 FR 2-6 FR 2	FR 144 ZZ FR 2-5 ZZ FR 2-6 ZZS FR 2 ZZ	4.0 4.0 4.4 5.2	3.9 4.3 4.6 4.8	0.1 0.1 0.15 0.3	0.31 0.62 1.04 1.51	0.35 0.81 1.25 1.55
3.967	7.938	9.119	2.779	3.175	0.580	0.910	0.1	360	149	53 0	00	63 000	FR 155	FR 155 ZZS	4.8	5.5	0.1	0.59	0.67
4.762	7.938 9.525 12.700	9.119 10.719 14.351	2.779 3.175 4.978	3.175 3.175 4.978	0.580 0.580 1.070	0.910 0.790 1.070	0.1 0.1 0.3	360 710 1 300	149 270 485	53 00 50 00 43 00	00	63 000 60 000 53 000	FR 156 FR 166 FR 3	FR 156 ZZS FR 166 ZZ FR 3 ZZ	5.6 5.6 6.8	5.5 5.9 6.5	0.1 0.1 0.3	0.47 0.90 2.97	0.53 0.98 3.09
6.350	9.525 12.700 15.875	10.719 13.894 17.526	3.175 3.175 4.978	3.175 4.762 4.978	0.580 0.580 1.070	0.910 1.140 1.070	0.1 0.15 0.3	420 1 080 1 610	204 440 660	48 00 40 00 38 00	00	56 000 50 000 45 000	FR 168B FR 188 FR 4B	FR 168 BZZ FR 188 ZZ FR 4B ZZ	7.2 7.6 8.4	7.0 7.4 8.4	0.1 0.15 0.3	0.66 1.64 4.78	0.75 2.49 4.78
7.938	12.700	13.894	3.967	3.967	0.790	0.790	0.15	540	276	40 00	00	48 000	FR 1810	FR 1810 ZZ	9.2	9.0	0.15	1.71	1.63
9.525	22.225	24.613	7.142	7.142	1.570	1.570	0.4	3 350	1 410	32 0	00	38 000	FR 6	FR 6 ZZ	12.6	11.9	0.4	10.1	12.1

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).



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INTRODUCTION C 072
TECHNICAL DATA
Free Space of Angular Contact Ball Bearings c 078
Dynamic Equivalent Load of Triplex Angular Contact Ball Bearingsc 080
Angular Clearances in Double-Row Angular Contact Ball Bearingsc 082
Relationship between Radial and Axial Clearances in Double-Row Angular Contact Ball Bearings C 084
BEARINGS TABLE
Single-Row and Matched Angular Contact Ball Bearings Bore Diameter 10 – 200 mm······ C 086
Double-Row Angular Contact Ball Bearings
Bore Diameter 10 – 85 mm C 106
Four-Point Contact Ball Bearings

Bore Diameter 30 – 200 mm------ C 108

Contact

angle

BEARINGS TABLE

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 standard cages.

Though the figures in the bearing tables (Pages C086 to C101; 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.

Table 1 Features of Single-Row Angular Contact Ball Bearings

Cage	Material	Steel	Nylo	n 46	L-PPS resin	Bra	iss
Spec.	Method	pressed	Mol	ded	Molded	macl	nined
	Symbols	W	TYN	T85	T7	Omitted	MR
Features	High Load Capacity	0	0	0	0	0	0
	High-Speed	\triangle	0	0	0	Δ	0
	High-Temperature	0	Δ	Δ	0	0	0
	Vibration	Δ	Δ	Δ	Δ	0	0

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
a	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 \boldsymbol{a}_0 is big, this type is suitable if moments are applied.
-a ₀ -	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

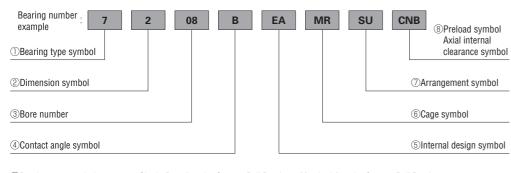
In comparison with standard angular contact ball bearings, these bearings have high capacity, high limiting speed, and highly accurate universal matching as the features. The molded polyamide cages are standard specification for the HPS type.





☐ Formulation of Bearing Numbers

Single-Row Angular Contact Ball Bearings Matched Angular Contact Ball Bearings



Bearing type symbol

7 : Single-Row Angular Contact Ball Bearings, Matched Angular Contact Ball Bearings

2 Dimension 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

Over 04, Bearing bore Bore number $\times 5$ (mm)

(4) Contact angle symbol

C: 15°, A5: 25°, A: 30°, B: 40°

5 Internal design symbol

EA: High Load Capacity

6 Cage symbol

W: Pressed Steel Cage, MR: Machined Brass Cage (Ball guided),

No symbol: Machined Brass Cage (Inner Ring guided), TYN: Polyamide Resin Cage,

T85: Polyamide 46 Resin Cage, T7: L-PPS Resin Cage

7 Arrangement symbol

SU: Universal arrangement (Single row), DU: Universal arrangement (Double row),

DB: Back-to-back arrangement, DF: Face-to-face arrangement, DT: Tandem arrangement EL: Extra light preload, L: Light preload, M: Medium preload, H: Heavy preload

®Preload symbol Axial internal

Omitted: CN clearance, C3: Clearance greater than CN, C4: Clearance greater than C3,

clearance symbol CNB: CN Clearance equivalent (Universal arrangement)



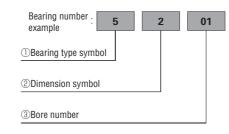
DOUBLE-ROW ANGULAR CONTACT BALL BEARINGS

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





2 Dimension symbol 2:02 Series

③Bore number Less than 03, Bearing bore 00: 10mm, 01: 12mm, 02: 15mm, 03: 17mm

Over 04, Bearing bore Bore number $\times 5$ (mm)



FOUR-POINT CONTACT BALL BEARINGS

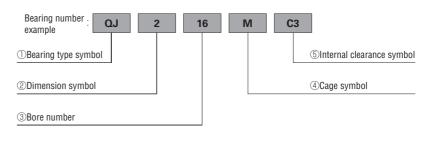
The inner ring is split radially into two pieces. Their design allows one bearing to sustain significant axial loads in either direction.

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



(1) Bearing type symbol QJ: Four-Point Contact Ball Bearings 2 Dimension symbol 10:10 Series, 2:02 Series, 3:03 Series

(3)Bore number Less than 03. Bearing bore 00: 10mm, 01: 12mm, 02: 15mm, 03: 17mm

Over 04, Bearing bore Bore number $\times 5$ (mm)

M: Machined Brass Cage 4 Cage symbol

(5)Internal clearance symbol C2: Clearance less than CN. Omitted: CN clearance.

C3: Clearance greater than CN, C4: Clearance greater than C3



BEARINGS TABLE

Units: um

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

SINGLE-ROW ANGULAR CONTACT
BALL BEARINGSTable 7.2 (Pages A128 to A131)
NSKHPS ANGULAR CONTACT BALL BEARINGS
Tolerance for Dimensions: Class 6,
Running Accuracy: Class 5Table 7.2 (Pages A128 to A131)
MATCHED ANGULAR CONTACT
BALL BEARINGSTable 7.2 (Pages A128 to A131)
DOUBLE-ROW ANGULAR CONTACT
BALL BEARINGSTable 7.2 (Pages A128 to A131)
FOUR-POINT CONTACT BALL
BEARINGS Table 7.2 (Pages A128 to A131)

REC

COMMENDED FITS	
SINGLE-ROW ANGULAR CONTACT BALL BEARINGS AND HPS ANGULAR CONTACT	
BALL BEARINGS	
MATCHED ANGULAR CONTACT BALL BEARINGS.	
DOUBLE-ROW ANGULAR CONTACT BALL	Table 8.5 (Page A165)
BEARINGS	Table 8.3 (Page A164) Table 8.5 (Page A165)
FOUR-POINT CONTACT BALL BEARINGS	Table 8.3 (Page A164) Table 8.5 (Page A165)

INTERNAL CLEARANCES

MATCHED ANGULAR CONTACT BALL BEARINGS..... Table 8.18 (Page 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 clearances 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 Clearances)

Nominal Bo	re Diameter		Axial Interr	nal Clearan	ce
d (r	nm)	CI	VВ	G	A
over	incl.	min.	max.	min.	max.
12	18	17	25		
18	18 30		28	-2	6
20	EΛ	24	22	1	

29 41

DOUBLE-ROW ANGULAR CONTACT BALL BEARINGS

For the clearance in double-row angular contact ball bearings, please consult with

FOUR-POINT CONTACT BALL BEARINGS.....Table 8.19 (Page 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.





BEARINGS TABLE

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 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 bearing 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 angle of 30°, 40°, and 15° of each bearing.

the proper amount of a suitable grease. A prerequisite for this job is a knowledge of the

Table 1 Free Space of Angular Contact Ball Bearing (1) (With Pressed Steel Cage)

Units: cm3

				Ollits, CIII
		Bearing f	ree space	
Bearing bore No.	Beari	ng series — Co	ontact angle sy	mbol
5010 140.	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
00	0.7	0.0	0.0	F 0
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: cm3

			Bearing free space		
Bearing		Bearing s	series — Contact angl	e symbol	
bore No.	70-C	72-A 72-C	72-B	73-A 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





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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.

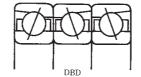
As in the case of single-row and double-row bearings, the dynamic equivalent load, which is determined from the radial and axial loads acting on a bearing, is used to calculate the fatigue life for these combined bearings.

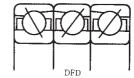
Assuming the dynamic equivalent radial load as $P_{\rm r}$, the radial load as $F_{\rm s}$, and axial load as $F_{\rm s}$, the relationship between the dynamic equivalent radial load and bearing load may be approximated as follows:

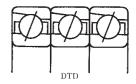
The axial load factor varies with the contact angle. In an angular contact ball bearing, whose contact angle is small, the contact angle varies substantially when the axial load increases.

A change in the contact angle can be expressed by the ratio between the basic static load rating $C_{\rm or}$ and axial load $F_{\rm a}$. 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)	DBD F_r F_a DFD F_r F_r
3 row matched stack, axial load is supported by 1 row. (Symbol DBD or DFD)	DBD F _r F _a F _r DFD F _r
3 row tandem matched stack (Symbol) DTD	DTD F _r







BEARINGS TABLE

Table 1 Factors \boldsymbol{X} and \boldsymbol{Y} of Triplex Angular Contact Ball Bearing

Contact angle	j	$\frac{C_{0r}}{jF_a}$	$\frac{F_{\rm a}}{F_{\rm r}}$	$\leq e$	$\frac{F_{\rm a}}{F_{ m r}}$	>e	e	Basic load 3 row bal	l rating of I bearings
α		J1 a	X	Y	X	Y		$C_{\rm r}$	C_{0r}
		5		0.64		1.46	0.51		
		10		0.70		1.61	0.47		
		15		0.74		1.70	0.44		
15°	1.5	20	1	0.76	0.58	1.75	0.42		
		25		0.78		1.81	0.41	2.16 times	3 times
		30		0.80		1.83	0.40	of single bearing	of single bearing
		50		0.83		1.91	0.39	Dearing	bearing
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		
		5		2.28		2.37	0.51		
		10		2.51		2.61	0.47		
		15		2.64		2.76	0.44		
15°	3	20	1	2.73	0.95	2.85	0.42		
		25		2.80		2.93	0.41	2.16 times	3 times
		30		2.85		2.98	0.40	of single bearing	of single bearing
		50		2.98		3.11	0.39	Dearing	Dearing
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		
		5				1.10	0.51		
		10				1.21	0.47		
		15				1.28	0.44		
15°	1	20	1	0	0.44	1.32	0.42		
		25				1.36	0.41	2.16 times	3 times
		30				1.38	0.40	of single bearing	of single bearing
		50				1.44	0.39	Dearing	Dearing
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		





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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.

$$\Delta_{a}=2m_{0}\left\{\sin\alpha_{0}+\frac{\theta R_{i}}{2m_{0}}-\sqrt{1-\left(\cos\alpha_{0}+\frac{\theta l}{4m_{0}}\right)^{2}}\right\}$$
.....(1)

where, Δ_a : Axial clearance (mm)

 m_0 : Distance between inner and outer ring groove curvature centers,

 $m_0 = r_e + r_i - D_w \text{ (mm)}$

 $r_{\rm e}$: Outer-ring groove radius (mm)

 r_i : Inner-ring groove radius (mm) α_0 : Initial contact angle (°)

 θ : Angular clearance (rad) R_i : Distance between shaft center and innerring 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 Δ_r and axial clearance Δ_a for double-row angular contact ball bearings was explained in pages C086 and C087. Based on those equations, Fig. 2 shows the relationship between angular clearance θ and radial clearance Δ_r .

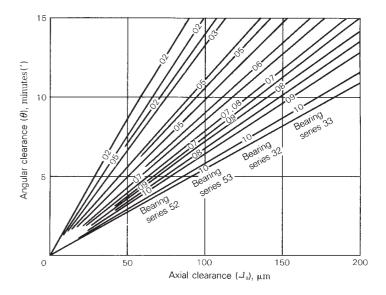


Fig. 1 Relationship between Axial and Angular Clearances

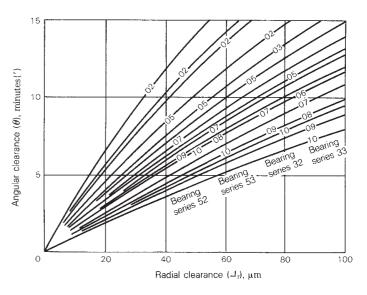


Fig. 2 Relationship between Radial and Angular Clearances





C 082 C 083

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.

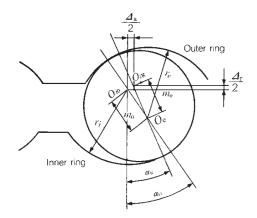


Fig. 1

where, $\Delta_{\rm r}$: Radial clearance (mm)

- Δ_a : Axial clearance (mm)
- α₀: Initial contact angle, inner or outer ring displaced axially
- α_R : Initial contact angle, inner or outer ring displaced radially
- O_e: Center of outer-ring groove curvature (outer ring fixed)
- O₁₀: 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, $m_0 = r_t + r_c D_w$
- $D_{\rm w}$: Ball diameter (mm)
- r_i : Radius of inner-ring groove (mm)
- $r_{\rm e}$: Radius of outer-ring groove (mm)

The following relations can be derived from Fig. 1:

$$m_0 \sin \alpha_0 = m_0 \sin \alpha_R + \frac{\Delta_a}{2}$$
 (1)

$$m_0 \cos \alpha_0 = m_0 \cos \alpha_R - \frac{\Delta_r}{2}$$
 (2)

since
$$\sin^2 \alpha_0 = 1 - \cos^2 \alpha_0$$
, $(m_0 \sin \alpha_0)^2 = m_0^2 - (m_0 \cos \alpha_0)^2 \cdots$ (3)

Combined Equations (1), (2), and (3), we obtain:

$$\left(m_0 \sin \alpha_R + \frac{\Delta_a}{2}\right)^2 = m_0^2 - \left(m_0 \cos \alpha_R - \frac{\Delta_r}{2}\right)^2 \qquad (4$$

 $\alpha_{\mathbb{R}}$ is 25° for 52 and 53 series bearings and 32° for 32 and 33 series bearings. If we set $\alpha_{\mathbb{R}}$ equal to 0°, Equation (5) becomes:

$$\Delta_{a}=2\sqrt{m_{0}^{2}-\left(m_{0}-\frac{\Delta_{r}}{2}\right)}$$
$$=2\sqrt{m_{0}\Delta_{r}-\frac{\Delta_{r}^{2}}{4}}$$

However, $\frac{\Delta_r^2}{4}$ is negligible.

$$\therefore \Delta_a = 2m_0^{1/2} \Delta_r^{1/2} \cdots$$
 (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 Δ_1 and Δ_2 , 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

$$\Delta_a = \Delta_r \cot \alpha_R$$
 (7)

However, when the clearance is relatively large, (when $\varDelta_{\rm r}/D_{\rm w}>0.002)$ the error in Equation (7) can be quite large.

The contact angle α_R is independent of the radial

clearance; however, the initial contact angle α_0 varies with the radial clearance when the inner or outer ring is displaced axially. This relationship is given by Equation (2).

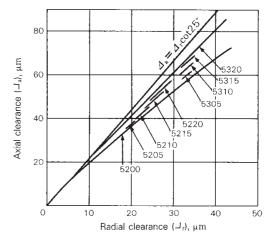


Fig. 2 Radial and Axial Clearances of Bearing Series 52 and 53

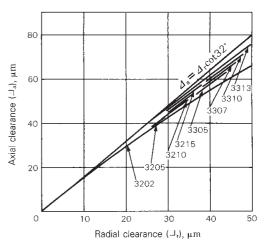


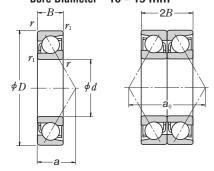
Fig. 3 Radial and Axial Clearances of Bearing Series 32 and 33







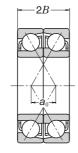
SINGLE/MATCHED MOUNTINGS Bore Diameter 10 – 15 mm



Back-to-Back

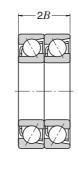
DB

Single



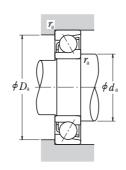
Face-to-Face

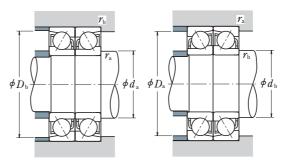
DF



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
		e	F_a/F	$r \leq e$	F_a/F	r > e	F_a/F	$r \leq e$	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25º	_	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
40⁰	_	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 $P_0=X_0F_r+Y_0F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25⁰	0.5	0.38	1	0.76
30⁰	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting When $F_r > 0.5F_r + Y_0F_a$ use $P_0 = F_r$



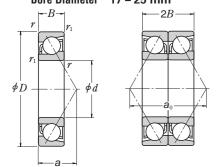
	Bounda	ary Dime	ensions		Basic Loa (Sin	gle)	Factor	Limiting S		Eff.Load Centers (mm)		nent and I nsions (n		Mass (kg)	Ca	Bear ge Symb	ring Numbers (2 ool (4)	() 	Basic Loa (Mato	ched)	Speeds (1)	(Matched)		(mm)		nent and	
d	D	B	γ min.	$ eals_1$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	a	$d_{ m a}$ min.	$D_{\rm a} \\ {\rm max.}$	${\it r}_{\rm a}$ max.	approx.	Single	Standar	d Option	Duplex	$C_{\rm r}$	C_{0r}	Grease (mi	Oil	DB a_0	DF	$d_{ m b}^{(3)}$ min.	$D_{ m b}$ max.	$\mathbf{\gamma}_{\mathrm{b}}^{(3)}$ max.
10	22 22 26	6 6 8	0.3 0.3 0.3	0.15 0.15 0.15	2 880 3 000 5 350	1 450 1 520 2 600	14.1 —	40 000 48 000 24 000	56 000 63 000 34 000	6.7 5.1 9.2	12.5 12.5 12.5	19.5 19.5 23.5	0.3 0.3 0.3	0.010 0.010 0.019	7900 A5 7900 C 7000 A		(M),T	DB DF DT DB DF DT DB DF DT		2 900 3 050 5 200	32 000 38 000 20 000	43 000 53 000 28 000	13.5 10.3 18.4	1.5 1.7 2.4	— — 11.2	20.8 20.8 24.8	0.15 0.15 0.15
	26 30 30	8 9 9	0.3 0.6 0.6	0.15 0.3 0.3	5 300 5 400 5 000	2 490 2 710 2 500	12.6 —	45 000 22 000 16 000	63 000 30 000 22 000	6.4 10.3 12.9	12.5 15 15	23.5 25 25	0.3 0.6 0.6	0.019 0.032 0.032	7000 C 7200 A 7200 B	TYN W W	W,(M),T (M), TYN (M), T	DB DF DT DB DF DT DB DF DT		5 000 5 400 5 000	36 000 18 000 13 000	50 000 24 000 18 000	12.8 20.5 25.8	3.2 2.5 7.8	— 12.5 12.5	24.8 27.5 27.5	0.15 0.3 0.3
	30 35 35	9 11 11	0.6 0.6 0.6	0.3 0.3 0.3	5 400 9 300 8 750	2 610 4 300 4 050	13.2 —	40 000 16 000 14 000	56 000 22 000 20 000	7.2 12.0 14.9	15 15 15	25 30 30	0.6 0.6 0.6	0.032 0.053 0.054	7200 C 7300 A 7300 B	TYN W W	W,(M),T (M), T (M), T	DB DF DT DB DF DT DB DF DT	15 100	5 200 8 600 8 100	13 000	45 000 17 000 16 000	14.4 24.0 29.9	3.6 2.0 7.9	— 12.5 12.5	27.5 32.5 32.5	0.3 0.3 0.3
12	24 24 28	6 6 8	0.3 0.3 0.3	0.15 0.15 0.15	3 200 3 350 5 800	1 770 1 860 2 980	14.7 —	38 000 45 000 22 000	53 000 63 000 30 000	7.2 5.4 9.8	14.5 14.5 14.5	21.5 21.5 25.5	0.3 0.3 0.3	0.011 0.011 0.021	7901 A5 7901 C 7001 A	TYN TYN W	(M),T	DB DF DT DB DF DT DB DF DT	5 450	3 550 3 700 5 950	36 000	43 000 50 000 24 000	14.4 10.8 19.5	2.4 1.2 3.5	— — 13.2	22.8 22.8 26.8	0.15 0.15 0.15
	28 32 32	8 10 10	0.3 0.6 0.6	0.15 0.3 0.3	5 800 8 000 7 450	2 900 4 050 3 750	13.2 —	40 000 20 000 15 000	56 000 28 000 20 000	6.7 11.4 14.2	14.5 17 17	25.5 27 27	0.3 0.6 0.6	0.021 0.037 0.038	7001 C 7201 A 7201 B	TYN W W	W,(M),T (M), T,TYN (M),T	DB DF DT DB DF DT DB DF DT	13 000	5 800 8 050 7 500	32 000 16 000 12 000	45 000 22 000 16 000	13.4 22.7 28.5	2.6 2.7 8.5	— 14.5 14.5	26.8 29.5 29.5	0.15 0.3 0.3
	32 32 37	10 10 12	0.6 0.6 1	0.3 0.3 0.6	8 150 7 900 9 450	3 750 3 850 4 500	12.5 —	20 000 36 000 15 000	30 000 50 000 20 000	14.2 7.9 13.1	17 17 18	27 27 31	0.6 0.6 1	0.036 0.036 0.060	*7201 BE/ 7201 C 7301 A		— W,(M),T (M), T		12 800 15 400	7 700 9 000	30 000	24 000 40 000 16 000	28.5 15.9 26.1	8.5 4.1 2.1	14.5 — 17	29.5 29.5 32	0.3 0.3 0.6
	37 37	12 12	1 1	0.6 0.6	8 850 11 100	4 200 4 950	=	13 000 18 000	18 000 26 000	16.3 16.3	18 18	31 31	1 1	0.062 0.061	7301 B *7301 BE	W A T85	(M), T —	DB DF DT	14 400 —	8 400 —	10 000 15 000	14 000 22 000	32.6 32.6	8.6 8.6	17 17	32 32	0.6 0.6
15	28 28 32	7 7 9	0.3 0.3 0.3	0.15 0.15 0.15	4 550 4 750 6 100	2 530 2 640 3 450	14.5 —	32 000 38 000 19 000	43 000 53 000 26 000	8.5 6.4 11.3	17.5 17.5 17.5	25.5 25.5 29.5	0.3 0.3 0.3	0.016 0.016 0.030	7902 A5 7902 C 7002 A		(M),T (M),T (M), T,TYN	DB DF DT DB DF DT DB DF DT	7 750	5 050 5 300 6 850	30 000	34 000 43 000 22 000	17.0 12.8 22.6	3.0 1.2 4.6	— — 16.2	26.8 26.8 30.8	0.15 0.15 0.15
	32 35 35	9 11 11	0.3 0.6 0.6	0.15 0.3 0.3	6 250 8 650 7 950	3 400 4 650 4 300	14.1 —	34 000 18 000 13 000	48 000 24 000 18 000	7.6 12.7 16.0	17.5 20 20	29.5 30 30	0.3 0.6 0.6	0.030 0.045 0.046	7002 C 7202 A 7202 B	TYN W W	W, (M),T (M), T,TYN (M),T	DB DF DT DB DF DT	14 000	6 750 9 300 8 600	14 000	38 000 20 000 14 000	15.3 25.4 32.0	2.7 3.4 10.0	— 17.5 17.5	30.8 32.5 32.5	0.15 0.3 0.3
	35 35 42	11 11 13	0.6 0.6 1	0.3 0.3 0.6	9 800 8 650 13 400	4 800 4 550 7 100	13.2 —	18 000 32 000 13 000	26 000 45 000 17 000	16.0 8.8 14.7	20 20 21	30 30 36	0.6 0.6 1	0.044 0.045 0.084	*7202 BE 7202 C 7302 A		— W,(M),T (M), T	 DB DF DT DB DF DT		9 050 14 200	14 000 26 000 10 000	20 000 36 000 13 000	32.0 17.7 29.5	10.0 4.3 3.5	17.5 — 20	32.5 32.5 37	0.3 0.3 0.6
	42 42	13 13	1 1	0.6 0.6	12 500 14 300	6 600 6 900		11 000 16 000	15 000 22 000	18.5 18.5	21 21	36 36	1 1	0.086 0.084	7302 B *7302 BE	W 4 T85	(M), T —	DB DF DT	20 200	13 200 —	9 000 13 000	12 000 18 000	36.9 36.9	10.9 10.9	20 20	37 37	0.6 0.6

- Notes (1) For applications operating near the limiting speed, refer to Page C077. (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 $d_{\rm b}$, $d_{\rm b}$ and $r_{\rm b}$ for shafts are $d_{\rm a}$ (min) and $r_{\rm a}$ (max) respectively.

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.

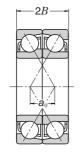
SINGLE/MATCHED MOUNTINGS Bore Diameter 17 - 25 mm



Back-to-Back

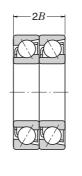
DB

Single



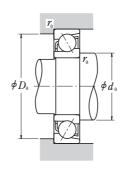
Face-to-Face

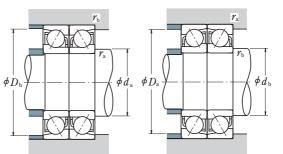
DF



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
	$\frac{i J_0 \Gamma_a}{C_{or}}$	e	$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	$c_{\rm r} > e$	F_a/F	r≦e	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25⁰	_	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41
30₂	_	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40⁰	_	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 $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25⁰	0.5	0.38	1	0.76
30º	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting When $F_r > 0.5F_r + Y_0F_a$ use $P_0 = F_r$

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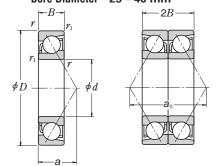
	Bounda	ary Dime	ensions		Basic Load	gle)	Factor		Speeds (1)	Eff.Load Centers		nent and nsions (r		Mass (kg)	(Be Cage Syr	aring Numbers	2)	(M	oad Ratings atched)	Speeds (1)	niting (Matched)	Load C Spacing	s (mm)		nent and	
d	D	B	r min.	$ eals_1$ min.	$C_{\rm r}$ (N	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	${\it r}_{\rm a}$ max.	approx.	Single	Stand	ard Option	Duplex	C_{r}	C_{0r}	Grease	in ⁻¹) Oil	DB DB	DF	$d_{ m b}^{(3)}$ min.		$ {\pmb{\gamma}}_{\bf b}(^3) \\ {\rm max}. \\$
17	30 30 35	7 7 10	0.3 0.3 0.3	0.15 0.15 0.15	4 750 5 000 6 400	2 800 2 940 3 800	14.8	30 000 34 000 17 000	40 000 48 000 24 000	9.0 6.6 12.5	19.5 19.5 19.5	27.5 27.5 32.5	0.3 0.3 0.3	0.017 0.017 0.040	7903 A 7903 C 7003 A	TY	N (M),T N (M),T (M), T,TYN	DB DF	7 75 0T 8 15 0T 10 40	0 5 850	28 000	38 000	18.0 13.3 25.0	4.0 0.7 5.0	— 18.2	28.8 28.8 33.8	0.15
	35 40 40	10 12 12	0.3 0.6 0.6	0.15 0.3 0.3	6 600 10 800 9 950	3 800 6 000 5 500	_	32 000 16 000 11 000	43 000 22 000 15 000	8.5 14.2 18.0	19.5 22 22	32.5 35 35	0.3 0.6 0.6	0.040 0.067 0.068	7003 C 7203 A 7203 B	W	W, (M),T (M), T,TYN (M),T	DB DF	OT 10 70 OT 17 60 OT 16 10	0 12 000	13 000	17 000	17.0 28.5 35.9	3.0 4.5 11.9	— 19.5 19.5	33.8 37.5 37.5	0.15 0.3 0.3
	40 40 47	12 12 14	0.6 0.6 1	0.3 0.3 0.6	11 600 10 900 15 900	6 100 5 850 8 650	13.3	16 000 28 000 11 000	22 000 38 000 15 000	18.2 9.8 16.2	22 22 23	35 35 41	0.6 0.6 1	0.065 0.065 0.116	*7203 B 7203 C 7303 A	TY	T7 N W,(M),T (M), T		OT 17 60 OT 25 90			32 000	36.3 19.6 32.5	12.3 4.4 4.5	19.5 — 22	37.5 37.5 42	0.3 0.3 0.6
	47 47	14 14	1 1	0.6 0.6	14 800 16 800	8 000 8 300		10 000 14 000	14 000 20 000	20.4 20.4	23 23	41 41	1 1	0.118 0.113	7303 B *7303 B		(M), T		24 00 -		8 000 11 000		40.9 40.9	12.9 12.9	22 22	42 42	0.6 0.6
20	37 37 42	9 9 12	0.3 0.3 0.6	0.15 0.15 0.3	6 600 6 950 10 800	4 050 4 250 6 600	14.9	24 000 28 000 14 000	32 000 38 000 20 000	11.1 8.3 14.9	22.5 22.5 25	34.5 34.5 37	0.3 0.3 0.6	0.037 0.036 0.068	7904 A 7904 C 7004 A	TY	N (M),T N (M),T (M), T,TYN	DB DF	T 10 70 T 11 30 T 17 60	8 500	22 000	32 000	22.3 16.6 29.9	4.3 1.4 5.9	 22.5	35.8 35.8 39.5	0.15 0.15 0.3
	42 47 47	12 14 14	0.6 1 1	0.3 0.6 0.6	11 100 14 500 13 300	6 550 8 300 7 650		26 000 13 000 9 500	36 000 18 000 13 000	10.1 16.7 21.1	25 26 26	37 41 41	0.6 1 1	0.068 0.106 0.109	7004 C 7204 A 7204 B	W	N W,(M),T (M), T,TYN (M),T	DB DF	18 00 0T 23 50 0T 21 60		11 000		20.3 33.3 42.1	3.7 5.3 14.1	25 25	39.5 42 42	0.3 0.6 0.6
	47 47	14 14	1 1	0.6 0.6	15 600 14 600	8 150 8 050		13 000 24 000	19 000 34 000	21.1 11.5	26 26	41 41	1 1	0.103 0.104	*7204 B 7204 C		5 T7 N W,(M),T	DB DF		 0 16 100	11 000 19 000		42.1 23.0	14.1 5.0	25 —	42 42	0.6 0.6
	52 52 52	15 15 15	1.1 1.1 1.1	0.6 0.6 0.6	18 700 17 300 19 800	10 400 9 650 10 500	_	10 000 9 000 13 000	13 000 12 000 18 000	17.9 22.6 22.6	27 27 27	45 45 45	1 1 1	0.146 0.150 0.149	7304 A 7304 B *7304 B	W	(M), T (M), T 6 MR, T7		30 50 28 20				35.8 45.2 45.2	5.8 15.2 15.2	25 25 25	47 47 47	0.6 0.6 0.6
25	42 42 47	9 9 12	0.3 0.3 0.6	0.15 0.15 0.3	7 450 7 850 11 300	5 150 5 400 7 400	15.5	20 000 24 000 12 000	28 000 34 000 17 000	12.3 9.0 16.4	27.5 27.5 30	39.5 39.5 42	0.3 0.3 0.6	0.043 0.043 0.079	7905 A 7905 C 7005 A	TY	N (M),T N (M),T (M), T,TYN	DB DF	OT 12 10 OT 12 70 OT 18 30		19 000		24.6 18.0 32.8	6.6 0.0 8.8	 27.5	40.8 40.8 44.5	0.15 0.15 0.3
	47 52 52	12 15 15	0.6 1 1	0.3 0.6 0.6	11 700 16 200 14 800	7 400 10 300 9 400	_	22 000 12 000 8 500	30 000 16 000 11 000	10.8 18.6 23.7	30 31 31	42 46 46	0.6 1 1	0.078 0.130 0.133	7005 C 7205 A 7205 B	W	W,(M),T (M), T,TYN (M),T		19 00 26 30 24 00	20 500	18 000 9 500 6 700	13 000	21.6 37.2 47.3	2.4 7.2 17.3	30 30	44.5 47 47	0.3 0.6 0.6
	52 52 62	15 15 17	1 1 1.1	0.6 0.6 0.6	17 600 16 600 26 400	10 200 10 200 15 800	14.0	12 000 22 000 8 500	17 000 28 000 11 000	23.7 12.7 21.1	31 31 32	46 46 55	1 1 1	0.127 0.129 0.235	*7205 B 7205 C 7305 A	TY	T7 N W,(M),T (M), T	DB DF DB DF	OT 27 00 43 00			24 000	47.3 25.3 42.1	17.3 4.7 8.1	30 30	47 47 57	0.6 0.6 0.6

- Notes (1) For applications operating near the limiting speed, refer to Page C077. (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 $d_{\rm b}$, $d_{\rm b}$ and $r_{\rm b}$ for shafts are $d_{\rm a}$ (min) and $r_{\rm a}$ (max) respectively.

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.

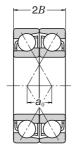
SINGLE/MATCHED MOUNTINGS Bore Diameter 25 - 40 mm



Back-to-Back

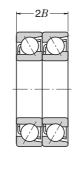
DB

Single



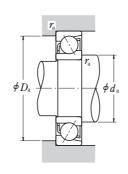
Face-to-Face

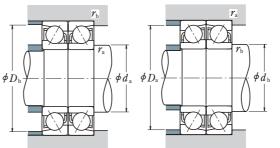
DF



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
Contact	$\frac{\iota j_0 r_a}{C_{or}}$	e	$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	$c_{\rm r} > e$	$F_{\rm a}/I$	r≦e	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25⁰	_	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
40⁰	_	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 $P_0=X_0F_r+Y_0F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25⁰	0.5	0.38	1	0.76
30₂	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting

When $F_r > 0.5F_r + Y_0F_a$ use $P_0 = F_r$

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	Bounda	ıry Dime	ensions		Basic Loa (Sin	gle)	Factor	Limiting S		Eff.Load Centers		nent and nsions (r		Mass (kg)	() 	(Mat		Speeds (1)	iting (Matched)	Load C Spacing:	s (mm)		nent and				
d	D	В	r min.	${m r}_1$ min.	$C_{\rm r}$ (N	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	D_{a} max.	${m \gamma}_{\rm a}$ max.	approx.	Single	Standard	d Option	Duplex	$C_{\rm r}$	C_{0r}	Grease	in ⁻¹) Oil	DB	DF	$d_{ m b}^{(3)}$ min.		$ {\pmb{\mathcal{T}}}_b(^3) \\ \text{max}. $
25	62 62	17 17	1.1 1.1	0.6 0.6	24 400 27 200	14 600 14 900	=	7 500 10 000	10 000 15 000	26.7 26.8	32 32	55 55	1 1	0.241 0.229	7305 B *7305 BE	W A T85	(M), T MR, T7	DB DF D1	39 500	29 300 —	6 000 8 500	8 000 12 000	53.5 53.5	19.5 19.5	30 30	57 57	0.6 0.6
30	47 47 55	9 9 13	0.3 0.3 1	0.15 0.15 0.6	7 850 8 300 14 500	5 950 6 250 10 100		18 000 22 000 11 000	24 000 28 000 14 000	13.5 9.7 18.8	32.5 32.5 36	44.5 44.5 49	0.3 0.3 1	0.050 0.049 0.116	7906 A5 7906 C 7006 A		(M),T (M),T (M), T,TYN		12 800 13 500 23 600	12 500	14 000 17 000 8 500	19 000 24 000 12 000	27.0 19.3 37.5	9.0 1.3 11.5	— — 35	45.8 45.8 50	0.15 0.15 0.6
	55 62 62	13 16 16	1 1 1	0.6 0.6 0.6	15 100 22 500 20 500	10 300 14 800 13 500	l —	19 000 9 500 7 100	26 000 13 000 9 500	12.2 21.3 27.3	36 36 36	49 56 56	1 1 1	0.115 0.197 0.202	7006 C 7206 A 7206 B	TYN W W	W,(M),T (M), T,TYN (M),T	DB DF D1 DB DF D1 DB DF D1	36 500	29 500	15 000 8 000 5 600	22 000 11 000 7 500	24.4 42.6 54.6	1.6 10.6 22.6	— 35 35	50 57 57	0.6 0.6 0.6
	62 62 72	16 16 19	1 1 1.1	0.6 0.6 0.6	23 700 23 000 33 500	14 300 14 700 20 900		10 000 18 000 7 100	14 000 24 000 9 500	27.3 14.2 24.2	36 36 37	56 56 65	1 1 1	0.194 0.197 0.346	*7206 BE 7206 C 7306 A		MR, T7 W,(M),T (M), T		37 500 54 500		8 000 14 000 5 600	11 000 20 000 7 500	54.6 28.3 48.4	22.6 3.7 10.4	35 — 35	57 57 67	0.6 0.6 0.6
	72 72	19 19	1.1 1.1	0.6 0.6	31 000 36 500	19 300 20 600	=	6 300 9 000	8 500 13 000	30.9 30.9	37 37	65 65	1 1	0.354 0.336	7306 B *7306 BE	W A T85	(M), T MR, T7	DB DF D1	50 500	38 500 —	5 000 7 100	7 100 10 000	61.8 61.8	23.8 23.8	35 35	67 67	0.6 0.6
35	55 55 62	10 10 14	0.6 0.6 1	0.3 0.3 0.6	11 400 12 100 18 300	8 700 9 150 13 400		15 000 18 000 9 000	20 000 24 000 13 000	15.5 11.0 21.0	40 40 41	50 50 56	0.6 0.6 1	0.075 0.075 0.153	7907 A5 7907 C 7007 A		(M),T (M),T (M), T,TYN	DB DF D1	18 600 19 600 29 700	18 300	12 000 14 000 7 500	17 000 20 000 10 000	31.0 22.1 42.0	11.0 2.1 14.0	_ 40	52.5 52.5 57	0.3 0.3 0.6
	62 72 72	14 17 17	1 1.1 1.1	0.6 0.6 0.6	19 100 29 700 27 100	13 700 20 100 18 400	_	17 000 8 500 6 000	22 000 12 000 8 000	13.5 23.9 30.9	41 42 42	56 65 65	1 1 1	0.153 0.287 0.294	7007 C 7207 A 7207 B	TYN W W	W,(M),T (M), T,TYN (M),T		31 000 48 500 44 000	40 000	13 000 6 700 4 800	19 000 9 500 6 700	27.0 47.9 61.9	1.0 13.9 27.9	 40 40	57 67 67	0.6 0.6 0.6
	72 72 80	17 17 21	1.1 1.1 1.5	0.6 0.6 1	32 500 30 500 40 000	19 600 19 900 26 300	13.9 —	8 500 15 000 6 300	12 000 20 000 8 500	30.9 15.7 27.1	42 42 44	65 65 71	1 1 1.5	0.271 0.320 0.464	*7207 BE 7207 C 7307 A	A T85 (M) W	MR, T7 W,T,TYN (M), T		49 500 65 000		6 700 12 000 5 000	9 500 17 000 6 700	61.9 31.3 54.2	27.9 2.7 12.2	40 — 41	67 67 74	0.6 0.6 1
	80 80	21 21	1.5 1.5	1 1	36 500 40 500	24 200 24 400	_	5 600 8 000	7 500 11 000	34.6 34.6	44 44	71 71	1.5 1.5	0.474 0.451	7307 B *7307 BE	W A T85	(M), T MR, T7	DB DF D1	59 500 —	48 5 <u>00</u>	4 500 6 300	6 000 9 000	69.2 69.2	27.2 27.2	41 41	74 74	1
40	62 62 68	12 12 15	0.6 0.6 1	0.3 0.3 0.6	14 300 15 100 19 500	11 200 11 700 15 400		14 000 16 000 8 500	18 000 22 000 11 000	17.9 12.8 23.1	45 45 46	57 57 62	0.6 0.6 1	0.110 0.109 0.190	7908 A5 7908 C 7008 A		(M),T		23 300 24 600 31 500	23 500	11 000 13 000 6 700	15 000 18 000 9 000	35.8 25.7 46.2	11.8 1.7 16.2	— — 45	59.5 59.5 63	0.3 0.3 0.6
	68 80 80	15 18 18	1 1.1 1.1	0.6 0.6 0.6	20 600 35 500 32 000	15 900 25 100 23 000	l —	15 000 7 500 5 300	20 000 10 000 7 500	14.7 26.3 34.2	46 47 47	62 73 73	1 1 1	0.213 0.375 0.383	7008 C 7208 A 7208 B	(M) W W	W,T, TYN (M), T,TYN (M),T	DB DF D1 DB DF D1 DB DF D1	33 500 57 500 52 000	50 500	12 000 6 000 4 300	17 000 8 500 6 000	29.5 52.6 68.3	0.5 16.6 32.3	— 45 45	63 75 75	0.6 0.6 0.6

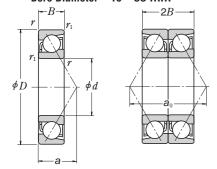
- Notes (1) For applications operating near the limiting speed, refer to Page C077. (2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively. (3) For bearings marked in the column for $d_{\rm b}$, $d_{\rm b}$ and $r_{\rm b}$ for shafts are $d_{\rm a}$ (min) and $r_{\rm a}$ (max) respectively.

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

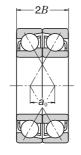


Back-to-Back

DB

Single

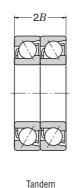
Boundary Dimensions



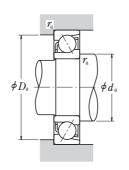
Face-to-Face

DF

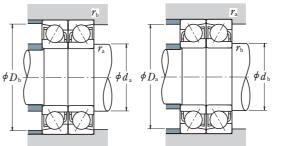
Basic Load Ratings | Factor | Limiting Speeds (1) | Eff.Load



DT



Mass



Bearing Numbers (2)

Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
		e	F_a/F	$r \leq e$	F_a/F	r > e	F_a/F	r≤e	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25º	_	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
40⁰	_	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

Load Center

*For i, use 2 for DB, DF and 1 for DT

Limiting

Basic Load Ratings

(Matched)

(N)

Static Equivalent Load $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25⁰	0.5	0.38	1	0.76
30°	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Speeds (1) (Matched) | Spacings (mm)

Single or DT mounting When $F_r > 0.5F_r + Y_0F_a$

Abutment and Fillet

Dimensions (mm)

		(mm)				gie)		(mı	n-')	Centers	Dime	ensions (mm)	(kg)	Cag	e Symb	OI (4)				
d	D	В	∤ min.	$oldsymbol{\gamma}_1$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	${m \gamma}_{ m a}$ max.	approx.	Single	Standard	d Option	[Duplex		(
40	80 80 90	18 18 23	1.1 1.1 1.5	0.6 0.6 1	38 500 36 500 49 000	24 500 25 200 33 000	14.1 —	7 500 14 000 5 600	11 000 19 000 7 500	34.2 17.0 30.3	47 47 49	73 73 81	1 1 1.5	0.357 0.418 0.633	*7208 BEA 7208 C 7308 A	(M) W	MR, T7 W,T,TYN (M), T	DB DB	DF DF	DT DT	59 79
	90 90	23 23	1.5 1.5	1 1	45 000 53 000	30 500 33 000	_	5 000 7 100	6 700 10 000	38.8 38.8	49 49	81 81	1.5 1.5	0.648 0.619	7308 B *7308 BEA	W T85	(M), T MR, T7	DB —	DF —	DT —	73
45	68 68 75	12 12 16	0.6 0.6 1	0.3 0.3 0.6	15 100 16 000 23 100	12 700 13 400 18 700	16.0 —	12 000 14 000 7 500	17 000 20 000 10 000	19.2 13.6 25.3	50 50 51	63 63 69	0.6 0.6 1	0.130 0.129 0.250	7909 A5 7909 C 7009 A	(M) (M) W	T,TYN T, TYN (M), TYN	DB DB DB	DF DF DF		26

Abutment and Fillet

d	D	В	γ min.	$ m \emph{r}_1$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{\rm a} \\ {\rm max.}$	${\it r}_{\rm a}$ max.	approx.	Single	Standa	rd Option	Duplex	$C_{\rm r}$	C_{0r}	Grease (mi	n-¹) Oil	DB	O DF	$d_{ m b}^{(3)}$ min.		$ {\pmb {\mathcal Y}}_b(^3) \\ \text{max}. $
40	80 80 90	18 18 23	1.1 1.1 1.5	0.6 0.6 1	38 500 36 500 49 000	24 500 25 200 33 000	14.1 —	7 500 14 000 5 600	11 000 19 000 7 500	34.2 17.0 30.3	47 47 49	73 73 81	1 1 1.5	0.357 0.418 0.633	*7208 BE 7208 C 7308 A	A T85 (M) W	MR, T7 W,T,TYN (M), T	DB DF DT DB DF DT				8 500 15 000 6 000	68.3 34.1 60.5	32.3 1.9 14.5	45 — 46	75 75 84	0.6 0.6 1
	90 90	23 23	1.5 1.5	1 1		30 500 33 000		5 000 7 100	6 700 10 000	38.8 38.8	49 49	81 81	1.5 1.5	0.648 0.619	7308 B *7308 BE	W A T85	(M), T MR, T7	DB DF DT	73 000 —	60 500 —		5 300 8 000	77.5 77.5	31.5 31.5	46 46	84 84	1
45	68 68 75	12 12 16	0.6 0.6 1	0.3 0.3 0.6	16 000	12 700 13 400 18 700	16.0 —	12 000 14 000 7 500	17 000 20 000 10 000	19.2 13.6 25.3	50 50 51	63 63 69	0.6 0.6 1	0.130 0.129 0.250	7909 A5 7909 C 7009 A		T,TYN T, TYN (M), TYN	DB DF DT DB DF DT DB DF DT	26 000	26 800	12 000	13 000 16 000 8 500	38.4 27.1 50.6	14.4 3.1 18.6	— 50	65.5 65.5 70	0.3 0.3 0.6
	75 85 85	16 19 19	1 1.1 1.1	0.6 0.6 0.6	24 400 39 500 36 000	19 300 28 700 26 200	15.4 —	14 000 6 700 5 000	19 000 9 500 6 700	16.0 28.3 36.8	51 52 52	69 78 78	1 1 1	0.274 0.411 0.421	7009 C 7209 A 7209 B	(M) W W	W,TYN (M), T,TYN (M),T	DB DF DT DB DF DT DB DF DT	64 500	57 500	5 600	15 000 7 500 5 300	32.1 56.5 73.5	0.1 18.5 35.5	— 50 50	70 80 80	0.6 0.6 0.6
	85 85 100	19 19 25	1.1 1.1 1.5	0.6 0.6 1	40 500 41 000 63 500	27 100 28 800 43 500	14.2 —	7 100 12 000 5 000	10 000 17 000 6 700	36.8 18.2 33.4	52 52 54	78 78 91	1 1 1.5	0.400 0.468 0.848	*7209 BE 7209 C 7309 A	A T85 (M) W	MR, T7 W,T, TYN (M), T	DB DF DT DB DF DT				8 000 14 000 5 300	73.5 36.4 66.9	35.5 1.6 16.9	50 — 51	80 80 94	0.6 0.6 1
	100 100	25 25	1.5 1.5	1 1	58 500 62 500	40 000 39 500		4 500 6 300	6 000 9 000	42.9 42.9	54 54	91 91	1.5 1.5	0.869 0.823	7309 B *7309 BE	W A T85	(M), T MR, T7	DB DF DT	95 000 —	80 500 —	3 600 5 000	4 800 7 100	85.8 85.8	35.8 35.8	51 51	94 94	1
50	72 72 80	12 12 16	0.6 0.6 1	0.3 0.3 0.6	16 900	14 200 15 000 21 100	16.2 —	11 000 13 000 6 700	15 000 18 000 9 500	20.2 14.2 26.8	55 55 56	67 67 74	0.6 0.6 1	0.132 0.130 0.263	7910 A5 7910 C 7010 A		T,TYN T, TYN (M), T,TYN	DB DF DT DB DF DT DB DF DT	27 400	30 000	11 000	12 000 15 000 7 500	40.5 28.3 53.5	16.5 4.3 21.5	— — 55	69.5 69.5 75	0.3 0.3 0.6
	80 90 90	16 20 20	1 1.1 1.1	0.6 0.6 0.6	41 500	21 900 31 500 28 600	15.7 —	12 000 6 300 4 500	17 000 9 000 6 300	16.7 30.2 39.4	56 57 57	74 83 83	1 1 1	0.293 0.466 0.477	7010 C 7210 A 7210 B	(M) W W	W,T, TYN (M), T,TYN (M),T	DB DF DT DB DF DT DB DF DT	67 000	63 000	5 000	14 000 7 100 5 000	33.4 60.4 78.7	1.4 20.4 38.7	— 55 55	75 85 85	0.6 0.6 0.6
	90 90 110	20 20 27	1.1 1.1 2	0.6 0.6 1	42 000 43 000 74 000		14.5 —	6 300 12 000 4 500	9 500 16 000 6 000	39.4 19.4 36.6	57 57 60	83 83 100	1 1 2	0.453 0.528 1.10	* 7210 BE 7210 C 7310 A	A T85 (M) W	MR, T7 W,T,TYN (M), T	DB DF DT DB DF DT	69 500		9 500	7 500 13 000 4 800	78.7 38.7 73.2	38.7 1.3 19.2	55 — 56	85 85 104	0.6 0.6 1
	110 110	27 27	2 2	1 1		48 000 50 500	_	4 000 5 600	5 600 8 000	47.1 47.1	60 60	100 100	2 2	1.12 1.07	7310 B *7310 BE	W A T85	(M), T MR, T7	DB DF DT	111 000 —	96 000 —	4	4 500 6 700	94.1 94.1	40.1 40.1		104 104	1
55	80 80 90	13 13 18	1 1 1.1	0.6 0.6 0.6	19 100	16 800 17 700 27 700	16.3 —	10 000 12 000 6 300	14 000 16 000 8 500	22.2 15.5 29.9	61 61 62	74 74 83	1 1 1	0.184 0.182 0.391	7911 A5 7911 C 7011 A	(M)	T,TYN T, TYN (M), T,TYN	DB DF DT DB DF DT DB DF DT	31 000	35 500	9 500	11 000 13 000 6 700	44.5 31.1 59.9	18.5 5.1 23.9	— 60	75 75 85	0.6 0.6 0.6

Notes (1) For applications operating near the limiting speed, refer to Page C077.

(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.

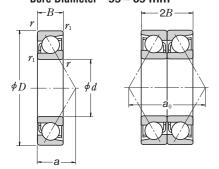
Note (4) (M) in the column of cage symbols are usually omitted from the bearing number.

Remark The bearings denoted by an asterisk (*) are NSKHPSTM Angular contact ball bearings and the column of Duplex in Bearing Numbers indicates the universal matching.





SINGLE/MATCHED MOUNTINGS Bore Diameter 55 - 65 mm



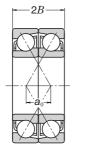
Back-to-Back

DB

Basic Load Ratings Factor

Single

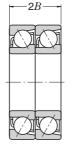
Boundary Dimensions



Face-to-Face

DF

Limiting Speeds (1)



Tandem

DT

Eff.Load

Abutment and Fillet

84

84

93

93

1.5

1.5

1.5

1.5

2

111

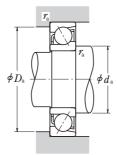
111

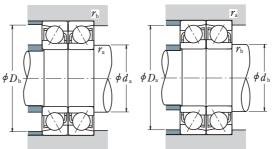
111

128

128

128





Bearing Numbers (2)

T.TYN

(M),T

MR, T7

(M), T

(M), T

W,T,TYN

(M)

W

(M)

W

*7313 BEA T85 MR, T7

T, TYN

(M), T,TYN

(M), T,TYN

Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
		e	F_a/F	$r \leq e$	F_a/F	r > e	F_a/F	r≤e	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25º	_	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
40⁰	_	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

Load Center

*For i, use 2 for DB, DF and 1 for DT

Limiting

Basic Load Ratings

Static Equivalent Load $P_0 = X_0 F_r + Y_0 F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25º	0.5	0.38	1	0.76
30₂	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting When $= F_r > 0.5F_r + Y_0F_a$ use $P_0=F_r$

 $r_{\rm b}(3)$

max.

0.6

Abutment and Fillet

Dimensions (mm) $D_{\rm h}$

max.

85 0.6

94 94

94 94

114

114

114

80 0.6

90 0.6

90 0.6

104

104

104 104

123

123

123

85 0.6

85 0.6

95 0.6

95

114

114

114

114

133

133

133

 $d_{\rm b}^{(3)}$

min.

61

61 61

61

61

61

65

66

66

66

67

67

67

70

71

71

71

72

72 72

	Dounua	(mm)	511510115		(Sin	igle)	ractor	(mi		Centers		inent and iensions (i		(kg)	Ca	ge Sym	bol (4)				(Matc	hed)	Speeds (1)	(Matched)		s (mm)	,
<i>d</i>	D	В	r min.	${m r}_1$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{\rm a} \atop {\rm max.}$	${m \gamma}_{ m a}$ max.	approx.	Single	Standa	rd Option		Duplex		$C_{\rm r}$ (N	C_{0r}	Grease	n-') Oil	DB DB	DF	d
55	90 100 100	18 21 21	1.1 1.5 1.5	0.6 1 1	34 000 51 000 46 500	28 600 39 500 36 000	15.5 — —	11 000 5 600 4 000	15 000 8 000 5 600	18.7 32.9 43.0	62 64 64	83 91 91	1 1.5 1.5	0.430 0.613 0.627	7011 C 7211 A 7211 B	(M) W W	W,T, TYN (M), T,TYN (M),T	DB		DT DT DT	83 000	57 500 79 000 72 000	9 000 4 500 3 400	12 000 6 300 4 500	37.4 65.7 86.0	1.4 23.7 44.0	6
	100 100 120	21 21 29	1.5 1.5 2	1 1 1	51 500 53 000 86 000		14.5 —	6 000 10 000 4 000	8 500 14 000 5 600	43.0 20.9 39.8	64 64 65	91 91 110	1.5 1.5 2	0.596 0.688 1.41	*7211 BE 7211 C 7311 A	A T85 (M) W	MR, T7 W,T,TYN (M), T			DT DT	86 000 139 000		4 500 8 500 3 200	6 700 12 000 4 300	86.0 41.7 79.5	44.0 0.3 21.5	-
	120 120	29 29	2 2	1 1		56 500 58 500	_	3 600 5 000	5 000 7 500	51.2 51.2	65 65	110 110	2 2	1.45 1.36	7311 B *7311 BE	W A T85	(M), T MR, T7	DB —	DF —	DT —	128 000	113 000	3 000 4 000	4 000 6 000	102.4 102.4	44.4 44.4	
60	85 85 95	13 13 18	1 1 1.1	0.6 0.6 0.6	18 300 19 400 33 000	18 700	16.5 —	9 500 11 000 5 600	13 000 15 000 8 000	23.4 16.2 31.4	66 66 67	79 79 88	1 1 1	0.197 0.194 0.417	7912 A5 7912 C 7012 A	(M) (M) W	T,TYN T, TYN (M), T,TYN		DF	DT DT DT		37 500	7 500 9 000 4 500	10 000 12 000 6 300	46.8 32.4 62.7	20.8 6.4 26.7	-
	95 110 110	18 22 22	1.1 1.5 1.5	0.6 1 1		30 500 48 500 44 500	15.7 —	10 000 5 300 3 800	14 000 7 100 5 300	19.4 35.5 46.7	67 69 69	88 101 101	1 1.5 1.5	0.460 0.798 0.815	7012 C 7212 A 7212 B	(M) W W	W,T, TYN (M), T,TYN (M),T		DF	DT	57 000 100 000 91 000	97 500	8 500 4 300 3 000	12 000 6 000 4 000	38.8 71.1 93.3	2.8 27.1 49.3	- 6
	110 110 130	22 22 31	1.5 1.5 2.1	1 1 1.1	61 500 64 000 98 000		14.4 —	5 300 9 500 3 800	7 500 13 000 5 000	46.7 22.4 42.9	69 69 72	101 101 118	1.5 1.5 2	0.791 0.889 1.74	*7212 BE 7212 C 7312 A	A T85 (M) W	MR, T7 W,T,TYN (M), T				104 000 159 000		4 300 7 500 3 000	6 000 11 000 4 000	93.3 44.8 85.9	49.3 0.8 23.9	-
	130 130	31 31	2.1 2.1	1.1 1.1	90 000 102 000	65 500 68 500	_	3 400 4 800	4 500 6 700	55.4 55.4	72 72	118 118	2 2	1.78 1.70	7312 B *7312 BE	W A T85	(M), T MR, T7	DB —	DF —	DT —	146 000	131 000	2 600 3 800	3 800 5 600	110.7 110.7	48.7 48.7	6

0.211

0.208

0.455

0.493

1.03 1.05

1.01

1.14

2.12

2.17

2.09

7913 A5

7913 C

7013 A

7013 C

7213 A

7213 B

7213 C

7313 A

7313 B

*7213 BEA T85

Mass

90

90

100

100

120

120

120

120

140

140

140

13

13

18

23 23

23 23

33

33

0.6

0.6

1.1

1.1

1.1 0.6

1.5

1.5

1.5

2.1

114 000 77 000 **Notes** (1) For applications operating near the limiting speed, refer to Page CO77.

19 100

35 000

37 000

70 500

63 500

70 000

73 000

111 000

102 000

20 200 20 500

19 400

33 000

34 500

58 000 52 500

53 500 58 500

82 000

75 500

- 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.

9 000

10 000

5 300

10 000

4 800

3 400

9 000

3 600

3 200

4 300

16.7

15.9

14.6

12 000

14 000

7 500

13 000

6 700

4 800

7 100

12 000

4 800

4 300

6 300

24.6

16.9

32.8

20.0

38.2 50.3

50.3 23.9

46.1

59.5

59.5

71

72

74

74

74

74

77

77

(4) (M) in the column of cage symbols are usually omitted from the bearing number.

DB DF DT

DB DF DT

DB

DF DT

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.

31 000 39 000

65 500

DB DF DT 33 000 41 000

DB DF DT 103 000 105 000

DB DF DT 119 000 117 000

DB DF DT 180 000 164 000

DB DF DT 166 000 151 000

56 500

60 500

DF DT 114 000 116 000

7 100

8 500

4 300

8 000

3 800

2 800

7 100

2 800

2 400

3 600

9 500

12 000

6 000

11 000

5 300

3 800

5 600

9 500

3 800

3 400

5 000

49.1

33.8

65.6

40.1

76.4

100.6

100.6

47.8

92.2

119.0

119.0

23.1

7.8

29.6

4.1

30.4

54.6

54.6

1.8

26.2

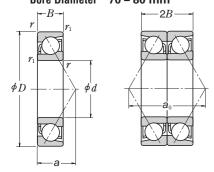
53.0

53.0





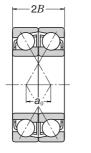
SINGLE/MATCHED MOUNTINGS Bore Diameter 70 – 80 mm



Back-to-Back

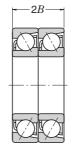
DB

Single



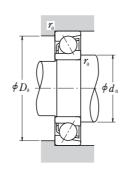
Face-to-Face

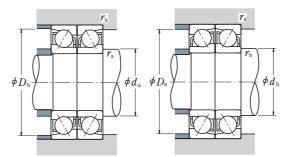
DF



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
	$\frac{i J_0 \Gamma_a}{C_{or}}$	e	$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	$c_{\rm r} > e$	F_a/F	r≦e	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25⁰	_	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41
30₂	_	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40⁰	_	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 $P_0=X_0F_r+Y_0F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25º	0.5	0.38	1	0.76
30₂	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

 Single or DT Single of D1

mounting

When $F_r > 0.5F_r + Y_0F_a$ $_$ use $P_0 = F_r$



	Bounda	ary Dime	ensions			gle)	Factor		Speeds (1)	Eff.Load Centers		ment and ensions (r		Mass (kg)	Ca	Bea ge Syml	ring Numbers (2 pol (4))	(Mat		Speeds (1)	(Matched)	Load C Spacing:	s (mm)		ent and nsions (r	
d	D	B	r min.	${m r}_1$ min.	$C_{\rm r}$ (1	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{\rm a} \\ {\rm max.}$	${m \gamma}_{\rm a}$ max.	approx.	Single	Standar	d Option	Duplex	$C_{\rm r}$	C_{0r}	Grease	n-') Oil	DB	DF	$d_{\mathrm{b}^{(3)}}$ min.	$D_{ m b}$ max.	
70	100 100 110	16 16 20	1 1 1.1	0.6 0.6 0.6	26 500 28 100 44 000	26 300 27 800 41 500	16.4	8 000 9 500 5 000	11 000 13 000 6 700	27.8 19.4 36.0	76 76 77	94 94 103	1 1 1	0.341 0.338 0.625	7914 A5 7914 C 7014 A	(M) (M) W	T,TYN T, TYN,T85 (M), T,TYN	DB DF D DB DF D DB DF D	4 5 500	55 500	6 300 7 500 4 000	9 000 11 000 5 600	55.6 38.8 72.0	23.6 6.8 32.0	— — 75		0.6 0.6 0.6
	110 125 125	20 24 24	1.1 1.5 1.5	0.6 1 1	47 000 76 500 69 000	43 000 63 500 58 000	_	9 000 4 500 3 200	12 000 6 300 4 500	22.1 40.1 52.9	77 79 79	103 116 116	1 1.5 1.5	0.698 1.11 1.14	7014 C 7214 A 7214 B	(M) W W	W,T, TYN (M), T,TYN (M),T		76 000 124 000 112 000	127 000	7 100 3 600 2 600	10 000 5 000 3 600	44.1 80.3 105.8	4.1 32.3 57.8	— 76 76	105 119 119	0.6 1 1
	125 125 150	24 24 35	1.5 1.5 2.1	1 1 1.1	75 500 79 500 125 000	58 500 64 500 93 500		4 500 8 500 3 200	6 700 11 000 4 300	52.9 25.1 49.3	79 79 82	116 116 138	1.5 1.5 2	1.08 1.24 2.60	*7214 BE 7214 C 7314 A	A T85 (M) W	MR, T7 W,T,TYN,T7 (M), T	DB DF D			3 600 6 700 2 600	5 300 9 000 3 400	105.8 50.1 98.5	57.8 2.1 28.5	76 — 77	119 119 143	1 1 1
	150 150	35 35	2.1 2.1	1.1 1.1	114 000 124 000	86 000 87 500	_	2 800 4 000	4 000 6 000	63.6 63.7	82 82	138 138	2 2	2.65 2.53	7314 B *7314 BE	W A T85	(M), T MR, T7	DB DF D	186 000	172 000 —	2 400 3 200	3 200 4 800	127.3 127.3	57.3 57.3	77 77	143 143	1
75	105 105 115	16 16 20	1 1 1.1	0.6 0.6 0.6	26 900 28 600 45 000	27 700 29 300 43 500	16.6	7 500 9 000 4 800	10 000 12 000 6 300	29.0 20.1 37.4	81 81 82	99 99 108	1 1 1	0.355 0.357 0.661	7915 A5 7915 C 7015 A	(M) (M) W	TYN T, TYN (M), T,TYN		44 000 46 500 73 000	58 500	6 000 7 100 3 800	8 500 10 000 5 300	58.0 40.1 74.8	26.0 8.1 34.8	— 80	100	0.6 0.6 0.6
	115 130 130	20 25 25	1.1 1.5 1.5	0.6 1 1	48 000 76 000 68 500	45 500 64 500 58 500	_	8 500 4 300 3 200	12 000 6 000 4 300	22.7 42.1 55.5	82 84 84	108 121 121	1 1.5 1.5	0.748 1.19 1.22	7015 C 7215 A 7215 B	(M) W W	W,T, TYN (M), T,TYN (M),T		78 000 123 000 112 000	129 000	6 700 3 600 2 400	9 500 4 800 3 400		5.4 34.2 61.0	81 81	110 124 124	0.6 1 1
	130 130 160 160 160	25 25 37 37 37	1.5 1.5 2.1 2.1 2.1	1 1 1.1 1.1 1.1	78 500 83 000 136 000 125 000 134 000	63 500 70 000 106 000 97 500 98 500	14.8 —	4 300 8 000 3 000 2 800 3 800	6 300 11 000 4 000 3 800 5 600	55.5 26.2 52.4 67.8 67.8	84 84 87 87 87	121 121 148 148 148	1.5 1.5 2 2 2	1.18 1.36 3.13 3.19 3.03	*7215 BE 7215 C 7315 A 7315 B *7315 BE	(M) W W	MR W,T,TYN,T7 (M), T (M),MR,T MR	DB DF D	134 000 1 221 000 202 000	212 000 195 000	3 600 6 300 2 400 2 200 3 000	5 000 9 000 3 200 3 000 4 500	52.4 104.8 135.6	61.0 2.4 30.8 61.6 61.6	81 — 82 82 82 82	124 124 153 153 153	1 1 1 1
80	110 110 125	16 16 22	1 1 1.1	0.6 0.6 0.6	27 300 29 000 55 000	29 000 30 500 53 000		7 100 8 500 4 300	10 000 12 000 6 000	30.2 20.7 40.6	86 86 87	104 104 118	1 1 1	0.380 0.376 0.880	7916 A5 7916 C 7016 A	(M) (M) W	T,TYN T, TYN (M), T,TYN	DB DF D	44 500 47 000 89 500	61 500	5 600 6 700 3 600	8 000 9 500 4 800	60.3 41.5 81.2	28.3 9.5 37.2	— — 85	105 105 120	0.6 0.6 0.6
	125 140 140	22 26 26	1.1 2 2	0.6 1 1	58 500 89 000 80 500	55 500 76 000 69 500	<u> </u>	8 000 4 000 2 800	11 000 5 600 4 000	24.7 44.8 59.1	87 90 90	118 130 130	1 2 2	0.966 1.46 1.49	7016 C 7216 A 7216 B	(M) W W	W,T, TYN (M), T,TYN (M),T		95 500 145 000 131 000	152 000	6 300 3 200 2 400	9 000 4 500 3 200	49.4 89.5 118.3	5.4 37.5 66.3	— 86 86	120 134 134	0.6 1 1
	140 140 170 170 170	26 26 39 39 39	2 2 2.1 2.1 2.1	1 1 1.1 1.1 1.1	87 500 93 000 147 000 135 000 144 000	109 000		4 000 7 500 2 800 2 600 3 600	6 000 10 000 3 800 3 400 5 300	59.2 27.7 55.6 71.9 71.9	90 90 92 92 92	130 130 158 158 158	2 2 2 2 2	1.42 1.63 3.71 3.79 3.59	*7216 BE 7216 C 7316 A 7316 B *7316 BE	(M) W W	MR, T7 W,T,TYN (M), T (M), T MR, T7	DB DF D	151 000 1 239 000 1 219 000	238 000	3 200 6 000 2 200 2 000 2 800	4 800 8 000 3 000 2 800 4 300	55.5 111.2 143.9	66.3 3.5 33.2 65.9 65.9	86 — 87 87 87	134 134 163 163 163	1 1 1 1

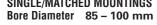
- Notes (1) For applications operating near the limiting speed, refer to Page C077. (2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively. (3) For bearings marked in the column for $d_{\rm b}$, $d_{\rm b}$ and $r_{\rm b}$ for shafts are $d_{\rm a}$ (min) and $r_{\rm a}$ (max) respectively.

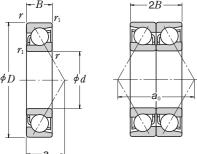
Note (4) (M) in the column of cage symbols are usually omitted from the bearing number.

Remark The bearings denoted by an asterisk (*) are NSKHPSTM Angular contact ball bearings and the column of Duplex in

Bearing Numbers indicates the universal matching.

SINGLE/MATCHED MOUNTINGS

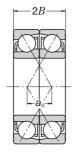




Back-to-Back

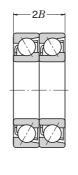
DB

Single



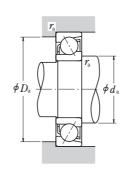
Face-to-Face

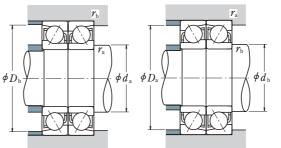
DF



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT		DB or DF							
	$\frac{i J_0 \Gamma_a}{C_{or}}$	e	$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	$c_{\rm r} > e$	F_a/F	r≦e	$F_a/F_r > e$					
Angle	Cor		X	Y	X	Y	X	Y	X	Y				
15º	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				
15-	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				
25⁰	_	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41				
30₂	_	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24				
40⁰	_	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 $P_0=X_0F_r+Y_0F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25º	0.5	0.38	1	0.76
30₂	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting When $F_r > 0.5F_r + Y_0F_a$ use $P_0 = F_r$

	Boundary Dimensions (Single) Basic Load Ratings Factor (Single)			Factor	r Limiting Speeds (1)		Eff.Load Abutment and Fillet Dimensions (mm)			Mass Bearing Numbers (kg) Cage Symbol (4))	Basic Load Ratings (Matched)		Limiting Speeds (1) (Matched)		Load Center Spacings (mm)		Abutment and Fille Dimensions (mm							
<i>d</i>	D	В	γ min.	${m r}_1$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{\gamma}_{\mathrm{a}}$ max.	approx.	Single	Standa	d Option	Duplex	$C_{\rm r}$	C_{0r}	Grease	oil	DB DB	O DF	$d_{ m b}^{(3)}$ min.	$D_{\rm b} \\ {\rm max.}$	$ m \emph{r}_b(^3)$ max.
85	120 120 130	18 18 22	1.1 1.1 1.1	0.6 0.6 0.6	36 500 39 000 56 500	38 500 40 500 56 000	— 16.5 —	6 700 8 000 4 300	9 000 11 000 5 600	32.9 22.7 42.0	92 92 92	113 113 123	1 1 1	0.541 0.534 0.913	7917 A5 7917 C 7017 A	(M) (M) W	T,TYN T, TYN (M), T,TYN	DB DF DT DB DF DT		81 500	5 300 6 300 3 400	7 500 9 000 4 500	65.8 45.5 84.1	29.8 9.5 40.1	— 90	115 115 125	0.6 0.6 0.6
	130 150 150	22 28 28	1.1 2 2	0.6 1 1	60 000 103 000 93 000	58 500 89 000 81 000	_	7 500 3 800 2 800	10 000 5 300 3 800	25.4 47.9 63.3	92 95 95	123 140 140	1 2 2	1.01 1.83 1.87	7017 C 7217 A 7217 B	(M) W W	W,T, TYN (M), T,TYN (M), T	DB DF D	98 000 167 000 151 000	178 000	6 000 3 000 2 200	8 500 4 300 3 000	50.8 95.8 126.6	6.8 39.8 70.6	— 91 91	125 144 144	0.6 1 1
	150 150 180 180 180	28 28 41 41 41	2 2 3 3 3	1 1 1.1 1.1 1.1		81 500 90 500 133 000 122 000 133 000	14.7 — —	3 800 6 700 2 600 2 400 3 400	5 600 9 500 3 600 3 200 5 000	63.3 29.7 58.8 76.1 76.1	95 95 99 99	140 140 166 166 166	2 2 2.5 2.5 2.5	1.75 2.04 4.33 4.42 4.34	7217 BE 7217 C 7317 A 7317 B 7317 BE	(M) W W	— W,T,TYN (M), T (M), T MR, T7	DB DF D	174 000 258 000 236 000	265 000 244 000	3 200 5 600 2 200 1 900 2 800	4 500 7 500 2 800 2 600 4 000	126.6 59.5 117.5 152.2 152.2	70.6 3.5 35.5 70.2 70.2	91 — 92 92 92	144 144 173 173 173	1 1 1 1
90	125 125 140	18 18 24	1.1 1.1 1.5	0.6 0.6 1	39 500 41 500 67 500	43 500 46 000 66 500	16.6 —	6 300 7 500 3 800	8 500 10 000 5 300	34.1 23.4 45.2	97 97 99	118 118 131	1 1 1.5	0.560 0.563 1.19	7918 A5 7918 C 7018 A	(M) (M) W	T,TYN T, TYN (M), T,TYN	DB DF D	64 000 67 500 109 000	92 000	5 000 6 000 3 200	7 100 8 500 4 300	68.1 46.8 90.4	32.1 10.8 42.4	— — 96	120 120 134	0.6 0.6 1
	140 160 160	24 30 30	1.5 2 2	1 1 1	71 500 118 000 107 000	69 000 103 000 94 000	15.7 —	7 100 3 600 2 600	9 500 4 800 3 400	27.4 51.1 67.4	99 100 100	131 150 150	1.5 2 2	1.34 2.25 2.29	7018 C 7218 A 7218 B	(M) W W	W,T, TYN (M), T,TYN (M), T	DB DF D	116 000 191 000 173 000	206 000	5 600 2 800 2 000	8 000 4 000 2 800	54.8 102.2 134.9	6.8 42.2 74.9	— 96 96	134 154 154	1 1 1
	160 160 190 190 190	30 30 43 43 43	2 2 3 3 3	1 1 1.1 1.1 1.1	171 000 156 000	105 000 147 000	14.6 — —	3 600 6 300 2 600 2 200 3 200	5 300 9 000 3 400 3 000 4 500	67.4 31.7 61.9 80.2 80.2	100 100 104 104 104	150 150 176 176 176	2 2 2.5 2.5 2.5	2.19 2.51 5.06 5.17 4.97	7218 BE 7218 C 7318 A 7318 B 7318 BE	(M) W W	MR W,T,TYN (M), T (M), T MR	DB DF D	199 000 277 000 254 000	294 000 270 000	3 000 5 300 2 000 1 800 2 600	4 300 7 100 2 800 2 400 3 600	134.9 63.5 123.8 160.5 160.5	74.9 3.5 37.8 74.5 74.5	96 — 97 97 97	154 154 183 183 183	1 1 1 1
95	130 130 145	18 18 24	1.1 1.1 1.5	0.6 0.6 1	40 000 42 500 67 000	45 500 48 000 67 000	16.7 —	6 000 7 100 4 500	8 500 10 000 6 300	35.2 24.1 46.6	102 102 104	123 123 136	1 1 1.5	0.597 0.591 1.43	7919 A5 7919 C 7019 A	(M) (M) (M)	T,TYN T, TYN T,TYN	DB DF D	64 500 68 500 109 000	96 000	4 800 5 600 3 800	6 700 8 000 5 000	70.5 48.1 93.3	34.5 12.1 45.3	_ _ _	125 125 139	0.6 0.6 1
	145 170 170	24 32 32	1.5 2.1 2.1	1 1.1 1.1		73 000 111 000 101 000	15.9 —	6 700 3 400 2 400	9 000 4 500 3 200	28.1 54.2 71.6	104 107 107	136 158 158	1.5 2 2	1.42 2.68 2.74	7019 C 7219 A 7219 B	(M) W W	T, TYN (M), T,TYN (M), T	DB DF D	119 000 208 000 188 000	221 000	5 300 2 600 1 900	7 500 3 600 2 600	56.1 108.5 143.2	8.1 44.5 79.2	— 102 102	139 163 163	1 1 1
	170 170 200 200 200	32 32 45 45 45	2.1 2.1 3 3 3	1.1 1.1 1.1 1.1 1.1	133 000 183 000 167 000	107 000 112 000 162 000 149 000 160 000	14.6 — —	3 400 6 000 2 400 2 200 3 000	5 000 8 500 3 200 3 000 4 500	71.6 33.7 65.1 84.3 84.3	107 107 109 109 109	158 158 186 186 186	2 2 2.5 2.5 2.5 2.5	2.67 3.05 5.83 5.98 5.82	7219 BE 7219 C 7319 A 7319 B 7319 BE	(M) W W	MR, T7 W,T,TYN (M), T (M), T MR	DB DF D	216 000 297 000 272 000	325 000	2 800 4 800 1 900 1 700 2 400	4 000 6 700 2 600 2 400 3 600	143.2 67.5 130.2 168.7 168.7	79.2 3.5 40.2 78.7 78.7	102 — 102 102 102	163 163 193 193 193	1 1 1 1
100	140 140 150	20 20 24	1.1 1.1 1.5	0.6 0.6 1	47 500 50 000 68 500	51 500 54 000 70 500	16.5 —	5 600 6 700 4 500	8 000 9 000 6 000	38.0 26.1 48.1	107 107 109	133 133 141	1 1 1.5	0.804 0.794 1.48	7920 A5 7920 C 7020 A	(M) (M) (M)	T,TYN T, TYN T,TYN	DB DF D1	77 000 81 500 111 000	108 000	4 500 5 300 3 600	6 300 7 500 5 000	76.0 52.2 96.2	36.0 12.2 48.2	_ _ _	135 135 144	0.6 0.6 1

Notes (1) For applications operating near the limiting speed, refer to Page C077.

(2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.

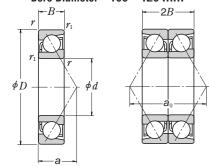
(3) For bearings marked — in the column for d_b , d_b and r_b for shafts are d_a (min) and r_a (max) respectively.

Note (4) (M) in the column of cage symbols are usually omitted from the bearing number.



■ ANGULAR CONTACT BALL BEARINGS

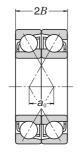
SINGLE/MATCHED MOUNTINGS Bore Diameter 100 – 120 mm



Back-to-Back

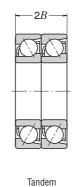
DB

Single

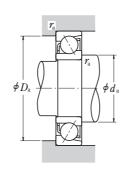


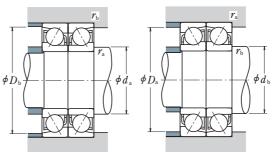
Face-to-Face

DF



DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
	$\frac{i J_0 \Gamma_a}{C_{or}}$	e	$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	$c_{\rm r} > e$	F_a/F	r≦e	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25⁰	_	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41
30₂	_	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40⁰	_	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 $P_0=X_0F_r+Y_0F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25⁰	0.5	0.38	1	0.76
30₂	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting When $F_r > 0.5F_r + Y_0F_a$ use $P_0 = F_r$



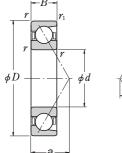
	Bounda	ary Dime	ensions		(Sir	ad Ratings	Factor		Speeds (1)	Eff.Load Centers		nent and nsions (r		Mass (kg)	Ca	Bea age Symb	ring Numbers (3	() 	Basic Load	hed)	Speeds (1)	(Matched)	Load C Spacing	s (mm)		nent and	
d	D	B	r min.	${\it r}_{\rm 1}$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{ m a}$ max.	${m \gamma}_{\rm a}$ max.	approx.	Single	Standar	d Option	Duplex	$C_{\rm r}$ (N	C_{0r}	Grease	Oil	DB	O DF	$d_{\mathrm{b}^{(3)}}$ min.	$D_{ m b}$ max.	$\begin{array}{c} \pmb{\varUpsilon}_b(^3) \\ \text{max.} \end{array}$
100	150 180 180	24 34 34	1.5 2.1 2.1	1 1.1 1.1		77 000 126 000 114 000	_	6 300 3 200 2 200	9 000 4 300 3 000	28.7 57.4 75.7	109 112 112	141 168 168	1.5 2 2	1.46 3.22 3.28	7020 C 7220 A 7220 B	(M) W W	T, TYN (M), T,TYN (M), T		122 000 233 000 212 000	251 000	2 600	7 100 3 400 2 400	57.5 114.8 151.5	9.5 46.8 83.5	— 107 107	144 173 173	1 1 1
	180 180 215 215 215	34 34 47 47 47	2.1 2.1 3 3	1.1 1.1 1.1 1.1	136 000 149 000 207 000 190 000	122 000 127 000 193 000 178 000 187 000	14.5 —	3 200 5 600 2 200 2 000 2 800	4 500 8 000 3 000 2 800 4 000	75.7 35.7 69.0 89.6 89.6	112 112 114 114 114	168 168 201 201 201	2 2 2.5 2.5 2.5 2.5	3.27 3.65 7.29 7.43 7.14	7220 BE 7220 C 7320 A 7320 B 7320 BE	A T85 (M) W	MR W,T,TYN (M), T (M), T MR, T7	 DB DF DT	242 000 3 335 000		2 600 4 500 1 800	3 600 6 300 2 400 2 200 3 200	151.5 71.5 137.9 179.2 179.2	83.5 3.5 43.9 85.2 85.2	107 — 107 107 107	173 173 208 208 208	1 1 1 1
105	145 145 160 160 190 190	20 20 26 26 36 36	1.1 1.1 2 2 2.1 2.1	0.6 0.6 1 1 1.1		57 000	16.6 — 15.9 —	5 600 6 300 4 300 6 000 3 000 2 200	7 500 9 000 5 600 8 500 4 000 3 000	39.2 26.7 51.2 30.7 60.6 79.9	112 112 115 115 117 117	138 138 150 150 178 178	1 1 2 2 2 2	0.820 0.826 1.84 1.82 3.84 3.92	7921 A5 7921 C 7021 A 7021 C 7221 A 7221 B	(M) (M) (M) (M) W	T,TYN T, TYN T,TYN T, TYN (M), T (M), T	DB DF DT DB DF DT DB DF DT	78 500 83 000 130 000 143 000 254 000 231 000	114 000 163 000 179 000 283 000	5 300 3 400 4 800 2 400	6 000 7 100 4 500 6 700 3 400 2 400	78.3 53.5 102.5 61.5 121.2 159.8	38.3 13.5 50.5 9.5 49.2 87.8	 112 112	140 140 154 154 183 183	0.6 0.6 1 1
	190 190 190 225 225 225	36 36 49 49	2.1 2.1 3 3 3	1.1 1.1 1.1 1.1 1.1	148 000 162 000 208 000	133 000 143 000 193 000 177 000	14.5 —	3 000 5 300 2 600 2 400 2 600	4 500 7 500 3 600 3 200 4 000	79.9 79.9 37.7 72.1 93.7 93.7	117 117 117 119 119 119	178 178 178 211 211 211	2 2 2.5 2.5 2.5 2.5	3.92 3.69 4.33 9.34 9.43 8.12	7221 B 7221 C 7221 C 7321 A 7321 B 7321 BE	(M) (M) (M)	W,T,TYN T	 DB DF DT DB DF DT	264 000 : 335 000 : 310 000 :		2 400 4 300 2 200	3 600 6 000 2 800 2 600 3 200	159.8 75.5 144.3 187.4 187.4	87.8 3.5 46.3 89.4 89.4	112 112 — — —	183 183 218 218 218	1 1 1 1 1
110	150 150 170 170	20 20 28 28	1.1 1.1 2	0.6 0.6 1	49 000 52 000 96 500	59 500	16.7 —	5 300 6 300 4 000 5 600	7 100 8 500 5 300 8 000	40.3 27.4 54.4 32.7	117 117 120 120	143 143 160 160	1 1 2 2	0.877 0.867 2.28 2.26	7922 A5 7922 C 7022 A 7022 C	(M) (M) (M)	T,TYN T, TYN T,TYN T, TYN	DB DF DT DB DF DT	79 500 84 500 157 000	119 000 191 000	5 000 3 200	5 600 6 700 4 300 6 300	80.6 54.8 108.8 65.5	40.6 14.8 52.8 9.5		145 145 164 164	0.6 0.6 1
	200 200 200	38 38 38	2.1 2.1 2.1	1.1 1.1 1.1	170 000 154 000	158 000 144 000 144 000	=	2 800 2 000 2 800	3 800 2 800 4 300	63.7 84.0 84.0	122 122 122	188 188 188	2 2 2	4.49 4.58 4.48	7222 A 7222 B 7222 BE	W	(M), T,TYN (M), T		276 000	315 000	2 200	3 200 2 200 3 400	127.5 168.1 168.1	51.5 92.1 92.1	117 117 117	193 193 193	1 1
	200 240 240 240	38 50 50 50	2.1 3 3 3	1.1 1.1 1.1 1.1	176 000 220 000 201 000	160 000	14.5 —	5 000 2 600 2 200 2 600	7 100 3 400 3 000 3 800	39.8 75.5 98.4 98.4	122 124 124 124	188 226 226 226	2 2.5 2.5 2.5 2.5	5.10 11.1 11.2 9.91	7222 C 7322 A 7322 B 7322 BE	(M) (M) (M)	W,T,TYN W,T W,T MR	DB DF DT	286 000 3 360 000 3 325 000 3	430 000	4 000 2 000	5 600 2 600 2 400 3 000	79.5 151.0 196.8 196.8	3.5 51.0 96.8 96.8		193 233 233 233	1 1 1 1
120	165 165 180	22 22 28	1.1 1.1 2	0.6 0.6 1		77 000 81 000 107 000	16.5	4 800 5 600 3 600	6 300 7 500 5 000	44.2 30.1 57.3	127 127 130	158 158 170	1 1 2	1.15 1.15 2.45	7924 A5 7924 C 7024 A	(M)	T,TYN T, TYN T,TYN	DB DF DT	110 000 117 000 166 000	162 000	4 500	5 300 6 300 4 000	88.5 60.2 114.6	44.5 16.2 58.6	_	160 160 174	0.6 0.6 1
	215 215 215	40 40 40	2.1 2.1 2.1	1.1 1.1 1.1	165 000	177 000 162 000 177 000	-	3 200 2 400 2 600	4 500 3 200 3 800	68.3 90.3 90.3	132 132 132	203 203 203	2 2 2	6.22 6.26 5.37	7224 A 7224 B 7224 BE	(M) (M) A T85	T T MR, T7		297 000 3 269 000 3			3 600 2 600 3 000	136.7 180.5 180.5	56.7 100.5 100.5		208 208 208	1 1 1
	260 260 260	55 55 55	3 3 3	1.1 1.1 1.1		252 000 231 000 250 000	_	2 200 2 000 2 200	3 000 2 800 3 400	82.3 107.2 107.2	134 134 134	246 246 246	2.5 2.5 2.5	14.5 14.4 12.8	7324 A 7324 B 7324 BE		T		400 000 365 000			2 400 2 200 2 800	164.7 214.4 214.4	54.7 104.4 104.4		253 253 253	1 1 1

Notes (1) For applications operating near the limiting speed, refer to Page C077. (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 $d_{\rm b}$, $d_{\rm b}$ and $r_{\rm b}$ for shafts are $d_{\rm a}$ (min) and $r_{\rm a}$ (max) respectively.

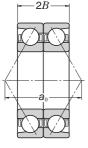
Note (4) (M) in the column of cage symbols are usually omitted from the bearing number.

MANGULAR CONTACT BALL BEARINGS

SINGLE/MATCHED MOUNTINGS Bore Diameter 130 – 170 mm

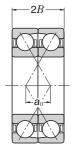


Single



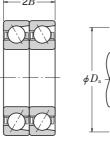
Back-to-Back

DB



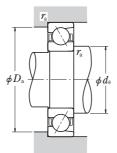
Face-to-Face

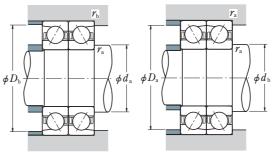
DF



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
	$\frac{i J_0 \Gamma_a}{C_{or}}$	e	$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	$c_{\rm r} > e$	F_a/F	r≦e	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25º	_	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41
30₂	_	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 $P_0=X_0F_r+Y_0F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25º	0.5	0.38	1	0.76
30₂	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting

When $F_r > 0.5F_r + Y_0F_a$ use $P_0 = F_r$

	Bounda	ı ry Dim e (mm)	ensions		(Sir	d Ratings	Factor		Speeds (1)	Eff.Load Centers (mm)		ment and ensions (r		Mass (kg)	Ca	Bea ige Sym	ring Numbers (3 pol (4)	2)		(Mat	ad Ratings ched)	Limi Speeds (1)	(Matched)	Load (nent and nsions (r	
<i>d</i>	D	В	r min.	$ m \emph{r}_{1}$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	a	$d_{ m a}$ min.	$D_{ m a}$ max.	${m \gamma}_{\rm a}$ max.	approx.	Single	Standa	rd Option	Duple	ex	$C_{\rm r}$	C_{0r}	Grease	Oil	DB	DF	$d_{ m b}^{(3)}$ min.	$D_{ m b}$ max.	$ m \emph{r}_b(^3)$ max.
130	180 180 200	24 24 33	1.5 1.5 2	1 1 1	74 000 78 500 117 000	86 000 91 000 125 000	16.5	4 300 5 000 3 400	6 000 7 100 4 500	48.1 32.8 64.1	139 139 140	171 171 190	1.5 1.5 2	1.54 1.50 3.68	7926 A5 7926 C 7026 A	(M) (M) (M)	T,TYN T, TYN T,TYN	DB DF	DT	128 000	172 000 182 000 251 000	3 400 4 000 2 600	4 800 5 600 3 600	96.3 65.5 128.3	48.3 17.5 62.3	=	174 174 194	1 1 1
	230 230 280 280	40 40 58 58	3 3 4 4	1.1 1.1 1.5 1.5	171 000 273 000	193 000 175 000 293 000 268 000	_	2 400 2 200 2 200 1 900	3 200 3 000 2 800 2 600	72.0 95.5 88.2 115.0	144 144 148 148	216 216 262 262	2.5 2.5 3	7.06 7.10 17.5 17.6	7226 A 7226 B 7326 A 7326 B	(M) (M) (M) (M)	T T T	DB DF	DT DT	278 000 445 000	385 000 350 000 585 000 535 000	1 900 1 700 1 700 1 500	2 600 2 400 2 200 2 000	176.3	63.9 111.0 60.3 114.0	_ _ _		1 1 1.5 1.5
140	190 190 210	24 24 33	1.5 1.5 2	1 1 1	75 000 79 500 120 000		16.7	4 000 4 800 3 200	5 600 6 700 4 300	50.5 34.1 67.0	149 149 150	181 181 200	1.5 1.5 2	1.63 1.63 3.90	7928 A5 7928 C 7028 A	(M) (M) (M)	T,TYN T, TYN T	DB DF	DT	129 000	180 000 191 000 265 000	3 200 3 800 2 600	4 500 5 300 3 400	100.9 68.2 134.0	52.9 20.2 68.0	_	184 184 204	1 1 1
	250 250 300 300	42 42 62 62	3 3 4 4	1.1 1.1 1.5 1.5	197 000 300 000	234 000 213 000 335 000 310 000	_	2 200 2 000 2 000 1 700	3 000 2 800 2 600 2 400	77.3 102.8 94.5 123.3	154 154 158 158	236 236 282 282	2.5 2.5 3	8.92 8.94 21.4 21.6	7228 A 7228 B 7328 A 7328 B	(M) (M) (M) (M)	T T T	DB DF	DT DT	320 000 490 000	470 000 425 000 670 000 615 000	1 800 1 600 1 600 1 400	2 400 2 200 2 000 1 900	154.6 205.6 189.0 246.6	70.6 121.6 65.0 122.6		243 243 291 291	1 1 1.5 1.5
150	210 210 225	28 28 35	2 2 2.1	1 1 1.1	102 000	115 000 122 000 154 000	16.6 —	3 800 4 300 2 400	5 000 6 000 3 000	56.0 38.1 71.6	160 160 162	200 200 213	2 2 2	2.97 2.96 4.75	7930 A5 7930 C 7030 A	(M) (M) (M)	_ _ T	DB DF	DT	166 000	231 000 244 000 305 000	3 000 3 600 1 900	4 000 4 800 2 400	112.0 76.2 143.3	56.0 20.2 73.3		204 204 218	1 1 1
	270 270 320 320	45 45 65 65	3 3 4 4	1.1 1.1 1.5 1.5	225 000 315 000	280 000 254 000 370 000 340 000	_	2 000 1 800 1 800 1 600	2 800 2 600 2 400 2 200	83.1 110.6 100.3 131.1	164 164 168 168	256 256 302 302	2.5 2.5 3	11.2 11.2 26.0 25.9	7230 A 7230 B 7330 A 7330 B	(M) (M) (M) (M)		DB DF	DT DT	365 000 515 000	560 000 510 000 745 000 680 000	1 600 1 500 1 500 1 300	2 200 2 000 1 900 1 800	166.3 221.2 200.7 262.2	76.3 131.2 70.7 132.2	_ _ _		1 1 1.5 1.5
160	220 240 290	28 38 48	2 2.1 3	1 1.1 1.1	155 000	133 000 176 000 305 000	_	3 800 2 200 1 900	5 000 2 800 2 600	39.4 76.7 89.0	170 172 174	210 228 276	2 2 2.5	3.10 5.77 14.1	7932 C 7032 A 7232 A	(M) (M) (M)	TYN T T	DB DF	DT	252 000	265 000 355 000 615 000	3 000 1 700 1 500	4 000 2 400 2 000	78.9 153.5 177.9	22.9 77.5 81.9		214 233 283	1 1 1
	290 340 340	48 68 68	3 4 4	1.1 1.5 1.5	345 000	279 000 420 000 385 000	_	1 700 1 700 1 500	2 400 2 200 2 000	118.4 106.2 138.9	174 178 178	276 322 322	2.5 3 3	14.2 30.7 30.8	7232 B 7332 A 7332 B	(M) (M) (M)	T T	DB DF	DT	565 000	555 000 845 000 770 000	1 400 1 400 1 200	1 900 1 800 1 700	236.8 212.3 277.8	140.8 76.3 141.8			1 1.5 1.5
170	230 260 310	28 42 52	2 2.1 4	1 1.1 1.5	186 000	148 000 214 000 360 000	l —	3 600 2 000 1 800	4 800 2 600 2 400	40.8 83.1 95.3	180 182 188	220 248 292	2 2 3	3.36 7.90 17.3	7934 C 7034 A 7234 A	(M) (M) (M)	Ξ	DB DF	DT	300 000	297 000 430 000 715 000	2 800 1 600 1 400	3 800 2 200 1 900	81.6 166.1 190.6	25.6 82.1 86.6		224 253 301	1 1 1.5
	310 360 360	52 72 72	4 4 4	1.5 1.5 1.5	266 000 390 000 355 000		_	1 600 1 600 1 400	2 200 2 200 2 000	126.7 112.5 147.2	188 188 188	292 342 342	3 3 3	17.6 35.8 35.6	7234 B 7334 A 7334 B	(M) (M) (M)	_ 	DB DF	DT	630 000	650 000 970 000 890 000	1 300 1 300 1 100	1 700 1 700 1 600	253.4 225.0 294.3	149.4 81.0 150.3	_	301 351 351	1.5 1.5 1.5

- Notes (1) For applications operating near the limiting speed, refer to Page C077.
 (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.

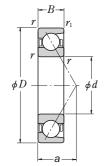
Note (4) (M) in the column of cage symbols are usually omitted from the bearing number.



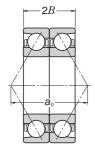


■ ANGULAR CONTACT BALL BEARINGS

SINGLE/MATCHED MOUNTINGS Bore Diameter 180 – 200 mm

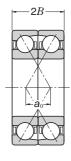


Single



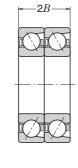
Back-to-Back

DB



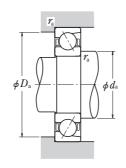
Face-to-Face

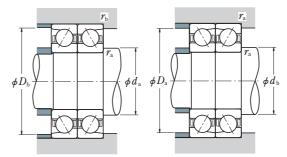
DF



Tandem

DT





Dynamic Equivalent Load $P = XF_r + YF_a$

Contact	$if_0F_a^*$			Singl	e, DT			DB c	r DF	
		e	F_a/F	$r \leq e$	F_a/F	r > e	F_a/F	$r \leq e$	F_a/F	r > e
Angle	Cor		X	Y	X	Y	X	Y	X	Y
	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
15º	1.07	0.46	1	0	0.44	1.23	1	1.38	0.72	2.00
15-	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
25º	_	0.68	1	0	0.41	0.87	1	0.92	0.67	1.41
30⁰	_	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40⁰	_	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 $P_0=X_0F_r+Y_0F_a$

Contact	Singl	e, DT	DB c	r DF
Angle	X_0	Y_0	X_0	Y_0
15º	0.5	0.46	1	0.92
25⁰	0.5	0.38	1	0.76
30₂	0.5	0.33	1	0.66
40º	0.5	0.26	1	0.52

Single or DT mounting
When $F_r > 0.5F_r + Y_0F_a$ use $P_0 = F_r$



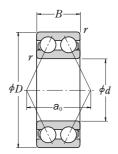
	Bounda	ary Dime (mm)	ensions			nd Ratings ngle)	Factor		Speeds (1) n-1)	Eff.Load Centers		ment and ensions (r		Mass (kg)	Ca	Beari ge Symb	ng Numbers ool (4)	(2)		(Mat		Limit Speeds (1)	(Matched)		s (mm)		nent and ensions (
d	D	B	γ min.	${m r}_1$ min.	$C_{\rm r}$	C_{0r}	f_0	Grease	Oil	(mm) a	$d_{ m a}$ min.	$D_{\rm a} \\ {\rm max.}$	${m \gamma}_{\rm a}$ max.	approx.	Single	Standar	d Option		Duplex	$C_{\rm r}$	C_{0r}	(mir Grease	Oil	DB DB	O DF	$d_{\mathrm{b}}^{(3)}$ min.	$D_{ m b}$ max.	$ {\pmb \gamma}_b(^3) \\ {\rm max}. $
180	250 280 320	33 46 52	2 2.1 4	1 1.1 1.5	145 000 207 000 305 000		_	3 200 1 900 1 700	4 500 2 400 2 200	45.3 89.4 98.2	190 192 198	240 268 302	2 2 3	4.90 10.5 18.1	7936 C 7036 A 7236 A	(M) (M) (M)	Ξ	DB	DF DT DF DT DF DT	335 000	370 000 505 000 770 000	2 600 1 500 1 400	3 600 2 000 1 800	90.6 178.8 196.3	24.6 86.8 92.3	_	244 273 311	1 1 1.5
	320 380 380	52 75 75	4 4 4	1.5 1.5 1.5		350 000 535 000 490 000	_	1 500 1 500 1 300	2 000 2 000 1 800	130.9 118.3 155.0	198 198 198	302 362 362	3 3 3	18.4 42.1 42.6	7236 B 7336 A 7336 B	(M) (M) (M)	=		DF DT DF DT DF DT		700 000 1 070 000 975 000	1 200 1 200 1 100		261.8 236.6 309.9	157.8 86.6 159.9	_ _ _	311 371 371	1.5 1.5 1.5
190	260 290 340	33 46 55	2 2.1 4	1 1.1 1.5	147 000 224 000 315 000		_	3 000 1 800 1 600	4 300 2 400 2 200	46.6 92.3 104.0	200 202 208	250 278 322	2 2 3	4.98 11.3 22.4	7938 C 7038 A 7238 A	(M) (M) (M)	TYN — —	DB	DF DT DF DT DF DT		385 000 560 000 825 000	2 400 1 400 1 300	3 400 1 900 1 700	93.3 184.6 208.0	27.3 92.6 98.0	_ _ _	254 283 331	1 1 1.5
	340 400 400	55 78 78	4 5 5	1.5 2 2		375 000 600 000 550 000	_	1 400 1 400 1 300	2 000 1 900 1 700	138.7 124.2 162.8	208 212 212	322 378 378	3 4 4	22.5 47.5 47.2	7238 B 7338 A 7338 B	(M) (M) (M)		DB	DF DT DF DT DF DT		750 000 1 200 000 1 100 000	1 100 1 100 1 000		277.3 248.3 325.5	167.3 92.3 169.5	_ _ _	331 390 390	1.5 2 2
200	280 310 360	38 51 58	2.1 2.1 4	1.1 1.1 1.5	240 000	244 000 310 000 450 000	_	2 800 1 700 1 500	4 000 2 200 2 000	51.2 99.1 109.8	212 212 218	268 298 342	2 2 3	6.85 13.7 26.5	7940 C 7040 A 7240 A	(M) (M) (M)	<u>T</u>	DB	DF DT DF DT DF DT	390 000	490 000 620 000 900 000	2 200 1 300 1 200	3 200 1 800 1 600	102.3 198.2 219.6	26.3 96.2 103.6	_ _ _	273 303 351	1 1 1.5
	360 420 420	58 80 80	4 5 5	1.5 2 2	475 000	410 000 660 000 600 000	_	1 300 1 300 1 200	1 800 1 800 1 600	146.5 129.5 170.1	218 222 222	342 398 398	3 4 4	26.6 54.4 55.3	7240 B 7340 A 7340 B	(M) (M) (M)	_ T _		DF DT	495 000 770 000 700 000	815 000 1 320 000 1 200 000	1 100 1 100 950		292.9 259.0 340.1	176.9 99.0 180.1	_ _ _	351 410 410	1.5 2 2

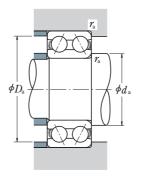
- **Notes** (1) For applications operating near the limiting speed, refer to Page C077.
 - (2) The suffixes A, A5, B, and C represent contact angles of 30°, 25°, 40°, and 15° respectively.
 - (3) For bearings marked in the column for d_b , d_b and r_b for shafts are d_a (min) and r_a (max) respectively.

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





Dynamic Equivalent Load

 $P = XF_{\rm r} + YF_{\rm a}$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e	
X	Y	X	Y	e
1	0.92	0.67	1.41	0.68

Static Equivalent Load

 $P_0 = F_r + 0.76 F_a$



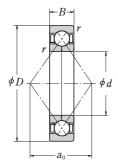
		ry Dimensions (mm)			nd Ratings		Speeds n ⁻¹)	Bearing	Load Center Spacings	Abutmen	t and Fillet D	Dimensions	Mass (kg)
<i>d</i>	D	В	γ min.	C_{r}	$C_{0\mathrm{r}}$	Grease	Oil	Numbers	(mm) <i>a</i> ₀	$d_{ m a}$ min.	$\begin{array}{c} D_{\rm a} \\ {\rm max.} \end{array}$	$m{r}_{ m a}$ max.	approx.
10	30	14.3	0.6	7 150	3 900	17 000	22 000	5200	14.5	15	25	0.6	0.050
12	32	15.9	0.6	10 500	5 800	15 000	20 000	5201	16.7	17	27	0.6	0.060
15	35	15.9	0.6	11 700	7 050	13 000	17 000	5202	18.3	20	30	0.6	0.070
	42	19	1	17 600	10 200	11 000	15 000	5302	22.0	21	36	1	0.13
17	40	17.5	0.6	14 600	9 050	11 000	15 000	5203	20.8	22	35	0.6	0.10
	47	22.2	1	21 000	12 600	10 000	13 000	5303	25.0	23	41	1	0.18
20	47	20.6	1	19 600	12 400	10 000	13 000	5204	24.3	26	41	1	0.16
	52	22.2	1.1	24 600	15 000	9 000	12 000	5304	26.7	27	45	1	0.22
25	52	20.6	1	21 300	14 700	8 500	11 000	5205	26.8	31	46	1	0.18
	62	25.4	1.1	32 500	20 700	7 500	10 000	5305	31.8	32	55	1	0.35
30	62	23.8	1	29 600	21 100	7 100	9 500	5206	31.6	36	56	1	0.30
	72	30.2	1.1	40 500	28 100	6 300	8 500	5306	36.5	37	65	1	0.57
35	72	27	1.1	39 000	28 700	6 300	8 000	5207	36.6	42	65	1	0.46
	80	34.9	1.5	51 000	36 000	5 600	7 500	5307	41.6	44	71	1.5	0.76
40	80	30.2	1.1	44 000	33 500	5 600	7 100	5208	41.5	47	73	1	0.62
	90	36.5	1.5	56 500	41 000	5 300	6 700	5308	45.5	49	81	1.5	1.03
45	85	30.2	1.1	49 500	38 000	5 000	6 700	5209	43.4	52	78	1	0.67
	100	39.7	1.5	68 500	51 000	4 500	6 000	5309	50.6	54	91	1.5	1.37
50	90	30.2	1.1	53 000	43 500	4 800	6 000	5210	45.9	57	83	1	0.72
	110	44.4	2	81 500	61 500	4 300	5 600	5310	55.6	60	100	2	1.84
55	100	33.3	1.5	56 000	49 000	4 300	5 600	5211	50.1	64	91	1.5	1.01
	120	49.2	2	95 000	73 000	3 800	5 000	5311	60.6	65	110	2	2.40
60	110	36.5	1.5	69 000	62 000	3 800	5 000	5212	56.5	69	101	1.5	1.33
	130	54	2.1	125 000	98 500	3 400	4 500	5312	69.2	72	118	2	2.92
65	120	38.1	1.5	76 500	69 000	3 600	4 500	5213	59.7	74	111	1.5	1.71
	140	58.7	2.1	142 000	113 000	3 200	4 300	5313	72.8	77	128	2	3.67
70	125	39.7	1.5	94 000	82 000	3 400	4 500	5214	63.8	79	116	1.5	1.75
	150	63.5	2.1	159 000	128 000	3 000	3 800	5314	78.3	82	138	2	4.55
75	130	41.3	1.5	93 500	83 000	3 200	4 300	5215	66.1	84	121	1.5	1.88
80	140	44.4	2	99 000	93 000	3 000	3 800	5216	69.6	90	130	2	2.51
85	150	49.2	2	116 000	110 000	2 800	3 600	5217	75.3	95	140	2	3.16

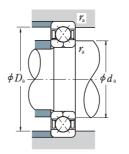


C 106 C 107

FOUR-POINT CONTACT BALL BEARINGS -

Bore Diameter 30 – 95 mm





Dynamic Equivalent Load

 $P_{\rm a} = F_{\rm a}$

Static Equivalent Load

 $P_{0a} = F_a$





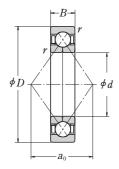
	Boundary (/ Dimensions		Basic Load	d Ratings	Limiting (mi		Bearing	Load Center Spacings	Abutmer	nt and Fillet [(mm)	Dimensions	Mass (kg)
d	D	B	r min.	$C_{\rm a}$	$C_{0\mathrm{a}}$	Grease	Oil	Numbers	(mm) a ₀	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{\gamma}_{\mathrm{a}}$ max.	approx.
30	62 72	16 19	1 1.1	31 000 46 000	45 000 63 000	8 500 8 000	12 000 11 000	QJ 206 QJ 306	32.2 35.7	36 37	56 65	1	0.24 0.42
35	72 80	17 21	1.1 1.5	41 000 55 000	61 500 80 000	7 500 7 100	10 000 9 500	QJ 207 QJ 307	37.5 40.3	42 44	65 71	1 1.5	0.35 0.57
40	80 90	18 23	1.1 1.5	49 000 67 000	77 500 100 000	6 700 6 300	9 000 8 500	QJ 208 QJ 308	42.0 45.5	47 49	73 81	1 1.5	0.45 0.78
45	85 100	19 25	1.1 1.5	55 000 87 500	88 500 133 000	6 300 5 600	8 500 7 500	QJ 209 QJ 309	45.5 50.8	52 54	78 91	1 1.5	0.52 1.05
50	90 110	20 27	1.1 2	57 000 102 000	97 000 159 000	5 600 5 000	8 000 6 700	QJ 210 QJ 310	49.0 56.0	57 60	83 100	1 2	0.59 1.35
55	100 120	21 29	1.5 2	71 000 118 000	122 000 187 000	5 300 4 500	7 100 6 300	QJ 211 QJ 311	54.3 61.3	64 65	91 110	1.5 2	0.77 1.75
60	110 130	22 31	1.5 2.1	85 500 135 000	150 000 217 000	4 800 4 300	6 300 5 600	QJ 212 QJ 312	59.5 66.5	69 72	101 118	1.5 2	0.98 2.15
65	120 140	23 33	1.5 2.1	97 500 153 000	179 000 250 000	4 300 3 800	6 000 5 300	QJ 213 QJ 313	64.8 71.8	74 77	111 128	1.5 2	1.2 2.7
70	125 150	24 35	1.5 2.1	106 000 172 000	197 000 285 000	4 000 3 600	5 600 5 000	QJ 214 QJ 314	68.3 77.0	79 82	116 138	1.5 2	1.3 3.18
75	130 160	25 37	1.5 2.1	110 000 187 000	212 000 320 000	3 800 3 400	5 300 4 800	QJ 215 QJ 315	71.8 82.3	84 87	121 148	1.5 2	1.5 3.9
80	125 140 170	22 26 39	1.1 2 2.1	77 000 124 000 202 000	167 000 236 000 360 000	3 800 3 600 3 200	5 300 5 000 4 300	QJ 1016 QJ 216 QJ 316	71.8 77.0 87.5	87 90 92	118 130 158	1 2 2	1.05 1.85 4.6
85	130 150 180	22 28 41	1.1 2 3	79 000 143 000 218 000	176 000 276 000 405 000	3 800 3 400 3 000	5 000 4 800 4 000	QJ 1017 QJ 217 QJ 317	75.3 82.3 92.8	92 95 99	123 140 166	1 2 2.5	1.1 2.2 5.34
90	140 160 190	24 30 43	1.5 2 3	94 000 164 000 235 000	208 000 320 000 450 000	3 400 3 200 2 800	4 800 4 300 3 800	QJ 1018 QJ 218 QJ 318	80.5 87.5 98.0	99 100 104	131 150 176	1.5 2 2.5	1.45 2.75 6.4
95	145 170 200	24 32 45	1.5 2.1 3	96 500 177 000 251 000	220 000 340 000 495 000	3 400 3 000 2 600	4 500 4 000 3 600	QJ 1019 QJ 219 QJ 319	84.0 92.8 103.3	104 107 109	136 158 186	1.5 2 2.5	1.5 3.35 7.4

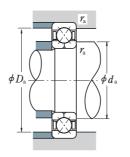
Remark When using four-point contact ball bearings, please contact NSK.

C 109 C 108

FOUR-POINT CONTACT BALL BEARINGS

Bore Diameter 100 – 200 mm





Dynamic Equivalent Load

 $P_{\rm a} = F_{\rm a}$

Static Equivalent Load

 $P_{0a} = F_a$



	Boundary Dimensions (mm)			Basic Load Ratings (N)		Limiting (Bearing	Load Center Spacings	Abutment and Fillet Dimensions (mm)			Mass (kg)
<i>d</i>	D	В	r min.	C_{a}	$C_{0\mathrm{a}}$	Grease	Oil	Numbers	(mm) <i>a</i> ₀	$d_{\scriptscriptstyle m a}$ min.	$D_{\rm a} \\ {\rm max.}$	$m{\gamma}_{\mathrm{a}}$ max.	approx.
100	150 180 215	24 34 47	1.5 2.1 3	98 500 199 000 300 000	232 000 390 000 640 000	3 200 2 800 2 400	4 300 3 800 3 400	QJ 1020 QJ 220 QJ 320	87.5 98.0 110.3	109 112 114	141 168 201	1.5 2 2.5	1.6 4.0 9.3
105	160 190 225	26 36 49	2 2.1 3	115 000 217 000 305 000	269 000 435 000 640 000	3 000 2 600 2 400	4 000 3 600 3 200	QJ 1021 QJ 221 QJ 321	92.8 103.3 115.5	115 117 119	150 178 211	2 2 2.5	2.0 4.7 10.5
110	170 200 240	28 38 50	2 2.1 3	139 000 235 000 320 000	315 000 490 000 710 000	2 800 2 600 2 200	3 800 3 400 3 000	QJ 1022 QJ 222 QJ 322	98.0 108.5 122.5	120 122 124	160 188 226	2 2 2.5	2.5 5.6 12.5
120	180 215 260	28 40 55	2 2.1 3	147 000 265 000 360 000	350 000 585 000 835 000	2 600 2 400 2 000	3 600 3 200 2 800	QJ 1024 QJ 224 QJ 324	105.0 117.3 133.0	130 132 134	170 203 246	2 2 2.5	2.65 6.9 15.4
130	200 230 280	33 40 58	2 3 4	169 000 274 000 400 000	415 000 635 000 970 000	2 400 2 200 1 900	3 200 3 000 2 600	QJ 1026 QJ 226 QJ 326	115.5 126.0 143.5	140 144 148	190 216 262	2 2.5 3	4.0 7.7 19
140	210 250 300	33 42 62	2 3 4	172 000 315 000 440 000	435 000 775 000 1 110 000	2 200 2 000 1 700	3 000 2 800 2 400	QJ 1028 QJ 228 QJ 328	122.5 136.5 154.0	150 154 158	200 236 282	2 2.5 3	4.3 9.8 24
150	225 270 320	35 45 65	2.1 3 4	197 000 360 000 460 000	505 000 925 000 1 230 000	2 000 1 800 1 600	2 800 2 600 2 200	QJ 1030 QJ 230 QJ 330	131.3 147.0 164.5	162 164 168	213 256 302	2 2.5 3	5.2 12 29
160	240 290 340	38 48 68	2.1 3 4	224 000 380 000 505 000	580 000 1 010 000 1 400 000	1 900 1 700 1 500	2 600 2 400 2 000	QJ 1032 QJ 232 QJ 332	140.0 157.5 175.1	172 174 178	228 276 322	2 2.5 3	6.4 15 31
170	260 310 360	42 52 72	2.1 4 4	268 000 425 000 565 000	705 000 1 180 000 1 610 000	1 800 1 600 1 400	2 400 2 200 2 000	QJ 1034 QJ 234 QJ 334	150.5 168.0 185.6	182 188 188	248 292 342	2 3 3	8.6 19.5 41
180	280 320 380	46 52 75	2.1 4 4	299 000 440 000 595 000	830 000 1 270 000 1 770 000	1 700 1 500 1 300	2 200 2 000 1 800	QJ 1036 QJ 236 QJ 336	161.0 175.1 196.1	192 198 198	268 302 362	2 3 3	11 20.5 48
190	290 340 400	46 55 78	2.1 4 5	325 000 440 000 655 000	925 000 1 290 000 1 980 000	1 600 1 400 1 300	2 200 2 000 1 700	QJ 1038 QJ 238 QJ 338	168.0 185.6 206.6	202 208 212	278 322 378	2 3 4	11.5 23 54.5
200	310 360 420	51 58 80	2.1 4 5	345 000 490 000 690 000	1 020 000 1 480 000 2 180 000	1 500 1 300 1 200	2 000 1 800 1 600	QJ 1040 QJ 240 QJ 340	178.6 196.1 217.1	212 218 222	298 342 398	2 3 4	15 27 61.5

Remark When using four-point contact ball bearings, please contact NSK.

C 110 C 111



4.	SEL	.F-/	AL	IGNI	NG	BALL	BEARINGS
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INTRODUCTION C 114
BEARINGS TABLE
SELF-ALIGNING BALL BEARINGS
Bore Diameter 5 – 110 mm C 116





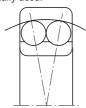


C 112

DESIGN, TYPES, AND FEATURES

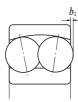
The outer ring has a spherical raceway and its center of curvature coincides with that of the bearing; therefore, the axis of the inner ring, balls and cage can deflect to some extent around the bearing center. This type is recommended when the alignment of the shaft and housing is difficult and when 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.	<i>b</i> ₁ (mm)					
2222(K), 2316(K)	0.5					
2319(K), 2320(K) 2321 , 2322(K)	0.5					
1318(K)	1.5					
1319(K)	2					
1320(K), 1321 1322(K)	3					

ACCURACY Table 7.2 (Pages A	A128 to A131
RECOMMENDED FITS Table 8.3 (Page A	,

INTERNAL CLEARANCE...... Table 8.13 (Page A170)

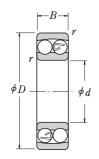
PERMISSIBLE MISALIGNMENT

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.

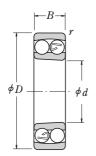


SELF-ALIGNING BALL BEARINGS

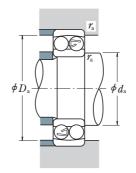
Bore Diameter 5 – 30 mm







Tapered Bore



Dynamic Equivalent Load

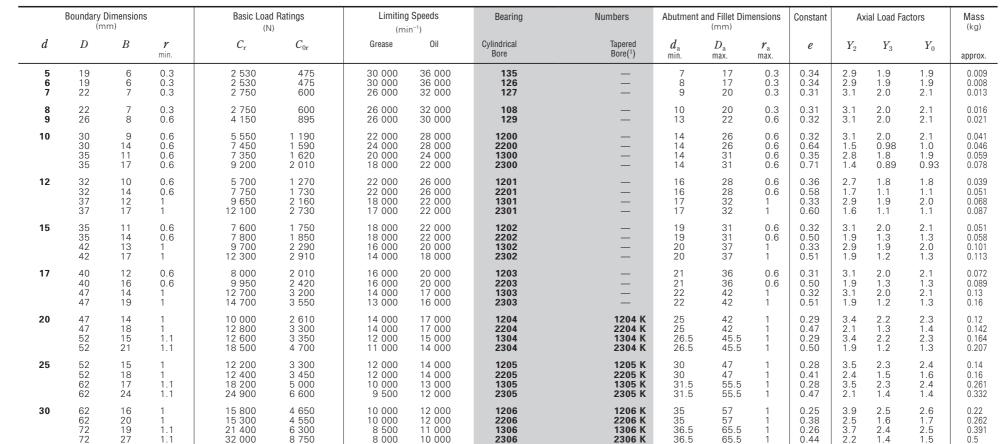
$P = XF_r + Y$	YF
----------------	----

F_a/F	r≤e	$F_{\rm a}/F_{\rm r}{>}e$					
X	Y	X	Y				
1	Y_3	0.65	Y_2				

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are listed in the table below.



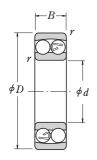
Note (1) The suffix K represents bearings with tapered bores (1 : 12)

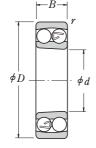
Remark For the dimensions related to adapters, refer to Page C348.





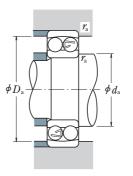
Bore Diameter 35 - 70 mm





Cylindrical Bore

Tapered Bore



Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/F$	r≤e	$F_{\rm a}/F_{\rm r} > e$					
X	Y	X	Y				
1	Y_3	0.65	Y_2				

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are listed in the table below.

		Dimension	S	Basic Load Ratings (N)		Limiting Speeds (min ⁻¹)		Bearing	Numbers	Abutment	and Fillet Dir	nensions	Constant	t Axial Load Factors		actors	Mass (kg)
d	D	B	γ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore	Tapered Bore(1)	$d_{ m a}$ min.	D_{a} max.	${m \gamma}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
35	72	17	1.1	15 900	5 100	8 500	10 000	1207	1207 K	41.5	65.5	1	0.23	4.2	2.7	2.8	0.33
	72	23	1.1	21 700	6 600	8 500	10 000	2207	2207 K	41.5	65.5	1	0.37	2.6	1.7	1.8	0.403
	80	21	1.5	25 300	7 850	7 500	9 500	1307	1307 K	43	72	1.5	0.26	3.8	2.5	2.6	0.52
	80	31	1.5	40 000	11 300	7 100	9 000	2307	2307 K	43	72	1.5	0.46	2.1	1.4	1.4	0.671
40	80	18	1.1	19 300	6 500	7 500	9 000	1208	1208 K	46.5	73.5	1	0.22	4.3	2.8	2.9	0.42
	80	23	1.1	22 400	7 350	7 500	9 000	2208	2208 K	46.5	73.5	1	0.33	3.0	1.9	2.0	0.506
	90	23	1.5	29 800	9 700	6 700	8 500	1308	1308 K	48	82	1.5	0.24	4.0	2.6	2.7	0.727
	90	33	1.5	45 500	13 500	6 300	8 000	2308	2308 K	48	82	1.5	0.43	2.3	1.5	1.5	0.918
45	85	19	1.1	22 000	7 350	7 100	8 500	1209	1209 K	51.5	78.5	1	0.21	4.7	3.0	3.1	0.47
	85	23	1.1	23 300	8 150	7 100	8 500	2209	2209 K	51.5	78.5	1	0.30	3.2	2.1	2.2	0.556
	100	25	1.5	38 500	12 700	6 000	7 500	1309	1309 K	53	92	1.5	0.25	4.0	2.6	2.7	0.971
	100	36	1.5	55 000	16 700	5 600	7 100	2309	2309 K	53	92	1.5	0.41	2.4	1.5	1.6	1.2
50	90	20	1.1	22 800	8 100	6 300	8 000	1210	1210 K	56.5	83.5	1	0.21	4.7	3.1	3.2	0.535
	90	23	1.1	23 300	8 450	6 300	8 000	2210	2210 K	56.5	83.5	1	0.28	3.4	2.2	2.3	0.598
	110	27	2	43 500	14 100	5 600	6 700	1310	1310 K	59	101	2	0.23	4.2	2.7	2.8	1.23
	110	40	2	65 000	20 200	5 000	6 300	2310	2310 K	59	101	2	0.42	2.3	1.5	1.6	1.63
55	100	21	1.5	26 900	10 000	6 000	7 100	1211	1211 K	63	92	1.5	0.20	4.9	3.2	3.3	0.708
	100	25	1.5	26 700	9 900	6 000	7 100	2211	2211 K	63	92	1.5	0.28	3.5	2.3	2.4	0.807
	120	29	2	51 500	17 900	5 000	6 300	1311	1311 K	64	111	2	0.23	4.2	2.7	2.8	1.6
	120	43	2	76 500	24 000	4 800	6 000	2311	2311 K	64	111	2	0.41	2.4	1.5	1.6	2.08
60	110	22	1.5	30 500	11 500	5 300	6 300	1212	1212 K	68	102	1.5	0.18	5.3	3.4	3.6	0.91
	110	28	1.5	34 000	12 600	5 300	6 300	2212	2212 K	68	102	1.5	0.28	3.5	2.3	2.4	1.1
	130	31	2.1	57 500	20 800	4 500	5 600	1312	1312 K	71	119	2	0.23	4.3	2.8	2.9	2.0
	130	46	2.1	88 500	28 300	4 300	5 300	2312	2312 K	71	119	2	0.40	2.4	1.6	1.6	2.58
65	120	23	1.5	31 000	12 500	4 800	6 000	1213	1213 K	73	112	1.5	0.17	5.7	3.7	3.8	1.16
	120	31	1.5	43 500	16 400	4 800	6 000	2213	2213 K	73	112	1.5	0.28	3.5	2.3	2.4	1.5
	140	33	2.1	62 500	22 900	4 300	5 300	1313	1313 K	76	129	2	0.23	4.2	2.7	2.9	2.47
	140	48	2.1	97 000	32 500	3 800	4 800	2313	2313 K	76	129	2	0.39	2.5	1.6	1.7	3.2
70	125 125 150 150	24 31 35 51	1.5 1.5 2.1 2.1	35 000 44 000 75 000 111 000	13 800 17 100 27 700 37 500	4 800 4 500 4 000 3 600	5 600 5 600 5 000 4 500	1214 2214 1314 2314	=	78 78 81 81	117 117 139 139	1.5 1.5 2 2	0.18 0.26 0.22 0.38	5.3 3.7 4.4 2.6	3.4 2.4 2.8 1.7	3.6 2.5 3.0 1.8	1.3 1.55 3.03 3.9

Note (1) The suffix K represents bearings with tapered bores (1 : 12)

Remark For the dimensions related to adapters, refer to Pages C348 and C349.

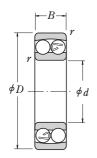




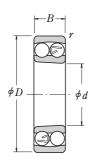
C 118 C 119

SELF-ALIGNING BALL BEARINGS

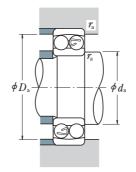
Bore Diameter 75 - 110 mm







Tapered Bore



Dynamic Equivalent Load

P	$=XF_{r}$	+	Y	F	7

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F_{\rm r}{>}e$					
X	Y	X	Y				
1	Y_3	0.65	Y_2				

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are listed in the table below.



		Dimension nm)	S	Basic Load Ratings (N)		Limiting Speeds (min ⁻¹)		Bearing	Numbers	Abutment	and Fillet Di	imensions	Constant	Axial Load Factors			Mass (kg)
d	D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	Cylindrical Bore	Tapered Bore(1)	$d_{ m a}$ min.	$D_{\rm a} \\ {\rm max.}$	${m \gamma}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
75	130	25	1.5	39 000	15 700	4 300	5 300	1215	1215 K	83	122	1.5	0.17	5.6	3.6	3.8	1.41
	130	31	1.5	44 500	17 800	4 300	5 300	2215	2215 K	83	122	1.5	0.25	3.9	2.5	2.6	1.6
	160	37	2.1	80 000	30 000	3 800	4 500	1315	1315 K	86	149	2	0.22	4.4	2.8	2.9	3.63
	160	55	2.1	125 000	43 000	3 400	4 300	2315	2315 K	86	149	2	0.38	2.5	1.6	1.7	4.78
80	140	26	2	40 000	17 000	4 000	5 000	1216	1216 K	89	131	2	0.16	6.0	3.9	4.1	1.73
	140	33	2	49 000	19 900	4 000	5 000	2216	2216 K	89	131	2	0.25	3.9	2.5	2.7	2.02
	170	39	2.1	89 000	33 000	3 600	4 300	1316	1316 K	91	159	2	0.22	4.5	2.9	3.1	4.24
	170	58	2.1	130 000	45 000	3 200	4 000	* 2316	* 2316 K	91	159	2	0.39	2.5	1.6	1.7	5.63
85	150	28	2	49 500	20 800	3 800	4 500	1217	1217 K	94	141	2	0.17	5.7	3.7	3.8	2.09
	150	36	2	58 500	23 600	3 800	4 800	2217	2217 K	94	141	2	0.25	3.9	2.5	2.6	2.56
	180	41	3	98 500	38 000	3 400	4 000	1317	1317 K	98	167	2.5	0.21	4.6	2.9	3.1	5.03
	180	60	3	142 000	51 500	3 000	3 800	2317	2317 K	98	167	2.5	0.37	2.6	1.7	1.8	6.56
90	160	30	2	57 500	23 500	3 600	4 300	1218	1218 K	99	151	2	0.17	5.8	3.8	3.9	2.55
	160	40	2	70 500	28 700	3 600	4 300	2218	2218 K	99	151	2	0.27	3.7	2.4	2.5	3.22
	190	43	3	117 000	44 500	3 200	3 800	* 1318	* 1318 K	103	177	2.5	0.22	4.3	2.8	2.9	5.83
	190	64	3	154 000	57 500	2 800	3 600	2318	2318 K	103	177	2.5	0.38	2.6	1.7	1.7	7.75
95	170	32	2.1	64 000	27 100	3 400	4 000	1219	1219 K	106	159	2	0.17	5.8	3.7	3.9	3.21
	170	43	2.1	84 000	34 500	3 400	4 000	2219	2219 K	106	159	2	0.27	3.7	2.4	2.5	3.96
	200	45	3	129 000	51 000	3 000	3 600	* 1319	* 1319 K	108	187	2.5	0.23	4.3	2.8	2.9	6.79
	200	67	3	161 000	64 500	2 800	3 400	* 2319	* 2319 K	108	187	2.5	0.38	2.6	1.7	1.8	8.97
100	180	34	2.1	69 500	29 700	3 200	3 800	1220	1220 K	111	169	2	0.17	5.6	3.6	3.8	3.82
	180	46	2.1	94 500	38 500	3 200	3 800	2220	2220 K	111	169	2	0.27	3.7	2.4	2.5	4.71
	215	47	3	140 000	57 500	2 800	3 400	* 1320	* 1320 K	113	202	2.5	0.24	4.1	2.7	2.8	8.4
	215	73	3	187 000	79 000	2 400	3 200	* 2320	* 2320 K	113	202	2.5	0.38	2.6	1.7	1.8	11.5
105	190 190 225 225	36 50 49 77	2.1 2.1 3 3	75 000 109 000 154 000 200 000	32 500 45 000 64 500 87 000	3 000 3 000 2 600 2 400	3 600 3 600 3 200 3 000	1221 2221 * 1321 * 2321	= =	116 116 118 118	179 179 212 212	2 2 2.5 2.5	0.18 0.28 0.23 0.38	5.5 3.5 4.2 2.6	3.6 2.3 2.7 1.7	3.7 2.4 2.9 1.7	4.52 5.73 9.58 14.5
110	200	38	2.1	87 000	38 500	2 800	3 400	1222	1222 K	121	189	2	0.17	5.7	3.7	3.9	5.33
	200	53	2.1	122 000	51 500	2 800	3 400	* 2222	* 2222 K	121	189	2	0.28	3.5	2.2	2.3	6.75
	240	50	3	161 000	72 000	2 400	3 000	* 1322	* 1322 K	123	227	2.5	0.22	4.4	2.8	3.0	11.5
	240	80	3	211 000	94 500	2 200	2 800	* 2322	* 2322 K	123	227	2.5	0.37	2.6	1.7	1.8	17.5

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

Remark For the dimensions related to adapters, refer to Pages C350 and C351.



C 120 C 121



. CYLINDRICAL RO	LLER BEARINGS	
SINGLE-ROW AND DOU	BLE-ROW CYLINDRICAL ROLLER	BEARINGS
INTRODUCTION		C 124
TECHNICAL DATA		
Free Space of Cylindri	ical Roller Bearings	C 130
BEARINGS TABLE		
Single-Row Cylindrica	l Roller Bearings	
	Bore Diameter 20 – 500 mm ·····	C 132
L-Shaped Thrust Colla	rs For Cylindrical Roller Bearin	gs
	Bore Diameter 20 – 320 mm ·····	C 156
Double-Row Cylindric	al Roller Bearings	
	Bore Diameter 25 – 360 mm ·····	C 158
FULL COMPLEMENT C	YLINDRICAL ROLLER BEARINGS	
SINGLE-ROW(NCF), D	OUBLE-ROW(NNCF) AND FOR S	HEAVES
INTRODUCTION		C 162
BEARINGS TABLE		
Single-Row(NCF)	Bore Diameter 100 – 800 mm·····	C 166
Double-Row(NNCF)	Bore Diameter 100 – 500 mm	C 170
For Sheaves Open Typ	e Fixed-End Bearing RS-48E4,	RS-49E4
	Free-End Bearing RSF-48E4,	RSF-49E4
	Bore Diameter 50 – 560 mm	C 174
For Sheaves Prelubric	ated Type RS-50, RS-50NR	
	Bore Diameter 40 – 400 mm ·····	C 178

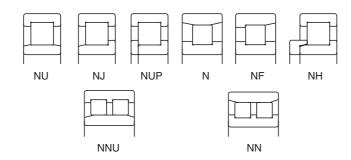




C 122

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 C156 and C157).

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 Spec.	Material	Steel	Steel	Polyamide 66 resin	L-PPS resin	Bra	ass	
	Method	pres	ssed	Mol	ded	machined		
	Symbols	W	EW	ET	ET7	M	EM	
	High Load Capacity	0	0	0	0	Δ	0	
Features	High-Speed	Δ	0	0	0	0	0	
	High-Temperature	0	0	Δ	0	0	0	
	Vibration	×	×	×	×	Δ	0	

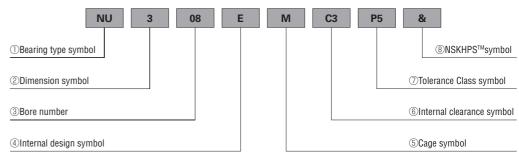
For a given bearing number, if the type of cage is not the standard one, the number of rollers may vary; in such a case, the load rating will differ from the one listed in the bearing tables.

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

(Outer ring with both ribs + Inner ring without rib) Please refer to page C124 for detailed information.

②Dimension symbol 10:10 Series, 2:02 Series, 2:22 Series, 3:03 Series, 23:23 Series, 4:04 Series,

③Bore number Less than 03, Bearing bore 01:12mm, 02:15mm, 03:17mm

Over 04, Bearing bore Bore number X 5 (mm)

4 Internal design symbol E: High Load Capacity

⑤Cage symbol W: Pressed Steel Cage, M: Machined Brass Cage, No symbol: Machined Brass Cage(In case of 10

Series) T: Polyamide 66 Resin Cage, T7: L-PPS Resin Cage

(6) Internal clearance symbol For All Radial Brgs.

Omitted: CN clearance, C3: Clearance greater than CN, C4: Clearance

greater than C3, CG: Special Clearance

For Non-Interchangeable Cylindrical Roller Bearings

CC: Normal Clearance, CC3: Clearance greater than CC, CC4: Clearance

greater than CC3, CCG: Special Clearance Omitted: ISO Normal, P6: ISO Class 6, P5: ISO Class 5, P4: ISO Class 4

a MOULIBOTHO I I

Tolerance Class : ISO Normal

NSKHPS™ Cylindrical Roller Bearings

Features (

Tolerance class symbol

Compared to the conventional bearing



1. Improved reliability

Bearing life has increased by a maximum of 60% compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology.

2. Wide-range product line-up

NSK has offerd the wide-range line-up of NSKHPS bearings with four types of cages focusing on a wide range of sizes offering a high degree of versatility for various general-purpose applications.

- Pressed steel cage with high cost perfomance
- · Highly reliable machined brass cage
- Polyamide resin cage that excels in heat resistance and chemical resistance





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

CYLINDRICAL ROLLER BEARINGS Table 7.2 (Pages A128 to A131) NSKHPS CYLINDRICAL ROLLER BEARINGS

NSKHPS CYLINDRICAL ROLLER BEAKING Tolerance for Dimensions : ISO Normal Running Accuracy : ISO Normal

DOUBLE-ROW CYLINDRICAL ROLLER

BEARINGS Table 7.2 (Pages A128 to A131)

Table 2 Tolerances for Roller Inscribed Circle Diameter $F_{\rm w}$ and Roller Circumscribed Circle Diameter $E_{\rm w}$ of Cylindrical Roller Bearings Having Interchangeable Rings

Nomina Diameter		Tolerances fo NU, NJ, NUP, NF	or $F_{ m w}$ of types H, and NNU ${ extstyle \Delta F_{ m w}}$	Tolerances for E_{w} of types N, NF, and NN \varDelta 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	-2 5		
200	250	+30	0	0	-30		
250	315	+35	0	0	-35		
315	400	+40	0	0	-40		
400	500	+45	0	_	_		

RECOMMENDED FITS

CYLINDRICAL ROLLER BEARINGS	Table 8.3	(Page A	164)
	Table 8.5	(Page A	165)
DOUBLE-ROW CYLINDRICAL ROLLER			
BEARINGS	Table 8.3	(Page A	164)
	Table 8.5	(Page A	165)

INTERNAL CLEARANCES

CYLINDRICAL ROLLER BEARINGS.....Table 8.15 (Page A171)

NSKHPS CYLINDRICAL ROLLER BEARINGS

INTERNAL CLEARANCE SYMBOL: CN, C3, C4

DOUBLE-ROW CYLINDRICAL ROLLER BEARINGS....Table 8.15 (Page 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 10.0012 radian (4') Cylindrical Roller Bearings of width series 2......0.0006 radian (2') For double-row cylindrical roller bearings, nearly no misalignment is allowed.





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LIMITING SPEEDS (Mechanical)

In some single row cylindrical roller bearings, optional cage types are available for special purposes or customer requests. The limiting speeds (mechanical) in the bearing tables are the values for the standard cage type. Please consult with NSK about 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.





C 128

TECHNICAL DATA

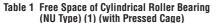
Free Space of Cylindrical Roller Bearings

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 hightension 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 cm³. This result was calculated by multiplying the free space 52 cm³ of NU310 in Table 1 by the space ratio 0.90 for the NJ type (Table 3).



Units: cm3

				Units: cm
		Bearing f	ree space	
Bearing bore No.		Bearing	g series	
5010 140.	NU2	NU3	NU22	NU23
05	6.6	11	7.8	16
06	9.6	17	12	24
07	14	22	18	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: cm3

Bearing bore No	NU2 5.0 7.4 9.6	NU3 7.6 12 16	series NU22 5.7 7.9 12	NU23 10 16 27
05 06 07 08 09	5.0 7.4 9.6 12	7.6 12 16	5.7 7.9 12	10 16 27
06 07 08 09	7.4 9.6 12 15	12 16 21	7.9 12	16 27
07 08 09	9.6 12 15	16 21	12	27
08 09	12 15	21		
09	15		15	00
09	15		15	
	-			32
10		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 1	15	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

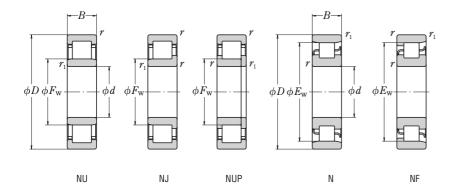




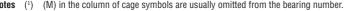
C 130 C 131

SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

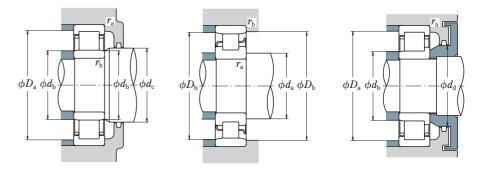
Bore Diameter 20 - 30 mm



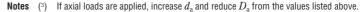
		Bou	ndary Dir (mm				Basic Loa			Speeds (min ⁻¹)	
d	D	B	γ min.	${m r}_1$ min.	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
20	47 47 47	14 14 18	1 1 1	0.6 0.6 0.6	26.5 27	40 	15 400 25 700 20 700	12 700 22 600 18 400	18 000 16 000 19 000	_ _ _	12 000 13 000 11 000
	52 52 52 52	15 15 21 21	1.1 1.1 1.1 1.1	0.6 0.6 0.6 0.6	— 27.5 28.5 27.5	44.5 — — —	21 400 31 500 30 500 42 000	17 300 26 900 27 200 39 000	14 000 13 000 14 000 13 000	_ _ _	10 000 12 000 11 000 11 000
25	47 52 52	12 15 15	0.6 1 1	0.3 0.6 0.6	30.5 — 31.5	45 —	14 300 17 700 33 500	13 100 15 700 27 700	15 000 16 000 14 000	_ _ 17 000	15 000 10 000 12 000
	52 52 52	15 18 18	1 1 1	0.6 0.6 0.6	31.5 31.5 31.5	=	29 300 40 000 35 000	27 700 34 500 34 500	14 000 14 000 14 000	17 000 20 000 20 000	12 000 12 000 12 000
	62 62 62	17 17 17	1.1 1.1 1.1	1.1 1.1 1.1	— 34 34	53 	29 300 48 000 41 500	25 200 37 500 37 500	12 000 11 000 11 000	 15 000 15 000	8 000 10 000 10 000
	62 62 80	24 24 21	1.1 1.1 1.5	1.1 1.1 1.5	34 34 38.8	— — 62.8	65 500 57 000 46 500	56 000 56 000 40 000	11 000 11 000 9 500	18 000 18 000 —	9 000 9 000 7 100
30	55 62 62	13 16 16	1 1 1	0.6 0.6 0.6	36.5 — 37.5	48.5 53.5 —	19 700 24 900 45 000	19 600 23 300 37 500	13 000 13 000 12 000	_ _ 14 000	12 000 8 500 9 500
	62 62 62	16 20 20	1 1 1	0.6 0.6 0.6	37.5 37.5 37.5	=	39 000 56 500 49 000	37 500 50 000 50 000	12 000 12 000 12 000	14 000 17 000 17 000	9 500 9 500 9 500
	72 72 72	19 19 19	1.1 1.1 1.1	1.1 1.1 1.1	— 40.5 40.5	62 	38 500 61 000 53 000	35 000 50 000 50 000	10 000 9 500 9 500	13 000 13 000	7 100 8 500 8 500
	72 72 90	27 27 23	1.1 1.1 1.5	1.1 1.1 1.5	40.5 40.5 45	— 73	86 000 74 500 62 500	77 500 77 500 55 000	9 500 9 500 8 500	16 000 16 000 —	8 000 8 000 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 C156) are used, the bearings become the NH type.



	Bea	ring Numl	oers	(9)					Ab	utment	and F	illet Dim m)	ensions	3			Mass (kg)
	Ŭ	symbol(1) rd Option	NU	(2) NJ NUF	N	NF	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}{}^{\!({\rm 3})}_{\rm max.}$	$D_{\rm b} \\ {\rm max.}$	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_{b}$ max.	approx.
N 204 NU204E NU2204	W T W	— Т7 М	NU NU	NJ NUI		NF —	25 25 25	 24 24	 25 25	 29 29	32 32	 42 42	43 	42 —	1 1 1	0.6 0.6 0.6	0.107 0.107 0.144
N 304 NU304E NU2304 NU2304E	W T M T7	 T7 _	NU	ON NUR	9 –	NF 	26.5 26.5 26.5 26.5	24 24 24	— 26 27 26	30 30 30	33 33 33	 45.5 45.5 45.5	48 — — —	46 — —	1 1 1	0.6 0.6 0.6 0.6	0.148 0.145 0.217 0.209
NU1005 N 205 * NU205E	(M) W W	— M M, T, T7	NU NU			NF	30 30	27 — 29	30 30	32 — 34	_ 37	43 — 47	 48 	— 46 —	0.6 1 1	0.3 0.6 0.6	0.094 0.135 0.136
NU205E * NU2205E NU2205E	W M M	M, T, T7 T, T7 T, T7	NU	NJ NUF NJ NUF	–	_	30 30 30	29 29 29	30 30 30	34 34 34	37 37 37	47 47 47	_	_	1 1 1	0.6 0.6 0.6	0.136 0.16 0.16
N 305 * NU305E NU305E	W W W	M M, T, T7 M, T, T7			–	NF —	31.5 31.5 31.5	— 31.5 31.5	— 32 32	— 37 37	40 40	— 55.5 55.5	55.5 — —	50 —	1 1 1	1 1 1	0.233 0.269 0.269
*NU2305E NU2305E NU405	M M W	T, T7 T, T7 —		NJ NUF NJ NUF	–		31.5 31.5 33	31.5 31.5 33	32 32 37	37 37 41	40 40 46	55.5 55.5 72	_ 72	_ 64	1 1 1.5	1 1 1.5	0.338 0.338 0.57
NU1006 N 206 * NU206E	(M) W W	— M M, T, T7	NU NU			NF	35 35 35	34 — 34	36 — 36	38 — 40	_ 44	50 — 57	51 58 —	49 56 —	1 1 1	0.5 0.6 0.6	0.136 0.208 0.205
NU206E * NU2206E NU2206E	W M M	M, T, T7 T, T7 T, T7	NU	NJ NUF NJ NUF	–	_	35 35 35	34 34 34	36 36 36	40 40 40	44 44 44	57 57 57	_	_	1 1 1	0.6 0.6 0.6	0.205 0.255 0.255
N 306 * NU306E NU306E	W W W	M M, T, T7 M, T, T7			—		36.5 36.5 36.5	— 36.5 36.5	— 39 39	— 44 44	— 48 48	— 65.5 65.5	65.5 — —	64 —	1 1 1	1 1 1	0.353 0.409 0.409
*NU2306E NU2306E NU406	M M W	T, T7 T, T7 M		NJ NUF NJ NUF NJ —	–	_ _ NF	36.5 36.5 38	36.5 36.5 38	39 39 43	44 44 47	48 48 52	65.5 65.5 82	_ 82	— 75	1 1 1.5	1 1 1.5	0.518 0.518 0.758



⁽⁴⁾ $d_{\rm b}$ (max.) are values for adjusting rings for NU, NJ Types.

Remark The bearings denoted by an asterisk (*) are NSKHPS™ Cylindrical roller bearings.

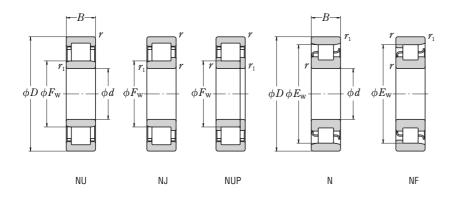




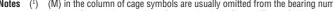
⁽⁵⁾ The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

Bore Diameter 35 - 40 mm

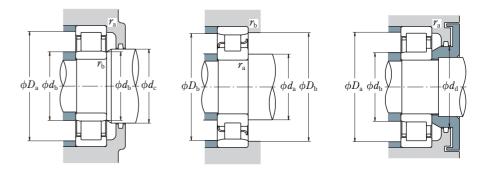
SINGLE-ROW CYLINDRICAL ROLLER BEARINGS



		Bou	ndary Dir (mm	nensions)				ad Ratings N)	Thermal	Speeds (min ⁻¹)	
d	D	B	γ min.	${m r}_1$ min.	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	$C_{ m r}$ $C_{0 m r}$		Limiting (5) Mechanical	Speeds Grease
35	62 72 72	14 17 17	1 1.1 1.1	0.6 0.6 0.6	42 — 44	55 61.8 —	22 600 35 500 58 000	23 200 34 000 50 000	11 000 11 000 10 000	_ _ 12 000	11 000 7 500 8 500
	72 72 72	17 23 23	1.1 1.1 1.1	0.6 0.6 0.6	44 44 44	=	50 500 71 000 61 500	50 000 65 500 65 500	10 000 11 000 11 000	12 000 15 000 15 000	8 500 8 500 8 500
	80 80 80	21 21 21	1.5 1.5 1.5	1.1 1.1 1.1	— 46.2 46.2	68.2 —	49 500 76 500 66 500	47 000 65 500 65 500	9 500 8 500 8 500	— 11 000 11 000	6 300 7 500 7 500
	80 80 100	31 31 25	1.5 1.5 1.5	1.1 1.1 1.5	46.2 46.2 53	— 83	107 000 93 000 75 500	101 000 101 000 69 000	9 000 9 000 7 500	14 000 14 000 —	6 700 6 700 5 300
40	68 80 80	15 18 18	1 1.1 1.1	0.6 1.1 1.1	47 — 49.5	61 70 —	27 300 43 500 64 000	29 000 43 000 55 500	10 000 9 500 9 000	_ _ 11 000	10 000 6 700 7 500
	80 80 80	18 23 23	1.1 1.1 1.1	1.1 1.1 1.1	49.5 49.5 49.5	=	55 500 83 000 72 500	55 500 77 500 77 500	9 000 9 000 9 000	11 000 13 000 13 000	7 500 7 500 7 500
	90 90 90	23 23 23	1.5 1.5 1.5	1.5 1.5 1.5	52 52	77.5 — —	58 500 95 500 83 000	57 000 81 500 81 500	8 500 7 500 7 500	10 000 10 000	5 600 6 700 6 700
	90 90 110	33 33 27	1.5 1.5 2	1.5 1.5 2	52 52 58	<u> </u>	131 000 114 000 95 500	122 000 122 000 89 000	8 000 8 000 6 700	12 000 12 000 —	6 000 6 000 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 C156) are used, the bearings become the NH type.



	Bearing Numbers			Ab	utmen		illet Dim m)	ension	S			Mass (kg)
	Cage symbol ⁽¹⁾ NU NJ NUP N N Standard Option	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}{}^{\scriptscriptstyle (4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}{}^{\!\! (3)}_{\rm max.}$	$\begin{array}{c} D_{\rm b} \\ {\rm max.} \end{array}$	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1007 N 207 *NU207E	(M) — NU NJ — N — W M — — — N N W M, T, T7 NU NJ NUP — —	40 41.5 41.5	39 — 39	41 — 42	44 — 46	_ 50	57 — 65.5	58 68 —	56 64 —	1 1 1	0.5 0.6 0.6	0.18 0.301 0.304
NU207E * NU2207E NU2207E	W M, T, T7 NU NJ NUP — — M T, T7 NU NJ NUP — — M T, T7 NU NJ NUP — —	41.5	39 39 39	42 42 42	46 46 46	50 50 50	65.5 65.5 65.5	_	_	1 1 1	0.6 0.6 0.6	0.304 0.40 0.40
N 307 * NU307E NU307E	W M — — — N N W M, T, T7 NU NJ NUP — — W M, T, T7 NU NJ NUP — —	41.5	— 41.5 41.5	 44 44	— 48 48	 53 53	— 72 72	73.5 — —	70 —	1.5 1.5 1.5	1 1 1	0.476 0.545 0.545
* NU2307E NU2307E NU407	M T, T7 NU NJ NUP — — M T, T7 NU NJ NUP — — W — NU NJ — N N	10	41.5 41.5 43	44 44 51	48 48 55	53 53 61	72 72 92	— 92	— 85	1.5 1.5 1.5	1 1 1.5	0.711 0.711 1.01
NU1008 N 208 * NU208E	(M) — NU NJ NUP N — W M — — N N W M, T, T7 NU NJ NUP — —	46.5	44 — 46.5	46 — 48	49 — 52	_ 56	63 — 73.5	64 73.5 —	62 72 —	1 1 1	0.6 1 1	0.223 0.375 0.379
NU208E * NU2208E NU2208E	W M, T, T7 NU NJ NUP — — M T, T7 NU NJ NUP — — M T, T7 NU NJ NUP — —	46.5	46.5 46.5 46.5	48 48 48	52 52 52	56 56 56	73.5 73.5 73.5	_	_	1 1 1	1 1 1	0.379 0.480 0.480
N 308 * NU308E NU308E	W M — — — N N W M, T, T7 NU NJ NUP — — W M, T, T7 NU NJ NUP — —	48	— 48 48	 50 50	— 55 55	 60 60	— 82 82	82 —	79 —	1.5 1.5 1.5	1.5 1.5 1.5	0.649 0.747 0.747
* NU2308E NU2308E NU408	M T, T7 NU NJ NUP — — M T, T7 NU NJ NUP — — W — NU NJ NUP N N	48	48 48 49	50 50 56	55 55 60	60 60 67	82 82 101	_ 101	_ 94	1.5 1.5 2	1.5 1.5 2	0.933 0.933 1.28

Notes (3) If axial loads are applied, increase d_a and reduce D_a from the values listed above.

(4) $d_{\rm b}$ (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.

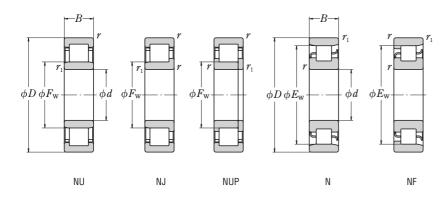




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SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

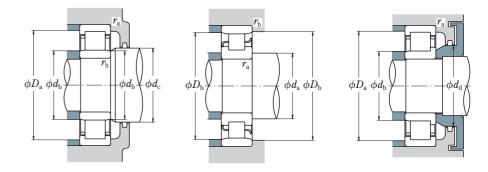
Bore Diameter 45 - 50 mm



		Bou	ndary Dir	mensions			Basic Loa				
d	D	B	γ min.	$ eals_1$ min.	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
45	75 85 85	16 19 19	1 1.1 1.1	0.6 1.1 1.1	52.5 — 54.5	67.5 75 —	32 500 46 000 72 500	35 500 47 000 66 500	9 500 9 000 8 500	_ 10 000	9 000 6 300 6 700
	85 85 85	19 23 23	1.1 1.1 1.1	1.1 1.1 1.1	54.5 54.5 54.5	=	63 000 87 500 76 000	66 500 84 500 84 500	8 500 8 500 8 500	10 000 12 000 12 000	6 700 6 700 6 700
	100 100 100	25 25 25	1.5 1.5 1.5	1.5 1.5 1.5	— 58.5 58.5	86.5 —	79 000 112 000 97 500	77 500 98 500 98 500	7 500 7 100 7 100	9 000 9 000	5 000 6 000 6 000
	100 100 120	36 36 29	1.5 1.5 2	1.5 1.5 2	58.5 58.5 64.5	— 100.5	158 000 137 000 107 000	153 000 153 000 102 000	7 100 7 100 6 300	11 000 11 000 —	5 300 5 300 4 300
50	80 90 90	16 20 20	1 1.1 1.1	0.6 1.1 1.1	57.5 — 59.5	72.5 80.4 —	32 000 48 000 79 500	36 000 51 000 76 500	8 500 8 500 8 000	9 000	8 000 5 600 6 300
	90 90 90	20 23 23	1.1 1.1 1.1	1.1 1.1 1.1	59.5 59.5 59.5	=	69 000 96 000 83 500	76 500 97 000 97 000	8 000 7 500 7 500	9 000 11 000 11 000	6 300 6 300 6 300
	110 110 110	27 27 27	2 2 2	2 2 2	65 65	95 — —	87 000 127 000 110 000	86 000 113 000 113 000	7 100 6 700 6 700	8 000 8 000	4 500 5 000 5 000
	110 110 130 130	40 40 31 31	2 2 2.1 2.1	2 2 2.1 2.1	65 65 — 70.8	110.8 —	187 000 163 000 139 000 129 000	187 000 187 000 136 000 124 000	6 700 6 700 5 600 5 600	10 000 10 000 —	5 000 5 000 4 000 4 000



⁽²⁾ When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page C156) are used, the bearings become the NH type.



	Bearing Numbers				Ab	utment		illet Dim m)	nension	IS			Mass (kg)
	Cage symbol(1) NU NJ NUP Standard Option	N NF	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}{}^{\!\! (3)}_{\rm max.}$	$D_{\rm b} \\ {\rm max.}$	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1009 N 209 *NU209E	(M) — NU — — W M — — — W M, T, T7 NU NJ NUP	N NF N NF	50 51.5 51.5	49 — 51.5	51 — 52	54 — 57	— 61	70 — 78.5	71 78.5 —	68 77 —	1 1 1	0.6 1 1	0.279 0.429 0.438
NU209E * NU2209E NU2209E	W M, T, T7 NU NJ NUP M T, T7 NU NJ NUP M T, T7 NU NJ NUP		51.5 51.5 51.5	51.5 51.5 51.5	52 52 52	57 57 57	61 61 61	78.5 78.5 78.5	_	_	1 1 1	1 1 1	0.438 0.521 0.521
N 309 * NU309E NU309E	W M — — — W M, T, T7 NU NJ NUP W M, T, T7 NU NJ NUP		53 53 53	— 53 53	— 56 56	 60 60	— 66 66	92 92	92 —	77 — —	1.5 1.5 1.5	1.5 1.5 1.5	0.869 1.01 1.01
*NU2309E NU2309E NU409	M T, T7 NU NJ NUP M T, T7 NU NJ NUP W — NU NJ NUP		53 53 54	53 53 54	56 56 62	60 60 66	66 66 74	92 92 111	_ 111	_ 103	1.5 1.5 2	1.5 1.5 2	1.28 1.28 1.62
NU1010 N 210 *NU210E	(M) — NU NJ NUP W M — — — W M, T, T7 NU NJ NUP	N — N NF — —	55 56.5 56.5	54 — 56.5	56 — 57	59 — 62	_ 67	75 — 83.5	76 83.5 —	73 82 —	1 1 1	0.6 1 1	0.301 0.483 0.50
NU210E * NU2210E NU2210E	141 1, 17 140 140 1401		56.5 56.5 56.5	56.5 56.5 56.5	57 57 57	62 62 62	67 67 67	83.5 83.5 83.5	_	_	1 1 1	1 1 1	0.50 0.562 0.562
N 310 * NU310E NU310E	, ., .,	N NF 	59 59 59	— 59 59	— 63 63	— 67 67	73 73	 101 101	101 —	97 —	2 2 2	2 2 2	1.11 1.3 1.3
*NU2310E NU2310E N 410 NU410	M T, T7 NU NJ NUP M T, T7 NU NJ NUP W M — — W M NU NJ NUP	 N NF 	59 59 65 61	59 59 — 61	63 63 — 68	67 67 — 73	73 73 — 81	101 101 — 119	_ 117 119	_ 113 113.3	2 2 2 2	2 2 2 2	1.7 1.7 2 1.99

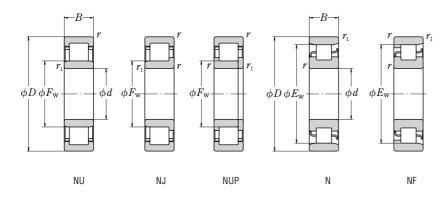




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SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

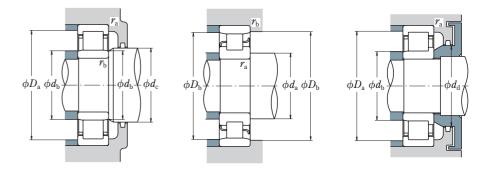
Bore Diameter 55 - 60 mm



			Bou	ndary Dir mm)	mensions)			Basic Loa	ad Ratings N)		Speeds (min ⁻¹)	
	d	D	B	γ min.	$oldsymbol{r}_1$ min.	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
-	55	90 100 100 100	18 21 21 21	1.1 1.5 1.5 1.5	1 1.1 1.1 1.1	64.5 — 66 66	80.5 88.5 —	37 500 58 000 99 000 86 500	44 000 62 500 98 500 98 500	8 000 7 500 6 700 6 700	8 500 8 500	7 500 5 300 5 600 5 600
		100 100 120	25 25 29	1.5 1.5 2	1.1 1.1 2	66 66 —	_ _ 104.5	117 000 101 000 111 000	122 000 122 000 111 000	6 700 6 700 6 300	10 000 10 000 —	5 600 5 600 4 000
		120 120 120	29 29 43	2 2 2	2 2 2	70.5 70.5 70.5	=	158 000 137 000 231 000	143 000 143 000 233 000	6 000 6 000 6 000	7 500 7 500 9 000	4 500 4 500 4 500
		120 140	43 33	2 2.1	2 2.1	70.5 77.2	— 117.2	201 000 139 000	233 000 138 000	6 000 5 300	9 000	4 500 3 800
	60	95 110 110	18 22 22	1.1 1.5 1.5	1 1.5 1.5	69.5 — 72	85.5 97.5 —	40 000 68 500 112 000	48 500 75 000 107 000	7 500 7 100 6 300	— — 7 500	6 700 4 800 5 300
		110 110 110	22 28 28	1.5 1.5 1.5	1.5 1.5 1.5	72 72 72	=	97 500 151 000 131 000	107 000 157 000 157 000	6 300 6 300 6 300	7 500 9 500 9 500	5 300 5 300 5 300
		130 130 130	31 31 31	2.1 2.1 2.1	2.1 2.1 2.1	— 77 77	113 — —	124 000 124 000 169 000	126 000 126 000 157 000	6 000 6 000 5 600	— — 9 500	3 800 3 800 4 800
_		130 130 130 150	31 46 46 35	2.1 2.1 2.1 2.1	2.1 2.1 2.1 2.1	77 77 77 83	 127	150 000 251 000 222 000 167 000	157 000 262 000 262 000 168 000	5 600 5 600 5 600 5 000	9 500 8 500 8 500 —	4 800 4 300 4 300 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 C156) are used, the bearings become the NH type.



	Bearing Numbers				Ab	utment	t and F	illet Dim m)	nension	S			Mass (kg)
	Cage symbol(1) NU NJ Standard Option	NUP N NF	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}{}^{\rm (3)}$ max.	$D_{\rm b} \\ {\rm max.}$	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_b$ max.	approx.
NU1011 N 211 * NU211E NU211E	(M) — NU NJ W M — — W M, T, T7 NU NJ W M, T, T7 NU NJ		61.5 63 63 63	60 — 61.5 61.5	63 — 64 64	66 — 68 68	— 73 73	83.5 — 92 92	85 93.5 —	82 91 —	1 1.5 1.5 1.5	1 1 1	0.445 0.634 0.669 0.669
*NU2211E NU2211E N 311	M T, T7 NU NJ M T, T7 NU NJ W M — —		63 63 64	61.5 61.5 —	64 64 —	68 68 —	73 73 —	92 92 —	_ 111	_ 107	1.5 1.5 2	1 1 2	0.783 0.783 1.42
*NU311E NU311E *NU2311E	W M, T, T7 NU NJ W M, T, T7 NU NJ M T, T7 NU NJ	NUP — —	64 64 64	64 64 64	68 68 68	72 72 72	80 80 80	111 111 111	_		2 2 2	2 2 2	1.64 1.64 2.18
NU2311E NU411	M T, T7 NU NJ W — NU NJ	NUP — — NUP N NF	64 66	64 66	68 75	72 79	80 87	111 129	_ 129	_ 119	2	2	2.18 2.5
NU1012 N 212 *NU212E	(M) — NU NJ W M — — W M, T, T7 NU NJ	— N NF — N NF NUP — —	66.5 68 68	65 — 68	68 — 70	71 — 75	_ 80	88.5 102	90 102 —	87 100 —	1 1.5 1.5	1 1.5 1.5	0.474 0.823 0.824
NU212E * NU2212E NU2212E	W M, T, T7 NU NJ M T, T7 NU NJ M T, T7 NU NJ	NUP — —	68 68 68	68 68 68	70 70 70	75 75 75	80 80 80	102 102 102	_	_ _ _	1.5 1.5 1.5	1.5 1.5 1.5	0.824 1.06 1.06
N 312 NU312 *NU312E	W M — — W M NU NJ M T, T7 NU NJ		71 71 71	— 71 71	— 75 75	— 79 79	— 86 86	— 119 119	119 —	11 <u>5</u> —	2 2 2	2 2 2	1.78 1.82 2.06
NU312E * NU2312E NU2312E NU412	M T, T7 NU NJ M T, T7 NU NJ M T, T7 NU NJ W M NU NJ	NUP — —	71 71 71 71	71 71 71 71	75 75 75 80	79 79 79 85	86 86 86 94	119 119 119 139	_ _ 139	_ _ 130	2 2 2 2	2 2 2 2	2.06 2.7 2.7 3.04



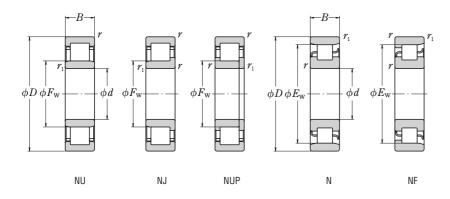




C 138 C 139

■ SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

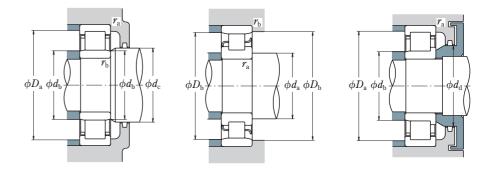
Bore Diameter 65 - 70 mm



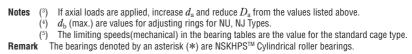
			Bou	ndary Dir	mensions)				ad Ratings N)		Speeds (min ⁻¹)	
	d	D	B	r	r_1	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	C_{0r}	Thermal Reference	Limiting (5)	Speeds
_				min.	min.	- vv	vv	-1	- 01	Speed	Mechanical	Grease
	65	100 120 120	18 23 23	1.1 1.5 1.5	1 1.5 1.5	74.5 — 78.5	90.5 105.6 —	41 000 84 000 124 000	51 000 94 500 119 000	6 700 6 300 6 000	_ _ 7 100	6 300 4 300 4 800
		120 120 120	23 31 31	1.5 1.5 1.5	1.5 1.5 1.5	78.5 78.5 78.5	_ _ _	108 000 171 000 149 000	119 000 181 000 181 000	6 000 6 000 6 000	7 100 8 500 8 500	4 800 4 800 4 800
		140 140 140	33 33 33	2.1 2.1 2.1	2.1 2.1 2.1	— 83.5 82.5	121.5 — —	135 000 135 000 204 000	139 000 139 000 191 000	5 600 5 600 5 300	— — 8 500	3 600 3 600 4 300
		140 140 140	33 48 48	2.1 2.1 2.1	2.1 2.1 2.1	82.5 82.5 82.5		181 000 263 000 233 000	191 000 265 000 265 000	5 300 5 600 5 600	8 500 7 500 7 500	4 300 3 800 3 800
		160 160	37 37	2.1 2.1	2.1 2.1	— 89.3	135.3	195 000 182 000	203 000 186 000	4 500 4 800	_	4 000 3 200
	70	110 125 125	20 24 24	1.1 1.5 1.5	1 1.5 1.5	80 — 83.5	100 110.5 —	58 500 83 500 136 000	70 500 95 000 137 000	6 300 6 300 5 600	9 000	6 000 4 000 5 000
		125 125 125	24 31 31	1.5 1.5 1.5	1.5 1.5 1.5	83.5 83.5 83.5	=	119 000 179 000 156 000	137 000 194 000 194 000	5 600 5 600 5 600	9 000 8 000 8 000	5 000 4 500 4 500
		150 150 150	35 35 35	2.1 2.1 2.1	2.1 2.1 2.1	90 89	130 — —	149 000 158 000 231 000	156 000 168 000 222 000	5 600 5 300 4 800	— 8 000	3 200 3 200 4 000
		150 150 150 180	35 51 51 42	2.1 2.1 2.1 3	2.1 2.1 2.1 3	89 89 89 100	 152	205 000 310 000 274 000 228 000	222 000 325 000 325 000 236 000	4 800 5 000 5 000 4 500	8 000 7 100 7 100 —	4 000 3 600 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 page C156) are used, the bearings become the NH type.



	Bearing I	Numbe		2)				Al	outmer		illet Din	nensior	าร			Mass (kg)
	Cage symb		NU N	J NUP	N NF	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\mathrm{a}}^{(3)}$ max.	$\begin{array}{c} D_{\rm b} \\ {\rm max.} \end{array}$	$D_{\rm b} \\ {\rm min.}$	$ holdsymbol{r}_{a}$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1013 N 213 *NU213E		M .	NU N NU N	J — J NUP	N NF N NF		70 — 73	73 — 76	76 — 81	— 87	93.5 — 112	95 112 —	92 108 —	1 1.5 1.5	1 1.5 1.5	0.504 1.05 1.05
NU213E * NU2213E NU2213E	Μ Ť,	Ť7 I	NU N	J NUP J NUP J NUP		73 73 73	73 73 73	76 76 76	81 81 81	87 87 87	112 112 112			1.5 1.5 1.5	1.5 1.5 1.5	1.05 1.41 1.41
N 313 NU313 *NU313E	w n			J NUP J NUP	N NF	76 76 76	— 76 76	— 81 80	— 85 85	93 93	— 129 129	129 —	125 — —	2 2 2	2 2 2	2.17 2.23 2.56
NU313E * NU2313E NU2313E	M T,	T7 I	NU N	J NUP J NUP J NUP	= =	76 76 76	76 76 76	80 80 80	85 85 85	93 93 93	129 129 129	_ _ _	_	2 2 2	2 2 2	2.56 3.16 3.16
N 413 NU413	M - W N	_ M I	 NU N	 J —	N NF	76 76	— 76	— 86	— 91	_ 100	— 149	149	138.8	2	2	3.63 3.63
NU1014 N 214 * NU214E	W N	M		J NUP J NUP	N NF N NF		75 — 78	79 — 81	82 — 86	_ 92	103.5 — 117	105 117 —	101 113 —	1 1.5 1.5	1 1.5 1.5	0.693 1.14 1.29
NU214E * NU2214E NU2214E	M T,	T7 i	NU N	J NUP J NUP J NUP	= =	78 78 78	78 78 78	81 81 81	86 86 86	92 92 92	117 117 117	_	_	1.5 1.5 1.5	1.5 1.5 1.5	1.29 1.49 1.49
N 314 NU314 * NU314E	W			J NUP J NUP	N NF	81 81 81	— 81 81	— 87 86	92 92	100 100	— 139 139	139 	133.5 — —	2 2 2	2 2 2	2.67 2.75 3.09
NU314E * NU2314E NU2314E NU414	M T, M T,	T7 I	NU N NU N	J NUP J NUP J NUP J NUP	 N NF	81 81 81 83	81 81 81 83	86 86 86 97	92 92 92 102	100 100 100 112	139 139 139 167	_ _ 167	_ _ _ 155	2 2 2 2.5	2 2 2 2.5	3.09 3.92 3.92 5.28

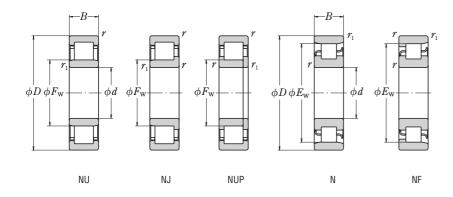






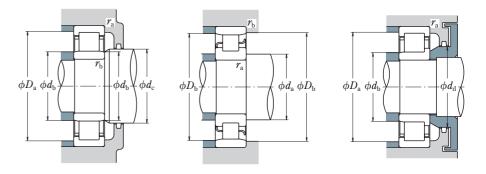
Bore Diameter 75 mm

SINGLE-ROW CYLINDRICAL ROLLER BEARINGS



		Bou	ı ndary Di ı (mm	mensions)				ad Ratings N)		Speeds (min ⁻¹)	
d	D	В	γ min.	$ m \emph{r}_{1}$ min.	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
75	115 130 130	20 25 25	1.1 1.5 1.5	1 1.5 1.5	85 — 88.5	105 116.5 —	60 000 96 500 150 000	74 500 111 000 156 000	6 000 6 000 5 300	 8 500	5 600 3 800 4 800
	130 130 130 160	25 31 31 37	1.5 1.5 1.5 2.1	1.5 1.5 1.5 2.1	88.5 88.5 88.5	 139.5	130 000 186 000 162 000 179 000	156 000 207 000 207 000 189 000	5 300 5 300 5 300 5 000	8 500 7 500 7 500 —	4 800 4 300 4 300 3 000
	160 160 160	37 37 37	2.1 2.1 2.1	2.1 2.1 2.1	95.5 95 95	_	179 000 271 000 240 000	189 000 263 000 263 000	5 000 4 500 4 500	7 500 7 500	3 000 3 800 3 800
	160 160 190	55 55 45	2.1 2.1 3	2.1 2.1 3	95 95 104.5	— — 160.5	370 000 330 000 262 000	395 000 395 000 274 000	4 800 4 800 4 300	6 700 6 700 —	3 400 3 400 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 C156) are used, the bearings become the NH type.



	Bearing Nu				Al	outmer		illet Din	nensio	าร			Mass (kg)
	Cage symbol Standard Option	NO NO NOP IN INI	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}{}^{\scriptscriptstyle (4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}{}^{\!\! (3)}_{\rm max.}$	$D_{\rm b} \\ {\rm max.}$	$D_{\rm b} \\ {\rm min.}$	${\it r}_{\rm a}$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1015 N 215 *NU215E	(M) — W M M T, T	NU — — N NI — — — N NI 7 NU NJ NUP — —	83	80 — 83	83 — 86	87 — 90	— 96	108.5 — 122	110 122 —	106 119 —	1 1.5 1.5	1 1.5 1.5	0.731 1.23 1.44
NU215E * NU2215E NU2215E N 315	M T, T M T, T M T, T W M	7 NU NJ NUP — —	· 83 · 83	83 83 —	86 86 86	90 90 90	96 96 96	122 122 122 —	_ _ 149	_ _ 143	1.5 1.5 1.5 2	1.5 1.5 1.5 2	1.44 1.57 1.57 3.2
NU315 * NU315E NU315E	W M M T, T M T, T	7 NU NJ NUP — —	00	86 86 86	93 92 92	97 97 97	106 106 106	149 149 149	_	_	2 2 2	2 2 2	3.26 3.73 3.73
* NU2315E NU2315E NU415	M T, T M T, T W M		86	86 86 88	92 92 102	97 97 107	106 106 118	149 149 177	_ 177	_ 164	2 2 2.5	2 2 2.5	4.86 4.86 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.

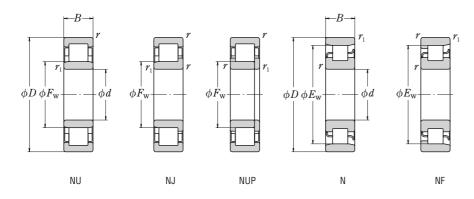
 (5)
 The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

 Remark
 The bearings denoted by an asterisk (*) are NSKHPSTM Cylindrical roller bearings.





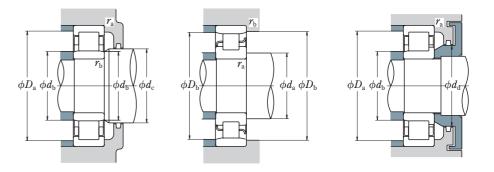
Bore Diameter 80 - 90 mm



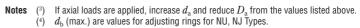
		Bou	ndary Di	mensions			Basic Load			Speeds (min ⁻¹)	
d	D	В	r min.	$oldsymbol{r}_1$ min.	$F_{ m W}$	$E_{ m W}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
80	125 140 140	22 26 26	1.1 2 2	1 2 2	91.5 — 95.3	113.5 125.3 —	72 500 106 000 160 000	90 500 122 000 167 000	6 000 5 600 5 000	8 000	5 300 3 600 4 500
	140 140 140	26 33 33	2 2 2	2 2 2	95.3 95.3 95.3	_	139 000 214 000 186 000	167 000 243 000 243 000	5 000 5 000 5 000	8 000 7 100 7 100	4 500 4 000 4 000
	170 170 170	39 39 39	2.1 2.1 2.1	2.1 2.1 2.1	— 101 101	147 — —	190 000 289 000 256 000	207 000 282 000 282 000	4 800 4 300 4 300	7 100 7 100	2 800 3 600 3 600
	170 170 200	58 58 48	2.1 2.1 3	2.1 2.1 3	101 101 110	_ _ 170	400 000 355 000 299 000	430 000 430 000 315 000	4 500 4 500 4 000	6 300 6 300 —	3 200 3 200 2 600
85	130 150 150	22 28 28	1.1 2 2	1 2 2	96.5 — 100.5	118.5 133.8 —	74 500 120 000 192 000	95 500 140 000 199 000	5 600 5 300 4 800		5 000 3 400 4 300
	150 150 150	28 36 36	2 2 2	2 2 2	100.5 100.5 100.5		167 000 250 000 217 000	199 000 279 000 279 000	4 800 4 800 4 800	7 500 6 700 6 700	4 300 3 800 3 800
	180 180 180	41 41 41	3 3 3	3 3 3	108 108	156 — —	225 000 212 000 360 000	247 000 228 000 330 000	4 500 4 800 4 000	- 6 700	2 600 2 600 3 400
	180 180 180 210	41 60 60 52	3 3 4	3 3 4	108 108 108 113	_ _ _ 177	291 000 485 000 395 000 335 000	330 000 485 000 485 000 350 000	4 000 4 300 4 300 4 000	6 700 6 000 6 000 —	3 400 3 000 3 000 3 000
90	140 160 160	24 30 30	1.5 2 2	1.1 2 2	103 — 107	127 143 —	88 000 152 000 205 000	114 000 178 000 217 000	5 300 5 000 4 800	7 100	4 500 3 200 4 000
	160 160 160	30 40 40	2 2 2	2 2 2	107 107 107	_	182 000 274 000 242 000	217 000 315 000 315 000	4 800 4 800 4 800	7 100 6 300 6 300	4 000 3 600 3 600
	190 190 190	43 43 43	3 3 3	3 3 3	— 115 113.5	165 — —	240 000 240 000 390 000	265 000 265 000 355 000	4 500 4 500 4 000	6 300	2 600 2 600 3 200
	190 190 190 225	43 64 64 54	3 3 4	3 3 4	113.5 113.5 113.5 123.5	_ _ _ 191.5	315 000 535 000 435 000 375 000	355 000 535 000 535 000 400 000	4 000 4 000 4 000 3 600	6 300 5 600 5 600 —	3 200 2 800 2 800 2 800

Motos	(1)	/B/I	in the	column	of oogo	ovmbolo	050 110110	lly amittac	I from the	haaring	number
MULES	(+)	(IVI)) III LIIE	COIUIIIII	oi cage	Syllibols	are usua	Ily omitted	i iroiii tiie	Dearing	mumber.

⁽²⁾ When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on pages C156 and C157) are used, the bearings become the NH type.



	Bearing	Numb	ers	(2)				А	butmeı		illet Din	nensio	าร			Mass (kg)
	Cage sym Standard O		NU I	(²) NJ NUP	N NI	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}{}^{\!\! (3)}_{\rm max.}$	$D_{\rm b} \\ {\rm max.}$	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1016 N 216 * NU216E	`W	_ М , Т7	_	— NUP	N -	86.5 89 89	85 — 89	90 — 92	94 — 97	_ _ 104	118.5 — 131	120 131 —	115 128 —	1 2 2	1 2 2	0.969 1.47 1.7
NU216E *NU2216E NU2216E	M T	, T7 , T7 , T7	NU I	NJ NUP NJ NUP NJ NUP		89 89 89	89 89 89	92 92 92	97 97 97	104 104 104	131 131 131	_	_	2 2 2	2 2 2	1.7 1.96 1.96
N 316 * NU316E NU316E	M T	M , T7 , T7		— — NJ NUP NJ NUP	N N	91 91 91	91 91	98 98	— 105 105	— 114 114	— 159 159	159 —	150 — —	2 2 2	2 2 2	3.85 4.45 4.45
*NU2316E NU2316E NU416	M T	, T7 , T7 M		NJ NUP NJ NUP		0 1	91 91 93	98 98 107	105 105 112	114 114 124	159 159 187	— 187	_ 173	2 2 2.5	2 2 2.5	5.73 5.73 7.36
NU1017 N 217 *NU217E		_ М , Т7	NU :	 NJ NUP	N - N N	91.5 94 94	90 — 94	95 — 98	99 — 104	_ 110	123.5 — 141	125 141 —	120 137 —	1 2 2	1 2 2	1.01 1.87 2.11
NU217E *NU2217E NU2217E	M T	, T7 , T7 , T7	NU I	NJ NUP NJ NUP NJ NUP	= =	94 94 94	94 94 94	98 98 98	104 104 104	110 110 110	141 141 141	_	_	2 2 2	2 2 2	2.11 2.44 2.44
N 317 NU317 * NU317E	W	M N		UJ NUP	N N	98 98 98	98 98	— 105 105	— 110 110	— 119 119	— 167 167	167 — —	159 — —	2.5 2.5 2.5	2.5 2.5 2.5	4.53 4.6 5.26
NU317E * NU2317E NU2317E NU417	M M T	, T7 _ , T7 _	NU I	NJ NUP		98	98 98 98 101	105 105 105 110	110 110 110 115	119 119 119 128	167 167 167 194	_ _ _ 194	_ _ _ 180	2.5 2.5 2.5 3	2.5 2.5 2.5 3	5.26 6.77 6.77 9.56
NU1018 N 218 *NU218E	W	— М , Т7	_	— NUP — — NJ NUP	N —	98 99 99	96.5 — 99	101	106 — 109	_ 116	132 — 151	133.5 151 —	129 146 —	1.5 2 2	1 2 2	1.35 2.31 2.6
NU218E * NU2218E NU2218E	M T	, T7 , T7 , T7	NU	NJ NUP NJ NUP NJ NUP		99 99 99	99 99 99	104 104 104	109 109 109	116 116 116	151 151 151	_	_	2 2 2	2 2 2	2.6 3.11 3.11
N 318 NU318 *NU318E	W	M M		— — NJ NUP NJ NUP	N NI	103 103 103	103 103	112 111	— 117 117	— 127 127	— 177 177	177 —	168 —	2.5 2.5 2.5	2.5 2.5 2.5	5.31 5.38 6.1
NU318E * NU2318E NU2318E NU418	M M T	, T7 — , T7 —	NU	NJ NUP NJ NUP NJ NUP NJ —		103 103 103 106	103 103 103 106	111 111 111 120	117 117 117 125	127 127 127 139	177 177 177 209	_ _ 209	_ _ 196	2.5 2.5 2.5 3	2.5 2.5 2.5 3	6.1 7.9 7.9 11.5



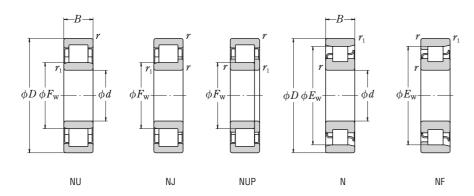


⁽⁵⁾ The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

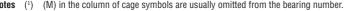
BEARINGS TABLE **NSK**

Bore Diameter 95 - 105 mm

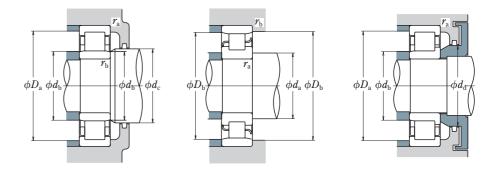
SINGLE-ROW CYLINDRICAL ROLLER BEARINGS



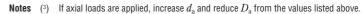
		Bou	ndary Dir (mm	mensions)			Basic Load			Speeds (min ⁻¹)	
d	D	В	γ min.	$oldsymbol{\gamma}_1$ min.	$F_{ m W}$	$E_{ m W}$	C_{r}	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
95	145 170 170	24 32 32	1.5 2.1 2.1	1.1 2.1 2.1	108 — 112.5	132 151.5 —	90 500 166 000 249 000	120 000 196 000 265 000	5 000 4 800 4 300	— — 6 700	4 300 3 000 3 800
	170 170 170	32 43 43	2.1 2.1 2.1	2.1 2.1 2.1	112.5 112.5 112.5	_	220 000 325 000 286 000	265 000 370 000 370 000	4 300 4 500 4 500	6 700 6 000 6 000	3 800 3 400 3 400
	200 200 200	45 45 45	3 3 3	3 3 3	— 121.5 121.5	173.5 — —	259 000 259 000 410 000	289 000 289 000 385 000	4 300 4 300 3 800	 6 000	2 400 2 400 3 000
	200 200 200 240	45 67 67 55	3 3 4	3 3 4	121.5 121.5 121.5 133.5	 201.5	335 000 565 000 460 000 400 000	385 000 585 000 585 000 445 000	3 800 3 800 3 800 3 200	6 000 5 300 5 300 —	3 000 2 600 2 600 2 600
100	150 180 180	24 34 34	1.5 2.1 2.1	1.1 2.1 2.1	113 119	137 160 —	93 000 183 000 305 000	126 000 217 000 305 000	4 800 4 500 4 300		4 300 2 800 3 600
	180 180 180	34 46 46	2.1 2.1 2.1	2.1 2.1 2.1	119 119 119		249 000 410 000 335 000	305 000 445 000 445 000	4 300 4 300 4 300	6 300 5 600 5 600	3 600 3 200 3 200
	215 215 215	47 47 47	3 3 3	3 3 3	— 129.5 127.5	185.5 — —	299 000 299 000 465 000	335 000 335 000 425 000	4 000 4 000 3 600	 5 600	2 200 2 200 2 800
	215 215 215 250	47 73 73 58	3 3 4	3 3 4	127.5 127.5 127.5 139	_ _ 211	380 000 700 000 570 000 450 000	425 000 715 000 715 000 500 000	3 600 3 400 3 400 3 000	5 600 5 000 5 000 —	2 800 2 400 2 400 2 600
105	160 190 190	26 36 36	2 2.1 2.1	1.1 2.1 2.1	119.5 — 125	145.5 168.8 —	109 000 201 000 320 000	149 000 241 000 310 000	4 500 4 500 4 300	 6 000	4 000 3 400 3 400
	190 225 225	36 49 49	2.1 3 3	2.1 3 3	125 — 133	195 —	262 000 340 000 525 000	310 000 390 000 480 000	4 300 3 800 3 400	6 000 — 5 300	3 400 2 200 2 600
	225 260	49 60	3 4	3 4	133 144.5	 220.5	425 000 495 000	480 000 555 000	3 400 2 800	5 <u>300</u>	2 600 2 400



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 C157) are used, the bearings become the NH type.



	Bearing Num					А	butmer		illet Din m)	nensior	IS			Mass (kg)
	Cage symbol (1) Standard Option	NU NJ NUP	N NF	$d_{\mathrm{a}^{(3)}}$ min.	$d_{ m b}$ min.	$d_{ m b}^{(4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}^{(3)}$ max.	$\begin{array}{c} D_{\rm b} \\ {\rm max.} \end{array}$	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_b$ max.	approx.
NU1019 N 219 *NU219E	(M) — W M M T, T7	NU NJ — NU NJ NUP		103 106 106	101.5 — 106	106 — 110	111 — 116	_ 123	137 — 159	138.5 159 —	134 155 —	1.5 2 2	1 2 2	1.41 2.79 3.17
NU219E * NU2219E NU2219E	M T, T7 M T, T7 M T, T7	NU NJ NUP NU NJ NUP NU NJ NUP		106 106 106	106 106 106	110 110 110	116 116 116	123 123 123	159 159 159	_	_	2 2 2	2 2 2	3.17 3.81 3.81
N 319 NU319 *NU319E	W M W M M —	— — — NU NJ NUP NU NJ NUP		108 108 108	108 108	— 118 118	— 124 124	— 134 134	— 187 187	187 —	177 — —	2.5 2.5 2.5	2.5 2.5 2.5	6.09 6.23 7.13
NU319E * NU2319E NU2319E NU419	M T, T7 M — M T, T7 M —	NU NJ NUP NU NJ NUP NU NJ NUP NU NJ NUP			108 108 108 111	118 118 118 130	124 124 124 136	134 134 134 149	187 187 187 224	_ _ _ 224	_ _ 206	2.5 2.5 2.5 3	2.5 2.5 2.5 3	7.13 9.21 9.21 13.6
NU1020 N 220 *NU220E	(M) — W M M —		N NF	108 111 111	106.5 111	111 — 116	116 — 122	_ 130	142 — 169	143.5 169 —	139 163 —	1.5 2 2	1 2 2	1.47 3.36 3.81
NU220E * NU2220E NU2220E	M T, T7 M — M T, T7	NU NJ NUP NU NJ NUP NU NJ NUP		111 111 111	111 111 111	116 116 116	122 122 122	130 130 130	169 169 169	_	=	2 2 2	2 2 2	3.81 4.69 4.69
N 320 NU320 *NU320E	W M W M M —	— — — NU NJ NUP NU NJ NUP		113 113 113	— 113 113	— 126 124	132 132	143 143	202 202	202 —	190 —	2.5 2.5 2.5	2.5 2.5 2.5	7.59 7.69 8.63
NU320E * NU2320E NU2320E NU420	M T, T7 M — M T, T7 M —	NU NJ NUP NU NJ NUP NU NJ NUP NU NJ —		113 113 113 116	113 113 113 116	124 124 124 135	132 132 132 141	143 143 143 156	202 202 202 234	_ _ 234	_ _ 215	2.5 2.5 2.5 3	2.5 2.5 2.5 3	8.63 11.8 11.8 15.5
NU1021 N 221 *NU221E	(M) — W M M —	NU — — NU NJ NUP	N NF	114 116 116	111.5 — 116	118 — 121	122 129	_ 137	151 — 179	153.5 179 —	147 172 —	2 2 2	1 2 2	1.83 4.0 4.58
NU221E N 321 * NU321E	M — W M M —	NU NJ NUP NU NJ NUP	N NF	116 118 118	116 — 118	121 — 131	129 — 137	137 — 149	179 	212	199 —	2 2.5 2.5	2 2.5 2.5	4.58 8.69 9.84
NU321E NU421	M — M —	NU NJ NUP NU NJ —	U NF	118 121	118 121	131 141	137 147	149 162	212 244	 244	 225	2.5 3	2.5 3	9.84 17.3



⁽⁴⁾ $d_{\rm b}$ (max.) are values for adjusting rings for NU, NJ Types.

Remark The bearings denoted by an asterisk (*) are NSKHPS™ Cylindrical roller bearings.

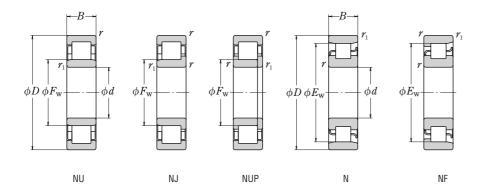




⁽⁵⁾ The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

Bore Diameter 110 – 130 mm

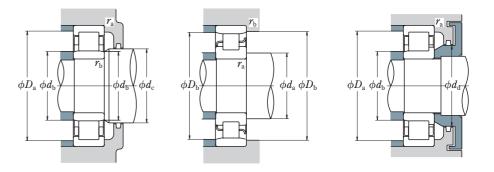
SINGLE-ROW CYLINDRICAL ROLLER BEARINGS



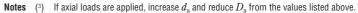
	Boundary Dimensions (mm)				ad Ratings N)		Speeds (min ⁻¹)				
d	D	B	γ min.	$oldsymbol{\gamma}_1$ min.	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
110	170 200 200	28 38 38	2 2.1 2.1	1.1 2.1 2.1	125 — 132.5	155 178.5 —	131 000 229 000 360 000	174 000 272 000 365 000	4 500 4 300 4 000	_ _ 5 600	3 800 2 600 3 200
	200 200 200	38 53 53	2.1 2.1 2.1	2.1 2.1 2.1	132.5 132.5 132.5	=	293 000 470 000 385 000	365 000 515 000 515 000	4 000 4 000 4 000	5 600 5 000 5 000	3 200 2 800 2 800
	240 240 240	50 50 50	3 3 3	3 3 3	143 143	207 — —	380 000 555 000 450 000	435 000 525 000 525 000	3 400 3 200 3 200	5 000 5 000	2 000 2 600 2 600
	240 240 280	80 80 65	3 3 4	3 3 4	143 143 155	=	830 000 675 000 550 000	880 000 880 000 620 000	3 000 3 000 2 600	4 500 4 500 —	2 200 2 200 2 200
120	180 215 215	28 40 40	2 2.1 2.1	1.1 2.1 2.1	135 — 143.5	165 191.5 —	139 000 260 000 410 000	191 000 320 000 420 000	4 000 4 000 3 600	 5 300	3 400 2 400 3 000
	215 215 215	40 58 58	2.1 2.1 2.1	2.1 2.1 2.1	143.5 143.5 143.5	_	335 000 555 000 450 000	420 000 620 000 620 000	3 600 3 600 3 600	5 300 4 800 4 800	3 000 2 600 2 600
	260 260 260	55 55 55	3 3 3	3 3 3	— 154 154	226 — —	450 000 650 000 530 000	510 000 610 000 610 000	3 000 2 800 2 800	4 800 4 800	2 200 2 200 2 200
	260 260 310	86 86 72	3 3 5	3 3 5	154 154 170	 260	975 000 795 000 675 000	1 030 000 1 030 000 770 000	2 600 2 600 2 400	4 300 4 300 —	2 000 2 000 2 000
130	200 230 230	33 40 40	2 3 3	1.1 3 3	148 — 153.5	182 204 —	172 000 270 000 445 000	238 000 340 000 455 000	4 000 3 800 3 400	_ 5 000	3 200 2 200 2 600
	230 230 230	40 64 64	3 3 3	3 3 3	153.5 153.5 153.5	_	365 000 650 000 530 000	455 000 735 000 735 000	3 400 3 400 3 400	5 000 4 500 4 500	2 600 2 400 2 400
	280 280 280	58 58 58	4 4 4	4 4 4	— 167 167	243 — —	500 000 760 000 615 000	570 000 735 000 735 000	2 800 2 600 2 600	4 300 4 300	2 200 2 200 2 200
	280 280 340	93 93 78	4 4 5	4 4 5	167 167 185	 285	1 130 000 920 000 825 000	1 230 000 1 230 000 955 000	2 400 2 400 2 000	3 800 —	1 900 1 900 1 800



⁽²⁾ When L-Shaped thrust collars (See section for L-Shaped Thrust Collars starting on page C157) are used, the bearings become the NH type.



	Bearing Num		Abutment and Fillet Dimensions (mm)								Mass (kg)			
	Cage symbol(1) Standard Option	NU NJ NUP	N NF	$d_{\mathrm{a}^{(3)}}$ min.	$d_{ m b}$ min.	$d_{ m b}{}^{\scriptscriptstyle (4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\rm a}{}^{\!\! (3)}_{\rm max.}$	$\begin{array}{c} D_{\rm b} \\ {\rm max.} \end{array}$	$\begin{array}{c} D_{\rm b} \\ {\rm min.} \end{array}$	$ m \emph{r}_a$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1022 N 222 *NU222E	(M) — W M M —	NU NJ — NU NJ NUP	N NF	119 121 121	116.5 — 121	123 — 129	128 — 135	_ _ 144	161 — 189	163.5 189 —	157 182 —	2 2 2	1 2 2	2.27 4.64 5.37
NU222E *NU2222E NU2222E	M T, T7 M — M —	NU NJ NUP NU NJ NUP NU NJ NUP		121 121 121	121 121 121	129 129 129	135 135 135	144 144 144	189 189 189	_	_	2 2 2	2 2 2	5.37 7.65 7.65
N 322 *NU322E NU322E	W M M — M —	— — — NU NJ NUP NU NJ NUP		123 123 123	123 123	139 139	— 145 145	— 158 158	— 227 227	227 — —	211 — —	2.5 2.5 2.5	2.5 2.5 2.5	10.3 11.8 11.8
*NU2322E NU2322E NU422	М — М — М —	NU NJ NUP NU NJ NUP NU NJ —		123 123 126	123 123 126	139 139 151	145 145 157	158 158 173	227 227 264	_	_	2.5 2.5 3	2.5 2.5 3	18.8 18.8 22.1
NU1024 N 224 *NU224E	(M) — W M M —	NU NJ NUP NU NJ NUP	N NF	129 131 131	126.5 — 131	133 — 140	138 — 146	_ 156	171 — 204	173.5 204 —	167 196 —	2 2 2	1 2 2	2.43 5.63 6.43
NU224E * NU2224E NU2224E	M — M — M —	NU NJ NUP	= =	131	131 131 131	140 140 140	146 146 146	156 156 156	204 204 204	_		2 2 2	2 2 2	6.43 9.51 9.51
N 324 * NU324E NU324E	W M M — M —	NU NJ NUP		133 133 133	133 133	150 150	156 156	— 171 171	247 247	247 —	230 —	2.5 2.5 2.5	2.5 2.5 2.5	12.9 15 15
*NU2324E NU2324E NU424	М — М — М —				133 133 140	150 150 166	156 156 172	171 171 190	247 247 290	_ 290	_ 266	2.5 2.5 4	2.5 2.5 4	25 25 30.2
NU1026 N 226 *NU226E	(M) — W M M —	NU NJ — NU NJ NUP	N NF	139 143 143	136.5 — 143	146 — 150	151 — 158	_ 168	191 — 217	193.5 217 —	184 208 —	2 2.5 2.5	1 2.5 2.5	3.66 6.48 8.03
NU226E * NU2226E NU2226E	M T, T7 M — M —	NU NJ NUP NU NJ NUP NU NJ NUP		143 143 143	143 143 143	150 150 150	158 158 158	168 168 168	217 217 217	_	_	2.5 2.5 2.5	2.5 2.5 2.5	8.03 9.44 9.44
N 326 * NU326E NU326E	М — М — М —	— — — NU NJ NUP NU NJ NUP	N NF — —		— 146 146	163 163	169 169	— 184 184	— 264 264	264 — —	247.5 — —	3 3 3	3 3 3	17.7 18.7 18.7
*NU2326E NU2326E NU426	M — M — M —	NU NJ NUP	 NF	146	146 146 150	163 163 180	169 169 187	184 184 208	264 264 320	_ 320	_ 291	3 3 4	3 3 4	30 30 39.6



⁽⁴⁾ $d_{\rm b}$ (max.) are values for adjusting rings for NU, NJ Types.





C 148 C 149

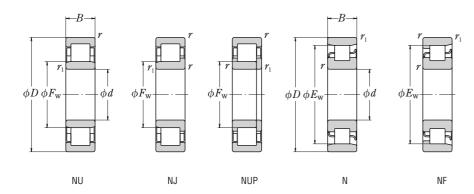
^(*) The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

Remark The bearings denoted by an asterisk (★) are NSKHPS™ Cylindrical roller bearings.

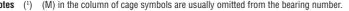
BEARINGS TABLE **NSK**

Bore Diameter 140 – 160 mm

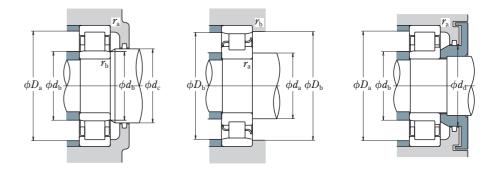
SINGLE-ROW CYLINDRICAL ROLLER BEARINGS



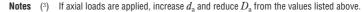
	Boundary Dimensions (mm)						ad Ratings N)		Speeds (min ⁻¹)		
d	D	B	γ min.	$ eals_1$ min.	$F_{ m W}$	$E_{ m W}$	C_{r}	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
140	210 250 250	33 42 42	2 3 3	1.1 3 3	158 — 169	192 221 —	176 000 297 000 485 000	250 000 375 000 515 000	3 800 3 400 3 200	 4 500	3 000 2 000 2 400
	250 250 250	42 68 68	3 3 3	3 3 3	169 169 169	_ _ _	395 000 675 000 550 000	515 000 790 000 790 000	3 200 3 200 3 200	4 500 4 000 4 000	2 400 2 200 2 200
	300 300 300	62 62 62	4 4 4	4 4 4	— 180 180	260 — —	550 000 815 000 665 000	640 000 795 000 795 000	2 600 2 400 2 400	4 000 4 000	2 000 2 000 2 000
	300 300 360	102 102 82	4 4 5	4 4 5	180 180 198	_ 302	1 250 000 1 020 000 875 000	1 380 000 1 380 000 1 020 000	2 200 2 200 1 900	2 600 2 600 —	1 700 1 700 1 700
150	225 270 270	35 45 45	2.1 3 3	1.5 3 3	169.5 — 182	205.5 238 —	202 000 360 000 550 000	294 000 465 000 595 000	3 600 3 000 2 800	 4 300	2 800 1 800 2 200
	270 270 270	45 73 73	3 3 3	3 3 3	182 182 182		450 000 780 000 635 000	595 000 930 000 930 000	2 800 2 800 2 800	4 300 3 800 3 800	2 200 2 000 2 000
	320 320 320	65 65 65	4 4 4	4 4 4	— 193 193	277 — —	665 000 930 000 760 000	805 000 920 000 920 000	2 200 2 200 2 200	3 800 3 800	1 800 1 800 1 800
	320 320 380	108 108 85	4 4 5	4 4 5	193 193 213		1 430 000 1 160 000 930 000	1 600 000 1 600 000 1 120 000	2 000 2 000 1 700	2 400 2 400 —	1 600 1 600 1 600
160	240 290 290	38 48 48	2.1 3 3	1.5 3 3	180 — 195	220 255 —	238 000 430 000 615 000	340 000 570 000 665 000	3 400 2 800 2 600	 4 000	2 600 2 200 2 200
	290 290 290	48 80 80	3 3 3	3 3 3	195 193 193		500 000 995 000 810 000	665 000 1 190 000 1 190 000	2 600 2 400 2 400	4 000 3 600 3 600	2 200 1 900 1 900
	340 340 340 340	68 68 68 114	4 4 4 4	4 4 4 4	204 204 204	292 — — —	700 000 1 060 000 860 000 1 310 000	875 000 1 050 000 1 050 000 1 820 000	2 000 1 900 1 900 1 800	3 600 3 600 2 400	1 700 1 700 1 700 1 500



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 C157) are used, the bearings become the NH type.



	Bearing Numb			А	butmer		illet Din	nensior	IS			Mass (kg)	
	Cage symbol(1) Standard Option	(2) NU NJ NUP N NF	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}{}^{\scriptscriptstyle (4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\mathrm{a}}^{(3)}$ max.	$\begin{array}{c} D_{\rm b} \\ {\rm max.} \end{array}$	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1028 N 228 * NU228E	(M) — W M M —		149 153 153	146.5 — 153	156 — 165	161 — 171	— — 182	201 — 237	203.5 237 —	194 225 —	2 2.5 2.5	1 2.5 2.5	3.87 8.08 9.38
NU228E * NU2228E NU2228E	M — M — M —	NU NJ NUP — — NU NJ NUP — — NU NJ NUP — —		153 153 153	165 165 165	171 171 171	182 182 182	237 237 237	_	_	2.5 2.5 2.5	2.5 2.5 2.5	9.38 15.2 15.2
N 328 * NU328E NU328E	M — M — M —	— — N NF NU NJ NUP — — NU NJ NUP — —	156 156 156	— 156 156	— 176 176	— 182 182	— 198 198	— 284 284	284 — —	266 —	3 3 3	3 3 3	21.7 22.8 22.8
* NU2328E NU2328E NU428	M — M — M —	NU NJ NUP — — NU NJ NUP — — NU NJ — N —		156 156 160	176 176 193	182 182 200	198 198 222	284 284 340	_ 340	_ 308	3 3 4	3 3 4	37.7 37.7 46.4
NU1030 N 230 *NU230E	(M) — W M M —	N NF	161 163 163	158 — 163	167 — 177	173 — 184	— 196	214 — 257	217 257 —	208 242 —	2 2.5 2.5	1.5 2.5 2.5	4.77 10.4 11.9
NU230E * NU2230E NU2230E	M — M — M —	NU NJ NUP — — NU NJ NUP — — NU NJ NUP — —	163 163 163	163 163 163	177 177 177	184 184 184	196 196 196	257 257 257	_	_	2.5 2.5 2.5	2.5 2.5 2.5	11.9 19.3 19.3
N 330 * NU330E NU330E	M — M — M —	N NF NU NJ NUP NU NJ NUP		— 166 166	— 188 188	— 195 195	 213 213	— 304 304	304 — —	283 — —	3 3 3	3 3 3	25.8 27.1 27.1
* NU2330E NU2330E NU430	M — M — M —	NU NJ NUP — — NU NJ NUP — — NU NJ — — —	166 166 170	166 166 170	188 188 208	195 195 216	213 213 237	304 304 360	_	_	3 3 4	3 3 4	45.1 45.1 55.8
NU1032 N 232 *NU232E	(M) — M — M —	— — N NF	171 173 173	168 — 173	178 — 190	184 — 197	_ 210	229 — 277	232 277 —	222 261 —	2 2.5 2.5	1.5 2.5 2.5	5.81 14.1 14.7
NU232E *NU2232E NU2232E	M — M — M —	NU NJ NUP — — NU NJ NUP — — NU NJ NUP — —	173 173 173	173 173 173	190 188 188	197 197 197	210 210 210	277 277 277	_	_	2.5 2.5 2.5	2.5 2.5 2.5	14.7 24.5 24.5
N 332 * NU332E NU332E NU2332E	M — M — M — M —	N NU NJ NUP NU NJ NUP NU NJ NUP	176 176 176 176	— 176 176 176	199 199 199	211 211 211	— 228 228 228	— 324 324 324	324 — — —	298 — — —	3 3 3	3 3 3	30.8 32.1 32.1 53.9



⁽⁴⁾ $d_{\rm b}$ (max.) are values for adjusting rings for NU, NJ Types.

Remark The bearings denoted by an asterisk (*) are NSKHPS™ Cylindrical roller bearings.



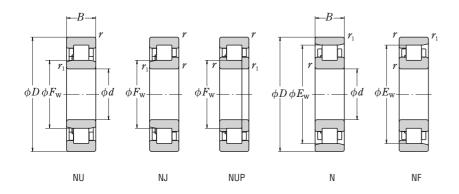


⁽⁵⁾ The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

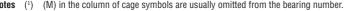
BEARINGS TABLE **NSK**

Bore Diameter 170 – 200 mm

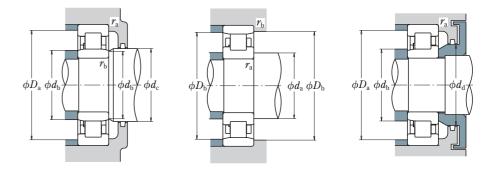
SINGLE-ROW CYLINDRICAL ROLLER BEARINGS



	Boundary Dimensions (mm)							ad Ratings N)		Speeds (min ⁻¹)	
d	D	B	γ min.	$ eals_1$ min.	$F_{ m W}$	$E_{ m W}$	C_{r}	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting (5) Mechanical	Speeds Grease
170	260 310 310 310 310 310 360 360	42 52 52 52 52 86 86 72 72	2.1 4 4 4 4 4 4	2.1 4 4 4 4 4 4	193 — 207 207 205 205 — 218	237 272 — — — — — 310	287 000 475 000 740 000 605 000 1 140 000 925 000 795 000 930 000	415 000 635 000 800 000 800 000 1 330 000 1 010 000 1 150 000	3 200 2 600 2 400 2 400 2 200 2 200 1 900 1 800		2 400 2 000 2 000 2 000 1 800 1 800 1 600
180	360 280 320 320	120 46 52 52	4 2.1 4 4	4 2.1 4 4	216 205 — 217	255 282 —	1 490 000 355 000 495 000 770 000	2 070 000 510 000 675 000 850 000	1 600 3 000 2 400 2 200	2 200 — — 3 600	1 400 2 200 1 900 1 900
	320 320 320	52 86 86	4 4 4	4 4 4	217 215 215	_	625 000 1 240 000 1 010 000	850 000 1 510 000 1 510 000	2 200 2 000 2 000	3 600 3 200 3 200	1 900 1 700 1 700
	380 380 380	75 75 126	4 4 4	4 4 4	231 227	328 	905 000 985 000 1 560 000	1 150 000 1 230 000 2 220 000	1 700 1 700 1 500	2 800 2 000	1 500 1 500 1 300
190	290 340 340	46 55 55	2.1 4 4	2.1 4 4	215 	265 299 —	365 000 555 000 855 000	535 000 770 000 955 000	2 800 2 200 2 000		2 000 1 800 1 800
	340 340 340	55 92 92	4 4 4	4 4 4	230 228 228	_	695 000 1 360 000 1 100 000	955 000 1 670 000 1 670 000	2 000 1 900 1 900	3 400 3 000 3 000	1 800 1 600 1 600
	400 400 400	78 78 132	5 5 5	5 5 5	— 245 240	345 — —	975 000 1 060 000 1 770 000	1 260 000 1 340 000 2 520 000	1 600 1 600 1 400	2 600 2 000	1 400 1 400 1 300
200	310 360 360	51 58 58	2.1 4 4	2.1 4 4	229 — 243	281 316 —	390 000 620 000 945 000	580 000 865 000 1 060 000	2 600 2 000 1 900		2 000 1 700 1 700
	360 360 360	58 98 98	4 4 4	4 4 4	243 241 241		765 000 1 500 000 1 220 000	1 060 000 1 870 000 1 870 000	1 900 1 800 1 800	3 200 2 200 2 200	1 700 1 500 1 500
	420 420 420	80 80 138	5 5 5	5 5 5	— 258 253	360 —	975 000 1 140 000 1 910 000	1 270 000 1 450 000 2 760 000	1 600 1 500 1 300	2 600 1 900	1 300 1 300 1 200



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 C157) are used, the bearings become the NH type.



	Bearing Numb		Abutment and Fillet Dimensions (mm)								Mass (kg)	
	Cage symbol (1) Standard Option	NU NJ NUP N NF	$egin{aligned} d_{\mathrm{a}}^{\mathrm{(3)}} & d_{\mathrm{b}} \ \mathrm{min.} \end{aligned}$	$d_{ m b}{}^{\scriptscriptstyle (4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{ m a}{}^{\!\! (3)}$ max.	$D_{ m b}$ max.	$D_{ m b}$ min.	$m{\gamma}_{\mathrm{a}}$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1034 N 234 * NU234E NU234E * NU2234E NU2234E	(M) — M — M — M — M — M —	O O O O O O O O O O O O O O O O O O O	181 181 186 — 186 186 186 186 186 186 186 186	190 202 202 202 200 200	197 — 211 211 211 211		249 — 294 294 294 294	249 294 — — —	239 278 — — —	2 3 3 3 3	2 3 3 3 3 3	7.91 17.4 18.3 18.3 29.9 29.9
N 334 NU334E NU2334E	M — M — M —		186 — 186 186 186 186	213 210	223 223	241 241	344 344	344 — —	316 — —	3 3 3	3 3 3	36.6 37.9 63.4
NU1036 N 236 * NU236E	(M) — M — M —	NU NJ — N NF — — — N NF NU NJ NUP — —		202 — 212	209 — 221	_ 233	269 304	269 304 —	258 288 —	2 3 3	2 3 3	10.2 18.1 19
NU236E * NU2236E NU2236E	M — M — M —	NU NJ NUP — —	196 196 196 196 196 196	212 210 210	221 221 221	233 233 233	304 304 304	_	_	3 3 3	3 3 3	19 31.4 31.4
N 336 NU336E NU2336E	M — M — M —		196 — 196 196 196 196	— 226 222	— 235 235	— 255 255	— 364 364	364 — —	335 — —	3 3 3	3 3 3	42.6 44 74.6
NU1038 N 238 * NU238E	(M) — M — M —	N NF	201 201 206 — 206 206	212 — 225	219 — 234	 247	279 — 324	279 324 —	268 305 —	2 3 3	2 3 3	10.7 22 23
NU238E * NU2238E NU2238E	М — М — М —	NU NJ NUP — —	206 206 206 206 206 206	225 223 223	234 234 234	247 247 247	324 324 324	_	_	3 3 3	3 3 3	23 38.3 38.3
N 338 NU338E NU2338E	М — М — М —	NU NJ NUP — —	210 — 210 210 210 210	240 235	248 248	268 268	380 380	380	352 — —	4 4 4	4 4 4	48.7 50.6 86.2
NU1040 N 240 * NU240E	(M) — M — M —	NU NJ — N NF — — — N NF NU NJ NUP — —		226 — 238	233 — 247	_ 261	299 344	299 344 —	284 323 —	2 3 3	2 3 3	14 26.2 27.4
NU240E * NU2240E NU2240E	М — М — М —	NU NJ NUP — —	216 216 216 216 216 216	238 235 235	247 247 247	261 261 261	344 344 344	=	_	3 3 3	3 3 3	27.4 46.1 46.1
N 340 NU340E NU2340E	М — М — М —		220 — 220 220 220 220		263 263	283 283	400 400	400 —	367 —	4 4 4	4 4 4	55.3 57.1 99.3



⁽⁴⁾ $d_{\rm b}$ (max.) are values for adjusting rings for NU, NJ Types.

Remark The bearings denoted by an asterisk (*) are NSKHPS™ Cylindrical roller bearings.



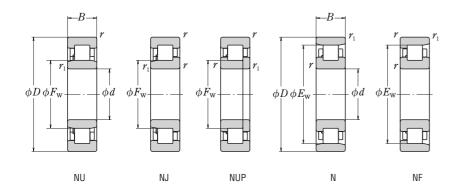


C 153 C 152

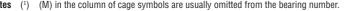
⁽⁵⁾ The limiting speeds(mechanical) in the bearing tables are the value for the standard cage type.

SINGLE-ROW CYLINDRICAL ROLLER BEARINGS

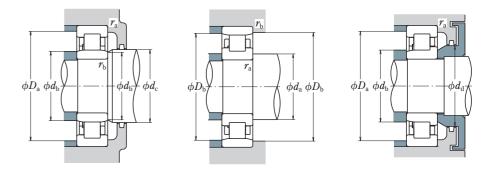
Bore Diameter 220 - 500 mm



	Boundary Dimensions (mm)							ad Ratings N)		Speeds (min ⁻¹)	
d	D	B	r	r_1	$F_{ m W}$	$E_{ m W}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference	Limiting	Speeds
	<i>D</i>		min.	min.	I'W	E_{W}	C _r	c_{0r}	Speed	Mechanical	Grease
220	340	56	3	3	250	310	500 000	750 000	2 400	_	1 800
	400 400	65 65	4 4	4 4	268	350	760 000 1 110 000	1 080 000 1 250 000	1 800 1 800	_	1 500 1 500
	400	65	4	4	268	_	905 000	1 250 000	1 800	_	1 500
	400 460	108 88	4 5	4 5	270	— 396	1 140 000	1 810 000 1 570 000	1 700 1 400	_	1 300 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
	440 440	72 72	4 4	4 4	 295	385	935 000 935 000	1 340 000 1 340 000	1 600 1 600	_	1 300 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	400 480	65 80	4 5	4 5	296 —	364 420	645 000 1 100 000	1 000 000 1 580 000	1 900 1 500	_	1 500 1 200
	480	80	5	5	320	_	1 100 000	1 580 000	1 500	_	1 200
	480 540	130 102	5 6	5 6	320 336	_	1 710 000 1 540 000	2 770 000 2 090 000	1 300 1 100	_	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
300	500 460	80 74	5 4	5 4	340 340	— 420	1 140 000 885 000	1 680 000 1 400 000	1 300 1 600		1 100 1 300
300	540	85	5	5	364	4 20	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
	580 580	92 92	5 5	5 5	390	510 —	1 540 000 1 540 000	2 270 000 2 270 000	1 100 1 100	_	950 950
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
460 480	680 700	100 100	6 6	6 6	516 536	624 644	1 580 000 1 620 000	2 740 000 2 860 000	950 900		750 750
480 500	700 720	100	6	6	536 556	664	1 660 000	2 970 000	900		750 710
500	120	100	U	U	550	004	1 000 000	2 3/0 000	300		/10



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 C157) are used, the bearings become the NH type.



	Bearing Numl		Abutment and Fillet Dimensions (mm)								Mass (kg)			
	Cage symbol (1) Standard Option	(2) NU NJ NUP	N NF	$d_{ m a}^{(3)}$ min.	$d_{ m b}$ min.	$d_{ m b}{}^{\scriptscriptstyle (4)}$ max.	$d_{ m c}$ min.	$d_{ m d}$ min.	$D_{\mathrm{a}}^{\mathrm{(3)}}$ max.	$D_{ m b}$ max.	$D_{\rm b} \\ {\rm min.}$	$ m \emph{r}_a$ max.	$ m \emph{r}_{b}$ max.	approx.
NU1044 N 244	(M) — M —	NU NJ —	N — N NF	233 236	233	247	254	_	327	327 384	313 357	2.5	2.5	18.2 37
*NU244E	М —	NU NJ NUP		236	236	264	273	289	384	_	_	3	3	37.4
NU244E	м —	NU NJ NUP		236	236	264	273	289	384	_	_	3	3	37.4
NU2244 N 344	M — M —	NU — —	N NF	240	236	264	273	289	384	440	403	3 4	3 4	61.8 72.8
NU344	М —	NU NJ —	— —	240	240	278	287	307	440	440	403	4	4	74.6
NU1048	(M) —	NU NJ —	N —	253	253	266	275	_	347	347	333	2.5	2.5	19.5
N 248	М —			256	_		. —		_	424	392	3	3	49.6
NU248	м —	NU NJ NUP		256	256	289	298	316	424	_	_	3	3	50.4
NU2248 N 348	M — M —	NU — —	N NF	260	256	289	298	316	424	— 480	438	3 4	3	84.9 92.3
NU348	М —	NU NJ —	— —	260	260	304	313	333	480	400	430	4	4	94.6
NU1052	(M) —	NU NJ —	N NF	276	276	292	300	_	384	384	367	3	3	29.1
N 252	м —		N —	280	_	_	_	_	_	460	428	4	4	66.2
NU252	м —	NU NJ —		280	280	314	323	343	460	_	_	4	4	67.1
NU2252 NU352	M — M —	NU — NUP NU NJ —		280 286	280 286	314 330	323 339	343 359	460 514	_	_	4 5	4 5	111 118
NU1056	(M) —		N NF		296	312	320	_	404	404	387	3	3	30.8
N 256	`м´ —		N NF	300	_	_	_	_	_	480	448	4	4	69.6
NU256	м —	NU NJ —		300	300	334	344	364	480	_	_	4	4	70.7
NU1060	(M) —		N NF		316	336	344	_	444	444	424	3	3	43.7
NU260 NU1064	M —	NU NJ — NU — —	N NF	320	320	358	368	391	520	464	444	4	4	89.2 46.1
N 264	(M) — M —			340	336	356	365	_	464	464 560	519	3 4	3 4	110
NU264	М —	NU NJ —		340	340	384	394	420	560	_	_	4	4	112
NU1068	(M) —	NU NJ —	N NF	360	360	381	390	_	500	500	479	4	4	61.8
NU1072	(M) —	NU	N NF	380	380	400	410	_	520	520	499	4	4	64.6
NU1076	(M) —	NU	— —	_	400	420	430	_	540	_	_	4	4	67.5
NU1080	(M) —	${\sf NU-NUP}$	N —	420	420	445	455	_	580	580	554.5	4	4	88.2
NU1084	(M) —	NU	N —	440	440	465	475	_	600	600	574.5	4	4	91.7
NU1088	(M) —	NU		_	466	488	498	_	624	_	_	5	5	105
NU1092	(M) —		N —	486	486	511	521	_	654	654	628.5	5	5	123
NU1096	(M) —	NU NJ —	N —	506	506	531	541	_	674	674	654	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. **Remark** The bearings denoted by an asterisk (*) are NSKHPSTM Cylindrical roller bearings.

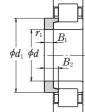






L-Shaped Thrust Collars Bore Diameter 20 – 85 mm

Bore Diameter 90 - 320 mm



L-Shaped Thrust Collar

L-Shaped Thrust Collar

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Г	Ī	

	Bounda	ry Dim (mm)	ensions		Bearing	Mass (kg)	•		Bounda	ı ry Dim (mm)	ensions		Bearing	Mass (kg)
<i>d</i>	d_1	B_1	B_2	${m r}_1$ min.	Numbers	approx.	_	d	$d_{\scriptscriptstyle 1}$	B_1	B_2	$ m \emph{r}_1$ min.	Numbers	approx.
20	30 29.8 30	3 3 3	6.75 5.5 7.5	0.6 0.6 0.6	HJ 204 HJ 204 E HJ 2204	0.012 0.011 0.012		55	70.9 70.9 77.6	6 6 9	9.5 10 14	1.1 1.1 2	HJ 211 E HJ 2211 E HJ 311 E	0.087 0.088 0.195
	29.8 31.7 31.4	3 4 4	6.5 7.5 6.5	0.6 0.6 0.6	HJ 2204 E HJ 304 HJ 304 E	0.012 0.017 0.017			77.6 85.2	9 10	15.5 16.5	2 2.1	HJ 2311 E HJ 411	0.20 0.29
	31.8 31.4	4	8.5 7.5	0.6	HJ 2304 HJ 2304 E	0.017 0.018		60	77.7 77.7 84.5	6 6 9	10 10 14.5	1.5 1.5 2.1	HJ 212 E HJ 2212 E HJ 312 E	0.108 0.108 0.231
25	34.8 34.8 38.2	3 3 4	6 6.5 7	0.6 0.6 1.1	HJ 205 E HJ 2205 E HJ 305 E	0.014 0.014 0.025			84.5 91.8	9 10	16 16.5	2.1 2.1	HJ 2312 E HJ 412	0.237 0.34
30	38.2 43.6 41.3	4 6 4	8 10.5 7	1.1 1.5 0.6	HJ 2305 E HJ 405 HJ 206 E	0.026 0.057 0.025		65	84.5 84.5 90.6	6 6 10	10 10.5 15.5	1.5 1.5 2.1	HJ 213 E HJ 2213 E HJ 313 E	0.129 0.131 0.288
30	41.4 45.1	4 5	7.5 8.5	0.6 1.1	HJ 2206 E HJ 306 E	0.025 0.042			90.6 98.5	10 11	18 18	2.1	HJ 2313 E HJ 413	0.298 0.42
35	45.1 50.5 48.2	5 7 4	9.5 11.5 7	1.1 1.5 0.6	HJ 2306 E HJ 406 HJ 207 E	0.043 0.080 0.033		70	89.5 89.5 97.5	7 7 10	11 11.5 15.5	1.5 1.5 2.1	HJ 214 E HJ 2214 E HJ 314 E	0.157 0.158 0.33
	48.2 51.1 51.1	4 6 6	8.5 9.5 11	0.6 1.1 1.1	HJ 2207 E HJ 307 E HJ 2307 E	0.035 0.060 0.062			97.5 110.5	10 12	18.5 20	2.1	HJ 2314 E HJ 414	0.345 0.605
40	59 54.1	8 5	13 8.5	1.5 1.1	HJ 407 HJ 208 E	0.12		75	94.5 94.5 104.2	7 7 11	11 11.5 16.5	1.5 1.5 2.1	HJ 215 E HJ 2215 E HJ 315 E	0.166 0.167 0.41
	54.1 57.6 57.7	5 7 7	9 11 12.5	1.1 1.5 1.5	HJ 2208 E HJ 308 E HJ 2308 E	0.050 0.088 0.091			104.2 116	11 13	19.5 21.5	2.1	HJ 2315 E HJ 415	0.43 0.71
45	64.8 59.1 59.1	8 5 5	13 8.5 9	2 1.1 1.1	HJ 408 HJ 209 E HJ 2209 E	0.14 0.055 0.055		80	101.6 101.6 110.6	8 8 11	12.5 12.5 17	2 2 2.1	HJ 216 E HJ 2216 E HJ 316 E	0.222 0.222 0.46
	64.5 64.5 71.7	7 7 8	11.5 13 13.5	1.5 1.5 2	HJ 2309 E HJ 409	0.11 0.113 0.175			111 122	11 13	20 22	2.1	HJ 2316 E HJ 416	0.48 0.78
50	64.1 64.1 71.4	5 5 8	9 9 13	1.1 1.1 2	HJ 210 E HJ 2210 E HJ 310 E	0.061 0.061 0.151		85	107.6 107.6 117.9	8 8 12	12.5 13 18.5	2 2 3	HJ 217 E HJ 2217 E HJ 317 E	0.25 0.252 0.575
	71.4 71.4 78.8	8 9	14.5 14.5	2 2.1	HJ 2310 E HJ 410	0.155 0.23	-		117.9 126	12 14	22 24	3 4	HJ 2317 E HJ 417	0.595 0.88

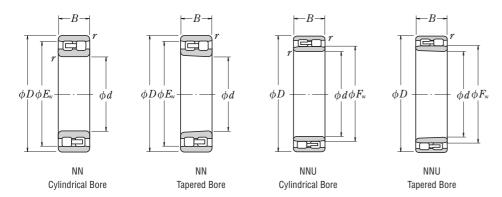
	Bounda	ary Dim (mm)	ensions		Bearing	Mass (kg)
d	d_1	B_1	B_2	${\pmb \gamma}_1 \\ {\rm min.}$	Numbers	approx.
90	114.3	9	14	2	HJ 218 E	0.32
	114.3	9	15	2	HJ 2218 E	0.325
	124.2	12	18.5	3	HJ 318 E	0.63
	124.2	12	22	3	HJ 2318 E	0.66
	137	14	24	4	HJ 418	1.05
95	120.6	9	14	2.1	HJ 219 E	0.355
	120.6	9	15.5	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
10	5 145	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

	Bounda	ary Dime	ensions		Bearing	Mass (kg)
d	$d_{\scriptscriptstyle 1}$	B_1	B_2	$\stackrel{\pmb{\gamma}_1}{\text{min.}}$	Numbers	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

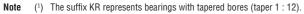
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DOUBLE-ROW CYLINDRICAL ROLLER BEARINGS

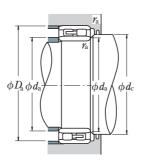
Bore Diameter 25 - 140 mm

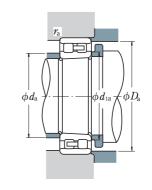


Bound				ndary Dimensions (mm)			Basic Load		Limiting Speeds (min ⁻¹)		
	d	D	B	γ min.	$F_{ m W}$	$E_{ m W}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	
	25	47	16	0.6	_	41.3	25 800	30 000	14 000	17 000	
	30	55	19	1	_	48.5	31 000	37 000	12 000	14 000	
	35	62	20	1	_	55	39 500	50 000	10 000	12 000	
	40	68	21	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	140 150	40 37	1.1 1.5	112 —	 137	155 000 157 000	295 000 265 000	4 000 4 000	5 000 4 800	
	105	145 160	40 41	1.1 2	117 —	 146	161 000 198 000	315 000 320 000	3 800 3 800	4 800 4 500	
	110	150 170	40 45	1.1 2	122 —	— 155	167 000 229 000	335 000 375 000	3 600 3 400	4 500 4 300	
	120	165 180	45 46	1.1 2	133.5 —	 165	183 000 239 000	360 000 405 000	3 200 3 200	4 000 3 800	
	130	180 200	50 52	1.5 2	144	 182	274 000 284 000	545 000 475 000	3 000 3 000	3 800 3 600	
	140	190 210	50 53	1.5 2	154 —	 192	283 000 298 000	585 000 515 000	2 800 2 800	3 600 3 400	



Remark Production of double-row cylindrical roller bearings is generally in the high precision classes (Class 5 or better).





Bearing		Abutment and Fillet Dimensions (mm)						Mass (kg)	
Cylindrical Bore	Tapered Bore(1)	d_{z} min.	(2) max.	$d_{ m 1a}$ min.	$d_{ m c}$ min.	max.	a min.	${\pmb \gamma}_a$ max.	approx.
NN 3005	NN 3005 KR	29	_	29	_	43	42	0.6	0.127
NN 3006	NN 3006 KR	35	_	36	_	50	50	1	0.198
NN 3007	NN 3007 KR	40	_	41	_	57	56	1	0.258
NN 3008	NN 3008 KR	45	_	46	_	63	62	1	0.309
NN 3009	NN 3009 KR	50	_	51	_	70	69	1	0.407
NN 3010	NN 3010 KR	55	_	56	_	75	74	1	0.436
NN 3011	NN 3011 KR	61.5	_	62	_	83.5	83	1	0.647
NN 3012	NN 3012 KR	66.5	_	67	_	88.5	88	1	0.693
NN 3013	NN 3013 KR	71.5	_	72	_	93.5	93	1	0.741
NN 3014	NN 3014 KR	76.5	_	77	_	103.5	102	1	1.06
NN 3015	NN 3015 KR	81.5	_	82	_	108.5	107	1	1.11
NN 3016	NN 3016 KR	86.5	_	87	_	118.5	115	1	1.54
NN 3017	NN 3017 KR	91.5	_	92	_	123.5	120	1	1.63
NN 3018	NN 3018 KR	98	_	99	_	132	129	1.5	2.09
NN 3019	NN 3019 KR	103	_	104	_	137	134	1.5	2.19
NNU 4920 NN 3020	NNU 4920 KR NN 3020 KR		111 —	108 109	115 —	133.5 142	 139	1 1.5	1.9 2.28
NNU 4921 NN 3021	NNU 4921 KR NN 3021 KR	111.5 114	116 —	113 115	120 —	138.5 151	 148	1 2	1.99 2.88
NNU 4922 NN 3022	NNU 4922 KR NN 3022 KR	116.5 119	121 —	118 121	125 —	143.5 161	 157	1 2	2.07 3.71
NNU 4924 NN 3024	NNU 4924 KR NN 3024 KR	126.5 129	133 —	128 131	137 —	158.5 171	 167	1 2	2.85 4.04
NNU 4926 NN 3026	NNU 4926 KR NN 3026 KR	138 139	143 —	140 141	148 —	172 191	 185	1.5 2	3.85 5.88
NNU 4928 NN 3028	NNU 4928 KR NN 3028 KR	148 149	153 —	150 151	158 —	182 201	— 195	1.5 2	4.08 6.34

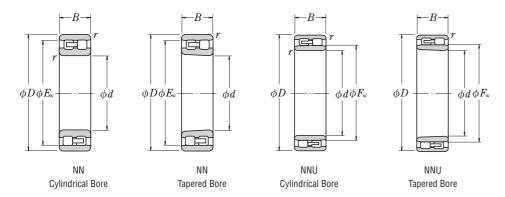
Note (2) d_a (max.) are values for adjusting rings for the NNU Type.



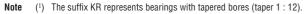


DOUBLE-ROW CYLINDRICAL ROLLER BEARINGS

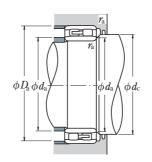
Bore Diameter 150 – 360 mm

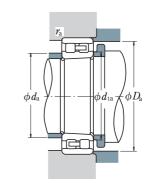


			ry Dimensio (mm)	ons		Basic Loa	Limiting Speeds (min ⁻¹)		
d	D	В	γ min.	$F_{ m W}$	$E_{ m W}$	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil
150	210 225	60 56	2 2.1	167 —	206	350 000 335 000	715 000 585 000	2 600 2 600	3 200 3 000
160	220 240	60 60	2 2.1	177 —	 219	365 000 375 000	760 000 660 000	2 400 2 400	3 000 2 800
170	230 260	60 67	2 2.1	187 —	 236	375 000 450 000	805 000 805 000	2 400 2 200	2 800 2 600
180	250 280	69 74	2 2.1	200	 255	480 000 565 000	1 020 000 995 000	2 200 2 000	2 600 2 400
190	260 290	69 75	2 2.1	211.5 —	 265	485 000 595 000	1 060 000 1 080 000	2 000 2 000	2 600 2 400
200	280 310	80 82	2.1 2.1	223 —	 282	570 000 655 000	1 220 000 1 170 000	1 900 1 800	2 400 2 200
220	300 340	80 90	2.1 3	243 —	310	600 000 815 000	1 330 000 1 480 000	1 700 1 700	2 200 2 000
240	320 360	80 92	2.1 3	263 —	330	625 000 855 000	1 450 000 1 600 000	1 600 1 500	2 000 1 800
260	360 400	100 104	2.1 4	289 —	 364	935 000 1 030 000	2 100 000 1 920 000	1 400 1 400	1 800 1 700
280	380 420	100 106	2.1 4	309	 384	960 000 1 080 000	2 230 000 2 080 000	1 300 1 300	1 700 1 500
300	420 460	118 118	3 4	336	— 418	1 230 000 1 290 000	2 870 000 2 460 000	1 200 1 200	1 500 1 400
320	440 480	118 121	3 4	356 —	 438	1 260 000 1 350 000	3 050 000 2 670 000	1 100 1 100	1 400 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



Remark Production of double-row cylindrical roller bearings is generally in the high precision classes (Class 5 or better).





Bearing	g Numbers	Abutment and Fillet Dimensions (mm)							Mass (kg)
Cylindrical Bore	Tapered Bore(1)	min.	$d_{ m a}^{(2)}$ max.	$d_{ m 1a}$ min.	$d_{ m c}$ min.	max.	$D_{ m a}$ min.	${\pmb \gamma}_{\rm a}$ max.	approx.
NNU 4930 NN 3030	NNU 4930 KR NN 3030 KR	159 161	166 —	162 162	171 —	201 214	209	2 2	6.39 7.77
NNU 4932 NN 3032	NNU 4932 KR NN 3032 KR	169 171	176 —	172 172	182 —	211 229	222	2 2	6.76 9.41
NNU 4934 NN 3034	NNU 4934 KR NN 3034 KR	179 181	186 —	182 183	192 —	221 249	239	2 2	7.12 12.8
NNU 4936 NN 3036	NNU 4936 KR NN 3036 KR	189 191	199 —	193 193	205 —	241 269	 258	2 2	10.4 16.8
NNU 4938 NN 3038	NNU 4938 KR NN 3038 KR	199 201	211 —	203 203	217 —	251 279	 268	2 2	10.9 17.8
NNU 4940 NN 3040	NNU 4940 KR NN 3040 KR	211 211	222 —	214 214	228 —	269 299	 285	2 2	15.3 22.7
NNU 4944 NN 3044	NNU 4944 KR NN 3044 KR	231 233	242 —	234 236	248 —	289 327	313	2 2.5	16.6 29.6
NNU 4948 NN 3048	NNU 4948 KR NN 3048 KR	251 253	262 —	254 256	269 —	309 347	334	2 2.5	18 32.7
NNU 4952 NN 3052	NNU 4952 KR NN 3052 KR	271 276	288 —	275 278	295 —	349 384	368	2	31.1 47.7
NNU 4956 NN 3056	NNU 4956 KR NN 3056 KR	291 296	308	295 298	315 —	369 404	388	2	33 51.1
NNU 4960 NN 3060	NNU 4960 KR NN 3060 KR	313 316	335 —	318 319	343 —	407 444	 422	2.5 3	51.9 70.7
NNU 4964 NN 3064	NNU 4964 KR NN 3064 KR	333 336	355 —	338 340	363 —	427 464	442	2.5 3	54.9 76.6
NN 3068	NN 3068 KR	360	_	365	_	500	477	4	102
NN 3072	NN 3072 KR	380	_	385	_	520	497	4	106







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	Туре	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.



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

0	perating Conditions	Fitting between Inner Ring and Shaft	Fitting between Outer Ring and Housing Bore	Recommended Internal Clearance
	Thin walled housings and heavy loads	g6 or h6	P7	C 3
Outer Ring Rotation	Normal to heavy loads	g6 or h6	N7	C 3
	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 on misalignment is allowed.



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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

Bearin	g Type	Fixed-End	Free-End
Open Type	Open Type Without Snap Ring		RSF-48E4 RSF-49E4
Shielded Type	Without Snap Ring With Snap Ring	RS-50 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 2 Features of Various Types

Figure	Туре	Design and Features
	RS-48E4 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 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 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

0	perating Conditions	Fitting between Inner Ring and Shaft	Fitting between Outer Ring and Housing Bore	Recommended Internal Clearance
	Thin walled housings and heavy loads	g6 or h6	P7	C3
Outer Ring Rotation	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

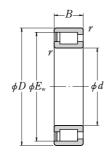
min. 15 20 20	Clear N max. 50 55 65	min. 35 40 45	max. 70 75
min. 15 20 20	max. 50 55	min. 35 40	max. 70 75
15 20 20	50 55	35 40	70 75
20	55	40	75
٥٦			90
25	75	55	105
30	80	65	115
35	90	80	135
40	105	90	155
50	115	100	165
60	125	110	175
65	135	125	195
75	150	140	215
90	165	155	230
100	180	175	255
110	195	195	280
125	215	215	305
140	235	245	340
155	275	270	390
180	300	300	420
	30	30 80	30 80 65
	35	35 90	35 90 80
	40	40 105	40 105 90
	50	50 115	50 115 100
	60	60 125	60 125 110
	65	65 135	65 135 125
	75	75 150	75 150 140
	90	90 165	90 165 155
	100	100 180	100 180 175
	110	110 195	110 195 195
	125	125 215	125 215 215
	140	140 235	140 235 245
	155	155 275	155 275 270

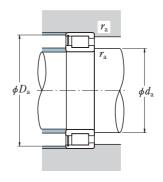


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■FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS

NCF Type, Single-Row Bore Diameter 100 – 260 mm





	Вс	oundary Din (mm)			Basic Loa		Daning Numbers
<i>d</i>	D	В	γ min.	$E_{ m W}$	$C_{\rm r}$	C_{0r}	Bearing Numbers
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

	ment and I ensions (n	Mass (kg)	
d_{a}	D_{a}	$m{r}_{ m a}$ 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 2	1.7
132	168		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 2	3.7
165	209		7.1
173	208	2 2	3.8
175	225		8.6
182 183	204 219	1.5 2 2	1.8 4.1
185	244	1.5	11.9
192	216		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		8.9
216 234 236	293 258 283	2 2 2 2 2.5	21.4 2.7 9.6
238 238 254	320 285	2.5	28.2
254 257 259	304 340	2 2 2.5	10.4 31.2
275	308	2	4.5
277	342	2	18.1
282	377	3	45.3

Remark Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.

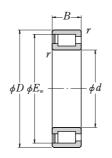


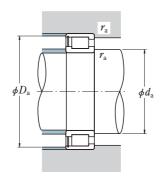


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■ FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS

NCF Type, Single-Row Bore Diameter 300 – 800 mm





	Во	oundary Din (mm				ad Ratings	
d	D	B	γ min.	$E_{ m W}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers
300	380	38	2.5	359	445	870	NCF1860V
	420	72	3	389.6	1 120	2 200	NCF2960V
	460	118	4	431.7	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	580 620	56 95	3	552.7 576.5	920 2 100	1 950 4 450	NCF1892V NCF2992V
480	600 650	56 100	3	573 615	940 2 380	2 040 5 100	NCF1896V NCF2996V
500	620	56	3	593.5	960	2 120	NCF18/500V
	670	100	5	630.2	2 420	5 250	NCF29/500V
530 560	650 680 820	56 56 195	3 3 6	624 654.7 770	990 1 020 5 600	2 240 2 360 11 300	NCF18/530V NCF18/560V 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	5	882.3	1 930	4 600	NCF18/750V
800	980	82	5	936	2 110	5 100	NCF18/800V
_							

	ment and f ensions (n	Mass (kg)	
$d_{\scriptscriptstyle \mathrm{a}}$	D_{a}	$m{\gamma}_{\mathrm{a}}$ max.	approx.
319 320 323 338 340 343 359 361 368 380 404 404 408 421 425 429 440 445 449 461 466 483 486 503 510 524 531 531 524 531 585 685 685 700 741 786 832	360 398 435 381 418 454 402 438 490 423 457 509 458 518 518 518 518 518 577 625 617 627 637 625 647 637 627 647 748 787 838 883 950	2 2.5 3 2 2.5 3 2 2.5 4 2 2.5 4 2 2 3 3 4 2 2 3 3 4 2 2 3 3 4 2 2 3 3 4 2 2 5 5 2.5 4 2.5 5 2.5	9.7 30.7 67.6 10.3 33 73 10.7 34.1 97 11.5 36 102 18.6 52 108 19.5 53.4 139 20.5 55.7 147 21.3 78.2 32.5 81.2 33.8 95.1 35.1 36 37 38 39 39 30 30 40 40 40 40 40 40 40 40 40 4

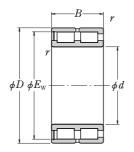
Remark Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.

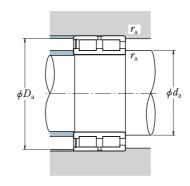


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■ FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS

NNCF Type, Double-Row Bore Diameter 100 – 260 mm





	Во	oundary Dim (mm)			Basic Loa (k		Bearing Numbers
<i>d</i>	D	В	∤ min.	$E_{ m W}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	bearing Numbers
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

	ment and I ensions (n	Mass (kg)	
$d_{ m a}$	D_{a}	$m{\gamma}_{ m a}$ max.	approx.
109	130	1	2.0
111	140	1.5	3.8
119	140	1 2	2.1
122	157		6.1
130	155	1 2	2.9
132	168		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	3	82.7

Remark Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.

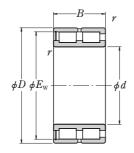


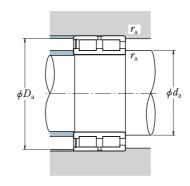


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■ FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS

NNCF Type, Double-Row Bore Diameter 280 – 500 mm





	Boundary Dimensions Basic Loa (mm) (kt						
d	D	В	γ min.	$E_{ m W}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers
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

	ment and l ensions (n	Mass (kg)	
$d_{ m a}$	D_{a}	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

Remark Full-complement cylindrical roller bearings are designed for specific applications, when using them, please contact NSK.



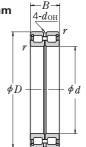


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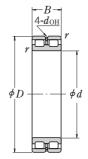
FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS FOR SHEAVES

RS-48 · RS-49 Types RSF-48 · RSF-49 Types

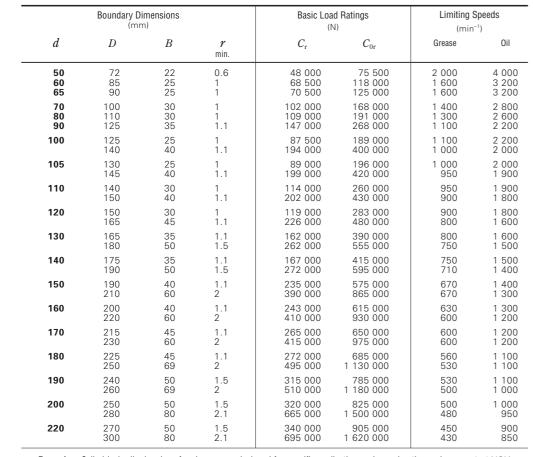
Bore Diameter 50 - 220 mm



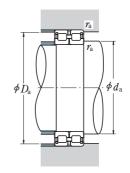




Free-End Bearing RSF



Remark Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.



Bearing Numbers ⁽¹⁾		Dimer (m		A Fillet D	Mass (kg)		
Fixed-End Bearing Free-End B	Bearing	$d_{ m OH}$ (2)	Axial Disp.(3)	$d_{ m a}$ min.	$D_{ m a}$ max.	$m{\gamma}_{\mathrm{a}}$ max.	approx.
RS-4910E4 RSF-49	912E4	2.5	1.5	54	68	0.6	0.30
RS-4912E4 RSF-49		2.5	1.5	65	80	1	0.46
RS-4913E4 RSF-49		2.5	2	70	85	1	0.50
RS-4914E4 RSF-49	916E4	3	2	75	95	1	0.79
RS-4916E4 RSF-49		3	2	85	105	1	0.89
RS-4918E4 RSF-49		3	2	96.5	118.5	1	1.35
RS-4820E4 RSF-48		2.5	1.5	105	120	1	0.74
RS-4920E4 RSF-48		3	2	106.5	133.5	1	1.97
RS-4821E4 RSF-48		2.5	1.5	110	125	1	0.77
RS-4921E4 RSF-49		3	2	111.5	138.5	1	2.05
RS-4822E4 RSF-49 RS-4922E4 RSF-49		3 3	2 2	115 116.5	135 143.5	1 1	1.09 2.15
RS-4824E4 RSF-49		3	2	125	145	1	1.28
RS-4924E4 RSF-49		4	3	126.5	158.5	1	2.95
RS-4826E4 RSF-49		3	2	136.5	158.5	1	1.9
RS-4926E4 RSF-49		5	3.5	138	172	1.5	3.95
RS-4828E4 RSF-49		3	2	146.5	168.5	1	2.03
RS-4928E4 RSF-49		5	3.5	148	182	1.5	4.25
RS-4830E4 RSF-48		3	2	156.5	183.5	1	2.85
RS-4930E4 RSF-48		5	3.5	159	201	2	6.65
RS-4832E4 RSF-49		3	2	166.5	193.5	1	3.05
RS-4932E4 RSF-49		5	3.5	169	211	2	7.0
RS-4834E4 RSF-48		4	3	176.5	208.5	1	4.1
RS-4934E4 RSF-48		4	3.5	179	221	2	7.35
RS-4836E4 RSF-48		4	3	186.5	218.5	1	4.3
RS-4936E4 RSF-48		6	4.5	189	241	2	10.7
RS-4838E4 RSF-48		5	3.5	198	232	1.5	5.65
RS-4938E4 RSF-48		6	4.5	199	251	2	11.1
RS-4840E4 RSF-49		5	3.5	208	242	1.5	5.95
RS-4940E4 RSF-49		7	5	211	269	2	15.7
RS-4844E4 RSF-49		5	3.5	228	262	1.5	6.45
RS-4944E4 RSF-49		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) $d_{\rm OH}$ represents the oil hole diameter in the outer ring.

(3) Permissible axial displacement for free-end bearings.

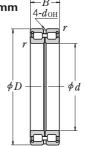




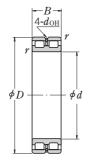
FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS FOR SHEAVES

RS-48 · RS-49 Types RSF-48 · RSF-49 Types

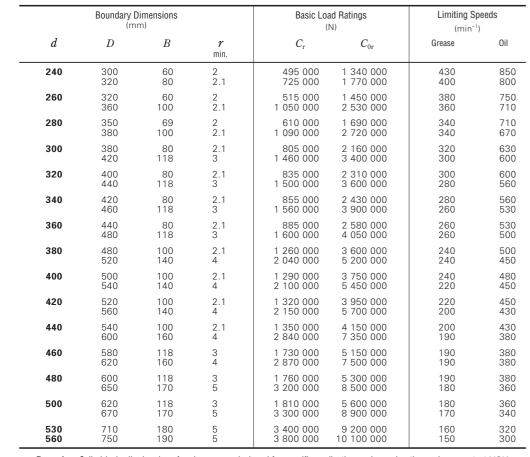
Bore Diameter 240 – 560 mm



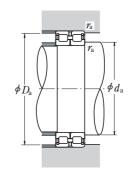




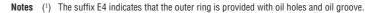
Free-End Bearing RSF



Cylindrical roller bearings for sheaves are designed for specific applications, when using them, please contact NSK.



Bearing N	lumbers(1)		nsions ım)		Abutment and Dimensions (r	mm)	Mass (kg)
Fixed-End Bearing	Free-End Bearing	$d_{ m OH}^{(2)}$	Axial Disp.(3)	$d_{ m a}$ min.	$D_{\rm a} \\ {\rm max.}$	${\pmb \gamma}_a$ 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



⁽²⁾ $d_{\rm OH}$ represents the oil hole diameter in the outer ring.

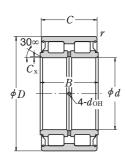




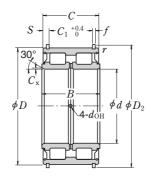
⁽³⁾ Permissible axial displacement for free-end bearings.

FULL-COMPLEMENT CYLINDRICAL ROLLER BEARINGS FOR SHEAVES

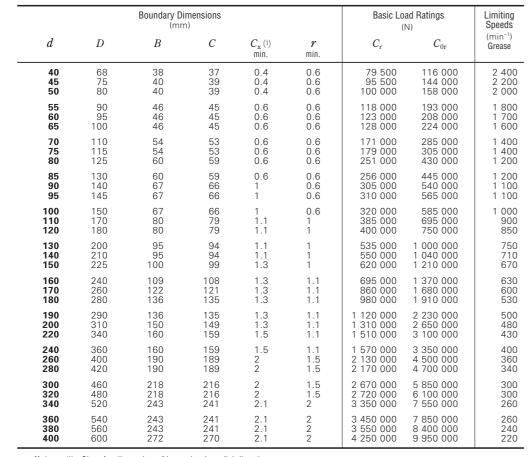
RS-50 Type (Prelubricated) Bore Diameter 40 – 400 mm







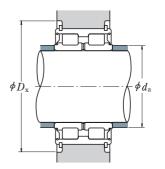
With Locating Ring



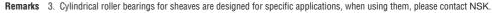
Note (1) Chamfer dimension of inner ring in radial direction.

Remarks 1. Good quality grease is prepacked in bearings.

2. Grease can be supplied through oil holes in the inner rings.



Bearing N	lumbers			ing Ring ions (mm)		Oil Holes (mm)		ent and isions (mm)	Mass (kg)
Without Locating Ring	With Locating Ring	C_1	S	D_2	f	$d_{ m OH}$	$d_{ m a}$ min.	$D_{\mathbf{x}} \\ \text{min.}$	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-5064 RS-5068	RS-5060NR — —	178 — —	19 — —	476 — —	7 —	8 8 10	310 330 352	512 — —	130 135 185
RS-5072 RS-5076 RS-5080	=	_ _ _	Ξ	=	Ξ	10 10 10	372 392 412	=	



^{4.} For shield with outside diameter larger than 180mm, the above figure is different actual shape. For detail drawing, please contact NSK.







6. TAPERED ROLLER BEARINGS	3
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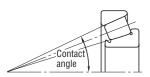
INTRODUCTION	C 182
TECHNICAL DATA	
Free Space of Tapered Roller Bearings	C 188
BEARINGS TABLE	
METRIC DESIGN TAPERED ROLLER BEARINGS	
Bore Diameter 15 – 100 mm	C 190
Bore Diameter 105 – 240 mm·····	C 202
Bore Diameter 260 – 440 mm·····	C 208
INCH DESIGN TAPERED ROLLER BEARINGS	
Bore Diameter 12.000 – 47.625 mm	C 210
Bore Diameter 48.412 – 69.850 mm	C 224
Bore Diameter 70.000 – 206.375 mm ·····	C 232
The index for inch design tapered roller bearings is in Appendix 14 (Page E020).	
DOUBLE-ROW TAPERED ROLLER BEARINGS	
Bore Diameter 40 – 260 mm	C 246





C 180

DESIGN, TYPES, AND FEATURES

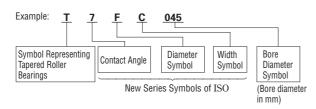


Tapered roller bearings are designed so the apices of the cones formed by the raceways of the cone and cup and the conical rollers all coincide at one point on the axis of the bearing. When a radial load is imposed, an axial force component occurs; therefore, it is necessary to use two bearings in opposition or some other multiple arrangement.

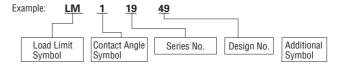
For metric-design medium-angle and steep-angle tapered roller bearings, the respective contact angle symbol C or D is added after the bore number. For normal-angle tapered roller bearings, no contact angle symbol is used. Medium-angle tapered roller bearings are primarily used for the pinion shafts of 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 than 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 than that for past metric design, is as follows:



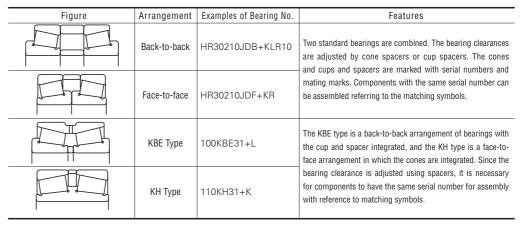
Besides metric design tapered roller bearings, there are also inch design bearings. For the cone assemblies and cups of inch design bearings, except four-row tapered roller bearings, the bearing numbers are approximately formulated as follows:



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.









TOLERANCES AND RUNNING ACCURACY

METRIC DESIGN TAPERED ROLLER **BEARINGS** Table 7.3 (Pages A132 to A135)

INCH DESIGN TAPERED ROLLER

BEARINGS Table 7.4 (Pages A136 and A137)

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 for Cones(CLASS K)

Units : μm

(ore Diameter d (m)	$\it \Delta_{dmp}$		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 for Cups(CALSS K)

Units : μm

Nominal Diam D (r	neter	${\it \Delta}_{Dmp}$		V_{Dp}	$V_{D{ m mp}}$	K_{ea}
over	incl.	high	low	max.	max.	max.
18 30 50	30 50 80	0 0 0	- 12 - 14 - 16	12 14 16	9 11 12	18 20 25
80 120 150	120 150 180	0 0 0	18 20 25	18 20 25	14 15 19	35 40 45
180 250 315 400	250 315 400 500	0 0 0	-30 -35 -40 -45	30 35 40 45	23 26 30 34	50 60 70 80

Table 4 Tolerances for 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 ΔT_{18}		Effective Width Deviation of Cup $\varDelta_{T_{2\mathrm{S}}}$		Overall Width Deviation Δ_{Ts}	
OV	er incl.	high	low	high	low	high	low
1	0 80	+100	0	+100	0	+200	0
8	120	+100	-100	+100	-100	+200	-200
12	0 315	+150	-150	+200	-100	+350	-250
31	5 400	+200	-200	+200	-200	+400	-400

(2) Bearings for Front Axles of Automobiles

(In the bearing tables, those preceded by t)

Table 5 Tolerances for Bore Diameter and Overall Width

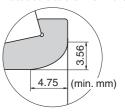
Units : μm

Nominal Bo	re Diameter t		Bore Diameter Deviation Δ_{ds}		Overall Width Deviation Δ_{Ts}	
over (mm) 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.







C 185 C 184

RECOMMENDED FITS

METRIC DESIGN TAPERED ROLLER BEARINGS Table 8.3 (Page A164) Table 8.5 (Page A165) INCH DESIGN TAPERED ROLLER BEARINGS...... Table 8.7 (Page A166) Table 8.8 (Page A167)

INTERNAL CLEARANCE

METRIC DESIGN TAPERED ROLLER BEARINGS (Matched and Double-Row)	Table	8.17	(Page	A173)
INCH DESIGN TAPERED ROLLER BEARINGS (Matched and Double-Row)	Table	8.17	(Page	A173)

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 (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.

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 , $S_{\rm b}$ 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

Units: cm3

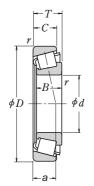
						Bearing f	ree space			
Bearing bore No.						Bearing	g series			
DOTO INO.	HR329-J	HR320-XJ	HR330-J	HR331-J	HR302-J	HR322-J	HR332-J	HR303-J	HR303-DJ	HR323-J
02	_	_	_	_	_	_	_	4.5	_	_
03	_	_	_	_	3.3	4.3	_	5.7	_	_
04	_	3.5	_	_	5.3	6.6	_	7.2	_	9.2
/22	_	3.6	_	_	_	7.3	_	9.1	_	_
05	_	3.7	4.3	_	6.3	7.4	7.5	11	13	15
/28	_	5.3	_	_	8.8	9.8	10	16	_	_
06	_	6.2	6.7	_	9.2	11	12	18	21	23
/32	_	6.6	_	_	11	13	14	20	_	_
07	4.0	7.5	8.9	_	13	17	18	23	26	35
08	5.8	9.1	11	_	18	23	25	31	35	45
09	_	11	_	18	22	24	26	41	48	58
10	_	12	15	20	23	26	29	55	59	77
11	8.8	19	21	29	30	36	40	72	78	99
12	9.0	20	23	_	39	47	53	88	95	130
13	_	21	25	_	45	62	65	110	120	150
14	17	29	33	_	53	67	69	130	150	190
15	_	30	34	_	58	73	74	160	180	230
16	_	40	_	_	75	91	100	200	200	270
17	_	43	49	76	92	120	130	230	250	320
18	28	58	_	110	110	150	_	260	310	370
19	29	60	_	_	140	170	_	310	350	430
20	37	64	_	150	160	210	240	380	460	580

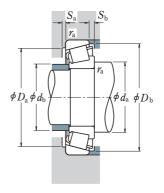




■ SINGLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 15 – 28 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$r_{\rm r} > e$				
X	Y	X	Y				
1	0	0.4	<i>Y</i> ₁				

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of \emph{e} , \emph{Y}_{1} , and \emph{Y}_{0} are

given in the table below.

		Bour	ndary Dimens (mm)	sions	0		Basic Loa	Ü	Limiting (mi			ISO355			Abutm		d Fillet D (mm)	imensi	ions		Eff. Load C	onstant	Axial I Fact		Mass (kg)
d	D	T	В	С	Cone 1 mi	r	$C_{\rm r}$	C_{0r}	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	$\max_{\text{max.}} D$	a min.	$D_{ m b}$ min.	S_{a} min.	$S_{ m b}$ min.	Cone Cup $ m \emph{r}_a$ max.	(mm) a	e	Y_1	Y_0	approx.
15	35 42	11.75 14.25	11 13	10 11	0.6 1	0.6 1	14 800 23 600	13 200 21 100	11 000 9 500	15 000 13 000	30202 HR 30302 J	_ 2FB	23 24	19 22	30 36	30 36	33 38.5	2	1.5 3	0.6 0.6 1 1			1.9 2.1	1.0 1.2	0.053 0.098
17	40 40 47	13.25 17.25 15.25	12 16 14	11 14 12	1 1 1	1 1 1	20 100 27 100 29 200	19 900 28 000 26 700	9 500 9 500 8 500	13 000 13 000 12 000	HR 30203 J HR 32203 J HR 30303 J	2DB 2DD 2FB	26 26 26	23 22 24	34 34 41	34 34 40	37.5 37 43	2 2 2	2 3 3	1 1 1 1 1 1	11.2 10.4	0.31	1.7 1.9 2.1	0.96 1.1 1.2	0.079 0.103 0.134
20	47 47 42 47	15.25 20.25 15 15.25	14 19 15 14	10.5 16 12 12	1 1 0.6	1 1 0.6	22 000 37 500 24 600 27 900	20 300 36 500 27 400 28 500	8 000 8 500 9 000 8 000	11 000 11 000 12 000 11 000	30303 D HR 32303 J HR 32004 XJ HR 30204 J	2FD 3CC 2DB	29 28 28 29	23 23 24 27	41 41 37 41	34 39 35 40	44 43 40 44	2 2 3 2	4.5 4 3 3	1 1 1 1 0.6 0.6	12.5 10.6	0.29 0.37	0.74 2.1 1.6 1.7	0.41 1.2 0.88 0.96	0.129 0.178 0.097 0.127
	47 47 47	15.25 19.25 19.25	14 18 18	12 15 15	0.3 1 1	1 1 1	23 900 35 500 31 500	24 000 37 500 33 500	8 000 8 500 8 000	11 000 11 000 11 000	HR 30204 C-A- HR 32204 J HR 32204 CJ	2DD 5DD	29 29 29	26 25 25	41 41 41	37 38 36	44 44.5 44	2 3 2	3 4 4	0.3 1 1 1 1 1	13.0 12.6 14.5	0.55 0.33 0.52	1.1 1.8 1.2	0.60 1.0 0.64	0.126 0.161 0.166
22	52 52 52	16.25 16.25 22.25	15 15 21	13 12 18 11.5	1.5 1.5 1.5	1.5 1.5 1.5	35 000 25 300 45 500	33 500 24 500 47 500	7 500 7 100 8 000	10 000 10 000 11 000 11 000	HR 30304 J 30304 D HR 32304 J	2FB — 2FD	31 34 33	27 26 26 27	44 43 43	44 37 42	47.5 49 48	2 2 3 3	3 4 4	1.5 1.5 1.5 1.5 1.5 1.5	16.7 13.9	0.81 0.30	2.0 0.74 2.0	1.1 0.41 1.1	0.172 0.168 0.241 0.103
22	44 50 50 50	15 15.25 15.25 19.25	15 14 14 18	11.5 12 12 15	0.6 1 1	0.6 1 1	25 600 29 200 27 200 36 500	29 400 30 500 29 500 40 500	8 500 7 500 7 500 7 500	10 000 10 000 10 000	HR 320/22 XJ HR 302/22 HR 302/22 C HR 322/22		30 31 31 31	27 29 29 28	39 44 44 44	37 42 40 41	42 47 47 47	2 2 2	3.5 3 3 4	0.6 0.6 1 1 1 1	11.6 13.0	0.37 0.49	1.5 1.6 1.2 1.6	0.83 0.90 0.67 0.89	0.103 0.139 0.144 0.18
	50 56 56	19.25 17.25 17.25	18 16 16	15 14 13	1 1.5 1.5	1 1.5 1.5	33 500 37 000 34 500	39 500 36 500 34 000	7 500 7 100 6 700	10 000 9 500 9 500	HR 322/22 C HR 303/22 HR 303/22 C		31 33 33	29 30 30	44 47 47	39 46 44	48 50 52.5	2 2 3	4 3 4	1 1 1.5 1.5 1.5 1.5	15.2 12.4 15.9	0.51 0.32 0.59	1.2 1.9 1.0	0.65 1.0 0.56	0.185 0.208 0.207
25	47 47 52	15 17 16.25	15 17 15	11.5 14 13	0.6 0.6 1	0.6 0.6 1	27 400 31 000 32 000	33 000 38 000 35 000	8 000 8 000 7 100	11 000 11 000 10 000	HR 32005 XJ HR 33005 J HR 30205 J	4CC 2CE 3CC	33 33 34	30 29 31	42 42 46	40 41 44	45 44 48.5	3 2	3.5 3 3	0.6 0.6 0.6 0.6 1 1	11.0 12.7	0.29 0.37	1.4 2.1 1.6	0.77 1.1 0.88	0.116 0.131 0.157
	52 52 52 52	16.25 19.25 19.25 22	15 18 18 22	12 16 15 18	1 1 1	1 1 1	28 100 40 000 35 000 47 500	31 500 45 000 42 000 56 500	9 700 7 100 7 100 7 500	9 500 10 000 9 500 10 000	HR 30205 C HR 32205 J HR 32205 C HR 33205 J	2CD - 2DE	34 34 34	32 30 30 29	46 46 46 46	43 44 40 43	49.5 50 50 49.5	2 2 2 4	4 3 4 4	1 1 1 1 1 1	13.5 15.8	0.36 0.53	1.1 1.7 1.1 1.7	0.62 0.92 0.62 0.94	0.155 0.189 0.19 0.221
	62 62 62	18.25 18.25 18.25	17 17 17	15 14 13	1.5 1.5 1.5	1.5 1.5 1.5	47 500 47 500 42 000 38 000	46 000 45 000 40 500	6 300 6 000 5 600	8 500 8 500 8 000	HR 30305 J HR 30305 C HR 30305 DJ	2FB — (7FB)	34 36 36 39	34 35 34	54 53 53	54 49 47	57 58.5 59	2 3 2	3 4 5	1.5 1.5 1.5 1.5 1.5 1.5	13.2 16.4	0.30 0.55	2.0 1.1 0.73	1.1 0.60 0.40	0.27 0.27 0.276 0.265
28	62 62 52	18.25 25.25 16	17 24 16	13 20 12	1.5 1.5 1.5	1.5 1.5 1.5	38 000 62 500 32 000	40 500 66 000 39 000	5 600 6 300 7 100	8 000 8 500 9 500	HR 31305 J HR 32305 J HR 320/28 XJ	7FB 2FD 4CC	39 38 37	33 32 33	53 53 46	47 51 44	59 57 50	3 3 3	5 5 4	1.5 1.5 1.5 1.5 1.5 1.5	19.9 15.6 12.8	0.83 0.30 0.43	0.73 2.0 1.4	0.40 1.1 0.77	0.265 0.376 0.146
	58 58 58	17.25 17.25 20.25	16 16 19	14 12 16	1 1 1	1 1 1	39 500 34 000 47 500	41 500 38 500 54 000	6 300 6 300 6 300	9 000 8 500 9 000	HR 302/28 HR 302/28 C HR 322/28		37 37 37	34 34 34	52 52 52	50 48 49	55 54 55	2 2 2	3 5 4	1 1 1 1 1 1	13.2 16.9 14.6	0.35 0.64 0.37	1.7 0.94 1.6	0.93 0.52 0.89	0.203 0.198 0.243
	58 68 68	20.25 19.75 19.75	19 18 18	16 15 14	1 1.5 1.5	1 1.5 1.5	42 000 55 000 49 500	49 500 55 500 50 500	6 300 6 000 5 600	9 000 8 000 7 500	HR 322/28 CJ HR 303/28 HR 303/28 C	5DD — —	37 39 39	33 37 38	52 59 59	45 58 57	55 61 63	2 2 3	4 4.5 5.5	1 1 1.5 1.5 1.5 1.5		0.31	1.1 1.9 1.2	0.59 1.1 0.64	0.251 0.341 0.335

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.



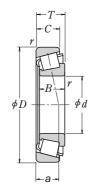


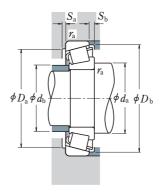
C 190 C 191

BEARINGS TABLE **NSK**

Bore Diameter 30 - 35 mm

SINGLE-ROW TAPERED ROLLER BEARINGS





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}\!>\!0.5F_{\rm r}\!+\!Y_0F_{\rm a}$, use $P_0\!=\!F_{\rm r}$ The values of e, Y_1 , and Y_0 are

given in the table below.

$\overline{}$	
	L

		Boun	dary Dimens (mm)	ions	0	0	Basic Loa	d Ratings	Limiting (mi		D . N .	ISO355			Abutm		d Fillet D	imensi	ons	0 0	Eff. Load Çenters	Constant		Load tors	Mass (kg)
d	D	T	В	C	Cone 1 mi	Cup r in.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	$\max_{\text{max.}} D$	a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone Cup γ_a max.	(mm) a	e	<i>Y</i> ₁	Y_0	approx.
30	47 55 55	12 17 20	12 17 20	9 13 16	0.3 1 1	0.3 1 1	17 600 36 000 42 000	24 400 44 500 54 000	7 500 6 700 6 700	10 000 9 000 9 000	HR 32906 J HR 32006 XJ HR 33006 J	2BD 4CC 2CE	34 39 39	34 35 35	44 49 49	42 47 48	44 53 52	3 3 3	3 4 4	0.3 0.3 1 1 1 1	9.2 13.5 13.1	0.32 0.43 0.29	1.9 1.4 2.1	1.0 0.77 1.1	0.074 0.172 0.208
	62 62 62	17.25 17.25 21.25	16 16 20	14 12 17	1 1 1	1 1 1	43 000 35 500 52 000	47 500 37 000 60 000	6 000 5 600 6 000	8 000 7 500 8 500	HR 30206 J HR 30206 C HR 32206 J	3DB — 3DC	39 39 39	37 36 36	56 56 56	52 49 51	58 59 58.5	2 2 2	3 5 4	1 1 1 1 1 1	13.9 17.8 15.4	0.37 0.68 0.37	1.6 0.88 1.6	0.88 0.49 0.88	0.238 0.221 0.297
	62 62 72 72	21.25 25 20.75 20.75	20 25 19 19	16 19.5 16 14	1 1 1.5 1.5	1 1 1.5 1.5	48 000 66 500 59 500 56 500	56 000 79 500 60 000 55 500	6 000 6 000 5 300 5 300	8 000 8 000 7 500 7 100	HR 32206 C HR 33206 J HR 30306 J HR 30306 C	2DE 2FB	39 39 41 41	35 35 40 38	56 56 63 63	48 52 62 59	59 59.5 66 67	2 5 3 3	4.5	1 1 1 1 1.5 1.5 1.5 1.5	17.8 16.1 15.1 18.5	0.55 0.34 0.32 0.55	1.1 1.8 1.9 1.1	0.60 0.97 1.1 0.60	0.293 0.355 0.403 0.383
	72 72 72 72	20.75 20.75 28.75 28.75	19 19 27 27	14 14 23 23	1.5 1.5 1.5 1.5	1.5 1.5 1.5 1.5	49 000 49 000 80 000 76 000	52 500 52 500 88 500 86 500	4 800 4 800 5 600 5 600	6 700 6 800 7 500 7 500	HR 30306 DJ HR 31306 J HR 32306 J HR 32306 CJ	(7FB) 7FB 2FD 5FD	44 44 43 43	40 40 38 36	63 63 63	55 55 59 54	68 68 66 68	3 3 3	6.5 5.5	1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	23.1 23.1 18.0 22.0		0.73 0.73 1.9 1.1	0.40 0.40 1.1 0.60	0.393 0.393 0.57 0.583
32	58 58 65 65	17 21 18.25 18.25	17 20 17 17	13 16 15 14	1 1 1	1 1 1	37 500 41 000 48 500 45 500	47 000 50 000 54 000 52 500	6 300 6 300 5 600 5 600	8 500 8 500 8 000 7 500	HR 320/32 XJ 330/32 HR 302/32 HR 302/32 C	4CC — —	41 41 41 41	37 37 39 39	52 52 59 59	49 50 56 54	55 55 61 62	3 2 3 3	4 4 3 4	1 1 1 1 1 1 1 1	14.2 13.8 14.7 16.9	0.45 0.31 0.37 0.55	1.3 1.9 1.6 1.1	0.73 1.1 0.88 0.60	0.191 0.225 0.277 0.273
	65 65 65 75	22.25 22.25 26 21.75	21 21 26 20	18 17 20.5 17	1 1 1 1.5	1 1 1 1.5	56 000 49 500 70 000 56 000	65 000 60 000 86 500 56 000	6 000 5 600 5 600 5 300	8 000 7 500 8 000 7 100	HR 322/32 HR 322/32 C HR 332/32 J 303/32	_ 2DE _	41 41 41 44	38 39 38 42	59 59 59 66	54 51 55 64	61 62 62 68	3 3 5 3	4 5 5.5 4.5	1 1 1 1 1 1 1.5 1.5	15.9 20.2 17.0 15.9	0.37 0.59 0.35 0.33	1.6 1.0 1.7 1.8	0.88 0.56 0.95 1.0	0.336 0.335 0.40 0.435
35	55 62 62	14 18 21	14 18 21	11.5 14 17	0.6 1 1	0.6 1 1	27 400 43 500 49 000	39 000 55 500 65 000	6 300 5 600 5 600	8 500 8 000 8 000	HR 32907 J HR 32007 XJ HR 33007 J	2BD 4CC 2CE	43 44 44	40 40 40	50 56 56	50 54 55	52.5 60 59	3 4 4	2.5 4 4	0.6 0.6 1 1 1 1	10.7 15.0 14.1	0.29 0.45 0.31	2.1 1.3 2.0	1.1 0.73 1.1	0.123 0.229 0.267
	72 72 72	18.25 18.25 24.25	17 17 23	15 13 19	1.5 1.5 1.5	1.5 1.5 1.5	54 000 47 000 70 500	59 500 54 500 83 500	5 300 5 000 5 300	7 100 6 700 7 100	HR 30207 J HR 30207 C HR 32207 J	3DB — 3DC	46 46 46	43 44 42	63 63 63	62 59 61	67 68 67.5	3 3 3	3 5 5	1.5 1.5 1.5 1.5 1.5 1.5	15.0 19.6 17.9	0.37 0.66 0.37	1.6 0.91 1.6	0.88 0.50 0.88	0.34 0.331 0.456
	72 72 80	24.25 28 22.75	23 28 21	18 22 18	1.5 1.5 2	1.5 1.5 1.5	60 500 86 500 76 000	71 500 108 000 79 000	5 000 5 300 4 800	7 100 7 100 6 700	HR 32207 C HR 33207 J HR 30307 J	2DE 2FB	46 46 47	42 41 45	63 63 71	58 61 69	68.5 68 74	3 5 3	6 6 4.5	1.5 1.5 1.5 1.5 2 1.5	20.6 18.3 16.7	0.55 0.35 0.32	1.1 1.7 1.9	0.60 0.93 1.1	0.442 0.54 0.538
	80 80 80	22.75 22.75 22.75 32.75	21 21 21 31	16 15 15 25	2 2 2 2	1.5 1.5 1.5 1.5	68 000 62 000 62 000 99 000	70 500 68 000 68 000 111 000	4 800 4 300 4 300 5 000	6 300 6 000 6 000 6 700	HR 30307 C HR 30307 DJ HR 31307 J HR 32307 J	— 7FB 7FB 2FE	47 51 51 49	44 44 44 43	71 71 71 71	65 62 62 66	74 77 77 74	3 3 3 3	7.5 7.5	2 1.5 2 1.5 2 1.5 2 1.5 2 1.5	20.3 25.2 25.2 20.7	0.55 0.83 0.83 0.32	1.1 0.73 0.73 1.9	0.60 0.40 0.40 1.1	0.518 0.519 0.52 0.765

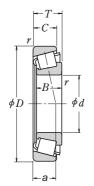
Remark The suffix C represents medium-angle tapered roller bearings. Since they are designed for specific applications, please consult NSK when using bearings with suffix C.

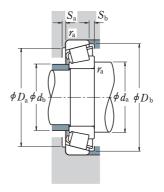
C 192 C 193



SINGLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 40 - 50 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e				
X	Y	X	Y				
1	0	0.4	<i>Y</i> ₁				

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of \emph{e} , \emph{Y}_{1} , and \emph{Y}_{0} are given in the table below.

		Boun	dary Dimensi (mm)	ions			Basic Loa	d Ratings	Limiting (mir			ISO355			Abutm		d Fillet [(mm))imensi	ions		Eff. Load Centers	Constant		l Load ctors	Mass (kg)
d	D	T	В	C	Cone 7 m	Cup r in.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	$\max_{\text{max.}} L$) _a min.	$D_{ m b}$ min.	S_{a} min.	$S_{ m b}$ min.	Cone Cup $\boldsymbol{r}_{\mathrm{a}}$ max.	(mm) a	e	Y_1	Y_0	approx.
40	62	15	15	12	0.6	0.6	34 000	47 000	5 600	7 500	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
	68	19	19	14.5	1	1	53 000	71 000	5 300	7 100	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
	68	22	22	18	1	1	59 000	81 500	5 300	7 100	HR 33008 J	2BE	49	45	62	61	65	4	4	1 1	14.6	0.28	2.1	1.2	0.322
	75	26	26	20.5	1.5	1.5	78 500	101 000	4 800	6 700	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
	80	19.75	18	16	1.5	1.5	63 500	70 000	4 800	6 300	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
	80	24.75	23	19	1.5	1.5	77 000	90 500	4 800	6 300	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
	80	24.75	23	19	1.5	1.5	74 000	90 500	4 500	6 300	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
	80	32	32	25	1.5	1.5	107 000	137 000	4 800	6 300	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
	90	25.25	23	20	2	1.5	90 500	101 000	4 300	5 600	HR 30308 J	2FB	52	52	81	76	82	3	5	2 1.5	19.5	0.35	1.7	0.96	0.758
	90 90 90 90	25.25 25.25 25.25 35.25	23 23 23 33	18 17 17 27	2 2 2 2	1.5 1.5 1.5 1.5	84 500 80 000 80 000 120 000	93 500 89 500 89 500 145 000	4 300 3 800 3 800 4 300	5 600 5 300 5 300 6 000	HR 30308 C HR 30308 DJ HR 31308 J HR 32308 J	7FB 7FB 2FD	52 56 56 54	50 50 50 50	81 81 81	72 70 70 73	84 87 87 82	3 3 3	7 8 8	2 1.5 2 1.5 2 1.5 2 1.5 2 1.5	22.8 28.7 28.7 23.4	0.53 0.83 0.83 0.35	1.1 0.73 0.73 1.7	0.62 0.40 0.40 0.96	0.735 0.728 0.728 1.05
45	68	15	15	12	0.6	0.6	34 500	50 500	5 000	6 700	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
	75	20	20	15.5	1	1	60 000	83 000	4 500	6 300	HR 32009 XJ	3CC	54	51	69	67	72	4	4.5	1 1	16.6	0.39	1.5	0.84	0.354
	75	24	24	19	1	1	69 000	99 000	4 800	6 300	HR 33009 J	2CE	54	51	69	67	71	4	5	1 1	16.3	0.29	2.0	1.1	0.414
	80	26	26	20.5	1.5	1.5	84 000	113 000	4 500	6 000	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
	85	20.75	19	16	1.5	1.5	68 500	79 500	4 300	6 000	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
	85	24.75	23	19	1.5	1.5	83 000	102 000	4 300	6 000	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
	85	24.75	23	19	1.5	1.5	75 500	95 500	4 300	5 600	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
	85	32	32	25	1.5	1.5	111 000	147 000	4 300	6 000	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
	95	29	26.5	20	2.5	2.5	88 500	109 000	3 600	5 000	T 7 FC045	7FC	60	53	83	71	91	3	9	2 2	32.1	0.87	0.69	0.38	0.918
	95	36	35	30	2.5	2.5	139 000	174 000	4 000	5 300	T 2 ED045	2ED	60	54	83	79	89	5	6	2 2	23.5	0.32	1.9	1.02	1.22
	100	27.25	25	22	2	1.5	112 000	127 000	3 800	5 300	HR 30309 J	2FB	57	58	91	86	93	3	5	2 1.5	21.1	0.35	1.7	0.96	1.01
	100	27.25	25	18	2	1.5	95 500	109 000	3 400	4 800	HR 30309 DJ	7FB	61	57	91	79	96	3	9	2 1.5	31.5	0.83	0.73	0.40	0.957
	100 100	27.25 38.25	25 36	18 30	2 2	1.5 1.5	95 500 144 000	109 000 177 000	3 400 3 800	4 800 5 300	HR 31309 J HR 32309 J	7FB 2FD	61 59	57 56	91 91	79 82	96 93	3	9	2 1.5 2 1.5	31.5 25.0	0.83 0.35	0.73 1.7	0.40 0.96	0.947 1.42
50	100 72 80	36 15 20	35 15 20	30 12 15.5	2.5 0.6 1	2.5 0.6 1	144 000 36 000 61 000	185 000 54 000 87 000	3 800 4 500 4 300	5 000 6 300 6 000	T 2 ED050 HR 32910 J HR 32010 XJ	2ED 2BC 3CC	65 58 59	59 54 56	88 67 74	83 66 71	94 69 77	6 3 4	6 3 4.5	2 0.6 0.6 1	24.2 13.5 17.9	0.34 0.34 0.42	1.8 1.8 1.4	0.96 0.97 0.78	1.3 0.193 0.38
	80	24	24	19	1	1	70 500	104 000	4 300	6 000	HR 33010 J	2CE	59	55	74	71	76	4	5	1 1	17.4	0.32	1.9	1.0	0.452
	85	26	26	20	1.5	1.5	89 000	126 000	4 300	5 600	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
	90	21.75	20	17	1.5	1.5	76 000	91 500	4 000	5 300	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
	90	24.75	23	19	1.5	1.5	87 500	109 000	4 000	5 300	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
	90	24.75	23	18	1.5	1.5	77 500	102 000	3 800	5 300	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
	90	32	32	24.5	1.5	1.5	118 000	165 000	4 000	5 300	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
	105 110 110	32 29.25 29.25	29 27 27	22 23 19	3 2.5 2.5	3 2 2	109 000 130 000 114 000	133 000 148 000 132 000	3 200 3 400 3 200	4 500 4 800 4 300	T 7 FC050 HR 30310 J HR 30310 DJ	7FC 2FB 7FB	74 65 70	59 65 62	91 100 100	95	100 102 105	5 3 3	10 6 10	2.5 2.5 2 2 2 2	36.4 23.1 34.3	0.87 0.35 0.83	0.69 1.7 0.73	0.38 0.96 0.40	1.22 1.28 1.26
	110 110 110	29.25 42.25 42.25	27 40 40	19 33 33	2.5 2.5 2.5	2 2 2	114 000 176 000 164 000	132 000 220 000 218 000	3 200 3 600 3 400	4 300 4 800 4 800	HR 31310 J HR 32310 J HR 32310 CJ	7FB 2FD 5FD	70 68 68	62 62 59	100 100 100	87 91	105 102 103	3 3 3	10 9 9	2 2 2 2 2 2	34.3 28.0 32.8	0.83 0.35 0.55	0.73 1.7 1.1	0.40 0.96 0.60	1.26 1.88 1.93

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.

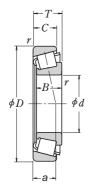


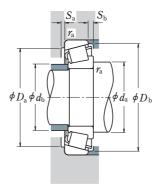


C 194 C 195

SINGLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 55 - 65 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$r_{\rm r} > e$				
X	Y	X	Y				
1	0	0.4	<i>Y</i> ₁				

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0F_a$

When $F_{\rm r} > 0.5F_{\rm r} + Y_0 F_{\rm a}$, use $P_0 = F_{\rm r}$ The values of e, Y_1 , and Y_0 are

given in the table below.

		Boun	dary Dimensi (mm)	ions	0	0	Basic Loa	d Ratings N)	Limiting (D : N .	ISO355			Abutm	ent and	Fillet [mm)	Dimens	ions		Eff. Load Centers	Constant		Load ctors	Mass (kg)
d	D	T	В	С	Cone 1 mi	r	$C_{\rm r}$	C_{0r}	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.		$D_{ m b}$ min.	S_{a} min.	$S_{ m b}$ min.	Cone Cup \mathcal{Y}_{a} max.	(mm) a	e	Y_1	Y_0	approx.
55	80 90 90	17 23 27	17 23 27	14 17.5 21	1 1.5 1.5	1 1.5 1.5	45 500 81 500 91 500	74 500 117 000 138 000	4 300 3 800 3 800	5 600 5 300 5 300	HR 32911 J HR 32011 XJ HR 33011 J	2BC 3CC 2CE	64 66 66	60 62 62	74 81 81	80	76 86 86	4 4 5	3 5.5 6	1 1 1.5 1.5 1.5 1.5	14.6 19.7 19.2	0.31 0.41 0.31	1.9 1.5 1.9	1.1 0.81 1.1	0.282 0.568 0.657
	95 100 100	30 22.75 26.75	30 21 25	23 18 21	1.5 2 2	1.5 1.5 1.5	112 000 94 500 110 000	158 000 113 000 137 000	3 800 3 600 3 600	5 000 5 000 5 000	HR 33111 J HR 30211 J HR 32211 J	3CE 3DB 3DC	66 67 67	62 64 63	86 91 91	89	91 94 95	5 4 4	7 4.5 5.5	1.5 1.5 2 1.5 2 1.5	22.4 20.9 22.7	0.37 0.41 0.41	1.6 1.5 1.5	0.88 0.81 0.81	0.877 0.736 0.859
	100 115 120	35 34 31.5	35 31 29	27 23.5 25	2 3 2.5	1.5 3 2	141 000 126 000 150 000	193 000 164 000 171 000	3 600 3 000 3 200	5 000 4 300 4 300	HR 33211 J T 7 FC055 HR 30311 J	3DE 7FC 2FB	67 73 70	62 66 71	91 101 110		96 09 11	6 4 4	8 10.5 6.5	2 1.5 2.5 2.5 2 2	25.2 39.0 24.6	0.40 0.87 0.35	1.5 0.69 1.7	0.83 0.38 0.96	1.18 1.58 1.63
	120 120 120 120	31.5 31.5 45.5 45.5	29 29 43 43	21 21 35 35	2.5 2.5 2.5 2.5	2 2 2 2	131 000 131 000 204 000 195 000	153 000 153 000 258 000 262 000	2 800 2 800 3 200 3 200	4 000 4 000 4 300 4 300	HR 30311 DJ HR 31311 J HR 32311 J HR 32311 CJ	7FB 7FB 2FD 5FD	75 75 73 73		110 110 110 110	94 1 94 1 99 1 91 1	14 11	4 4 4 4	10.5 10.5 10.5 10.5	2 2 2 2 2 2 2 2	37.0 37.0 29.9 35.8	0.83 0.83 0.35 0.55	0.73 0.73 1.7 1.1	0.40 0.40 0.96 0.60	1.58 1.58 2.39 2.47
60	85 95 95	17 23 27	17 23 27	14 17.5 21	1 1.5 1.5	1 1.5 1.5	49 000 85 500 96 000	84 500 127 000 150 000	3 800 3 600 3 600	5 300 5 000 5 000	HR 32912 J HR 32012 XJ HR 33012 J	2BC 4CC 2CE	69 71 71	65 66 66	79 86 86	85	81 91 90	4 4 5	3 5.5 6	1 1 1.5 1.5 1.5 1.5	15.5 20.9 20.0	0.33 0.43 0.33	1.8 1.4 1.8	1.0 0.77 1.0	0.306 0.608 0.713
	100 110 110	30 23.75 29.75	30 22 28	23 19 24	1.5 2 2	1.5 1.5 1.5	115 000 104 000 131 000	166 000 123 000 167 000	3 400 3 400 3 400	4 800 4 500 4 500	HR 33112 J HR 30212 J HR 32212 J	3CE 3EB 3EC	71 72 72	68 69 68	91 101 101		96 03 04	5 4 4	7 4.5 5.5	1.5 1.5 2 1.5 2 1.5	23.6 22.0 24.1	0.40 0.41 0.41	1.5 1.5 1.5	0.83 0.81 0.81	0.91 0.930 1.18
	110 125 130	38 37 33.5	38 33.5 31	29 26 26	2 3 3	1.5 3 2.5	166 000 151 000 174 000	231 000 197 000 201 000	3 400 2 800 3 000	4 500 3 800 4 000	HR 33212 J T 7 FC060 HR 30312 J	3EE 7FC 2FB	72 78 78		101 111 118	94 1 94 1 112 1	19	6 4 4	9 11 7.5	2 1.5 2.5 2.5 2.5 2	27.6 41.4 26.0	0.40 0.82 0.35	1.5 0.73 1.7	0.82 0.40 0.96	1.56 2.03 2.03
	130 130 130 130	33.5 33.5 48.5 48.5	31 31 46 46	22 22 37 35	3 3 3	2.5 2.5 2.5 2.5	151 000 151 000 233 000 196 000	177 000 177 000 295 000 249 000	2 600 2 600 3 000 2 800	3 800 3 800 4 000 3 800	HR 30312 DJ HR 31312 J HR 32312 J 32312 C	7FB 7FB 2FD	84 84 81 81	74 74	118 118 118 116	103 1 103 1 107 1 102 1	25 20	4 4 4	11.5 11.5 11.5 13.5	2.5 2 2.5 2 2.5 2 2.5 2	40.3 40.3 31.4 39.9	0.83 0.83 0.35 0.58	0.73 0.73 1.7 1.0	0.40 0.40 0.96 0.57	1.98 1.98 2.96 2.86
65	90 100 100	17 23 27	17 23 27	14 17.5 21	1 1.5 1.5	1 1.5 1.5	49 000 86 500 97 500	86 500 132 000 156 000	3 600 3 400 3 400	5 000 4 500 4 500	HR 32913 J HR 32013 XJ HR 33013 J	2BC 4CC 2CE	74 76 76	70 71 71	84 91 91	90	86 97 96	4 4 5	3 5.5 6	1 1 1.5 1.5 1.5 1.5	16.8 22.4 21.1	0.35 0.46 0.35	1.7 1.3 1.7	0.93 0.72 0.95	0.323 0.646 0.76
	110 120 120	34 24.75 32.75	34 23 31	26.5 20 27	1.5 2 2	1.5 1.5 1.5	148 000 122 000 157 000	218 000 151 000 202 000	3 200 3 000 3 000	4 300 4 000 4 000	HR 33113 J HR 30213 J HR 32213 J	3DE 3EB 3EC	76 77 77	73 78 75	101 111 111	96 1 106 1 104 1		6 4 4	7.5 4.5 5.5	1.5 1.5 2 1.5 2 1.5	26.0 23.8 27.1	0.39 0.41 0.41	1.5 1.5 1.5	0.85 0.81 0.81	1.32 1.18 1.55
	120 140 140	41 36 36	41 33 33	32 28 23	2 3 3	1.5 2.5 2.5	202 000 200 000 173 000	282 000 233 000 205 000	3 000 2 600 2 400	4 000 3 600 3 400	HR 33213 J HR 30313 J HR 30313 DJ	3EE 2GB 7GB	77 83 89	74 83 80	111 128 128	102 1 121 1 111 1	30	6 4 4	9 8 13	2 1.5 2.5 2 2.5 2	29.2 27.9 43.2	0.39 0.35 0.83	1.5 1.7 0.73	0.85 0.96 0.40	2.04 2.51 2.43
	140 140	36 51	33 48	23 39	3 3	2.5 2.5	173 000 267 000	205 000 340 000	2 400 2 800	3 400 3 800	HR 31313 J HR 32313 J	7GB 2GD	89 86		128 128	111 1 116 1		4 4	13 12	2.5 2 2.5 2	43.2 34.0	0.83 0.35	0.73 1.7	0.40 0.96	2.43 3.6

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.

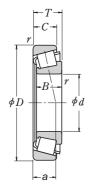


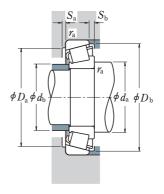


C 197 C 196

■ SINGLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 70 – 80 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$r_{\rm r} > e$				
X	Y	X	Y				
1	0	0.4	<i>Y</i> ₁				

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of e, Y_1 , and Y_0 are

		0. 0, 2	1,
given	in the	table	below.

		Bour	ndary Dimensi (mm)	ons	Cana	Cun	Basic Loa	nd Ratings	Limiting (Danis North	ISO355			Abutm	ent and Fillet (mm)	Dimens	sions	0	Eff. Load Centers	Constant	Axial Fact		Mass (kg)
d	D	T	B	С	Cone m	r	$C_{\rm r}$	C_{0r}	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	$\max_{\text{max.}} L$	$D_{ m a}$ $D_{ m b}$ min. min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone Cup r_a max.	(mm) a	e	Y_1	Y_0	approx.
70	100	20	20	16	1	1	70 000	113 000	3 200	4 500	HR 32914 J	2BC	79	76	94	93 96	4	4	1 1	17.6	0.32	1.9	1.1	0.494
	110	25	25	19	1.5	1.5	104 000	158 000	3 200	4 300	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
	110	31	31	25.5	1.5	1.5	127 000	204 000	3 000	4 300	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
	120 125 125	37 26.25 33.25	37 24 31	29 21 27	2 2 2	1.5 1.5 1.5	177 000 132 000 157 000	262 000 163 000 205 000	3 000 2 800 2 800	4 000 4 000 4 000	HR 33114 J HR 30214 J HR 32214 J	3DE 3EB 3EC	82 82 82		111 116 116	104 115 110 118 108 119	6 4 4	8 5 6	2 1.5 2 1.5 2 1.5	27.9 25.6 28.6	0.38 0.42 0.42	1.6 1.4 1.4	0.87 0.79 0.79	1.71 1.3 1.66
	125	41	41	32	2	1.5	209 000	299 000	2 800	4 000	HR 33214 J	3EE	82	78	116	107 120	7	9	2 1.5	30.4	0.41	1.5	0.81	2.15
	140	39	35.5	27	3	3	177 000	229 000	2 400	3 400	T 7 FC070	7FC	88	79	126	106 133	5	12	2.5 2.5	46.4	0.87	0.69	0.38	2.55
	150	38	35	30	3	2.5	227 000	268 000	2 400	3 400	HR 30314 J	2GB	88	89	138	132 140	4	8	2.5 2	29.7	0.35	1.7	0.96	3.03
	150 150 150 150	38 38 54 54	35 35 51 51	25 25 42 42	3 3 3	2.5 2.5 2.5 2.5	192 000 192 000 300 000 280 000	229 000 229 000 390 000 390 000	2 200 2 200 2 600 2 400	3 200 3 200 3 400 3 400	HR 30314 DJ HR 31314 J HR 32314 J HR 32314 CJ	7GB 7GB 2GD 5GD	94 94 91 91	85 85 86 84	138 138 138 138	118 142 118 142 124 140 115 141	4 4 4	13 13 12 12	2.5 2 2.5 2 2.5 2 2.5 2	45.8 45.8 36.1 43.3	0.83 0.83 0.35 0.55	0.73 0.73 1.7 1.1	0.40 0.40 0.96 0.60	2.94 2.94 4.35 4.47
75	105	20	20	16	1	1	72 500	120 000	3 200	4 300	HR 32915 J	2BC	84	81	99	98 101	4	4	1 1	18.7	0.33	1.8	0.99	0.53
	115	25	25	19	1.5	1.5	109 000	171 000	3 000	4 000	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
	115	31	31	25.5	1.5	1.5	133 000	220 000	3 000	4 000	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
	125	37	37	29	2	2	182 000	275 000	2 800	3 800	HR 33115 J	3DE	87	83	115	109 120	6	8	2 2	29.2	0.40	1.5	0.83	1.8
	130	27.25	25	22	2	1.5	143 000	182 000	2 800	3 800	HR 30215 J	4DB	87	85	121	115 124	4	5	2 1.5	27.0	0.44	1.4	0.76	1.43
	130	33.25	31	27	2	1.5	165 000	219 000	2 800	3 800	HR 32215 J	4DC	87	84	121	113 125	4	6	2 1.5	29.8	0.44	1.4	0.76	1.72
	130	41	41	31	2	1.5	215 000	315 000	2 800	3 800	HR 33215 J	3EE	87	83	121	111 125	7	10	2 1.5	31.6	0.43	1.4	0.77	2.25
	160	40	37	31	3	2.5	253 000	300 000	2 400	3 200	HR 30315 J	2GB	93	95	148	141 149	4	9	2.5 2	31.8	0.35	1.7	0.96	3.63
	160	40	37	26	3	2.5	211 000	251 000	2 200	3 000	HR 30315 DJ	7GB	99	91	148	129 152	6	14	2.5 2	48.8	0.83	0.73	0.40	3.47
	160	40	37	26	3	2.5	211 000	251 000	2 200	3 000	HR 31315 J	7GB	99	91	148	129 152	6	14	2.5 2	48.8	0.83	0.73	0.40	3.47
	160	58	55	45	3	2.5	340 000	445 000	2 400	3 200	HR 32315 J	2GD	96	91	148	134 149	4	13	2.5 2	38.9	0.35	1.7	0.96	5.31
	160	58	55	43	3	2.5	310 000	420 000	2 200	3 200	32315 CA	—	96	90	148	124 153	4	15	2.5 2	47.7	0.58	1.0	0.57	5.3
80	110	20	20	16	1	1	75 000	128 000	3 000	4 000	HR 32916 J	2BC	89	85	104	102 106	4	4	1 1	19.8	0.35	1.7	0.94	0.56
	125	29	29	22	1.5	1.5	140 000	222 000	2 800	3 600	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
	125	36	36	29.5	1.5	1.5	172 000	282 000	2 800	3 600	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
	130 140 140	37 28.25 28.25	37 26 26	29 22 20	2 2.5 2.5	1.5 2 2	186 000 157 000 147 000	289 000 195 000 190 000	2 600 2 600 2 400	3 600 3 400 3 400	HR 33116 J HR 30216 J 30216 CA	3DE 3EB	82 95 95	88 91 92	121 130 130	113 126 124 132 122 133	6 4 4	8 6 8	2 1.5 2 2 2 2	30.4 28.1 33.8	0.42 0.42 0.58	1.4 1.4 1.0	0.79 0.79 0.57	1.88 1.68 1.66
	140	35.25	33	28	2.5	2	192 000	254 000	2 600	3 400	HR 32216 J	3EC	95	90	130	122 134	4	7	2 2	30.6	0.42	1.4	0.79	2.13
	140	46	46	35	2.5	2	256 000	385 000	2 600	3 400	HR 33216 J	3EE	95	89	130	119 135	7	11	2 2	34.8	0.43	1.4	0.78	2.93
	170	42.5	39	33	3	2.5	276 000	330 000	2 200	3 000	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
	170	42.5	39	27	3	2.5	235 000	283 000	2 000	2 800	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
	170	42.5	39	27	3	2.5	235 000	283 000	2 000	2 800	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
	170	61.5	58	48	3	2.5	385 000	505 000	2 200	3 000	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
	170	61.5	58	48	3	2.5	365 000	530 000	2 200	3 000	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

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.

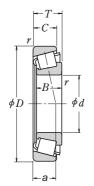


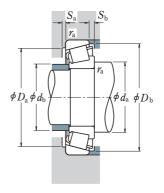


C 198 C 199

■ SINGLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 85 - 100 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$r_{\rm r} > e$
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of e, Y_1 , and Y_0 are

	• • • •		٠.	٠,	* I	,
aive	n in	the	ta	hle	e he	wole

		Bour	ndary Dimensi (mm)	ions	Cono	Cup	Basic Loa	d Ratings	Limiting S		Dagwing Mumbaga	ISO355			Abutm	ent and	Fillet Di	imensio	ons	Cana Cun	Eff. Load Centers	Constant	Axial Fact		Mass (kg)
d	D	T	B	С	oone 1 mi	Cup r in.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	$\max_{}$ L		$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone Cup γ_a max.	(mm) a	e	Y_1	Y_0	approx.
85	120 130 130	23 29 36	23 29 36	18 22 29.5	1.5 1.5 1.5	1.5 1.5 1.5	93 500 143 000 180 000	157 000 231 000 305 000	2 800 2 600 2 600	3 800 3 600 3 600	HR 32917 J HR 32017 XJ HR 33017 J	2BC 4CC 2CE	96 96 96	92 94 94	111 121 121		15 25 25	5 6 6	5 7 6.5	1.5 1.5 1.5 1.5 1.5 1.5	20.9 28.2 26.5	0.33 0.44 0.29	1.8 1.4 2.1	1.0 0.75 1.1	0.8 1.38 1.75
	140 150 150	41 30.5 30.5	41 28 28	32 24 22	2.5 2.5 2.5	2 2 2	230 000 184 000 171 000	365 000 233 000 226 000	2 400 2 400 2 200	3 400 3 200 3 200	HR 33117 J HR 30217 J 30217 CA	3DE 3EB	100 100 100	94 97 98	130 140 140	122 1 133 1 131 1	41	7 5 5	9 6.5 8.5	2 2 2 2 2 2	32.7 30.3 36.2	0.41 0.42 0.58	1.5 1.4 1.0	0.81 0.79 0.57	2.51 2.12 2.07
	150 150 180	38.5 49 44.5	36 49 41	30 37 34	2.5 2.5 4	2 2 3	210 000 281 000 310 000	277 000 415 000 375 000	2 200 2 400 2 000	3 200 3 200 2 800	HR 32217 J HR 33217 J HR 30317 J	3EC 3EE 2GB	100 100 106	96 95 108	140 140 166	131 1 129 1 157 1	44		12	2 2 2 2 3 2.5	33.9 37.3 35.8	0.42 0.42 0.35	1.4 1.4 1.7	0.79 0.79 0.96	2.64 3.57 5.08
	180 180 180	44.5 44.5 63.5	41 41 60	28 28 49	4 4 4	3 3	261 000 261 000 410 000	315 000 315 000 535 000	1 900 1 900 2 000	2 600 2 600 2 800	HR 30317 DJ HR 31317 J HR 32317 J	7GB 7GB 2GD	113 113 110	103 103 104	166 166 166		69 69 67	6 6	16.5 16.5	3 2.5 3 2.5 3 2.5	55.4 55.4 43.6	0.83 0.83 0.35	0.73 0.73 1.7	0.40 0.40 0.96	4.88 4.88 7.31
90	125 140 140	23 32 39	23 32 39	18 24 32.5	1.5 2 2	1.5 1.5 1.5	97 000 170 000 220 000	167 000 273 000 360 000	2 600 2 400 2 400	3 600 3 200 3 200	HR 32918 J HR 32018 XJ HR 33018 J	2BC 3CC 2CE	101 102 102	97 99 99	116 131 131	116 1 124 1 129 1	34	5 6 7	5 8 6.5	1.5 1.5 2 1.5 2 1.5	22.0 29.7 27.9	0.34 0.42 0.27	1.8 1.4 2.2	0.96 0.78 1.2	0.838 1.78 2.21
	150 160 160	45 32.5 42.5	45 30 40	35 26 34	2.5 2.5 2.5	2 2 2	259 000 201 000 256 000	405 000 256 000 350 000	2 400 2 200 2 200	3 200 3 000 3 000	HR 33118 J HR 30218 J HR 32218 J	3DE 3FB 3FC	105 105 105	100 103 102	140 150 150	132 1 141 1	44 50 52	7 5 5	10 6.5 8.5	2 2 2 2 2 2	35.2 31.7 36.2	0.40 0.42 0.42	1.5 1.4 1.4	0.83 0.79 0.79	3.14 2.6 3.41
	190 190 190 190	46.5 46.5 46.5 67.5	43 43 43 64	36 30 30 53	4 4 4	3 3 3 3	345 000 264 000 264 000 450 000	425 000 315 000 315 000 590 000	1 900 1 800 1 800 2 000	2 600 2 400 2 400 2 600	HR 30318 J HR 30318 DJ HR 31318 J HR 32318 J	2GB 7GB 7GB 2GD	111 118 118 115	114 110 110 109	176 176 176 176	152 1	76 79 79 77	6 6	16.5 16.5	3 2.5 3 2.5 3 2.5 3 2.5	37.3 58.7 58.7 46.5	0.35 0.83 0.83 0.35	1.7 0.73 0.73 1.7	0.96 0.40 0.40 0.96	5.91 5.52 5.52 8.6
95	130 145 145	23 32 39	23 32 39	18 24 32.5	1.5 2 2	1.5 1.5 1.5	98 000 173 000 231 000	172 000 283 000 390 000	2 400 2 400 2 400	3 400 3 200 3 200	HR 32919 J HR 32019 XJ HR 33019 J	2BC 4CC 2CE	106 107 107	102 104 103	121 136 136	121 1	25 40	5 6 7	5 8 6.5	1.5 1.5 2 1.5 2 1.5	23.2 31.2 28.6	0.36 0.44 0.28	1.7 1.4 2.2	0.92 0.75 1.2	0.877 1.88 2.3
	160 170 170	46 34.5 45.5	46 32 43	38 27 37	3 3 3	3 2.5 2.5	283 000 223 000 289 000	445 000 286 000 400 000	2 200 2 200 2 200	3 000 2 800 2 800	T 2 ED095 HR 30219 J HR 32219 J	2ED 3FB 3FC	113 113 113	108 110 108	146 158 158	141 1 150 1 147 1	59	6 5 5	8 7.5 8.5	2.5 2.5 2.5 2 2.5 2	34.5 33.7 39.3	0.34 0.42 0.42	1.8 1.4 1.4	0.97 0.79 0.79	3.74 3.13 4.22
	200 200 200	49.5 49.5 49.5	45 45 45	38 36 32	4 4 4	3 3 3	370 000 350 000 310 000	455 000 435 000 375 000	1 900 1 800 1 700	2 600 2 400 2 400	HR 30319 J 30319 CA HR 30319 DJ	2GB — 7GB	116 116 123	119 119 115	186 186 186		84 88 87	5	13.5	3 2.5 3 2.5 3 2.5	38.6 48.6 61.9	0.35 0.54 0.83	1.7 1.1 0.73	0.96 0.61 0.40	6.92 6.71 6.64
	200 200	49.5 71.5	45 67	32 55	4 4	3 3	310 000 525 000	375 000 710 000	1 700 1 900	2 400 2 600	HR 31319 J HR 32319 J	7GB 2GD	123 120	115 115	186 186		86	5	16.5	3 2.5 3 2.5	61.9 48.6	0.83 0.35	0.73 1.7	0.40 0.96	6.64 10.4
100	140 145 150	25 24 32	25 22.5 32	20 17.5 24	1.5 3 2	1.5 3 1.5	117 000 113 000 176 000	205 000 163 000 294 000	2 200 2 200 2 200	3 200 3 000 3 000	HR 32920 J T 4 CB100 HR 32020 XJ	2CC 4CB 4CC	111 118 112	109 108 109	132 135 141		34 42 44	5 6 6	5 6.5 8	1.5 1.5 2.5 2.5 2 1.5	24.2 30.1 32.5	0.33 0.47 0.46	1.8 1.3 1.3	1.0 0.70 0.72	1.18 1.18 1.95
	150 165 180	39 52 37	39 52 34	32.5 40 29	2 2.5 3	1.5 2 2.5	235 000 315 000 255 000	405 000 515 000 330 000	2 200 2 000 2 000	3 000 2 800 2 600	HR 33020 J HR 33120 J HR 30220 J	2CE 3EE 3FB	112 115 118	107 110 116	141 155 168	144 1	43 59 68	7 8 5	6.5 12 8	2 1.5 2 2 2.5 2	29.3 40.5 36.1	0.29 0.41 0.42	2.1 1.5 1.4	1.2 0.81 0.79	2.38 4.32 3.78
	180 180 215	49 63 51.5	46 63 47	39 48 39	3 3 4	2.5 2.5 3	325 000 410 000 425 000	450 000 635 000 525 000	2 000 2 000 1 700	2 600 2 600 2 400	HR 32220 J HR 33220 J HR 30320 J	3FC 3FE 2GB	118 118 121	115 113 128	168 168 201	155 1 152 1 185 1	72	10		2.5 2 2.5 2 3 2.5	41.5 46.0 41.4	0.42 0.40 0.35	1.4 1.5 1.7	0.79 0.82 0.96	5.05 6.76 8.41
	215 215	56.5 77.5	51 73	35 60	4 4	3 3	385 000 565 000	505 000 755 000	1 500 1 700	2 200 2 400	HR 31320 J HR 32320 J	7GB 2GD	136 125	125 125	201 201	169 2 178 2	102 100			3 2.5 3 2.5	67.7 53.2	0.83 0.35	0.73 1.7	0.40 0.96	9.02 12.7

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.

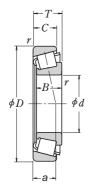


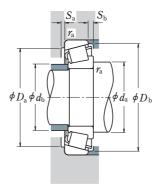


C 200 C 201

Bore Diameter 105 – 130 mm

SINGLE-ROW TAPERED ROLLER BEARINGS





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$r_{\rm r} > e$
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of \emph{e} , \emph{Y}_{1} , and \emph{Y}_{0} are

given in the table below.

		Bound	ary Dimensio (mm)	ns			Basic Load	Ratings	Limiting (min			ISO355			Abutn	nent an	d Fillet I	Dimens	ions		Eff. Load Centers	Constant		l Load ctors	Mass (kg)
d	D	T	В	С	Cone 7 m		C_{r}	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	O _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone Cup γ_a max.	(mm) a	e	Y_1	Y_0	approx.
105	145 160 160	25 35 43	25 35 43	20 26 34	1.5 2.5 2.5	1.5 2 2	119 000 204 000 256 000	212 000 340 000 435 000	2 200 2 000 2 000	3 000 2 800 2 800	HR 32921 J HR 32021 XJ HR 33021 J	2CC 4DC 2DE	116 120 120	114 115 115	137 150 150	137 144 146	154	5 6 7	5 9 9	1.5 1.5 2 2 2 2	25.3 34.3 30.9	0.34 0.44 0.28	1.8 1.4 2.1	0.96 0.74 1.2	1.23 2.48 3.03
	190 190 225	39 53 53.5	36 50 49	30 43 41	3 3 4	2.5 2.5 3	280 000 360 000 455 000	365 000 510 000 565 000	1 900 1 900 1 600	2 600 2 600 2 200	HR 30221 J HR 32221 J HR 30321 J	3FB 3FC 2GB	123 123 126	123 120 133	178 178 211	166 162 195	180	6 5 6	9 10 12.5	2.5 2 2.5 2 3 2.5	38.1 44.8 43.3	0.42 0.42 0.35	1.4 1.4 1.7	0.79 0.79 0.96	4.51 6.25 9.52
	225 225	58 81.5	53 77	36 63	4	3	415 000 670 000	540 000 925 000	1 500 1 700	2 000 2 200	HR 31321 J HR 32321 J	7GB 2GD	141 130	130 129	211 211	177 186		7 6	22 18.5	3 2.5 3 2.5	70.2 55.2	0.83 0.35	0.73 1.7	0.40 0.96	10 14.9
110	150 170 170	25 38 47	25 38 47	20 29 37	1.5 2.5 2.5	1.5 2 2	123 000 236 000 294 000	224 000 390 000 515 000	2 200 2 000 2 000	2 800 2 600 2 600	HR 32922 J HR 32022 XJ HR 33022 J	2CC 4DC 2DE	121 125 125	119 121 121	142 160 160	142 153 153	163	5 7 7	5 9 10	1.5 1.5 2 2 2 2	26.5 35.9 33.7	0.36 0.43 0.29	1.7 1.4 2.1	0.93 0.77 1.2	1.29 3.09 3.84
	180 200 200	56 41 56	56 38 53	43 32 46	2.5 3 3	2 2.5 2.5	365 000 315 000 400 000	610 000 420 000 565 000	1 900 1 800 1 800	2 600 2 400 2 400	HR 33122 J HR 30222 J HR 32222 J	3EE 3FB 3FC	125 128 128	121 129 127	170 188 188	156 175 171	187	9 6 5	13 9 10	2 2 2.5 2 2.5 2	44.1 40.2 47.2	0.42 0.42 0.42	1.4 1.4 1.4	0.79 0.79 0.79	5.54 5.28 7.35
	240 240 240	54.5 63 84.5	50 57 80	42 38 65	4 4 4	3 3 3	485 000 470 000 675 000	595 000 605 000 910 000	1 500 1 400 1 500	2 000 1 900 2 000	HR 30322 J HR 31322 J HR 32322 J	2GB 7GB 2GD	131 146 135	143 136 139	226 226 226	208 191 201	224	6 7 6	12.5 25 19.5	3 2.5 3 2.5 3 2.5	45.1 74.8 58.6		1.7 0.73 1.7	0.96 0.40 0.96	
120	165 170 180	29 27 38	29 25 38	23 19.5 29	1.5 3 2.5	1.5 3 2	161 000 153 000 242 000	291 000 243 000 405 000	1 900 1 800 1 800	2 600 2 600 2 400	HR 32924 J T 4 CB120 HR 32024 XJ	2CC 4CB 4DC	131 138 135	129 129 131	156 158 170	155 158 162	164	6 7 7	6 7.5 9	1.5 1.5 2.5 2.5 2 2	29.2 35.0 39.7	0.35 0.47 0.46	1.7 1.3 1.3	0.95 0.70 0.72	1.8 1.78 3.27
	180 200 215	48 62 43.5	48 62 40	38 48 34	2.5 2.5 3	2 2 2.5	300 000 460 000 335 000	540 000 755 000 450 000	1 800 1 700 1 600	2 600 2 400 2 200	HR 33024 J HR 33124 J HR 30224 J	2DE 3FE 4FB	135 135 138	130 133 141	168 190 203	161 173 190	192	6 9 6	10 14 9.5	2 2 2 2 2.5 2	36.0 47.9 44.4	0.31 0.40 0.44	2.0 1.5 1.4	1.1 0.83 0.76	4.2 7.67 6.28
	215 260 260 260	61.5 59.5 68 90.5	58 55 62 86	50 46 42 69	3 4 4 4	2.5 3 3 3	440 000 535 000 560 000 770 000	635 000 655 000 730 000 1 060 000	1 600 1 400 1 300 1 400	2 200 1 900 1 800 1 900	HR 32224 J HR 30324 J HR 31324 J HR 32324 J	4FD 2GB 7GB 2GD	138 141 156 145	137 154 148 149	203 246 246 246	181 223 206 216	237 244	6 6 9 6	11.5 13.5 26 21.5	2.5 2 3 2.5 3 2.5 3 2.5	52.1 50.0 81.7 62.5	0.44 0.35 0.83 0.35	1.4 1.7 0.73 1.7	0.76 0.96 0.40 0.96	9.0 13.9 15.6 21.8
130	180 180 185	32 32 29	30 32 27	26 25 21	2 2 3	1.5 1.5 3	167 000 200 000 183 000	281 000 365 000 296 000	1 800 1 800 1 700	2 400 2 400 2 400	32926 HR 32926 J T 4 CB130	2CC 4CB	142 142 148	141 140 141	171 170 171	168 168 171	173	6 6 8	6 7 8	2 1.5 2 1.5 2.5 2.5	34.7 31.4 37.5	0.36 0.34 0.47	1.7 1.8 1.3	0.92 0.97 0.70	2.25 2.46 2.32
	200 200 230	45 55 43.75	45 55 40	34 43 34	2.5 2.5 4	2 2 3	320 000 395 000 375 000	535 000 715 000 505 000	1 600 1 700 1 500	2 200 2 200 2 000	HR 32026 XJ HR 33026 J HR 30226 J	4EC 2EE 4FB	145 145 151	144 144 151	190 188 216	179 179 205	192	8 8 7	11 12 9.5	2 2 2 2 3 2.5	43.9 42.4 45.9	0.43 0.34 0.44	1.4 1.8 1.4	0.76 0.97 0.76	5.06 6.25 7.25
	230 280 280	67.75 63.75 63.75	64 58 58	54 49 49	4 5 5	3 4 4	530 000 545 000 650 000	790 000 675 000 820 000	1 500 1 300 1 300	2 000 1 800 1 800	HR 32226 J 30326 HR 30326 J	4FD — 2GB	151 157 157	147 168 166	216 262 262	196 239 241	255	7 8 8	13.5 14.5 14.5	3 2.5 4 3 4 3	57.0 53.9 52.8	0.44 0.36 0.35	1.4 1.7 1.7	0.76 0.92 0.96	11.3 16.6 17.2
	280 280	72 98.75	66 93	44 78	5 5	4 4	625 000 830 000	820 000 1 150 000	1 200 1 300	1 700 1 800	HR 31326 J 32326	7GB —	174 162	159 165	262 262	220 233		9 8	28 20.5	4 3 4 3	87.1 69.2	0.83 0.36	0.73 1.7	0.40 0.92	18.8 26.6

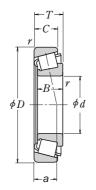


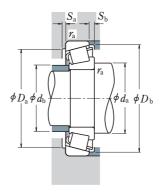


C 203 C 202

Bore Diameter 140 – 170 mm

SINGLE-ROW TAPERED ROLLER BEARINGS





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of \emph{e} , \emph{Y}_{1} , and \emph{Y}_{0} are given in the table below.

		Boun	dary Dimensio	ons	Cono	Cun	Basic Load	•	Limiting (mir		Danis North	ISO355			Abutr		d Fillet I (mm)	Dimens	ions	0		Centers	Constant	Axial Fac		Mass (kg)
d	D	T	В	С		Cup Y nin.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	Dimension Series approx	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	S_{a} min.	$S_{ m b}$ min.	Cone $\gamma_{\rm a}$ max		(mm) a	e	Y_1	Y_0	approx.
140	190 210 210	32 45 56	32 45 56	25 34 44	2 2.5 2.5	1.5 2 2	206 000 325 000 410 000	390 000 555 000 770 000	1 700 1 600 1 600	2 200 2 200 2 200	HR 32928 J HR 32028 XJ HR 33028 J	2CC 4DC 2DE	152 155 155	150 152 153	180 200 198	178 189 189	202	6 8 7	7 11 12	2 :	1.5 2 2		0.46	1.7 1.3 1.7	0.92 0.72 0.92	2.64 5.32 6.74
	250 250 300	45.75 71.75 67.75	42 68 62	36 58 53	4 4 5	3 3 4	390 000 610 000 740 000	515 000 915 000 945 000	1 400 1 400 1 200	1 900 1 900 1 700	HR 30228 J HR 32228 J HR 30328 J	4FB 4FD 2GB	161 161 167	164 159 177	236 236 282	221 213 256	238	7 9 9	9.5 13.5 14.5	3 :	2.5 2.5 3		0.44 0.44 0.35	1.4 1.4 1.7	0.76 0.76 0.96	8.74 14.3 21.1
	300 300	77 107.75	70 102	47 85	5 5	4 4	695 000 985 000	955 000 1 440 000	1 100 1 200	1 500 1 600	HR 31328 J 32328	7GB —	184 172	174 177	282 282	236 246		9	30 22.5	4 3	3		0.83 0.37	0.73 1.6	0.40 0.88	28.5 33.9
150	210 210 225	38 38 48	36 38 48	31 30 36	2.5 2.5 3	2 2 2.5	247 000 281 000 375 000	440 000 520 000 650 000	1 500 1 500 1 400	2 000 2 000 2 000	32930 HR 32930 J HR 32030 XJ	2DC 4EC	165 165 168	162 163 164	200 198 213	195 196 202	202	7 7 8	7 8 12	2 2 2.5	2 2 2	36.7 36.5 49.8	0.33 0.33 0.46	1.8 1.8 1.3	1.0 1.0 0.72	3.8 4.05 6.6
	225 270 270	59 49 77	59 45 73	46 38 60	3 4 4	2.5 3 3	435 000 485 000 705 000	805 000 665 000 1 080 000	1 400 1 300 1 300	2 000 1 800 1 800	HR 33030 J HR 30230 J HR 32230 J	2EE 2GB 4GD	168 171 171	165 175 171	213 256 256	203 236 228	250	8 7 8	13 11 17		2 2.5 2.5	48.7 51.3 64.7	0.36 0.44 0.44	1.7 1.4 1.4	0.90 0.76 0.76	8.07 11.2 17.8
	320 320 320 320	72 72 82 114	65 65 75 108	55 55 50 90	5 5 5 5	4 4 4 4		860 000 1 060 000 1 100 000 1 700 000	1 100 1 100 1 000 1 100	1 500 1 600 1 400 1 500	30330 HR 30330 J HR 31330 J 32330	2GB 7GB	177 177 194 182	193 190 187 191	302 302 302 302	275 276 253 262	292 300	8 9 8	17 17 32 24	4	3 3 3 3		0.36 0.35 0.83 0.37	1.7 1.7 0.73 1.6	0.92 0.96 0.40 0.88	
160	220 240 290	38 51 52	38 51 48	30 38 40	2.5 3 4	2 2.5 3	296 000 425 000 530 000	570 000 750 000 730 000	1 400 1 300 1 200	1 900 1 800 1 600	HR 32932 J HR 32032 XJ HR 30232 J	2DC 4EC 4GB	175 178 181	173 175 189	208 228 276	206 216 253	231	7 8 8	8 13 12		2 2 2.5	38.7 53.0 55.0	0.35 0.46 0.44	1.7 1.3 1.4	0.95 0.72 0.76	4.32 7.93 13.7
	290 340 340	84 75 75	80 68 68	67 58 58	4 5 5	3 4 4	765 000	1 220 000 960 000 1 180 000	1 200 1 000 1 100	1 600 1 400 1 400	HR 32232 J 30332 HR 30332 J	4GD — 2GB	181 187 187	184 205 201	276 322 322	243 293 293	311	10 10 10	17 17 17	4 :	2.5 3 3	70.5 64.6 62.9	0.44 0.36 0.35	1.4 1.7 1.7	0.92	22.5 28.4 29.7
	340 340	75 121	68 114	48 95	5 5	4 4	675 000 1 210 000	875 000 1 770 000	950 1 000	1 300 1 400	30332 D 32332	=	196 192	198 202	322 322	270 281		9 10	27 26	4 3	3	99.4 87.1	0.81 0.37	0.74 1.6	0.41 0.88	27.5 48.3
170	230 230 260	38 38 57	36 38 57	31 30 43	2.5 2.5 3	2.5 2 2.5	258 000 294 000 505 000	485 000 560 000 890 000	1 300 1 400 1 200	1 800 1 800 1 700	32934 HR 32934 J HR 32034 XJ	3DC 4EC	185 185 188	183 180 187	220 218 248	216 215 232	222	7 7 10	7 8 14	2 2 2.5		41.6 41.7 56.6	0.36 0.38 0.44	1.7 1.6 1.4	0.90 0.86 0.74	4.3 4.44 10.6
	310 310 360	57 91 80	52 86 72	43 71 62	5 5 5	4 4 4		885 000 1 450 000 1 080 000	1 100 1 100 950	1 500 1 500 1 300	HR 30234 J HR 32234 J 30334	4GB 4GD	197 197 197	202 197 221	292 292 342	273 262 312	294	8 10 10	14 20 18		3 3 3	59.4 76.4 70.1	0.44 0.44 0.37	1.4 1.4 1.6	0.76 0.76 0.90	28
	360 360 360	80 80 127	72 72 120	62 50 100	5 5 5	4 4 4	760 000	1 230 000 1 040 000 2 050 000	1 000 900 1 000	1 300 1 200 1 300	HR 30334 J 30334 D 32334	2GB — —	197 206 202	214 215 213	342 342 342	310 288 297	332	10 10 10	18 30 27	4 4 4	3 3 3	67.3 107.3 91.3	0.35 0.81 0.37	1.7 0.74 1.6		

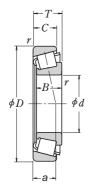


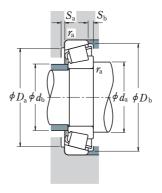


C 205 C 204

SINGLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 180 – 240 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of \emph{e} , \emph{Y}_{1} , and \emph{Y}_{0} are given in the table below.

		Boun	dary Dimension (mm)	ons			Basic Load	•	Limiting (min			ISO355			Abutn		d Fillet I (mm)	Dimens	sions		Eff. Load Centers			l Load ctors	Mass (kg)
<i>d</i>	D	T	В	С		Cup r nin.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	Dimension Series approx.	$d_{ m a}$ min.	$d_{ m b}$ max.	max.	D _a min.	$D_{ m b}$ min.	$S_{ m a}$ min.	$S_{ m b}$ min.	Cone Cu $oldsymbol{\mathcal{Y}}_a$ max.	(mm) a	e	Y_1	Y_0	approx.
180	250 280 320	45 64 57	45 64 52	34 48 43	2.5 3 5	2 2.5 4	350 000 640 000 650 000	685 000 1 130 000 930 000	1 300 1 200 1 100	1 700 1 600 1 400	HR 32936 J HR 32036 XJ HR 30236 J	4DC 3FD 4GB	195 198 207	192 199 210	240 268 302	227 248 281	267	8 10 9	11 16 14	2 2.5 2 4 3	53.9 60.4 61.8	0.42	1.3 1.4 1.3	0.69 0.78 0.73	14.3
	320 380 380 380	91 83 83 134	86 75 75 126	71 64 53 106	5 5 5	4 4 4	935 000	1 540 000 1 230 000 1 120 000 2 290 000	1 100 900 850 950	1 400 1 300 1 200 1 300	HR 32236 J 30336 30336 D 32336	4GD — —	207 207 216 212		302 362 362 362	270 324 304 310	345 352	10 10 10 10	20 19 30 28	4 3 4 3 4 3 4 3		0.36	1.3 1.7 0.74 1.6		39.3
190	260 290 340	45 64 60	45 64 55	34 48 46	2.5 3 5	2 2.5 4	365 000 650 000 715 000	715 000 1 170 000 1 020 000	1 200 1 100 1 000	1 600 1 500 1 300	HR 32938 J HR 32038 XJ HR 30238 J	4DC 4FD 4GB	205 208 217	201 209 223	250 278 322	237 258 302	279	8 10 9	11 16 14	2 2 2.5 2 4 3		0.48 0.44 0.44	1.3 1.4 1.4	0.69 0.75 0.76	14.9
	340 400 400	97 86 140	92 78 132	75 65 109	5 6 6	4 5 5		1 770 000 1 340 000 2 580 000	1 000 850 850	1 400 1 200 1 200	HR 32238 J 30338 32338	4GD — —	217 223 229	248	322 378 378	290 346 332	366	10 11 11	22 21 31	4 3 5 4 5 4	80.5 76.1 102.7	0.44 0.36 0.37	1.4 1.7 1.6	0.76 0.92 0.88	46
200	280 280 310	51 51 70	48 51 70	41 39 53	3 3 3	2.5 2.5 2.5	410 000 480 000 760 000	780 000 935 000 1 370 000	1 100 1 100 1 000	1 500 1 500 1 400	32940 HR 32940 J HR 32040 XJ	3EC 4FD	218 218 218	217 216 221	268 268 298	256 258 277	271	9 9 11	10 12 17	2.5 2 2.5 2 2.5 2	53.4 54.2 67.4		1.6 1.5 1.4	0.88 0.84 0.77	
	360 360 420	64 104 89	58 98 80	48 82 67	5 5 6	4 4 5	1 210 000	1 120 000 1 920 000 1 390 000	950 950 850	1 300 1 300 1 200	HR 30240 J HR 32240 J 30340	4GB 3GD	227 227 233	236 230 253	342 342 398	318 305 346	340	10 11 11	16 22 22	4 3 4 3 5 4	69.1 85.1 81.4	0.44 0.41 0.37	1.4 1.5 1.6	0.76 0.81 0.88	42.6
	420 420	89 146	80 138	56 115	6 6	5 5	965 000 1 820 000	1 330 000 2 870 000	750 800	1 000 1 100	30340 D 32340	=	244 239	253 253	398 398	336 346		11 11	33 31	5 4 5 4	122.9 106.7	0.81 0.37	0.74 1.6	0.41 0.88	49.6 90.9
220	300 340 400	51 76 72	51 76 65	39 57 54	3 4 5	2.5 3 4		990 000 1 610 000 1 150 000	1 000 950 850	1 400 1 300 1 100	HR 32944 J HR 32044 XJ 30244	3EC 4FD —	238 241 247	235 244 267	288 326 382	278 303 350	326	9 12 11	12 19 18	2.5 2 3 2.5 4 3	59.2 73.6 74.7	0.43	1.4 1.4 1.5	0.78 0.77 0.82	24.4
	400 460 460	114 97 154	108 88 145	90 73 122	5 6 6	4 5 5		2 210 000 1 990 000 3 200 000	850 750 750	1 100 1 000 1 000	32244 30344 32344	=	247 253 259	260 283 274	382 438 438	340 390 372	414	12 12 12	24 24 32	4 3 5 4 5 4	93.0 85.4 114.9	0.36	1.5 1.7 1.6	0.82 0.92 0.88	72.4
240	320 360 440	51 76 79	51 76 72	39 57 60	3 4 5	2.5 3 4	920 000	1 040 000 1 730 000 1 400 000	950 850 750	1 300 1 200 1 000	HR 32948 J HR 32048 XJ 30248	4EC 4FD —	258 261 267	255 262 288	308 346 422	297 321 384	346	9 12 11	12 19 19	2.5 2 3 2.5 4 3	65.1 79.1 85.1	0.46 0.46 0.44	1.3 1.3 1.4	0.72 0.72 0.74	26.2
	440 500 500	127 105 165	120 95 155	100 80 132	5 6 6	4 5 5		2 730 000 2 340 000 4 100 000	750 670 670	1 000 950 900	32248 30348 32348	=	267 273 279	285 308 301	422 478 478	374 422 410	447	12 12 12	27 25 33	4 3 5 4 5 4	102.5 92.8 123.2	0.36	1.5 1.7 1.6	0.82 0.92 0.88	78 92.6 145





C 207 C 206

BEARINGS TABLE

NSK

Bore Diameter 260 – 440 mm

D

540

540

440

440

480

580

580

670

460

460

520

480

480

540

520

540

600

560

620

650

320

340

360

380

400

420

440

96

76

76

100

104

159

210

76

76

112

76

76

112

87

87

125

125

130

149

d

SINGLE-ROW TAPERED ROLLER BEARINGS

Boundary Dimensions

(mm)

B

140

72

76

100

92

150

200

72

76

72

76

106

82

82

118

82

118

122

106

C

115

63

57

74

75

125

170

63

57

92

62

57

92

71

71

100

100

104

6

5

7.5

4

6

4

6

5

6

6

6

4

7.5

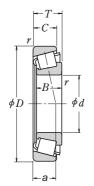
5

4

5

5

6



Cone Cup

Basic Load Ratings

(N)

1 440 000 2 100 000

2 220 000 3 700 000

1510000 2910000

4 200 000 7 100 000

910 000 1 940 000

1 050 000 2 220 000

1 650 000 3 400 000

945 000 2 100 000

1 080 000 2 340 000

1 680 000 3 500 000

1 210 000 2 550 000

1 250 000 2 700 000

1 960 000 4 050 000

1 300 000 2 810 000

2 000 000 4 200 000

2 230 000 4 600 000

1 880 000

2 220 000

2 420 000

5 050 000

900 000

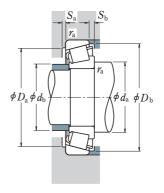
1 040 000

1 640 000

2 860 000

 C_{0r}

 C_{r}



ISO355

Dimension

Series

 $d_{\rm a}$

355 352

344

350 462

381

383

381 466

428 522

447 448 542

463 598

333

341 345 426

347

353 353

383 412 634

373 386 498

393

427

433

453

3FD 341

4GD

4FD 361

4FD 381

518

518

426

558 558

446

466

406 502 478 501

362 446

402 518

443 578

473 487 622 582 616

Bearing Numbers

30260

32260

32964

HR 32064 XJ

30264

32264

32364

32968

32068

32972

32072

32976

32980

32080

32984

32084

32088

HR 32972 J

HR 32968 J

HR 32964 J

Abutment and Fillet Dimensions

(mm)

 $D_{\rm b}$

470 499

458 514

404 425

406 426

430 461

547 616

426 446

427 446

464 496

445 465

445 466

480 514

499 524

533 565

521 544

552 586

503

487 550

14

15 34 5

13 13 15

14 29

15 34 5

14 42

13 13

> 14 13

16 16 4

16 16 4

5

 $D_{\rm a}$

Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	$r_{\rm r} > e$
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}$ > $0.5F_{\rm r}$ $+Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of e, Y_1 , and Y_0 are

Axial Load

Factors

0.81

0.76 38.5

0.76

0.74 | 60.7 0.73 | 103

0.92 114 0.88 188

0.72 40.6

0.74 66.3

0.70 109

0.89 224

0.88 30.5

0.84 31.4

0.76 56.6

0.74 80.6

0.84

0.72

0.80 33.6

0.75

0.82

0.72

0.86 86.5

0.86

0.82

0.81

0.92 116

0.88 121

0.92 136

0.72 | 132

0.79 33.3

0.74 99.3

0.72 175

0.88 343

0.89 83.7

35.8

36.1

49.5

52.7

32

60

 Y_1 Y_0

1.5

1.4

1.4

1.3

1.7 1.6

1.4 1.3

1.4

1.3

1.6

1.6

1.5 1.4

1.4

1.3

1.4

1.3

1.3

1.6

1.5

1.6

1.5 1.3

1.6

1.6

1.5 1.7

1.6

1.7

Mass

(kg)

approx.

given in the table below.

Centers

(mm)

а

Cone Cup

 $r_{\rm a}$

5

3

3

5

6

3

5

3 2.5 3 2.5

5

5

5 5

19

26

19

19

25 5

15 4

6.5 25

5 26

3.5 22

5.5 22

2.5

2.5

2.5 2.5

4

 S_{b}

 $S_{\rm a}$

Eff. Load | Constant |

0.41

0.43

0.44

0.45

0.36 0.37

0.43

0.46

0.44

0.47

0.37 0.37

0.39

0.43

0.44

0.46

0.39

0.42

0.46

0.44

0.46

0.37

0.41

0.44

0.37

0.38

0.39

0.40

0.36

0.41

0.37

126.3 0.36

105.1

131.7

84.3

85.0

104.5

113.7

141.7

157.5

89.2

91.0

104.5

91.4 0.40

96.8 0.46

108.6

95.2

100.8

115.3

106.

120.0

					m	iin.							approx.	min.	max.	max.	min.	min.	min.	min.	m	nax.		
260	360 400 480	63.5 87 89	63.5 87 80	48 65 67	3 5 6	2.5 4 5	730 000 1 160 000 1 190 000	1 450 000 2 160 000 1 700 000	850 800 670	1 100 1 100 900	·	HR 32952 J HR 32052 XJ 30252	3EC 4FC	278 287 293	278 287 316	348 382 458	357	347 383 447	11 14 12	15.5 22 22	2.5 4 5	2 3 4	69.8 86.3 94.6	0
	480 540 540	137 113 176	130 102 165	106 85 136	6 6 6	5 6 6		3 300 000 2 640 000 4 800 000	670 630 630	950 850 850		32252 30352 32352	=	293 293 293	305 336 328	458 512 512	460	446 487 495	14 16 13	31 28 40	5 5 5	4 5 5	116.0 101.6 130.5	000
280	380 420 500	63.5 87 89	63.5 87 80	48 65 67	3 5 6	2.5 4 5	765 000 1 180 000 1 240 000	1 580 000 2 240 000 1 900 000	800 710 630	1 100 1 000 850		HR 32956 J HR 32056 XJ 30256	4EC 4FC	298 307 313	297 305 339	368 402 478	374	368 402 462	12 14 12	15.5 22 22	2.5 4 5	2 3 4	75.3 91.6 98.5	0
	500 580	137 187	130 175	106 145	6 6	5 6		3 450 000 5 400 000	630 560	850 800		32256 32356	_	313 319	325 353	478 552		467 532	14 14	31 42	5 5	4 5	123.1 139.6	0
300	420 420 460	76 76 100	72 76 100	62 57 74	4 4 5	3 3 4	895 000 1 010 000 1 440 000	1 820 000 2 100 000 2 700 000	710 710 670	950 950 900		32960 HR 32960 J HR 32060 XJ	3FD 4GD	321 321 327	326 324 330	406 406 442	387	405 405 439	13 13 15	14 19 26	3 3 4	2.5 2.5 3	79.3 79.9 98.4	000

800

800

900

900

850

750

750

670

850

850

750

800

800

750

750

710

670

670

630

600

600

970

670

630

530

530

480

630

560

560

530

560

530

480

450

430

Limiting Speeds

(min⁻¹)

0il

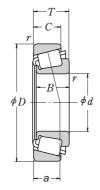
Grease

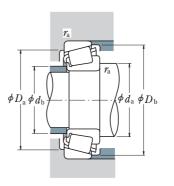




C 208

Bore Diameter 12.000 - 22.225 mm





Dynamic Equivalent Load

P = X	$F_{\rm r} + YF_{\rm a}$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	n	0.4	<i>V</i> .

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ When $F_{\mathrm{r}}\!>\!0.5F_{\mathrm{r}}\!+\!Y_{0}F_{\mathrm{a}}$, use $P_{0}\!=\!F_{\mathrm{r}}$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

	Boundary Dimensions (mm)			Basic Load Ratings (N)		Limiting Speeds (min ⁻¹)		Bearing Numbers		А	Abutment and Fillet Dimensions (mm)				Eff. Load Centers	Constant	Axial Load Factors		Mass (kg)			
d	D	T	В	С	Cone Cup <i>Y</i> min.	$C_{\rm r}$	C_{0r}	Grease	Oil		CONE	CUP	d_{a}	$d_{ m b}$	D_{a}	D_{b}	Cone Cup \mathcal{Y}_{a} max.	(mm) a	e	Y_1	Y_0	approx.
12.000 12.700 15.000	31.991 34.988 34.988	10.008 10.998 10.998	10.785 10.988 10.988	7.938 8.730 8.730	0.8 1.3 1.3 1.3 0.8 1.3	10 300 11 700 11 700	8 900 10 900 10 900	13 000 12 000 12 000	18 000 16 000 16 000		*A 2047 A 4050 *A 4059	A 2126 A 4138 A 4138	16.5 18.5 19.5	15.5 17 19	26 29 29	29 32 32	0.8 1.3 1.3 1.3 0.8 1.3	6.8 8.2 8.2	0.41 0.45 0.45	1.5 1.3 1.3	0.81 0.73 0.73	0.023 0.017 0.033 0.022 0.029 0.022
15.875	34.988 39.992 41.275	10.998 12.014 14.288	10.998 11.153 14.681	8.712 9.525 11.112	1.3 1.3 1.3 1.3 1.3 2.0	13 800 14 900 21 300	13 400 15 700 19 900	11 000 9 500 10 000	15 000 13 000 13 000		L 21549 A 6062 03062	L 21511 A 6157 03162	21.5 22 21.5	19.5 20.5 20	29 34 34	32.5 37 37.5	1.3 1.3 1.3 1.3 1.3 2	7.7 10.3 9.1	0.32 0.53 0.31	1.9 1.1 1.9	1.0 0.63 1.1	0.031 0.018 0.044 0.031 0.061 0.035
	42.862 42.862 44.450 49.225	14.288 16.670 15.494 19.845	14.288 16.670 14.381 21.539	9.525 13.495 11.430 14.288	1.5 1.5 1.5 1.5 1.5 1.5 0.8 1.3	17 300 26 900 23 800 37 500	17 200 26 300 23 900 37 000	8 500 9 500 8 500 8 500	12 000 13 000 11 000 11 000		11590 17580 05062 09062	11520 17520 05175 09195	24.5 23 23.5 22	22.5 21 21 21.5	34.5 36.5 38 42	39.5 39 42 44.5	1.5 1.5 1.5 1.5 1.5 1.5 0.8 1.3	13.0 10.6 11.2 10.7	0.33 0.36	0.85 1.8 1.7 2.3	0.47 1.0 0.93 1.2	0.061 0.040 0.075 0.048 0.081 0.039 0.139 0.065
16.000 16.993 17.455	47.000 39.992 36.525	21.000 12.014 11.112	21.000 11.153 11.112	16.000 9.525 7.938	1.0 2.0 0.8 1.3 1.5 1.5	35 000 14 900 11 600	36 500 15 700 11 000	9 000 9 500 10 000	12 000 13 000 14 000		*HM 81649 A 6067 A 5069	**HM 81610 A 6157 A 5144	27.5 22 23.5	23 21 21.5	37.5 34 30	43 37 33.5	1 2 0.8 1.3 1.5 1.5	14.9 10.3 8.9	0.55 0.53 0.49	1.1 1.1 1.2	0.63	0.115 0.082 0.042 0.031 0.030 0.020
17.462	39.878 47.000	13.843 14.381	14.605 14.381	10.668 11.112	1.3 1.3 0.8 1.3	22 500 23 800	22 500 23 900	10 000 8 500	13 000 11 000		† LM 11749 05068	† LM 11710 05185	23 23	21.5 22.5	34 40.5	37 42.5	1.3 1.3 0.8 1.3	8.7 10.1	0.29 0.36	2.1 1.7	1.2 0.93	0.055 0.028 0.082 0.047
19.050	39.992 45.237 47.000	12.014 15.494 14.381	11.153 16.637 14.381	9.525 12.065 11.112	1.0 1.3 1.3 1.3 1.3 1.3	14 900 28 500 23 800	15 700 28 900 23 900	9 500 9 000 8 500	13 000 12 000 11 000		A 6075 † LM 11949 05075	A 6157 † LM 11910 05185	24 25 25	23 23.5 23.5	34 39.5 40.5	37 41.5 42.5	1 1.3 1.3 1.3 1.3 1.3	10.3 9.5 10.1	0.53 0.30 0.36	1.1 2.0 1.7	0.63 1.1 0.93	0.037 0.031 0.081 0.044 0.077 0.047
	49.225 49.225 49.225	18.034 19.845 21.209	19.050 21.539 19.050	14.288 14.288 17.462	1.3 1.3 1.2 1.3 1.3 1.5	37 500 37 500 37 500	37 000 37 000 37 000	8 500 8 500 8 500	11 000 11 000 11 000		09067 09078 09067	09195 09195 09196	25.5 25.5 25.5	24 24 24	42 42 41.5	44.5 44.5 44.5	1.3 1.3 1.2 1.3 1.3 1.5	10.7	0.27 0.27 0.27	2.3 2.3 2.3	1.2 1.2 1.2	0.115 0.065 0.124 0.065 0.115 0.085
	49.225 53.975	23.020 22.225	21.539 21.839	17.462 15.875	C1.5 3.5 1.5 2.3	37 500 40 500	37 000 39 500	8 500 7 500	11 000 10 000		09074 21075	09194 21212	26 31.5	24 26	39 43	44.5 50	1.5 3.5 1.5 2.3	13.8 16.3	0.27 0.59	2.3 1.0	1.2 0.56	0.124 0.082 0.156 0.097
19.990 20.000 20.625	47.000 51.994 49.225	14.381 15.011 23.020	14.381 14.260 21.539	11.112 12.700 17.462	1.5 1.3 1.5 1.3 1.5 1.5	23 800 26 000 37 500	23 900 27 900 37 000	8 500 7 500 8 500	11 000 10 000 11 000		05079 07079 09081	05185 07204 09196	26.5 27.5 27.5	24 27 25.5	40.5 45 41.5	42.5 48 44.5	1.5 1.3 1.5 1.3 1.5 1.5	10.1 12.1 13.8		1.7 1.5 2.3	0.93 0.82 1.2	0.073 0.047 0.105 0.061 0.115 0.085
20.638 21.430	49.225 50.005	19.845 17.526	19.845 18.288	15.875 13.970	1.5 1.5 1.3 1.3	36 000 38 500	37 000 40 000	8 000 8 000	11 000 11 000		12580 † M 12649	12520 † M 12610	28.5 27.5	26 25.5	42.5 44	45.5 46	1.5 1.5 1.3 1.3	12.9 10.9	0.32 0.28	1.9 2.2	1.0 1.2	0.114 0.067 0.115 0.059
22.000	45.237 45.975	15.494 15.494	16.637 16.637	12.065 12.065	1.3 1.3 1.3 1.3	29 200 29 200	33 500 33 500	8 500 8 500	11 000 11 000		*† LM 12749 *† LM 12749	† LM 12710 † LM 12711	27.5 27.5	26 26	39.5 40	42.5 42.5	1.3 1.3 1.3 1.3			2.0 2.0	1.1 1.1	0.078 0.038 0.078 0.043
22.225	50.005 50.005 52.388	13.495 17.526 19.368	14.260 18.288 20.168	9.525 13.970 14.288	1.3 1.0 1.3 1.3 1.5 1.5	26 000 38 500 40 500	27 900 40 000 43 000	7 500 8 000 7 500	10 000 11 000 10 000		07087 † M 12648 1380	07196 † M 12610 1328	28.5 28.5 29.5	27 26.5 27	44.5 44 45	47 46 48.5	1.3 1 1.3 1.3 1.5 1.5	10.6 10.9 11.3	0.40 0.28 0.29	1.5 2.2 2.1	0.82 1.2 1.1	0.097 0.035 0.111 0.059 0.137 0.067
	53.975 56.896 57.150	19.368 19.368 22.225	20.168 19.837 22.225	14.288 15.875 17.462	1.5 1.5 1.3 1.3 0.8 1.5	40 500 38 000 48 000	43 000 40 500 50 000	7 500 7 100 7 100	10 000 9 500 9 500		1380 1755 1280	1329 1729 1220	29.5 29 29.5	27 27.5 29	46 49 49	49 51 52	1.5 1.5 1.3 1.3 0.8 1.5			2.1 2.0 1.7	1.1 1.1 0.95	0.137 0.082 0.152 0.102 0.183 0.106

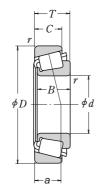
- Notes * The maximum bore diameter is listed and its tolerance is negative (See Table 7.4.1 on Page A136).
 - ** The maximum outside diameter is listed and its tolerance is negative (See Table 7.4.2 on Pages A136 and A137).
 - † The tolerances for the bore diameter and overall bearing width differ from the standard (See Table 5 on Page C185).
 - * † The tolerance for the bore diameter is 0 to $-20 \, \mu m$, and for overall bearing width is +356 to 0 μm .

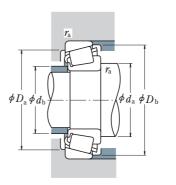




BEARINGS TABLE **NSK**

Bore Diameter 22.606 – 28.575 mm





Dynamic Equivalent Load

$P = XF_{\rm r} + YF_{\rm a}$	
$F_{\circ}/F_{r} \leq e$	F

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	r > e				
X	Y	X	Y				
1	0	0.4	<i>Y</i> ₁				

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}\!>\!0.5F_{\rm r}\!+\!Y_0F_{\rm a}$, use $P_0\!=\!F_{\rm r}$ The values of e, Y_1 , and Y_0 are

given in the table below.

	Boundary Dimensions (mm)					Basic Loa	3 -	Limiting Speeds (min ⁻¹)		Bearing I	Numbers	Al	outment	and Fille (mm)			Centers	d Constant		l Load ctors	Mass (kg)
d	D	T	В	С	Cone Cup ** min.	$C_{\rm r}$	C_{0r}	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{ m a}$	$D_{ exttt{b}}$	Cone Cu \mathcal{Y}_{a} max.	p (mm a	e	Y_1	Y_0	approx.
22.606	47.000	15.500	15.500	12.000	1.5 1.0	26 300	30 000	8 000	11 000	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
23.812	50.292 56.896	14.224 19.368	14.732 19.837	10.668 15.875	1.5 1.3 0.8 1.3	27 600 38 000	32 000 40 500	7 100 7 100	10 000 9 500	† L 44640 1779	† L 44610 1729	30.5 29.5	28.5 28.5	44.5 49	47 51	1.5 1. 0.8 1.					0.097 0.039 0.143 0.102
24.000	55.000	25.000	25.000	21.000	2.0 2.0	49 500	55 000	7 100	9 500	▲JHM 33449	▲JHM 33410	35	30	47	52	2 2	15.8	0.35	1.7	0.93	0.181 0.107
24.981	51.994 52.001 62.000	15.011 15.011 16.002	14.260 14.260 16.566	12.700 12.700 14.288	1.5 1.3 1.5 2.0 1.5 1.5	26 000 26 000 37 000	27 900 27 900 39 500	7 500 7 500 6 300	10 000 10 000 8 500	07098 07098 17098	07204 07205 17244	31 31 33	29 29 30.5	45 44.5 54	48 48 57	1.5 1. 1.5 2 1.5 1.	12.1	0.40 0.40 0.38	1.5	0.82	0.085 0.061 0.085 0.061 0.165 0.091
25.000	50.005 51.994	13.495 15.011	14.260 14.260	9.525 12.700	1.5 1.0 1.5 1.3	26 000 26 000	27 900 27 900	7 500 7 500	10 000 10 000	07097 07097	07196 07204	31 31	29 29	44.5 45	47 48	1.5 1 1.5 1	10.6 3 12.1	0.40 0.40		0.82 0.82	0.085 0.035 0.085 0.061
25.400	50.005 50.005 50.292	13.495 13.495 14.224	14.260 14.260 14.732	9.525 9.525 10.668	3.3 1.0 1.0 1.0 1.3 1.3	26 000 26 000 27 600	27 900 27 900 32 000	7 500 7 500 7 100	10 000 10 000 10 000	07100 SA 07100 † L 44643	07196 07196 † L 44610	35 30.5 31.5	29.5 29.5 29.5	44.5 44.5 44.5	47 47 47	3.3 1 1 1 1.3 1	10.6 10.6 3 10.9	0.40	1.5	0.82	0.082 0.035 0.084 0.035 0.090 0.039
	57.150 57.150 59.530	17.462 19.431 23.368	17.462 19.431 23.114	13.495 14.732 18.288	1.3 1.5 1.5 1.5 0.8 1.5	39 500 42 500 50 000	45 500 49 000 58 000	6 700 6 700 6 300	9 000 9 000 9 000	15578 M 84548 M 84249	15520 M 84510 M 84210	32.5 36 36	30.5 33 32.5	51 48.5 49.5	53 54 56	1.3 1. 1.5 1. 0.8 1.	5 16.1	0.55	1.1	0.60	0.151 0.070 0.156 0.089 0.194 0.13
	62.000 63.500 64.292	19.050 20.638 21.433	20.638 20.638 21.433	14.288 15.875 16.670	0.8 1.3 3.5 1.5 1.5 1.5	46 000 46 000 51 000	53 000 53 000 64 500	6 000 6 000 5 600	8 000 8 000 8 000	15101 15100 M 86643	15245 15250 X M 86610	32.5 38 38	31.5 31.5 36.5	55 55 54	58 59 61	0.8 1. 3.5 1. 1.5 1.	5 14.9		1.7	0.94 0.94 0.60	
	65.088 68.262 72.233 72.626	22.225 22.225 25.400 24.608	21.463 22.225 25.400 24.257	15.875 17.462 19.842 17.462	1.5 1.5 0.8 1.5 0.8 2.3 2.3 1.5	45 000 55 000 63 500 60 000	47 500 64 000 83 500 58 000	5 600 5 600 5 000 5 600	8 000 7 500 7 100 7 500	23100 02473 HM 88630 41100	23256 02420 HM 88610 41286	39 34.5 39.5 41	34.5 33.5 39.5 36.5	53 59 60 61	61 63 69 68	1.5 1. 0.8 1. 0.8 2. 2.3 1.	5 16.9		1.1	0.79 0.60	0.214 0.142 0.28 0.152 0.398 0.188 0.32 0.177
26.988	50.292 57.150 60.325 62.000	14.224 19.845 19.842 19.050	14.732 19.355 17.462 20.638	10.668 15.875 15.875 14.288	3.5 1.3 3.3 1.5 3.5 1.5 0.8 1.3	27 600 40 000 39 500 46 000	32 000 44 500 45 500 53 000	7 100 6 700 6 700 6 000	10 000 9 000 9 000 8 000	† L 44649 1997 X 15580 15106	† L 44610 1922 15523 15245	37.5 37.5 38.5 33.5	31 31.5 32 33	44.5 51 51 55	47 53.5 54 58	3.5 1. 3.3 1. 3.5 1. 0.8 1.	5 13.9 5 14.7	0.33 0.35	1.8 1.7	1.0 0.95	0.081 0.039 0.152 0.077 0.141 0.123 0.211 0.081
28.575	57.150 59.131 62.000	19.845 15.875 19.050	19.355 16.764 20.638	15.875 11.811 14.288	3.5 1.5 spec. 1.3 3.5 1.3	40 000 34 500 46 000	44 500 41 500 53 000	6 700 6 300 6 000	9 000 8 500 8 000	1988 † LM 67043 15112	1922 † LM 67010 15245	39.5 40 40	33.5 33.5 34	51 52 55	53.5 56 58	3.5 1. 3.5 1. 3.5 1.		0.41	1.5		0.141 0.077 0.147 0.062 0.199 0.081
	62.000 64.292 68.262	19.050 21.433 22.225	20.638 21.433 22.225	14.288 16.670 17.462	0.8 1.3 1.5 1.5 0.8 1.5	46 000 51 000 55 000	53 000 64 500 64 000	6 000 5 600 5 600	8 000 8 000 7 500	15113 M 86647 02474	15245 M 86610 02420	34.5 40 36.5	34 38 36	55 54 59	58 61 63	0.8 1. 1.5 1. 0.8 1.	5 17.7	0.55	1.1	0.60 0.79	0.20 0.081 0.223 0.128 0.257 0.152
	72.626 72.626 73.025	24.608 24.608 22.225	24.257 24.257 22.225	17.462 17.462 17.462	4.8 1.5 1.5 1.5 0.8 3.3	60 000 60 000 54 500	58 000 58 000 64 500	5 600 5 600 5 300	7 500 7 500 7 100	41125 41126 02872	41286 41286 02820	48 41.5 37.5	36.5 36.5 37	61 61 62	68 68 68	4.8 1. 1.5 1. 0.8 3.	5 20.7	0.60 0.60 0.45	1.0		0.292 0.177 0.295 0.177 0.321 0.16
								•		Notes + T	he tolerances for the l	ore diam	atar and	l overall l	haarina	width diff	r from t	no etand	ard (Sa	a Tabla	5 on Dago (185)

Notes

- † The tolerances for the bore diameter and overall bearing width differ from the standard (See Table 5 on Page C185).
- The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.



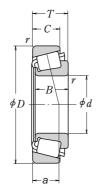


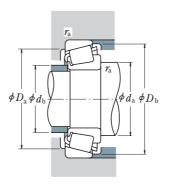
C 212

BEARINGS TABLE **NSK**

Bore Diameter 29.000 - 32.000 mm

■ SINGLE-ROW TAPERED ROLLER BEARINGS (INCH DESIGN)





Dynamic Equivalent Load

$P = XF_{\rm r} + YF_{\rm a}$	
$F_{\rm a}/F_{\rm r} \leq e$	$F_{\rm a}/$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$

The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

	Boundary Dimensions (mm)						Basic Load Ratings (N)		Limiting Speeds (min ⁻¹)		Bearing Numbers		Abutment and Fillet Dime (mm)				Çe				I Load ctors	Mass (kg)	
d	D	T	В	С	Cone Cu ** min.	р	$C_{\rm r}$	C_{0r}	Grease	Oil		CONE	CUP	$d_{\scriptscriptstyle \mathrm{a}}$	$d_{\scriptscriptstyle m b}$	$D_{\rm a}$	$D_{ m b}$	Cone Cone Cone Cone Max.		n)	Y_1	Y_0	approx.
29.000 29.367	50.292 66.421	14.224 23.812	14.732 25.433	10.668 19.050	3.5 1.3 3.5 1.3		26 800 65 000	34 000 73 000	7 100 6 000	9 500 8 000		† L 45449 2690	† L 45410 2631	39.5 41	33 35	44.5 58	48 60	3.5 1 3.5 1	.3 10 .3 14		7 1.6 5 2.4		0.079 0.036 0.242 0.165
30.000	62.000 62.000 63.500 72.000	16.002 19.050 20.638 19.000	16.566 20.638 20.638 18.923	14.288 14.288 15.875 15.875	1.5 1.5 1.3 1.3 1.3 1.3 1.5 1.5	3	37 000 46 000 46 000 52 000	39 500 53 000 53 000 56 000	6 300 6 000 6 000 5 600	8 500 8 000 8 000 7 500		* 17118 * 15117 * 15117 * 26118	17244 15245 15250 26283	37 36.5 36.5 38	34.5 35 35 36	54 55 56 62	57 58 59 65	1.3 1	.5 12 .3 13 .3 14 .5 14	3 0.3 9 0.3	1.7	0.94 0.94	0.136 0.091 0.189 0.081 0.189 0.113 0.225 0.163
30.112	62.000	19.050	20.638	14.288	0.8 1.3	3	46 000	53 000	6 000	8 000		15116	15245	36	35.5	55	58	0.8 1	.3 13	3 0.3	5 1.7	0.94	0.189 0.081
30.162	58.738 64.292 68.262	14.684 21.433 22.225	15.080 21.433 22.225	10.716 16.670 17.462	3.5 1.0 1.5 1.5 2.3 1.5	5	28 800 51 000 55 500	33 500 64 500 70 500	6 000 5 600 5 300	8 000 8 000 7 500		08118 M 86649 M 88043	08231 M 86610 M 88010	41.5 41 43.5	35 38 39.5	52 54 58	55 61 65	3.5 1 1.5 1 2.3 1	.5 13 .5 17 .5 19	7 0.5	5 1.1	0.60	0.12 0.057 0.211 0.128 0.263 0.146
	69.850 69.850 76.200	23.812 23.812 24.608	25.357 25.357 24.074	19.050 19.050 16.670	2.3 1.3 0.8 1.3 1.5 C3.3	3	71 000 71 000 67 500	84 000 84 000 69 500	5 600 5 600 5 000	7 500 7 500 6 700		2558 2559 43118	2523 2523 43300	40 37 45	36.5 36.5 42	61 61 64	64 64 73		.3 14 .3 14 .3 22	5 0.2	7 2.2 7 2.2 7 0.90		0.297 0.169 0.298 0.169 0.383 0.146
30.213	62.000 62.000 62.000	19.050 19.050 19.050	20.638 20.638 20.638	14.288 14.288 14.288	3.5 1.3 0.8 1.3 1.5 1.3	3	46 000 46 000 46 000	53 000 53 000 53 000	6 000 6 000 6 000	8 000 8 000 8 000		15118 15120 15119	15245 15245 15245	41.5 36 37.5	35.5 35.5 35.5	55 55 55	58 58 58		.3 13 .3 13 .3 13	3 0.3	5 1.7	0.94	0.186 0.081 0.188 0.081 0.188 0.081
30.955	64.292	21.433	21.433	16.670	1.5 1.5	5	51 000	64 500	5 600	8 000		M 86648 A	M 86610	42	38	54	61	1.5 1	.5 17	7 0.5	5 1.1	0.60	0.205 0.128
31.750	58.738 59.131 62.000	14.684 15.875 18.161	15.080 16.764 19.050	10.716 11.811 14.288	1.0 1.0 spec. 1.3 spec. 1.3	3	28 800 34 500 46 000	33 500 41 500 53 000	6 000 6 300 6 000	8 000 8 500 8 000		08125 † LM 67048 15123	08231 † LM 67010 15245	37.5 42.5 42.5	36 36 36.5	52 52 55	55 56 58		.3 12 .3 13	6 0.4	1 1.5	0.80	0.113 0.057 0.127 0.062 0.165 0.081
	62.000 62.000 63.500	19.050 19.050 20.638	20.638 20.638 20.638	14.288 14.288 15.875	0.8 1.3 3.5 1.3 0.8 1.3	3	46 000 46 000 46 000	53 000 53 000 53 000	6 000 6 000 6 000	8 000 8 000 8 000		15126 15125 15126	15245 15245 15250	37 42.5 37	36.5 36.5 36.5	55 55 56	58 58 59		.3 13 .3 13 .3 14	3 0.3	5 1.7	0.94	0.176 0.081 0.174 0.081 0.176 0.113
	68.262 68.262 69.012	22.225 22.225 19.845	22.225 22.225 19.583	17.462 17.462 15.875	3.5 1.5 1.5 1.5 3.5 1.3	5	55 000 55 500 47 000	64 000 70 500 56 000	5 600 5 300 5 600	7 500 7 500 7 500		02475 M 88046 14125 A	02420 M 88010 14276	44.5 43 44	38.5 40.5 37.5	59 58 60	63 65 63	3.5 1 1.5 1 3.5 1	.5 19	1 0.5		0.60	0.229 0.152 0.25 0.146 0.219 0.135
	69.012 69.850 69.850	26.982 23.812 23.812	26.721 25.357 25.357	15.875 19.050 19.050	4.3 3.3 0.8 1.3 3.5 1.3	3	47 000 71 000 71 000	56 000 84 000 84 000	5 600 5 600 5 600	7 500 7 500 7 500		14123 A 2580 2582	14274 2523 2523	41.5 38.5 44	37.5 37.5 37.5	59 61 61	63 64 64		.3 15 .3 14 .3 14	5 0.2		0.87 1.2 1.2	0.289 0.132 0.282 0.169 0.28 0.169
	72.626 73.025 80.000	30.162 29.370 21.000	29.997 27.783 22.403	23.812 23.020 17.826	0.8 3.3 1.3 3.3 0.8 1.3	3	79 500 74 000 68 500	90 000 100 000 75 500	5 300 5 000 4 500	7 500 7 100 6 300		3188 HM 88542 346	3120 HM 88510 332	39.5 45.5 40	39.5 42.5 39.5	61 59 73	67 70 75	0.8 3 1.3 3 0.8 1	.3 23	5 0.5			0.368 0.225 0.379 0.242 0.419 0.146
32.000	72.233	25.400	25.400	19.842	3.3 2.3	3	63 500	83 500	5 000	7 100		*HM 88638	HM 88610	48.5	42.5	60	69	3.3 2	.3 20	7 0.5	5 1.1	0.60	0.337 0.188
												Notes * The	maximum hore dia	matar ic	lictad an	d ite tala	ranca is	e negative	(See T	hla 7 /	on Pag	Δ136)	

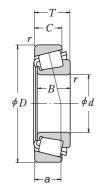
- * The maximum bore diameter is listed and its tolerance is negative (See Table 7.4.1 on Page A136).
- † The tolerances for the bore diameter and overall bearing width differ from the standard (See Table 5 on Page C185).

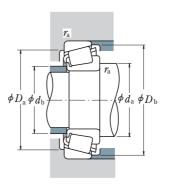




C 214 C 215

Bore Diameter 33.338 - 35.000 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$ $F_a/F_r \le e \qquad F_a/$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_{\rm r} + Y_0 F_{\rm a}$

When $F_{\mathrm{r}}\!>\!0.5F_{\mathrm{r}}\!+\!Y_{\!0}F_{\mathrm{a}}$, use $P_{\!0}\!=\!F_{\mathrm{r}}$

The values of e, Y_1 , and Y_0 are given in the table below.

		Dimensions m)				Basic Load		Limiting S		Bearing N	lumbers	А	butment	and Fille		sions	Eff. Load Centers	Constant		Load	Mass (kg)	
d	D	T	В	С	Cone γ min	٠ . ا	$C_{\rm r}$	C_{0r}	Grease	Oil	CONE	CUP	d_{a}	$d_{ m b}$	D_{a}	$D_{ m b}$	Cone Cup \mathcal{Y}_{a} max.	(mm) a	e	Y_1	Y_0	approx.
33.338	66.675 68.262 69.012	20.638 22.225 19.845	20.638 22.225 19.583	15.875 17.462 15.875	3.5 0.8 3.5	1.5 1.5 3.3	46 000 55 500 47 000	53 500 70 500 56 000	5 600 5 300 5 600	7 500 7 500 7 500	1680 M 88048 14130	1620 M 88010 14274	44.5 42.5 45	38.5 41 38.5	58 58 59	61 65 63	3.5 1.5 0.8 1.5 3.5 3.3	19.0	0.37 0.55 0.38	1.1	0.60	0.196 0.121 0.236 0.146 0.207 0.132
	69.012 69.850 72.000	19.845 23.812 19.000	19.583 25.357 18.923	15.875 19.050 15.875	0.8 3.5 3.5	1.3 1.3 1.5	47 000 71 000 52 000	56 000 84 000 56 000	5 600 5 600 5 600	7 500 7 500 7 500	14131 2585 26131	14276 2523 26283	39.5 45 44.5	38.5 39 38.5	60 61 62	63 64 65	0.8 1.3 3.5 1.3 3.5 1.5	14.5	0.38 0.27 0.36	2.2	1.2	0.209 0.135 0.263 0.169 0.20 0.163
	72.626 73.025 76.200	30.162 29.370 29.370	29.997 27.783 28.575	23.812 23.020 23.020		3.3 3.3 0.8	79 500 74 000 78 500	90 000 100 000 106 000	5 300 5 000 4 800	7 500 7 100 6 700	3197 HM 88547 HM 89444	3120 HM 88510 HM 89411	41.5 45.5 53	40.5 42.5 44.5	61 59 65	67 70 73	0.8 3.3 0.8 3.3 3.8 0.8	23.5		1.1	0.60	0.348 0.225 0.362 0.242 0.419 0.261
	76.200 79.375	29.370 25.400	28.575 24.074	23.020 17.462	0.8 3.5	3.3 1.5	78 500 67 500	106 000 69 500	4 800 5 000	6 700 6 700	HM 89443 43131	HM 89410 43312	46.5 51	44.5 42	62 67	73 74			0.55 0.67			0.421 0.257 0.348 0.22
34.925	65.088 65.088 66.675	18.034 20.320 20.638	18.288 18.288 20.638	13.970 16.256 16.670	spec. spec. 3.5	1.3 1.3 2.3	47 500 47 500 53 000	57 500 57 500 62 500	5 600 5 600 5 600	7 500 7 500 7 500	† LM 48548 † LM 48548 M 38549	† LM 48510 † LM 48511 M 38510	46 46 46.5	40 40 40	58 58 58	61 61 62	3.5 1.3	14.1 16.4 15.2	0.38 0.38 0.35	1.6	0.88	0.172 0.087 0.172 0.108 0.194 0.112
	69.012 69.012 72.233	19.845 19.845 25.400	19.583 19.583 25.400	15.875 15.875 19.842	3.5 1.5 2.3	1.3 1.3 2.3	47 000 47 000 63 500	56 000 56 000 83 500	5 600 5 600 5 000	7 500 7 500 7 100	14138 A 14137 A HM 88649	14276 14276 HM 88610	46 42 48.5	40 40 42.5	60 60 60	63 63 69	3.5 1.3 1.5 1.3 2.3 2.3	15.1	0.38 0.38 0.55		0.86	0.194 0.135 0.196 0.135 0.307 0.188
	73.025 73.025 73.025	22.225 22.225 23.812	22.225 23.812 24.608	17.462 17.462 19.050	0.8 3.5 1.5	3.3 3.3 0.8	54 500 63 500 71 000	64 500 77 000 86 000	5 300 5 300 5 300	7 100 7 100 7 100	02878 2877 25877	02820 2820 25821	42.5 47 43	42 41.5 40.5	62 63 65	68 68 68	0.8 3.3 3.5 3.3 1.5 0.8	16.1	0.45 0.37 0.29	1.6	0.90	0.266 0.16 0.291 0.15 0.306 0.167
	73.025 76.200 76.200	23.812 29.370 29.370	24.608 28.575 28.575	19.050 23.020 23.020	0.8	2.3 0.8 0.8	71 000 78 500 78 500	86 000 106 000 106 000	5 300 4 800 4 800	7 100 6 700 6 700	25878 HM 89446 A HM 89446	25820 HM 89411 HM 89411	47 47.5 53	40.5 44.5 44.5	64 65 65	68 73 73	3.5 2.3 0.8 0.8 3.5 0.8	23.6	0.29 0.55 0.55	1.1	0.60	0.304 0.165 0.403 0.261 0.40 0.261
	76.200 76.200 79.375	29.370 29.370 29.370	28.575 28.575 29.771	23.020 23.812 23.812	3.5 1.5 3.5	3.3 3.3 3.3	78 500 80 500 88 000	106 000 96 500 106 000	4 800 5 000 4 800	6 700 6 700 6 700	HM 89446 31594 3478	HM 89410 31520 3420	53 46 50	44.5 43.5 43.5	62 64 67	73 72 74		21.6	0.55 0.40 0.37		0.82	0.40 0.257 0.404 0.235 0.448 0.259
34.976	68.262 72.085 80.000	15.875 22.385 21.006	16.520 19.583 20.940	11.908 18.415 15.875	1.5 1.3 1.5	1.5 2.3 1.5	45 000 47 000 56 500	53 500 56 000 64 500	5 300 5 600 5 000	7 100 7 500 6 700	19138 14139 28138	19268 14283 28315	42.5 41.5 43.5	40.5 40 41	61 60 69	65 65 73	1.5 1.5 1.3 2.3 1.5 1.5	17.7	0.44 0.38 0.40	1.6	0.87	0.196 0.073 0.198 0.21 0.308 0.199
35.000	59.131 59.975 62.000	15.875 15.875 16.700	16.764 16.764 17.000	11.938 11.938 13.600	spec. spec. spec.	1.3 1.3 1.0	35 000 35 000 38 000	47 000 47 000 50 000	6 000 6 000 5 600	8 000 8 000 8 000	*† L 68149 *† L 68149 * LM 78349	† L 68110 † L 68111 ** LM 78310	45.5 45.5 46	39 39 40	52 53 55	56 56 59	3.5 1.3 3.5 1.3 3.5 1	13.2 13.2 14.4	0.42 0.42 0.44	1.4	0.79	0.117 0.056 0.117 0.064 0.137 0.074
	62.000 65.987 73.025	16.700 20.638 26.988	17.000 20.638 26.975	13.600 16.670 22.225	spec. 3.5 3.5	1.5 2.3 0.8	38 000 53 000 75 500	50 000 62 500 88 500	5 600 5 600 5 300	8 000 7 500 7 500	* LM 78349 M 38547 23691	** LM 78310 A M 38511 23621	46 46 49	40 39.5 42	54 59 63	59 61 68	3.5 1.5 3.5 2.3 3.5 0.8	15.2	0.44 0.35 0.37		0.94	0.138 0.073 0.193 0.103 0.309 0.212
											Notes * Th	ne maximum hore dia	motor io	lioted on	d ita tala	ranga ia	nogotivo (on Table	7110	n Dogo	A126)	

Note

- * 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 C185).
- * † The tolerance for the bore diameter is 0 to $-20 \, \mu m$, and for overall bearing width is +356 to 0 μm .

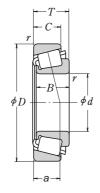


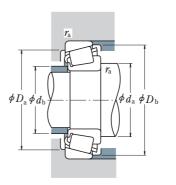


BEARINGS TABLE **NSK**

Bore Diameter 35.717 - 41.275 mm

■ SINGLE-ROW TAPERED ROLLER BEARINGS (INCH DESIGN)





Dynamic Equivalent Load

P = X	$F_{\rm r} + YF_{\rm a}$						
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e				
X	Y	X	Y				
1	0	0.4	<i>Y</i> ₁				

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

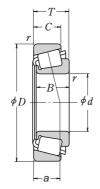
	Boundary Dimensions (mm) Cone C							Limiting Speeds (min ⁻¹)		Bearing	Numbers	A	butment	and Fille		sions	Eff. Load Centers	Constant	Axial Fac	Load tors	Mass (kg)
<u>d</u>	D	T	В	С	Cone Cup ** min.	$C_{\rm r}$	C_{0r}	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\rm a}$	$D_{\scriptscriptstyle m b}$	Cone Cup γ_a max.	(mm) a	e	Y_1	Y_0	approx.
35.717 36.487	72.233 73.025	25.400 23.812	25.400 24.608	19.842 19.050	3.5 2.3 1.5 0.8	63 500 71 000	83 500 86 000	5 000 5 300	7 100 7 100	HM 88648 25880	HM 88610 25821	52 44	43 42	60 65	69 68	3.5 2.3 1.5 0.8	20.7 15.7	0.55 0.29	1.1 2.1		0.298
36.512	76.200 79.375 88.501 93.662	29.370 29.370 25.400 31.750	28.575 29.771 23.698 31.750	23.020 23.812 17.462 26.195	3.5 3.3 0.8 3.3 2.3 1.5 1.5 3.3	78 500 88 000 73 000 110 000	106 000 106 000 81 000 142 000	4 800 4 800 4 000 4 000	6 700 6 700 5 600 5 600	HM 89449 3479 44143 46143	HM 89410 3420 44348 46368	54 45.5 54 48.5	44.5 44.5 50 46.5	62 67 75 79	73 74 84 87	3.5 3.3 0.8 3.3 2.3 1.5 1.5 3.3	27.9	0.55 0.37 0.78 0.40		0.90 0.42	0.38 0.257 0.429 0.259 0.502 0.245 0.765 0.405
38.000	63.000	17.000	17.000	13.500	spec. 1.3	38 500	52 000	5 600	7 500	▲ 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
38.100	63.500 65.088 65.088	12.700 18.034 18.034	11.908 18.288 18.288	9.525 13.970 13.970	1.5 0.8 2.3 1.3 spec. 1.3	24 100 42 500 42 500	30 500 55 000 55 000	5 300 5 300 5 300	7 100 7 500 7 500	13889 LM 29749 LM 29748	13830 LM 29710 LM 29710	45 46 49	42.5 42.5 42.5	59 59 59	60 62 62	1.5 0.8 2.3 1.3 3.5 1.3	11.9 13.7 13.7	0.35 0.33 0.33	1.7 1.8 1.8	0.99	0.109 0.046 0.16 0.079 0.158 0.079
	65.088 68.262 69.012	19.812 15.875 19.050	18.288 16.520 19.050	15.748 11.908 15.083	2.3 1.3 1.5 1.5 2.0 2.3	42 500 45 000 49 000	55 000 53 500 61 000	5 300 5 300 5 300	7 500 7 100 7 100	LM 29749 19150 13687	LM 29711 19268 13621	46 45 46.5	42.5 43 43	58 61 61	62 65 65	2.3 1.3 1.5 1.5 2 2.3		0.33 0.44 0.40	1.8 1.4 1.5	0.74	0.16 0.094 0.173 0.073 0.193 0.104
	69.012 72.238 73.025	19.050 20.638 23.812	19.050 20.638 25.654	15.083 15.875 19.050	3.5 0.8 3.5 1.3 3.5 0.8	49 000 48 500 73 500	61 000 59 500 91 000	5 300 5 300 5 000	7 100 7 100 6 700	13685 16150 2788	13620 16284 2735 X	49.5 49.5 50	43 43 43.5	62 63 66	65 67 69	3.5 0.8 3.5 1.3 3.5 0.8	16.0	0.40 0.40 0.30	1.5	0.82	0.191 0.105 0.212 0.146 0.312 0.135
	76.200 76.200 79.375	23.812 23.812 29.370	25.654 25.654 29.771	19.050 19.050 23.812	3.5 3.3 3.5 0.8 3.5 3.3	73 500 73 500 88 000	91 000 91 000 106 000	5 000 5 000 4 800	6 700 6 700 6 700	2788 2788 3490	2720 2729 3420	50 50 52	43.5 43.5 45.5	66 68 67	70 70 74	3.5 3.3 3.5 0.8 3.5 3.3			2.0 2.0 1.6	1.1	0.312 0.187 0.312 0.191 0.404 0.259
	80.035 82.550 88.501	24.608 29.370 25.400	23.698 28.575 23.698	18.512 23.020 17.462	0.8 1.5 0.8 3.3 2.3 1.5	69 000 87 000 73 000	84 500 117 000 81 000	4 500 4 500 4 000	6 300 6 000 5 600	27880 HM 801346 44150	27820 HM 801310 44348	48 51 55	47 49 51	68 68 75	75 78 84	0.8 1.5 0.8 3.3 2.3 1.5	24.2	0.56 0.55 0.78	1.1 1.1 0.77	0.60	0.362 0.209 0.483 0.282 0.484 0.245
	88.501 95.250	26.988 30.958	29.083 28.301	22.225 20.638	3.5 1.5 1.5 0.8	96 500 87 500	109 000 97 000	4 500 3 600	6 000 5 300	418 53150	414 53375	51 55	44.5 53	77 81	80 89	3.5 1.5 1.5 0.8	17.1 30.7	0.26 0.74	2.3 0.81	1.3 0.45	0.50 0.329 0.665 0.365
39.688	73.025 76.200 80.167	25.654 23.812 29.370	22.098 25.654 30.391	21.336 19.050 23.812	0.8 2.3 3.5 3.3 0.8 3.3	62 500 73 500 92 500	80 000 91 000 108 000	5 000 5 000 4 800	6 700 6 700 6 300	M 201047 2789 3386	M 201011 2720 3320	45.5 52 46.5	48 45 45.5	64 66 70	69 70 75	0.8 2.3 3.5 3.3 0.8 3.3	19.7 15.9 18.4	0.33 0.30 0.27	1.8 2.0 2.2		0.266 0.169 0.292 0.187 0.442 0.217
40.000	80.000 80.000 88.501	21.000 21.000 25.400	22.403 22.403 23.698	17.826 17.826 17.462	3.5 1.3 0.8 1.3 2.3 1.5	68 500 68 500 73 000	75 500 75 500 81 000	4 500 4 500 4 000	6 300 6 300 5 600	344 344 A 44157	332 332 44348	52 46 56	45.5 45.5 51	73 73 75	75 75 84	3.5 1.3 0.8 1.3 2.3 1.5	14.5 14.5 27.9		2.2	1.2	0.338
41.000	68.000	17.500	18.000	13.500	spec. 1.5	43 500	58 000	5 300	7 100	* LM 300849	** LM 300811	52	45	61	65	3.5 1.5	13.9	0.35	1.7	0.95	
41.275	73.025 73.431 73.431	16.667 19.558 21.430	17.462 19.812 19.812	12.700 14.732 16.604	3.5 1.5 3.5 0.8 3.5 0.8	44 500 54 500 54 500	54 000 67 000 67 000	4 800 4 800 4 800	6 700 6 700 6 700	18590 LM 501349 LM 501349	18520 LM 501310 LM 501314	53 53 53	46 46.5 46.5	66 67 66	69 70 70	3.5 1.5 3.5 0.8 3.5 0.8	14.0 16.3 18.2	0.35 0.40 0.40	1.7 1.5 1.5	0.83	0.199 0.086 0.226 0.108 0.226 0.129
										Motoo da	The maximum here dia	motor in	liated on	d ita tala	ranga ia	nogotivo (C	aa Tabla	7110	n Dogo	A 4 9 C \	

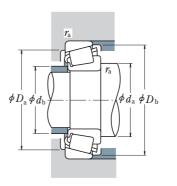
- Notes * The maximum bore diameter is listed and its tolerance is negative (See Table 7.4.1 on Page A136).
 - ** The maximum outside diameter is listed and its tolerance is negative (See Table 7.4.2 on Pages A136 and A137).
 - The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.



C 218 C 219

Bore Diameter 41.275 – 44.450 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	r > e
X	Y	X	Y
1	0	0.4	<i>Y</i> ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$

The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

		Boundary [Basic Loa	Ü	Limiting S		Bearing I	Numbers	A	Abutment	and Fille		sions	Eff. Load Centers	Constant		Load tors	Mass (kg)
d	D	T	В	С	Cone <i>1</i> mi	r ·	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	d_{a}	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{ m b}$	Cone Cup $r_{\rm a}$ max.		e	Y_1	Y_0	approx.
41.275	76.200 76.200 76.200	18.009 22.225 25.400	17.384 23.020 23.020	14.288 17.462 20.638	1.5 3.5 3.5	1.5 0.8 2.3	42 500 66 000 66 000	51 000 82 000 82 000	4 500 4 800 4 800	6 300 6 700 6 700	11162 24780 24780	11300 24720 24721	49 53 54	46.5 47.5 47	67 68 66	71 72 72	1.5 1.5 3.5 0.8 3.5 2.3	17.0	0.49 0.39 0.39	1.2 1.5 1.5	0.84	0.279 0.15
	79.375 80.000 80.000	23.812 21.000 21.000	25.400 22.403 22.403	19.050 17.826 17.826	3.5 0.8 3.5	0.8 1.3 1.3	77 000 68 500 68 500	98 500 75 500 75 500	4 800 4 500 4 500	6 300 6 300 6 300	26882 336 342	26822 332 332	54 47 53	47 46 46	71 73 73	74 75 75	3.5 0.8 0.8 1.3 3.5 1.3	14.5	0.32 0.27 0.27	1.9 2.2 2.2	1.0 1.2 1.2	0.349 0.186 0.325 0.146 0.323 0.146
	80.167 82.550 85.725	25.400 26.543 30.162	25.400 25.654 30.162	20.638 20.193 23.812	3.5 3.5 3.5	3.3 3.3 3.3	77 000 78 500 91 000	98 500 102 000 115 000	4 800 4 300 4 300	6 300 6 000 6 000	26882 M 802048 3877	26820 M 802011 3820	54 57 57	47 51 50	69 70 73	74 79 81	3.5 3.3 3.5 3.3 3.5 3.3	22.9	0.32 0.55 0.40	1.9 1.1 1.5	1.0 0.60 0.82	0.349 0.219 0.406 0.23 0.506 0.285
	87.312 88.501 88.900	30.162 25.400 30.162	30.886 23.698 29.370	23.812 17.462 23.020	0.8 2.3 3.5	3.3 1.5 3.3	96 000 73 000 96 500	120 000 81 000 129 000	4 300 4 000 4 000	6 000 5 600 5 600	3576 44162 HM 803146	3525 44348 HM 803110	49 57 60	48 51 53	75 75 74	81 84 85	0.8 3.3 2.3 1.5 3.5 3.3	28.0	0.31 0.78 0.55	2.0 0.77 1.1		0.532 0.304 0.447 0.245 0.579 0.322
	88.900 90.488 93.662	30.162 39.688 31.750	29.370 40.386 31.750	23.020 33.338 26.195	0.8 3.5 0.8	3.3 3.3 3.3	96 500 139 000 110 000	129 000 180 000 142 000	4 000 4 300 4 000	5 600 5 600 5 600	HM 803145 4388 46162	HM 803110 4335 46368	54 57 52	53 51 51	74 77 79	85 85 87	0.8 3.3 3.5 3.3 0.8 3.3	24.6	0.55 0.28 0.40	1.1 2.1 1.5	1.2	0.789 0.459
	95.250 98.425	30.162 30.958	29.370 28.301	23.020 20.638	3.5 1.5	3.3 0.8	106 000 87 500	143 000 97 000	3 800 3 600	5 300 5 300	HM 804840 53162	HM 804810 53387	61 57	54 53	81 82	91 91	3.5 3.3 1.5 0.8		0.55 0.74	1.1 0.81		0.726 0.354 0.618 0.442
42.862	76.992 82.550 82.931 82.931	17.462 19.842 23.812 26.988	17.145 19.837 25.400 25.400	11.908 15.080 19.050 22.225	1.5 2.3 2.3 2.3	1.5 1.5 0.8 2.3	44 000 58 500 76 500 76 500	54 000 69 000 99 000 99 000	4 500 4 500 4 500 4 500	6 000 6 300 6 000 6 000	12168 22168 25578 25578	12303 22325 25520 25523	51 52 53 53	48.5 48.5 49.5 49.5	68 73 74 72	73 76 77 77	1.5 1.5 2.3 1.5 2.3 0.8 2.3 2.3	17.6	0.51 0.43 0.33 0.33	1.2 1.4 1.8 1.8	0.77 0.99	0.283 0.176
42.875	76.200 80.000 82.931 83.058	25.400 21.000 26.988 23.812	25.400 22.403 25.400 25.400	20.638 17.826 22.225 19.050	3.5 3.5 3.5 3.5	1.5 1.3 2.3 3.3	77 000 68 500 76 500 76 500	98 500 75 500 99 000 99 000	4 800 4 500 4 500 4 500	6 300 6 300 6 000 6 000	26884 342 S 25577 25577	26823 332 25523 25521	55 54 55 55	48.5 47.5 49 49	69 73 72 72	73 75 77 77	3.5 1.5 3.5 1.3 3.5 2.3 3.5 3.3	3 14.5 3 20.8	0.32 0.27 0.33 0.33	1.9 2.2 1.8 1.8	1.0 1.2 0.99 0.99	0.337 0.136 0.305 0.146 0.381 0.248 0.381 0.201
43.000	74.988	19.368	19.837	14.288	1.5	1.3	52 500	68 000	4 800	6 300	* 16986	16929	51	48.5	67	71	1.5 1.3		0.44	1.4		
44.450	80.962 82.931 83.058	19.050 23.812 23.812	17.462 25.400 25.400	14.288 19.050 19.050	0.3 3.5 3.5	1.5 0.8 3.3	45 000 76 500 76 500	57 000 99 000 99 000	4 300 4 500 4 500	6 000 6 000 6 000	13175 25580 25580	13318 25520 25521	50 57 56	50 50 51	72 74 72	76 77 78	0.3 1.5 3.5 0.8 3.5 3.3	17.6	0.53 0.33 0.33	1.1 1.8 1.8	0.99	0.252 0.144 0.359 0.203 0.359 0.201
	87.312 88.900 93.264	30.162 30.162 30.162	30.886 29.370 30.302	23.812 23.020 23.812	3.5 3.5 3.5	3.3 3.3 3.2	96 000 96 500 103 000	120 000 129 000 136 000	4 300 4 000 3 800	6 000 5 600 5 300	3578 HM 803149 3782	3525 HM 803110 3720	57 62 58	51 53 52	75 74 82	81 85 88	3.5 3.3 3.5 3.3 3.5 3.2	25.6	0.31 0.55 0.34	2.0 1.1 1.8		0.477 0.304 0.528 0.322 0.678 0.292
	93.662 93.662 93.662 95.250	31.750 31.750 31.750 27.783	31.750 31.750 31.750 29.901	25.400 25.400 26.195 22.225	0.8 3.5 3.5 3.5	3.3 3.3 3.3 2.3	120 000 120 000 110 000 106 000	147 000 147 000 142 000 126 000	4 000 4 000 4 000 4 300	5 600 5 600 5 600 5 600	49176 49175 46176 438	49368 49368 46368 432	54 59 60 57	53 53 54 51	82 82 79 83	87 87 87 87	0.8 3.3 3.5 3.3 3.5 3.3 3.5 2.3	21.6 24.0	0.36 0.36 0.40 0.28		0.92 0.82	0.648 0.371 0.645 0.371 0.635 0.405 0.555 0.384
											Note * T	he maximum bore dia	meter is	listed an	d its tole	rance is	negative (See Table	7.4.1 c	n Page	A136).	



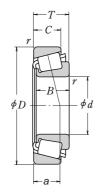


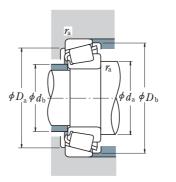
C 220 C 221

BEARINGS TABLE **NSK**

Bore Diameter 44.450 – 47.625 mm

■ SINGLE-ROW TAPERED ROLLER BEARINGS (INCH DESIGN)





Dynamic Equivalent Load

	P = X	$F_{\rm r} + YF_{\rm a}$		
_	$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	7,>
	X	Y	X	

0 Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

		Boundary [Dimensions m)				Basic Loa	d Ratings	Limiting S		Bearing	Numbers	ļ ,	butment	and Fille		nsions	Eff. Loa Centers	Constant	Axial Fac	Load tors	Mass (kg)
d	D	T	В	С	Cone 7 m	r ·	$C_{\rm r}$	C_{0r}	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{ m b}$	$D_{\rm a}$	$D_{ m b}$	Cone C γ_a max.	(mm) a	e	Y_1	Y_0	approx.
44.450	95.250 95.250 95.250	30.162 30.958 30.958	29.370 28.301 28.301	23.020 20.638 20.638	3.5 3.5 1.3	3.3 0.8 0.8	106 000 87 500 87 500	143 000 97 000 97 000	3 800 3 600 3 600	5 300 5 300 5 300	HM 804843 53177 53176	HM 804810 53375 53375	63 63 59	57 53 53	81 81 81	91 89 89	3.5 3 3.5 0 1.3 0	.8 30.7	0.55 0.74 0.74	0.81	0.45	0.677 0.354 0.572 0.365 0.574 0.365
	95.250 95.250 95.250	30.958 30.958 30.958	28.301 28.301 28.575	20.638 22.225 22.225	2.0 1.3 3.5	0.8 0.8 0.8	87 500 100 000 100 000	97 000 122 000 122 000	3 600 3 600 3 600	5 300 5 000 5 000	53178 HM 903247 HM 903249	53375 HM 903210 HM 903210	60 61 65	53 54 54	81 81 81	89 91 91	2 0 1.3 0 3.5 0		0.74 0.74 0.74	0.81	0.45	0.574 0.365 0.651 0.389 0.635 0.389
	98.425 103.188 104.775	30.958 43.658 36.512	28.301 44.475 36.512	20.638 36.512 28.575	3.5 1.3 3.5	0.8 3.3 3.3	87 500 178 000 139 000	97 000 238 000 192 000	3 600 3 800 3 400	5 300 5 000 4 800	53177 5356 HM 807040	53387 5335 HM 807010	63 58 66	53 56 59	82 89 89	91 97 100	3.5 0 1.3 3 3.5 3	.3 27.0	0.74 0.30 0.49	2.0	1.1	0.568 0.442 1.23 0.637 1.14 0.502
	107.950 111.125 114.300	27.783 30.162 44.450	29.317 26.909 44.450	22.225 20.638 34.925	3.5 3.5 3.5	0.8 3.3 3.3	116 000 92 500 172 000	149 000 110 000 205 000	3 400 3 200 3 600	4 800 4 300 4 800	460 55175 65385	453 A 55437 65320	60 67 65	54 60 59	97 92 97	100 105 107		.3 37.3	0.34 0.88 0.43	0.68		0.93 0.42 0.867 0.514 1.39 0.894
44.983 45.000 45.230	82.931 93.264 79.985	23.812 20.638 19.842	25.400 22.225 20.638	19.050 15.082 15.080	1.5 0.8 2.0	0.8 1.3 1.3	76 500 77 000 62 000	99 000 93 000 78 500	4 500 3 800 4 500	6 000 5 300 6 000	25584 376 17887	25520 374 17831	53 54 57	51 54 52	74 85 68	77 88 74		.3 17.1	0.33 0.34 0.37	1.8	0.97	0.354 0.203 0.492 0.174 0.274 0.136
45.242	73.431 77.788 77.788	19.558 19.842 21.430	19.812 19.842 19.842	15.748 15.080 16.667	3.5 3.5 3.5	0.8 0.8 0.8	53 500 56 000 56 000	75 000 71 000 71 000	4 800 4 500 4 500	6 300 6 300 6 300	LM 102949 LM 603049 LM 603049	LM 102910 LM 603011 LM 603012	56 57 57	50 50 50	68 71 70	70 74 74	3.5 0 3.5 0 3.5 0	.8 17.2	0.31 0.43 0.43	1.4	0.77	0.213 0.102 0.249 0.119 0.249 0.137
45.618	82.931 82.931	23.812 26.988	25.400 25.400	19.050 22.225	3.5 3.5	0.8 2.3	76 500 76 500	99 000 99 000	4 500 4 500	6 000 6 000	25590 25590	25520 25523	58 58	51 51	74 72	77 77		.8 17.6 .3 20.8	0.33 0.33	1.8 1.8		0.343 0.203 0.343 0.248
46.000	75.000	18.000	18.000	14.000	2.3	1.5	51 000	71 500	4 500	6 300	* LM 503349	** LM 503310	55	51	67	71	2.3 1		0.40			0.209 0.096
46.038	79.375 80.962 85.000	17.462 19.050 20.638	17.462 17.462 21.692	13.495 14.288 17.462	2.8 0.8 2.3	1.5 1.5 1.3	46 000 45 000 71 500	57 000 57 000 81 500	4 500 4 300 4 300	6 000 6 000 6 000	18690 13181 359 S	18620 13318 354 A	56 52 55	51 52 51	71 72 77	74 76 80	0.8 1	.5 15.5 .5 20.1 .3 15.4	0.53	1.1	0.63	0.211 0.126 0.236 0.144 0.343 0.162
	85.000 95.250	25.400 27.783	25.608 29.901	20.638 22.225	3.5 3.5	1.3 0.8	79 500 106 000	105 000 126 000	4 300 4 300	6 000 5 600	2984 436	2924 432 A	58 59	52 52	76 84	80 87	3.5 1 3.5 0		0.35 0.28			0.397 0.223 0.536 0.381
47.625	88.900 88.900 95.250	20.638 25.400 30.162	22.225 25.400 29.370	16.513 19.050 23.020	3.5 3.5 3.5	1.3 3.3 3.3	73 000 86 000 106 000	85 000 107 000 143 000	4 000 4 000 3 800	5 600 5 600 5 300	369 A M 804049 HM 804846	362 A M 804010 HM 804810	60 63 66	53 56 57	81 77 81	84 85 91	3.5 3		0.55	1.1	0.60	0.381 0.166 0.455 0.218 0.626 0.354
	101.600 111.125 112.712	34.925 30.162 30.162	36.068 26.909 26.909	26.988 20.638 20.638	3.5 3.5 3.5	3.3 3.3 3.3	137 000 92 500 92 500	169 000 110 000 110 000	3 800 3 200 3 200	5 000 4 300 4 300	528 55187 55187	522 55437 55443	62 69 69	55 62 62	89 92 92	95 105 106	3.5 3	.3 22.1 .3 37.3 .3 37.3	0.29 0.88 0.88	0.68	0.37	0.894 0.416 0.817 0.514 0.816 0.554
	117.475 123.825	33.338 36.512	31.750 32.791	23.812 25.400	3.5 3.5	3.3 3.3	137 000 143 000	156 000 160 000	3 200 3 000	4 300 4 000	66187 72187	66462 72487	66 72	62 66	100 102	111 116		.3 32.1 .3 37.0	0.63 0.74			1.19 0.552 1.29 0.79
											 Notes t T	ha mavimum hara dia		linted or	ما مد مدا			(Can Tabl	711	n Dono	A 1 0 C \	

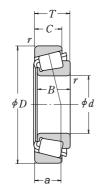
- Notes * The maximum bore diameter is listed and its tolerance is negative (See Table 7.4.1 on Page A136).
 - ** The maximum outside diameter is listed and its tolerance is negative (See Table 7.4.2 on Pages A136 and A137).

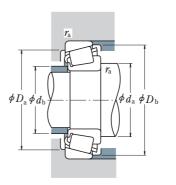




C 222 C 223

Bore Diameter 48.412 – 52.388 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$

The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

		Boundary [(m					Basic Loa	3	Limiting S		Bearing	Numbers	A	Abutment	and Fille (mm			Centers	Constant		Load tors		ass (g)
d	D	T	В	С		Cup Y iin.	$C_{\rm r}$	C_{0r}	Grease	Oil	CONE	CUP	d_{a}	$d_{\scriptscriptstyle m b}$	$D_{\rm a}$	$D_{ m b}$	Cone C γ_a max.	up (mm) a	e	Y_1	Y_0	app CONE	orox. CUP
48.412	95.250 95.250	30.162 30.162	29.370 29.370	23.020 23.020	3.5 2.3	3.3 3.3	106 000 106 000	143 000 143 000	3 800 3 800	5 300 5 300	HM 804849 HM 804848	HM 804810 HM 804810	66 63	57 57	81 81	91 91		.3 26.1 .3 26.1	0.55 0.55		0.60 0.60	0.61 0.614	0.354 0.354
49.212	104.775 114.300	36.512 44.450	36.512 44.450	28.575 36.068	3.5 3.5	0.8 3.3	139 000 196 000	192 000 243 000	3 400 3 400	4 800 4 800	HM 807044 HH 506348	HM 807011 HH 506310	69 71	63 61	91 97	100 107		.8 29.7 .3 30.8	0.49 0.40		0.68 0.82		0.508 0.837
50.000	82.000 82.550 88.900	21.500 21.590 20.638	21.500 22.225 22.225	17.000 16.510 16.513	3.0 0.5 2.3	0.5 1.3 1.3	71 000 71 000 73 000	96 000 96 000 85 000	4 300 4 300 4 000	5 600 5 600 5 600	▲ JLM 104948 * LM 104947 A 366	▲ JLM 104910 LM 104911 362 A	60 55 59	55 55 55	76 75 81	78 78 84	0.5 1	.5 16.1 .3 15.7 .3 16.6	0.31 0.31 0.32		1.1 1.1 1.0	0.316	0.133
	90.000 105.000	28.000 37.000	28.000 36.000	23.000 29.000	3.0 3.0	2.5 2.5	104 000 139 000	136 000 192 000	4 000 3 400	5 600 4 800	▲ JM 205149 ▲ JHM 807045	▲ JM 205110 ▲ JHM 807012	62 69	57 63	80 90	85 100		.5 19.9 .5 29.7	0.33 0.49	1.8 1.2	1.0 0.68	0.507 1.01	0.246 0.523
50.800	80.962 82.550 82.931	18.258 23.622 21.590	18.258 22.225 22.225	14.288 18.542 16.510	1.5 3.5 3.5	1.5 0.8 1.3	53 000 71 000 71 000	81 000 96 000 96 000	4 300 4 300 4 300	5 600 5 600 5 600	L 305649 LM 104949 LM 104949	L 305610 LM 104911 A LM 104912	58 62 62	56 55 55	73 75 75	77 78 78	3.5 0	.5 15.7 .8 17.8 .3 15.7	0.36 0.31 0.31	2.0	1.1	0.239 0.303 0.301	0.156
	85.000 85.725 88.900	17.462 19.050 20.638	17.462 18.263 22.225	13.495 12.700 16.513	3.5 1.5 3.5	1.5 1.5 1.3	48 500 42 500 73 000	63 000 54 000 85 000	4 300 4 000 4 000	5 600 5 300 5 600	18790 18200 368 A	18720 18337 362 A	62 59 62	56 56 56	77 76 81	80 81 84	1.5 1	.5 16.7 .5 21.0 .3 16.6	0.41 0.57 0.32	1.5 1.1 1.9			0.136
	88.900 92.075 93.264	20.638 24.608 30.162	22.225 25.400 30.302	16.513 19.845 23.812	1.5 3.5 0.8	1.3 0.8 0.8	73 000 84 500 103 000	85 000 117 000 136 000	4 000 4 000 3 800	5 600 5 300 5 300	368 28580 3775	362 A 28521 3730	58 63 58	56 57 58	81 83 84	84 87 88	1.5 1 3.5 0 0.8 0			1.9 1.6 1.8	0.87		0.247
	93.264 95.250 101.600	30.162 27.783 31.750	30.302 28.575 31.750	23.812 22.225 25.400	3.5 3.5 3.5	0.8 2.3 3.3	103 000 110 000 118 000	136 000 144 000 150 000	3 800 3 800 3 600	5 300 5 300 5 000	3780 33889 49585	3730 33821 49520	64 64 66	58 58 59	84 85 88	88 90 96	3.5 2	.8 22.4 .3 19.8 .3 23.4			1.0	0.564 0.601 0.744	0.267
	101.600 101.600 104.775	34.925 34.925 36.512	36.068 36.068 36.512	26.988 26.988 28.575	0.8 3.5 3.5	3.3 3.3 0.8	137 000 137 000 139 000	169 000 169 000 192 000	3 800 3 800 3 400	5 000 5 000 4 800	529 529 X HM 807046	522 522 HM 807011	59 65 70	58 58 63	89 89 91	95 95 100	3.5 3	.3 22.1 .3 22.1 .8 29.7	0.29 0.29 0.49	2.1	1.2 1.2 0.68	0.822 0.819 0.992	0.416
	104.775 108.966 111.125	36.512 34.925 30.162	36.512 36.512 26.909	28.575 26.988 20.638	3.5 3.5 3.5	3.3 3.3 3.3	139 000 145 000 113 000	192 000 181 000 152 000	3 400 3 600 3 000	4 800 4 800 4 300	HM 807046 59200 55200 C	HM 807010 59429 55437	70 68 71	63 61 65	89 93 92	100 101 105	3.5 3	.3 29.7 .3 25.4 .3 37.6	0.49 0.40 0.88		0.82	0.993 0.943 0.845	0.594
	111.125 123.825 123.825	30.162 36.512 36.512	26.909 32.791 32.791	20.638 25.400 25.400	3.5 3.5 3.5	3.3 3.3 3.3	92 500 162 000 143 000	110 000 199 000 160 000	3 200 2 800 3 000	4 300 4 000 4 000	55200 72200 C 72200	55437 72487 72487	71 77 74	64 67 66	92 102 102	105 116 116	3.5 3	.3 37.3 .3 38.0 .3 37.0		0.81	0.45		0.514 0.79 0.79
	127.000 127.000	44.450 50.800	44.450 52.388	34.925 41.275	3.5 3.5	3.3 3.3	199 000 236 000	258 000 300 000	3 000 3 200	4 000 4 300	65200 6279	65500 6220	75 71	69 65	107 108	119 117		.3 35.0 .3 30.7	0.49 0.30		0.68 1.1		1.03 1.22
52.388	92.075 100.000 111.125	24.608 25.000 30.162	25.400 22.225 26.909	19.845 21.824 20.638	3.5 2.3 3.5	0.8 2.0 3.3	84 500 77 000 92 500	117 000 93 000 110 000	4 000 3 800 3 200	5 300 5 300 4 300	28584 377 55206	28521 372 55437	65 62 72	58 58 64	83 86 92	87 90 105	3.5 0 2.3 2 3.5 3		0.38 0.34 0.88		0.97	0.435 0.392 0.737	0.435
											Notes * T	he maximum hore dia	motor ic	licted or	d ito tole	aranaa i	c nogativo	(Coo Tabl	07/1/	n Dago	A126\		

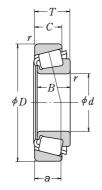
- * The maximum bore diameter is listed and its tolerance is negative (See Table 7.4.1 on Page A136).
- The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.

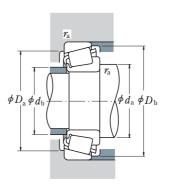




C 224 C 225

Bore Diameter 53.975 – 58.738 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	<i>Y</i> ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are

given in the table below.

		Boundary [(m					Basic Load	Ü	Limiting (Bearing N	lumbers	A	Abutmen	t and Fille (mm			Cen			Load tors		ass kg)
d	D	T	В	С	Cone C r min.	Sup	$C_{\rm r}$	C_{0r}	Grease	Oil	CONE	CUP	d_{a}	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{\scriptscriptstyle \mathrm{b}}$	Cone C $\gamma_{\rm a}$ max.	up (m		Y_1	Y_0	app CONE	prox. CUP
53.975	104.775 107.950 122.238	39.688 36.512 33.338	40.157 36.957 31.750	33.338 28.575 23.812	3.5 3	3.3 3.3 3.3	148 000 144 000 135 000	207 000 182 000 156 000	3 600 3 600 3 000	4 800 4 800 4 000	4595 539 66584	4535 532 X 66520	70 68 75	63 61 68	90 94 105	99 100 116	3.5	3.3 27 3.3 24 3.3 34	3 0.30	2.0	1.1	0.989 0.88 1.2	0.589 0.57 0.558
	123.825 123.825 123.825	36.512 36.512 38.100	32.791 32.791 36.678	25.400 25.400 30.162	3.5 3	3.3 3.3 3.3	143 000 162 000 161 000	160 000 199 000 221 000	3 000 2 800 3 000	4 000 4 000 4 000	72212 72212 C 557 S	72487 72487 552 A	77 79 71	66 67 65	102 102 109	116 116 116	3.5	3.3 37 3.3 38 3.3 28	0 0.74	0.81	0.45 0.45 0.95	1.16 1.27 1.49	0.79 0.79 0.764
	127.000 127.000 130.175	44.450 50.800 36.512	44.450 52.388 33.338	34.925 41.275 23.812	3.5 3	3.3 3.3 3.3	236 000	258 000 300 000 154 000	3 000 3 200 2 600	4 000 4 300 3 600	65212 6280 HM911242	65500 6220 HM911210	77 74 79	71 67 74	107 108 109	119 117 124	3.5	3.3 35 3.3 30 3.3 42	7 0.30	2.0	0.68 1.1 0.40	1.76 1.97 1.45	1.03 1.22 0.725
55.000	90.000 95.000 96.838	23.000 29.000 21.000	23.000 29.000 21.946	18.500 23.500 15.875	1.5 2).5 2.5).8	111 000	111 000 152 000 100 000	3 800 3 800 3 600	5 300 5 000 5 000	▲ JLM506849 ▲ JM207049 385	▲ JLM506810 ▲ JM207010 382 A	63 64 65	61 62 61	82 85 89	86 91 92		0.5 19 2.5 21 0.8 17	3 0.33	1.8	0.82 0.99 0.93	0.378 0.59 0.455	0.26
	110.000 115.000	39.000 41.021	39.000 41.275	32.000 31.496		2.5		225 000 214 000	3 400 3 200	4 500 4 500	▲ JH307749 622 X	▲ JH307710 614 X	71 70	64 64	97 101	104 108		2.5 27 3 26		1.7 1.9	0.95 1.1	1.13 1.3	0.567 0.597
55.562	97.630 122.238 123.825 123.825	24.608 43.658 36.512 36.512	24.608 43.764 32.791 32.791	19.446 36.512 25.400 25.400	1.3 3 3.5 3).8 3.3 3.3 3.3	143 000	129 000 292 000 160 000 199 000	3 600 3 000 3 000 2 800	5 000 4 000 4 000 4 000	28680 5566 72218 72218 C	28622 5535 72487 72487	68 70 78 80	62 68 66 67	88 106 102 102	92 116 116 116	1.3 3 3.5 3	0.8 21 3.3 29 3.3 37 3.3 38	9 0.36 0 0.74	1.7	0.82 0.92 0.45 0.45	1.76 1.12	0.27 0.815 0.79 0.79
57.150	96.838 96.838 96.838	21.000 21.000 25.400	21.946 21.946 21.946	15.875 15.875 20.275	2.3 0).8).8).3	80 500 80 500 80 500	100 000 100 000 100 000	3 600 3 600 3 600	5 000 5 000 5 000	387 A 387 387 A	382 A 382 A 382 S	69 66 69	62 62 62	89 89 87	92 92 91		0.8 17 0.8 17 2.3 22	6 0.35	1.7	0.93	0.423	0.179 0.179 0.249
	98.425 104.775 104.775	21.000 30.162 30.162	21.946 29.317 29.317	17.826 24.605 24.605	3.5 3).8 3.3 3.3	116 000	100 000 149 000 149 000	3 600 3 400 3 400	5 000 4 800 4 800	387 A 469 462	382 453 X 453 X	69 70 67	62 63 63	90 92 92	92 98 98	3.5	0.8 17 3.3 23 3.3 23	1 0.34	1.8	0.98	0.42 0.692 0.694	
	104.775 104.775 122.238	30.162 30.162 33.338	30.958 30.958 31.750	23.812 23.812 23.812	0.8 0	3.3).8 3.3	130 000 130 000 135 000	170 000 170 000 156 000	3 400 3 400 3 000	4 800 4 800 4 000	45289 45289 66587	45220 45221 66520	65 65 77	65 65 71	93 95 105	99 99 116	0.8	3.3 21 0.8 21 3.3 34	9 0.33	1.8			0.347 0.35 0.558
	123.825 123.825 140.030	36.512 38.100 36.512	32.791 36.678 33.236	25.400 30.162 23.520	3.5 3	3.3 3.3 2.3		199 000 221 000 183 000	2 800 3 000 2 600	4 000 4 000 3 600	72225 C 555 S 78225	72487 552 A 78551	81 83 83	67 68 77	102 109 117	116 116 132	3.5	3.3 38 3.3 28 2.3 44	8 0.35		0.45 0.95 0.38	1.19 1.41 1.67	0.79 0.764 0.926
	144.983 149.225	36.000 53.975	33.236 54.229	23.007 44.450		3.5 3.3		183 000 410 000	2 600 2 600	3 600 3 400	78225 6455	78571 6420	83 81	77 75	118 129	132 140	3.5 3 3.5 3	3.5 43 3.3 39			0.38 0.91	1.68 3.49	1.08 1.63
57.531 58.738	96.838 112.712	21.000 33.338	21.946 30.048	15.875 26.988).8 3.3	80 500 120 000	100 000 173 000	3 600 3 200	5 000 4 300	388 A 3981	382 A 3926	69 73	63 67	89 98	92 106	3.5 (3.5 3	0.8 17 3.3 28		1.7 1.5		0.416 0.899	

▲ The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.

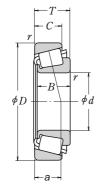


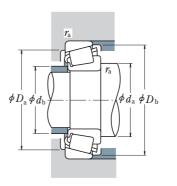


C 226 C 227

Bore Diameter 60.000 - 64.963 mm

■ SINGLE-ROW TAPERED ROLLER BEARINGS (INCH DESIGN)





Dynamic Equivalent Load

P = X	$F_{\rm r} + YF_{\rm a}$	
$F_{\rm a}/I$	$T_{r} \leq e$	$F_{\rm a}/F_{\rm r}$
v	17	v

0 Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ 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.

0.4

Color Colo			Boundary D					Basic Loa	d Ratings	Limiting S		Bearing	Numbers	Д	butmen	t and Fill (mm		nsions	Eff. Lo	ad Constant rs		Load		ass (g)
104.775	d	D	T	В	С	1	r		-	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{ exttt{b}}$	$\boldsymbol{r}_{\mathrm{a}}$			Y_1	Y_0	арр	orox.
101800 25.400 25.400 25.400 25.400 25.400 3.400 3.400 4.000 4.000 5.58 5.53 73 67 69 108 115 2.3 3.3 3.2 2.8 0.35 1.7 0.95 1.33 0.692 1.2 2.238 3.8 3.00 3.8 3.5 3.2 3.2 3.5 3.3 0.692 1.8 3.0 6.9 3.0 4.000 4.0	60.000	104.775 110.000	21.433 22.000	22.000 21.996	15.875 18.824	2.3 0.8	2.0 1.3	83 500 85 500	107 000 113 000	3 400 3 200	4 500 4 300	* 39236 397	39412 394 A	71 69	67 68	96 101	100 104	2.3 2 0.8 1	3 20.	0.39	1.5 1.5	0.85 0.82	0.559 0.642	0.186 0.263
122,238 43,688 43,764 36,512 3.5 3.3 19900 292,000 3 000 4 000 6537 6530 6537 6530 82 71 107 119 3.5 3.3 299 0.36 1.7 0.92 1.61 0.815 0.315 0.94 1.75 1.	60.325	101.600	25.400	25.400	19.845	3.5	3.3	91 000	135 000	3 400	4 800	28985	28920	73	67	90	97	3.5 3	3 22.	0.43	1.4	0.78	0.538	0.272
61.912 136.755 53.975 56.007 44.450 3.5 3.3 264.000 355.000 2 800 3 800 6376 6320 81 74 117 126 3.5 3.3 3.3 3.0 0.32 1.8 1.0 2.45 1.39 61.912 136.525 46.038 36.512 3.5 3.3 193.000 225.000 2 400 3 400 H913342 H913810 80 82 124 138 3.5 3.3 44.4 0.78 0.77 0.42 2.2 0.898 1.52 40.000 4.600		122.238	43.658	43.764	36.512	0.8	3.3	198 000	292 000	3 000	4 000	5582	5535	73	72	106	116	0.8 3	3 29.	0.36	1.7	0.92	1.61	0.815
146,050																								
104.775	61.912	146.050	41.275	39.688	25.400	3.5	3.3	193 000	225 000	2 400	3 400	H 913842	H 913810	90	82	124	138	3.5	3 44.	0.78	0.77	0.42	2.2	0.898
110.000 22.000 21.996 18.824 1.5 1.3 85.500 113.000 3 200 4 300 3982 3920 77 71 90 104 1.5 1.3 20.9 0.40 1.5 0.82 0.583 0.263 112.712 30.162 30.162 30.162 23.812 3.5 3.3 142.000 173.000 3 200 4 300 3982 3920 77 71 90 106 3.5 3.2 25.5 0.40 1.5 0.82 0.583 0.263 112.712 33.338 30.048 26.988 3.5 3.3 120.000 173.000 3 200 4 300 3985 39520 77 71 101 107 3.5 3.2 25.5 0.40 34 1.8 0.97 0.899 0.355 112.712 33.338 30.048 26.988 3.5 3.3 120.000 173.000 3 200 4 300 3982 3982 3982 78 71 10 107 3.5 3.2 3.2 3.2 3.2 3.2 3.2 3.2 3.2 3.2 3.2	63.500	104.775	21.433	22.000	15.875	2.0	2.0	83 500	107 000	3 400	4 500	39250	39412	73	69	96	100	2 2	20.	0.39	1.5	0.85	0.501	0.186
112.712 33.338 30.048 26.988 3.5 3.3 120 000 173 000 3 200 4 300 4 000		110.000	22.000	21.996	18.824	1.5	1.3	85 500	113 000	3 200	4 300	390 A	394 A	73	70	101	104	1.5 1	3 20.	0.40	1.5	0.82	0.583	0.263
122.238		112.712	33.338	30.048	26.988	3.5	3.3	120 000	173 000	3 200	4 300	3982	3926	78	71	98	106	3.5 3	3 28.	0.40	1.5	0.82	0.789	0.541
127.000 36.512 36.170 28.575 3.5 3.3 166 000 234 000 2800 3800 565 639 633 81 74 116 120 3.5 3.3 28.3 0.36 1.6 0.91 1.46 0.655 130.175 41.275 41.275 31.750 3.5 3.3 195 000 263 000 2800 3800 639 633 81 74 116 124 3.5 3.3 29.9 0.36 1.7 0.91 1.77 0.712 136.525 41.275 41.275 31.750 3.5 3.3 152 000 183 000 2 600 3 600 78250 78537 85 79 115 130 2.3 3.3 44.2 0.87 0.69 0.38 1.51 0.782 140.030 36.512 33.236 23.520 2.3 2.3 180 00 2 600 3 600 78250 78551 85 79 117 132 2.3 2.3 44.2 0.87 0.69 0.38 1.51 0.926 <th></th> <th>122.238</th> <th>38.100</th> <th>38.354</th> <th>29.718</th> <th>3.5</th> <th>1.5</th> <th>188 000</th> <th>245 000</th> <th>3 000</th> <th>4 000</th> <th>HM 212046</th> <th>HM 212010</th> <th>80</th> <th>73</th> <th>110</th> <th>116</th> <th>3.5 1</th> <th>5 26.</th> <th>0.34</th> <th>1.8</th> <th>0.98</th> <th>1.35</th> <th>0.604</th>		122.238	38.100	38.354	29.718	3.5	1.5	188 000	245 000	3 000	4 000	HM 212046	HM 212010	80	73	110	116	3.5 1	5 26.	0.34	1.8	0.98	1.35	0.604
136.525 41.275 41.275 31.750 3.5 3.3 195 000 263 000 2 800 3 800 639 78250 79 76 119 125 3.5 3.3 29.9 0.36 1.7 0.91 1.77 1.04 140.030 36.512 33.236 23.520 2.3 2.3 2.3 2.3 2.3 2.3 2.4 0.87 0.69 0.38 1.51 0.926		127.000	36.512	36.170	28.575	3.5	3.3	166 000	234 000	2 800	3 800	565	563	80	73	112	120	3.5 3	3 28.	0.36	1.6	0.91	1.46	0.655
64.963 127.000 36.512 36.170 28.575 3.5 3.3 166 000 234 000 2 800 3 800 569 563 81 74 112 120 3.5 3.3 28.3 0.36 1.6 0.91 1.41 0.655		136.525	41.275	41.275	31.750	3.5	3.3	195 000	263 000	2 800	3 800	639	632	79	76	119	125	3.5 3	3 29.	0.36	1.7	0.91	1.77	1.04
Nate: * The maximum hard diameter is listed and its telerance is negative (See Table 7.4.1 on Page A126)	64.963	127.000	36.512	36.170	28.575	3.5	3.3	166 000	234 000	2 800	3 800												1.41	0.655

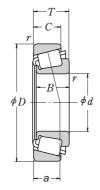
- * The maximum bore diameter is listed and its tolerance is negative (See Table 7.4.1 on Page A136).
- ▲ The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.

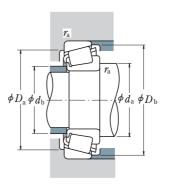




C 228 C 229

Bore Diameter 65.000 - 69.850 mm





Dynamic Equivalent Load

	P = X	$F_{\rm r} + YF_{\rm a}$		
_	$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	7;>
	X	Y	X	

0 Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$ When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

0.4

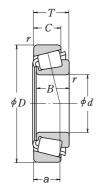
		Boundary [ad Ratings	Limiting S		Bearing N	lumbers	A	Abutmen	t and Fill (mm			Centers	Constant		l Load ctors		Mass (kg)
d	D	T	B	С		e Cup r min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	d_{a}	$d_{\scriptscriptstyle m b}$	$D_{\rm a}$	$D_{ m b}$	Cone (a	e	Y_1	Y_0		pprox. CUP
65.000	105.000 110.000 120.000 120.000	24.000 28.000 29.002 39.000	23.000 28.000 29.007 38.500	18.500 22.500 23.444 32.000	3.0 3.0 2.3 3.0	2.5	93 000 120 000 123 000 185 000	126 000 173 000 169 000 249 000	3 400 3 200 3 000 3 000	4 500 4 300 4 000 4 000	▲ JLM 710949 ▲ JM 511946 478 ▲ JH 211749	▲ JLM 710910 ▲ JM 511910 472 A ▲ JH 211710	77 78 77 80	71 72 73 74	96 99 106 107	101 105 114 114	2.3	1 23.7 2.5 24.5 3.3 24.3 2.5 27.9	0.45 0.40 0.38 0.34	1.3 1.5 1.6 1.8	0.73 0.82 0.86 0.98	0.72	0.237 0.342 0.466 0.625
65.088	135.755 136.525	53.975 46.038	56.007 46.038	44.450 36.512	3.5 3.5	3.3 3.3	264 000 233 000	355 000 370 000	2 800 2 600	3 800 3 400	6379 H 715340	6320 H 715311	84 88	77 82	117 118	126 132		3.3 35.0 3.3 37.1	0.32 0.47	1.8 1.3	1.0 0.70	2.25 2.4	1.39 0.961
66.675	110.000 110.000 112.712	22.000 22.000 30.162	21.996 21.996 30.048	18.824 18.824 23.812	0.8 3.5 3.5	1.3 1.3 3.2	85 500 85 500 120 000		3 200 3 200 3 200	4 300 4 300 4 300	395 A 395 S 3984	394 A 394 A 3920	73 79 80	73 73 74	101 101 99	104 104 106	3.5	1.3 20.9 1.3 20.9 3.2 25.5	0.40 0.40 0.40	1.5 1.5 1.5	0.82		0.263 0.263 0.454
	112.712 112.712 112.712	30.162 30.162 30.162	30.048 30.162 30.162	23.812 23.812 23.812	5.5 3.5 3.5		120 000 142 000 142 000	173 000 202 000 202 000	3 200 3 200 3 200	4 300 4 300 4 300	3994 39590 39590	3920 39521 39520	84 80 80	74 74 74	99 103 101	106 107 107	3.5	3.2 25.5 0.8 23.5 3.3 23.5	0.40 0.34 0.34	1.5 1.8 1.8	0.82 0.97 0.97	0.706 0.822 0.822	
	117.475 122.238 122.238	30.162 38.100 38.100	30.162 36.678 38.354	23.812 30.162 29.718	3.5 3.5 3.5		119 000 161 000 188 000	179 000 221 000 245 000	3 000 3 000 3 000	4 000 4 000 4 000	33262 560 HM 212049	33462 553 X HM 212010	81 81 82	75 75 75	104 108 110	112 115 116	3.5	3.3 26.8 3.3 28.8 1.5 26.9	0.44 0.35 0.34	1.4 1.7 1.8	0.76 0.95 0.98	0.911 1.14 1.25	0.442 0.692 0.604
	122.238 123.825 136.525	38.100 38.100 46.038	38.354 36.678 46.038	29.718 30.162 36.512	3.5 3.5 3.5	3.3 3.3 3.3	188 000 161 000 233 000		3 000 3 000 2 600	4 000 4 000 3 400	HM 212049 560 H 715341	HM 212011 552 A H 715311	81 81 89	74 75 83	108 109 118	116 116 132	3.5	3.3 26.9 3.3 28.8 3.3 37.1	0.34 0.35 0.47	1.8 1.7 1.3	0.98 0.95 0.70	1.25 1.14 2.34	0.598 0.764 0.961
68.262	110.000 120.000 122.238	22.000 29.795 38.100	21.996 29.007 36.678	18.824 24.237 30.162	2.3 3.5 3.5	1.3 2.0 3.3	85 500 123 000 161 000	113 000 169 000 221 000	3 200 3 000 3 000	4 300 4 000 4 000	399 A 480 560 S	394 A 472 553 X	78 83 83	74 76 76	101 106 108	104 113 115	3.5	1.3 20.9 2 25.1 3.3 28.8	0.40 0.38 0.35	1.5 1.6 1.7	0.82 0.86 0.95	0.497 0.862 1.09	
	127.000 136.525 136.525 152.400	36.512 41.275 46.038 47.625	36.170 41.275 46.038 46.038	28.575 31.750 36.512 31.750	3.5 3.5 3.5 3.5	3.3	166 000 229 000 233 000 237 000		2 800 2 600 2 600 2 400	3 800 3 600 3 400 3 400	570 H 414245 H 715343 9185	563 H 414210 H 715311 9121	83 86 90 94	77 82 84 81	112 121 118 130	120 129 132 145	3.5 3.5	3.3 28.3 3.3 30.6 3.3 37.1 3.3 44.3	0.36 0.36 0.47 0.66	1.6 1.7 1.3 0.92	0.91 0.92 0.70 0.50	1.32 1.95 2.28 2.53	0.655 0.796 0.961 1.21
69.850	112.712 112.712 117.475	22.225 25.400 30.162	21.996 25.400 30.162	15.875 19.050 23.812	1.5 1.5 3.5		85 000 96 000 119 000	113 000 152 000 179 000	3 000 2 800 3 000	4 000 4 000 4 000	LM 613449 29675 33275	LM 613410 29620 33462	78 80 84	76 77 77	104 101 104	107 109 112	1.5	0.8 22.1 3.3 26.3 3.3 26.8	0.42 0.49 0.44	1.4 1.2 1.4	0.68	0.562 0.695 0.83	
	120.000 120.650 127.000	32.545 25.400 36.512	32.545 25.400 36.170	26.195 19.050 28.575	3.5 1.5 3.5	3.3 3.3 0.8	152 000 96 000 166 000	225 000 152 000 234 000	3 000 2 800 2 800	4 000 4 000 3 800	47487 29675 566	47420 29630 563 X	84 79 85	78 78 78	107 105 114	114 113 120	1.5	3.3 26.0 3.3 26.3 0.8 28.3	0.36 0.49 0.36	1.7 1.2 1.6	0.92 0.68 0.91	1.02 0.695 1.27	0.477 0.489 0.658
	130.175 146.050 146.050	41.275 41.275 41.275	41.275 39.688 41.275	31.750 25.400 31.750	3.5 3.5 3.5		195 000 193 000 207 000		2 800 2 400 2 400	3 800 3 400 3 200	643 H 913849 655	633 H 913810 653	86 95 88	80 82 82	116 124 131	124 138 139	3.5	3.3 29.9 3.3 44.4 3.3 33.2	0.36 0.78 0.41	1.7 0.77 1.5	0.91 0.42 0.81	1.56 1.95 2.35	0.712 0.898 0.891
	149.225 150.089	53.975 44.450	54.229 46.672	44.450 36.512	5.0 3.5	3.3 3.3	287 000 265 000	410 000 370 000	2 600 2 400	3 400 3 200	6454 745 A	6420 742	94 88	85 82	129 134	140 142		3.3 39.0 3.3 32.5	0.36 0.33	1.7 1.8	0.91 1.0	2.95 2.82	1.63 1.07

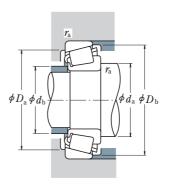
▲ The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.





Bore Diameter 70.000 - 76.200 mm





Dynamic Equivalent Load

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	Y_1

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_{\rm r}$ > 0.5 $F_{\rm r}$ + $Y_0F_{\rm a}$, use P_0 = $F_{\rm r}$ The values of e, Y_1 , and Y_0 are

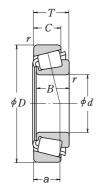
given in the table below.

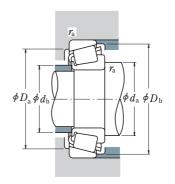
		Boundary D			0	0		d Ratings	Limiting (Bearing N	umbers	Д	Abutmen	nent and Fillet Dimensions (mm) Cone			Cente			Load tors		ass (g)
<i>d</i>	D	T	В	С	Cone Y min.	Cup	C_{r}	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	$D_{\scriptscriptstyle m a}$	$D_{ ext{b}}$	Cone C $r_{\rm a}$ max.	i a	e e	Y_1	Y_0	app CONE	orox. CUP
70.000	110.000 115.000 120.000	26.000 29.000 29.795	25.000 29.000 29.007	20.500 23.000 24.237	3.0	2.5 2.5 2.0	98 500 126 000 123 000	152 000 177 000 169 000	3 000 3 000 3 000	4 000 4 000 4 000	▲ JLM 813049 ▲ JM 612949 484	▲ JLM 813010 ▲ JM 612910 472	78 83 80	77 77 78	98 103 106	105 110 113	3	2.5 26.4 2.5 26.4 2 25.		1.4	0.68 0.77 0.86	0.604 0.800 0.822	0.362
71.438	117.475 120.000 127.000	30.162 32.545 36.512	30.162 32.545 36.170	23.812 26.195 28.575	3.5	3.3 3.3 3.3	119 000 152 000 166 000	179 000 225 000 234 000	3 000 3 000 2 800	4 000 4 000 3 800	33281 47490 567 S	33462 47420 563	85 86 92	79 79 80	104 107 112	112 114 120	3.5	3.3 26.3 3.3 26.3 3.3 28.3	0.36	1.4 1.7 1.6	0.76 0.92 0.91		
	127.000 130.175 136.525	36.512 41.275 41.275	36.170 41.275 41.275	28.575 31.750 31.750	6.4	3.3 3.3 3.3	166 000 195 000 195 000	234 000 263 000 263 000	2 800 2 800 2 800	3 800 3 800 3 800	567 A 645 644	563 633 632	86 93 87	80 81 81	112 116 118	120 124 125	6.4	3.3 28.3 3.3 29.3 3.3 29.3	0.36	1.6 1.7 1.7	0.91 0.91 0.91	1.23 1.49 1.5	0.655 0.712 1.04
	136.525 136.525	41.275 46.038	41.275 46.038	31.750 36.512		3.3 3.3	229 000 233 000	297 000 370 000	2 600 2 600	3 600 3 400	H 414249 H 715345	H 414210 H 715311	89 92	83 84	121 119	129 132		3.3 30.0 3.3 37.	0.36 0.47	1.7 1.3	0.92 0.70		0.796 0.961
73.025	112.712 117.475 127.000	25.400 30.162 36.512	25.400 30.162 36.170	19.050 23.812 28.575	3.5	3.3 3.3 3.3	96 000 119 000 166 000	152 000 179 000 234 000	2 800 3 000 2 800	4 000 4 000 3 800	29685 33287 567	29620 33462 563	86 87 88	80 80 81	101 104 112	109 112 120	3.5	3.3 26.3 3.3 26.3 3.3 28.3	0.44	1.2 1.4 1.6		0.746	0.273 0.442 0.655
	146.050 149.225	41.275 53.975	41.275 54.229	31.750 44.450		3.3 3.3	207 000 287 000	296 000 410 000	2 400 2 600	3 200 3 400	657 6460	653 6420	91 93	85 87	131 129	139 140		3.3 33.3 3.3 39.0		1.5 1.7	0.81 0.91	2.24 2.8	0.891 1.63
73.817 74.612	127.000 150.000	36.512 41.275	36.170 41.275	28.575 31.750		3.3 3.0	166 000 207 000	234 000 296 000	2 800 2 400	3 800 3 200	568 658	563 653 X	83 92	82 86	112 133	120 141		3.3 28.3 3 33.3		1.6 1.5	0.91 0.81		0.655 0.932
75.000	115.000 120.000 145.000	25.000 31.000 51.000	25.000 29.500 51.000	19.000 25.000 42.000	3.0	2.5 2.5 2.5	101 000 129 000 283 000	150 000 198 000 410 000	3 000 2 800 2 600	4 000 3 800 3 400	▲ JLM 714149 ▲ JM 714249 ▲ JH 415647	▲ JLM 714110 ▲ JM 714210 ▲ JH 415610	87 88 94	81 83 89	104 108 129	110 115 139	3	2.5 25.3 2.5 28.3 2.5 36.	0.44	1.3 1.4 1.7	0.72 0.74 0.91	0.863	
76.200	121.442 127.000 127.000	24.608 30.162 30.162	23.012 31.000 31.001	17.462 22.225 22.225	3.5	2.0 3.3 3.3	89 000 134 000 134 000	124 000 195 000 195 000	2 800 2 800 2 800	3 800 3 800 3 800	34300 42687 42688	34478 42620 42620	86 90 94	84 84 84	111 114 114	116 121 121		2 26.3 3.3 27.3 3.3 27.3	0.42	1.3 1.4 1.4	0.79	1.03	0.316 0.438 0.438
	133.350 135.733 136.525	33.338 44.450 30.162	33.338 46.101 29.769	26.195 34.925 22.225	3.5	3.3 3.3 3.3	154 000 216 000 130 000	237 000 340 000 192 000	2 600 2 600 2 600	3 600 3 600 3 400	47680 5760 495 A	47620 5735 493	86 94 92	85 88 86	119 119 122	128 130 130	3.5	3.3 29.0 3.3 32.3 3.3 28.	0.41	1.5 1.5 1.4	0.82 0.81 0.74		0.577 0.887 0.55
	136.525 139.992 149.225	30.162 36.512 53.975	29.769 36.098 54.229	22.225 28.575 44.450	3.5	3.3 3.3 3.3	130 000 175 000 271 000	192 000 260 000 385 000	2 600 2 600 2 600	3 400 3 400 3 400	495 AX 575 6461	493 572 6420	98 92 96	86 86 89	122 125 129	130 133 140	3.5	3.3 28. 3.3 31. 3.3 39.	0.40	1.4 1.5 1.7	0.74 0.82 0.91		0.55 0.788 1.67
	152.400 152.400 161.925	39.688 41.275 49.212	36.322 41.275 46.038	30.162 31.750 31.750	3.5	3.2 3.3 3.3	183 000 207 000 248 000	285 000 296 000 290 000	2 200 2 400 2 200	3 200 3 200 3 000	590 A 659 9285	592 A 652 9220	95 93 103	89 87 90	135 134 138	145 141 153	3.5 3.5	3.2 37. 3.3 33.3 3.3 49.8	0.44	1.4 1.5 0.85	0.75 0.81 0.47	2.11	1.06 1.26 1.4
	161.925 161.925 161.925	53.975 53.975 53.975	55.100 55.100 55.100	42.862 42.862 42.862	6.4	3.3 3.3 0.8	325 000 325 000 325 000	480 000 480 000 480 000	2 200 2 200 2 200	3 000 3 000 3 000	6576 6575 6575	6535 6535 6536	99 104 104	92 92 92	141 141 144	154 154 154	6.4	3.3 40. 3.3 40. 0.8 40.	0.40	1.5	0.82 0.82 0.82	3.73	1.67 1.67 1.68





Bore Diameter 76.200 - 83.345 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	<i>Y</i> ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are

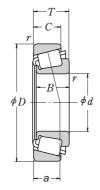
given in the table below.

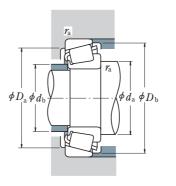
		Boundary [(m						d Ratings	Limiting (Bearing N	Numbers	А	butmen	t and Fille (mm			Eff. Load Centers	Constant		Load tors		Mass (kg)
d	D	T	В	С	Cone m	Cup r in.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle \mathrm{a}}$	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{\scriptscriptstyle m b}$	Cone Cup \mathcal{V}_a max.	(mm) a	e	Y_1	Y_0		oprox.
76.200	168.275 168.275 171.450 177.800	53.975 53.975 49.212 55.562	56.363 56.363 46.038 50.800	41.275 41.275 31.750 34.925	6.4 0.8 3.5 3.5	3.3 3.3 3.3 3.3	345 000 345 000 257 000 257 000	470 000 470 000 310 000 310 000	2 200 2 200 2 000 2 000	3 000 3 000 2 800 2 800	843 837 9380 9378	832 832 9321 9320	101 90 105 105	89 89 98 98	149 149 147 148	155 155 164 164	6.4 3.3 0.8 3.3 3.5 3.3 3.5 3.3	35.2	0.30 0.30 0.76 0.76	2.0 0.79	1.1 1.1 0.43 0.43		1.74 1.74 1.51 2.24
77.788	121.442 127.000 135.733	24.608 30.162 44.450	23.012 31.000 46.101	17.462 22.225 34.925	3.5 3.5 3.5	2.0 3.3 3.3	89 000 134 000 216 000	124 000 195 000 340 000	2 800 2 800 2 600	3 800 3 800 3 600	34306 42690 5795	34478 42620 5735	90 91 96	84 85 89	110 114 119	116 121 130	3.5 2 3.5 3.3 3.5 3.3	26.3 27.3 32.9	0.45 0.42 0.41	1.4			0.316 0.438 0.887
79.375	146.050 150.089	41.275 44.450	41.275 46.672	31.750 36.512	3.5 3.5	3.3 3.3	207 000 265 000	296 000 370 000	2 400 2 400	3 200 3 200	661 750	653 742	96 96	90 90	131 134	139 142	3.5 3.3 3.5 3.3		0.41 0.33	1.5 1.8	0.81 1.0	1.99 2.42	0.891 1.07
80.000	130.000	35.000	34.000	28.500	3.0	2.5	166 000	251 000	2 600	3 600	▲ JM 515649	▲ JM 515610	94	88	117	125	3 2.	29.9	0.39	1.5	0.85	1.18	0.583
80.962	136.525 139.700 139.992	30.162 36.512 36.512	29.769 36.098 36.098	22.225 28.575 28.575	3.5 3.5 3.5	3.3 3.3 3.3	130 000 175 000 175 000	192 000 260 000 260 000	2 600 2 600 2 600	3 400 3 400 3 400	496 581 581	493 572 X 572	95 96 96	89 90 90	122 125 125	130 133 133	3.5 3.3 3.5 3.3 3.5 3.3		0.44 0.40 0.40	1.5	0.74 0.82 0.82	1.13 1.44 1.44	0.55 0.774 0.788
82.550	125.412 133.350 133.350	25.400 30.162 33.338	25.400 29.769 33.338	19.845 22.225 26.195	3.5 3.5 3.5	1.5 3.3 3.3	102 000 130 000 154 000	164 000 192 000 237 000	2 600 2 600 2 600	3 600 3 400 3 600	27687 495 47686	27620 492 A 47620	96 97 97	89 90 90	115 120 119	120 128 128	3.5 1.5 3.5 3.5 3.5 3.5		0.42 0.44 0.40	1.4	0.79 0.74 0.82	0.747 1.08 1.18	0.348 0.434 0.577
	133.350 133.350 133.350	33.338 33.338 39.688	33.338 33.338 39.688	26.195 26.195 32.545	0.8 6.8 6.8	3.3 3.3 3.3	154 000 154 000 179 000	237 000 237 000 310 000	2 600 2 600 2 600	3 600 3 600 3 600	47685 47687 HM 516448	47620 47620 HM 516410	90 103 105	90 90 92	119 119 118	128 128 128	0.8 3.3 6.8 3.3 6.8 3.3		0.40 0.40 0.40	1.5	0.82 0.82 0.82	1.18 1.16 1.35	0.577 0.577 0.767
	136.525 139.700 139.992	30.162 36.512 36.512	29.769 36.098 36.098	22.225 28.575 28.575	3.5 3.5 3.5	3.3 3.3 3.3	130 000 175 000 175 000	192 000 260 000 260 000	2 600 2 600 2 600	3 400 3 400 3 400	495 580 580	493 572 X 572	97 98 98	90 91 91	122 125 125	130 133 133	3.5 3.3 3.5 3.3 3.5 3.3		0.44 0.40 0.40	1.5	0.74 0.82 0.82	1.08 1.39 1.39	0.55 0.774 0.788
	139.992 146.050 150.000	36.512 41.275 44.455	36.098 41.275 46.672	28.575 31.750 35.000	6.8 3.5 3.5	3.3 3.3 3.3	175 000 207 000 265 000	260 000 296 000 370 000	2 600 2 400 2 400	3 400 3 200 3 200	582 663 749 A	572 653 743	104 99 99	91 92 93	125 131 134	133 139 142	6.8 3.3 3.5 3.3 3.5 3.3		0.40 0.41 0.33	1.5	0.82 0.81 1.0	1.37 1.85 2.26	0.788 0.891 1.04
	150.089 152.400 161.925	44.450 41.275 47.625	46.672 41.275 48.260	36.512 31.750 38.100	3.5 3.5 3.5	3.3 3.3 3.3	265 000 207 000 274 000	370 000 296 000 390 000	2 400 2 400 2 200	3 200 3 200 3 000	749 A 663 757	742 652 752	98 99 100	93 92 94	135 134 144	143 141 150	3.5 3.3 3.5 3.3 3.5 3.3	33.2		1.8 1.5 1.8	1.0 0.81 0.97	2.26 1.85 2.79	1.07 1.26 1.61
	161.925 168.275 168.275	53.975 47.625 53.975	55.100 48.260 56.363	42.862 38.100 41.275	3.5 3.5 3.5	3.3 3.3 3.3	325 000 274 000 345 000	480 000 390 000 470 000	2 200 2 200 2 200	3 000 3 000 3 000	6559 757 842	6535 753 832	104 100 101	98 94 94	141 147 149	154 150 155	3.5 3.3 3.5 3.3 3.5 3.3		0.40 0.34 0.30	1.8	0.82 0.97 1.1	3.4 2.79 3.76	1.67 2.1 1.74
83.345	125.412 125.412	25.400 25.400	25.400 25.400	19.845 19.845	3.5 0.8	1.5 1.5	102 000 102 000	164 000 164 000	2 600 2 600	3 600 3 600	27690 27689	27620 27620	96 90	90 90	115 115	120 120	3.5 1.5 0.8 1.5		0.42 0.42				0.348



C 234 C 235

Bore Diameter 84.138 – 90.488 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	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 \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

		Boundary D						ad Ratings N)	Limiting (Bearing	Numbers	,	Abutmei	nt and Fil (mr			C	enters	Constant		Load tors		Mass (kg)
d	D	T	В	С	1	Cup Y in.	C_{r}	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	d_{a}	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{ m b}$	Cone \mathcal{V}_{a} max	.	nm) a	e	Y_1	Y_0		pprox. CUP
84.138	136.525 146.050 171.450	30.162 41.275 49.212	29.769 41.275 46.038	22.225 31.750 31.750	3.5 3.5 3.5	3.3 3.3 3.3	130 000 207 000 257 000	192 000 296 000 310 000	2 600 2 400 2 000	3 400 3 200 2 800	498 664 9385	493 653 9321	98 99 111	91 93 98	122 131 147	130 139 164	3.5	3.3	3.2	0.44 0.41 0.76	1.5	0.74 0.81 0.43	1.04 1.79 3.11	0.55 0.891 1.51
85.000	130.000 130.000 140.000 150.000	30.000 30.000 39.000 46.000	29.000 29.000 38.000 46.000	24.000 24.000 31.500 38.000	6.0 3.0 3.0 3.0	2.5 2.5 2.5 2.5	138 000 138 000 202 000 275 000	222 000 222 000 305 000 390 000	2 600 2 600 2 400 2 400	3 600 3 600 3 400 3 200	▲ JM 716648 ▲ JM 716649 ▲ JHM 516849 ▲ JH 217249	▲ JM 716610 ▲ JM 716610 ▲ JHM 516810 ▲ JH 217210	104 98 100 101	92 92 94 95	117 117 125 134	125 125 134 142	6 3 3 3	2.5 2	9.5	0.44 0.44 0.41 0.33	1.4 1.4 1.5 1.8	0.74 0.74 0.81 0.99	0.931 0.943 1.55 2.29	0.461 0.461 0.768 1.09
85.026	150.089 150.089	44.450 44.450	46.672 46.672	36.512 36.512	3.5 5.0	3.3 3.3	265 000 265 000	370 000 370 000	2 400 2 400	3 200 3 200	749 749 S	742 742	101 104	95 95	134 134	142 142	3.5 5			0.33 0.33	1.8 1.8	1.0 1.0	2.14 2.14	1.07 1.07
85.725	133.350 136.525 142.138	30.162 30.162 42.862	29.769 29.769 42.862	22.225 22.225 34.133	3.5 3.5 4.8	3.3 3.3 3.3	130 000 130 000 221 000	192 000 192 000 360 000	2 600 2 600 2 400	3 400 3 400 3 400	497 497 HM 617049	492 A 493 HM 617010	99 99 106	93 93 95	120 122 125	128 130 137	3.5	3.3 2	8.7	0.44 0.44 0.43	1.4 1.4 1.4	0.74 0.74 0.76		7 0.434 7 0.55 0.911
	146.050 146.050 152.400	41.275 41.275 39.688	41.275 41.275 36.322	31.750 31.750 30.162	6.4 3.5 3.5	3.3 3.3 3.2	207 000 207 000 183 000	296 000 296 000 285 000	2 400 2 400 2 200	3 200 3 200 3 200	665 A 665 596	653 653 592 A	107 102 102	95 95 96	131 131 135	139 139 144	3.5	3.3	3.2	0.41 0.41 0.44	1.5 1.5 1.4	0.81 0.81 0.75	1.71 1.72 1.85	0.891 0.891 1.06
	161.925 168.275	47.625 41.275	48.260 41.275	38.100 30.162	3.5 3.5	3.3 3.3	274 000 223 000	390 000 345 000	2 200 2 000	3 000 2 800	758 677	752 672	103 105	97 99	144 149	150 160				0.34 0.47	1.8 1.3	0.97 0.70	2.63 2.91	1.61 1.24
87.312	190.500	57.150	57.531	46.038	8.0	3.3	390 000	520 000	1 900	2 600	HH 221432	HH 221410	118	103	171	179	8	3.3	2.3	0.33	1.8	0.99	5.51	2.24
88.900	149.225 152.400 152.400	31.750 39.688 39.688	28.971 36.322 39.688	24.608 30.162 30.162	3.0 3.5 6.4	3.3 3.2 3.3	140 000 183 000 253 000	285 000	2 200 2 200 2 200	3 000 3 200 3 200	42350 593 HM 518445	42587 592 A HM 518410	104 104 107	98 98 96	134 135 137	143 144 148		3.2	37.1	0.49 0.44 0.40	1.2 1.4 1.5	0.67 0.75 0.82	1.39 1.73 2.11	0.711 1.06 0.776
	161.925 161.925 161.925	47.625 47.625 53.975	48.260 48.260 55.100	38.100 38.100 42.862	3.5 7.0 3.5	3.3 3.3 3.3	274 000 274 000 325 000	390 000	2 200 2 200 2 200	3 000 3 000	759 766 6580	752 752 6535	106 113 109	99 99 102	144 144 141	150 150 154	7	3.3	5.6	0.34 0.34 0.40	1.8 1.8 1.5	0.97 0.97 0.82		
	168.275 168.275	47.625 53.975	48.260 56.363	38.100 41.275	3.5 3.5	3.3 3.3	274 000 345 000		2 200 2 200	3 000 3 000	759 850	753 832	106 106	99 100	147 149	150 155				0.34 0.30	1.8 2.0	0.97 1.1	2.47 3.39	2.1 1.74
	190.500 190.500	57.150 57.150	57.531 57.531	44.450 46.038	8.0 8.0	3.3 3.3	355 000 390 000		1 900 1 900	2 600 2 600	855 HH 221434	854 HH 221410	118 120	103 105	170 171	174 179	8		1.8	0.33 0.33	1.8 1.8	0.99 0.99	4.99 5.41	2.55 2.24
90.000	145.000 147.000 155.000	35.000 40.000 44.000	34.000 40.000 44.000	27.000 32.500 35.500	3.0 7.0 3.0	2.5 3.5 2.5	190 000 229 000 274 000	345 000	2 400 2 400 2 200	3 200 3 200 3 000	▲ JM 718149 *HM 218248 ▲ JHM 318448	▲ JM 718110 **HM 218210 ▲ JHM 318410	105 111 106	99 98 100	131 133 140	139 141 148	3 7 3	3.5	80.8	0.44 0.33 0.34	1.4 1.8 1.7	0.74 0.99 0.96	1.49 1.77 2.32	0.66 0.796 1.01
90.488	161.925	47.625	48.260	38.100	3.5	3.3	274 000	390 000	2 200	3 000	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 C184 and C185.





C 236 C 237

Boundary Dimensions

(mm)

46.038

26.000

28.000

32.000

26.195

6.4 3.3

2.3 2.3

3.5 3.3

3.0 2.5

3.0 2.5

57.150

32.000

36.000

41.000

36.512

57.531

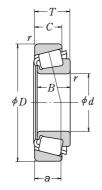
30.000

35.000

40.000

36.116

Bore Diameter 92.075 - 100.012 mm



Cone Cup

Basic Load Ratings

(N)

Limiting Speeds

(min⁻¹)

1 900

2 200

2 000

2 000

2 000

2 600

3 000

2 800

2 800

2 800

520 000

235 000

325 000

380 000

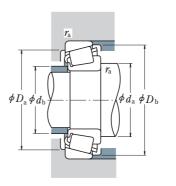
191 000 310 000

390 000

146 000

191 000

239 000



Bearing Numbers

HH 221447

▲ JLM 820048

▲ JM 720249

52393

▲ JHM 720249

Abutment and Fillet Dimensions

(mm)

Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	r > e
X	Y	X	Y
1	0	0.4	<i>Y</i> 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

Axial Load

Factors

Mass

(kg)

given in the table below.

Eff. Load Constant

42.3 0.33

36.8 0.50

36.8 0.47

38.2 0.47

3.5 3.3 36.1 0.47 1.3

1.8

1.2

1.3

1.3

0.99

0.66

0.70

0.70

0.69

4.68 2.24

1.27 0.616

1.68 0.772

2.09 0.974

1.81 0.702

Centers

(mm)

Cone Cup

	d	D	T	В	С	<i>1</i> mi	r oup in.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	$d_{ m a}$	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{ m b}$	$rac{\mathcal{T}_a}{\max}$	a	e	Y_1	Y_0	app CONE	
92.	14	46.050 48.430 52.400	33.338 28.575 39.688	34.925 28.971 36.322	26.195 21.433 30.162	3.5 3.5 3.5	3.3 3.0 3.2	169 000 140 000 183 000	280 000 218 000 285 000	2 400 2 200 2 200	3 200 3 000 3 200	47890 42362 598	47820 42584 592 A	107 107 107	101 101 101	131 134 135	140 142 144	3.5 3.3 3.5 3 3.5 3.2	32.3 31.8 37.1	0.45 0.49 0.44	1.3 1.2 1.4	0.74 0.67 0.75	1.29	0.664 0.553 1.06
	16	52.400 68.275 90.500	39.688 41.275 57.150	36.322 41.275 57.531	30.162 30.162 44.450	6.4 3.5 8.0	3.2 3.3 3.3	183 000 223 000 355 000	285 000 345 000 500 000	2 200 2 000 1 900	3 200 2 800 2 600	598 A 681 857	592 A 672 854	113 110 121	101 104 106	135 149 170	144 160 174	6.4 3.2 3.5 3.3 8 3.3		0.44 0.47 0.33	1.4 1.3 1.8			1.06 1.24 2.55
93.	14	48.430 49.225 52.400	28.575 31.750 39.688	28.971 28.971 36.322	21.433 24.608 30.162	3.0 3.0 3.5	3.0 3.3 3.2	140 000 140 000 183 000	218 000 218 000 285 000	2 200 2 200 2 200	3 000 3 000 3 200	42368 42368 597	42584 42587 592 A	107 107 109	102 102 102	134 134 135	142 143 144	3 3 3 3.3 3.5 3.2	34.9	0.49 0.49 0.44	1.2 1.2 1.4	0.67 0.67 0.75	1.24	0.553 0.711 1.06
95.	000 15	50.000	35.000	34.000	27.000	3.0	2.5	183 000	285 000	2 200	3 200	▲ JM 719149	▲ JM 719113	109	104	135	143	3 2.5	33.4	0.44	1.4	0.75	1.46	0.765
95.	14	46.050 48.430 49.225	33.338 28.575 31.750	34.925 28.971 28.971	26.195 21.433 24.608	3.5 3.0 3.5	3.3 3.0 3.3	169 000 140 000 140 000	280 000 218 000 218 000	2 400 2 200 2 200	3 200 3 000 3 000	47896 42375 42376	47820 42584 42587	110 108 109	103 103 103	131 134 134	140 142 143	3.5 3.3 3 3 3.5 3.3	32.3 31.8 34.9	0.45 0.49 0.49	1.3 1.2 1.2	0.74 0.67 0.67	1.18	0.664 0.553 0.711
	15	52.400 52.400 68.275	39.688 39.688 41.275	36.322 36.322 41.275	30.162 33.338 30.162	3.5 3.5 3.5	3.2 3.3 3.3	183 000 183 000 223 000	285 000 285 000 345 000	2 200 2 200 2 000	3 200 3 200 2 800	594 594 683	592 A 592 672	110 109 113	104 103 106	135 135 149	144 145 160	3.5 3.2 3.5 3.3 3.5 3.3	37.1 37.1 38.3	0.44 0.44 0.47	1.4 1.4 1.3	0.75 0.75 0.70	1.47	1.06 1.12 1.24
	18 19	71.450 80.975 90.500 90.500	47.625 47.625 57.150 57.150	48.260 48.006 57.531 57.531	38.100 38.100 44.450 46.038	3.5 3.5 8.0 8.0	3.3 3.3 3.3 3.3	282 000 258 000 355 000 390 000	415 000 375 000 500 000 520 000	2 000 2 000 1 900 1 900	2 800 2 600 2 600 2 600	77375 776 864 HH 221440	77675 772 854 HH 221410	117 114 123 125	105 107 108 110	152 161 170 171	159 168 174 179	3.5 3.3 3.5 3.3 8 3.3 8 3.3	37.8 39.1 41.8 42.3	0.37 0.39 0.33 0.33	1.6 1.6 1.8 1.8	0.86 0.99	3.25 4.57	1.67 1.99 2.55 2.24
96.		48.430 49.225	28.575 31.750	28.971 28.971	21.433 24.606	3.5 3.5	3.0 3.3	140 000 140 000	218 000 218 000	2 200 2 200	3 000 3 000	42381 42381	42584 42587	110 111	104 105	134 135	142 143	3.5 3 3.5 3.3	31.8 34.9	0.49 0.49	1.2 1.2	0.67 0.67		0.553 0.711
98.	16	61.925 68.275 80.975	36.512 41.275 47.625	36.116 41.275 48.006	26.195 30.162 38.100	3.5 3.5 3.5	3.3 3.3 3.3	191 000 223 000 258 000	310 000 345 000 375 000	2 000 2 000 2 000	2 800 2 800 2 600	52387 685 779	52637 672 772	114 116 116	108 109 110	144 149 161	154 160 168	3.5 3.3 3.5 3.3 3.5 3.3	38.3	0.47 0.47 0.39	1.3 1.3 1.6		2.32	0.942 1.24 1.99
		90.500 90.500	57.150 57.150	57.531 57.531	44.450 46.038	3.5 3.5	3.3 3.3	355 000 390 000	500 000 520 000	1 900 1 900	2 600 2 600	866 HH 221442	854 HH 221410	118 119	111 113	170 171	174 179	3.5 3.3 3.5 3.3	41.8 42.3		1.8 1.8	0.99 0.99		2.55 2.24

116 ▲ The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.

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6.4 3.3

2.3 2.3

3 2.5 2.5

HH 221410

52618

▲ JLM 820012

▲ JM 720210 ▲ JHM 720210





99.982

100.000

100.012

190.500

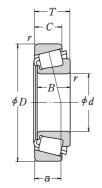
150.000

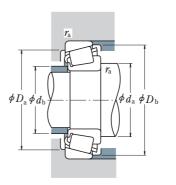
155.000

160.000

157.162

Bore Diameter 101.600 - 117.475 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	<i>Y</i> ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are

given in the table below.

			Dimensions m)					d Ratings	Limiting S		Bearing Numbers			Abutmei	nt and Fil mr			Cente	ad Constant		l Load ctors		lass kg)
d	D	T	B	С	Cone 1 mi	r ·	$C_{\rm r}$	C_{0r}	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{ m b}$	D_{a}	$D_{ m b}$	Cone Cu $\gamma_{ m a}$ max.	ip (mm a) e	Y_1	Y_0		prox. CUP
101.600	157.162 161.925 168.275	36.512 36.512 41.275	36.116 36.116 41.275	26.195 26.195 30.162	3.5 3.5 3.5	3.3 3.3 3.3	191 000 191 000 223 000	310 000 310 000 345 000	2 000 2 000 2 000	2 800 2 800 2 800	52400 52400 687	52618 52637 672	117 117 118	111 111 112	142 144 149	152 154 160	3.5 3 3.5 3 3.5 3		0.47	1.3 1.3 1.3	0.69 0.69 0.70	1.75 1.75 2.15	0.702 0.942 1.24
	180.975 190.500 190.500 212.725	47.625 57.150 57.150 66.675	48.006 57.531 57.531 66.675	38.100 44.450 46.038 53.975	3.5 8.0 8.0 7.0	3.3 3.3 3.3 3.3	258 000 355 000 390 000 570 000	375 000 500 000 520 000 810 000	2 000 1 900 1 900 1 700	2 600 2 600 2 600 2 200	780 861 HH 221449 HH 224335	772 854 HH 221410 HH 224310	119 129 131 132	113 114 116 121	161 170 171 192	168 174 179 202	8 3 8 3	.3 39. .3 41. .3 42. .3 47.	0.33	1.6 1.8 1.8 1.8	0.86 0.99 0.99 1.0		1.99 2.55 2.24 3.06
104.775	180.975 180.975 190.500	47.625 47.625 47.625	48.006 48.006 49.212	38.100 38.100 34.925	7.0 3.5 3.5	3.3 3.3 3.3	258 000 258 000 296 000	375 000 375 000 465 000	2 000 2 000 1 800	2 600 2 600 2 400	787 782 71412	772 772 71750	129 122 124	116 116 118	161 161 171	168 168 181	3.5 3	.3 39. .3 39. .3 40.		1.6 1.6 1.4	0.86 0.86 0.79	2.66 2.68 4.0	1.99 1.99 1.71
106.362	165.100	36.512	36.512	26.988	3.5	3.3	195 000	320 000	2 000	2 600	56418	56650	122	116	149	159	3.5 3	.3 38.	0.50	1.2	0.66	1.87	0.861
107.950	158.750 159.987 161.925	23.020 34.925 34.925	21.438 34.925 34.925	15.875 26.988 26.988	3.5 3.5 3.5	3.3 3.3 3.3	102 000 164 000 164 000	165 000 315 000 280 000	2 000 2 000 2 000	2 800 2 800 2 800	37425 LM 522546 48190	37625 LM 522510 48120	122 122 122	115 116 116	143 146 146	152 154 156	3.5 3	.3 37. .3 33. .3 38.	0.40	0.99 1.5 1.2	0.54 0.82 0.65	0.886 1.65 1.59	0.488 0.784 0.83
	165.100 190.500 212.725	36.512 47.625 66.675	36.512 49.212 66.675	26.988 34.925 53.975	3.5 3.5 8.0	3.3 3.3 3.3	195 000 296 000 570 000	320 000 465 000 810 000	2 000 1 800 1 700	2 600 2 400 2 200	56425 71425 HH 224340	56650 71750 HH 224310	123 126 139	117 120 126	149 171 192	159 181 202	3.5 3			1.2 1.4 1.8	0.66 0.79 1.0	1.8 3.79 7.58	0.861 1.71 3.06
109.987	159.987 159.987	34.925 34.925	34.925 34.925	26.988 26.988	3.5 8.0	3.3 3.3	164 000 164 000	315 000 315 000	2 000 2 000	2 800 2 800	LM 522549 LM 522548	LM 522510 LM 522510	124 133	118 118	146 146	154 154	3.5 3 8 3	.3 33. .3 33.		1.5 1.5	0.82 0.82	1.55 1.53	0.784 0.784
109.992	177.800	41.275	41.275	30.162	3.5	3.3	232 000	375 000	1 800	2 600	64433	64700	128	121	160	172	3.5 3	.3 42.	0.52	1.2	0.64	2.64	1.11
110.000	165.000 180.000	35.000 47.000	35.000 46.000	26.500 38.000	3.0 3.0	2.5 2.5	195 000 310 000	320 000 490 000	2 000 1 900	2 600 2 600	▲ JM 822049 ▲ JHM 522649	▲ JM 822010 ▲ JHM 522610	124 127	119 122	149 162	159 172		.5 38. .5 40.		1.2 1.5	0.66 0.81	1.64 3.12	0.842 1.51
111.125	190.500	47.625	49.212	34.925	3.5	3.3	296 000	465 000	1 800	2 400	71437	71750	129	123	171	181	3.5 3	.3 40.	0.42	1.4	0.79	3.58	1.71
114.300	152.400 177.800 180.000	21.433 41.275 34.925	21.433 41.275 31.750	16.670 30.162 25.400	1.5 3.5 3.5	1.5 3.3 0.8	89 500 232 000 174 000	178 000 375 000 254 000	2 000 1 800 1 800	2 800 2 600 2 400	L 623149 64450 68450	L 623110 64700 ** 68709	123 131 130	121 125 123	143 160 165	148 172 172	3.5 3	.5 27. .3 42. .8 40.	0.52	1.5 1.2 1.2	0.80 0.64 0.66	0.725 2.39 1.95	0.344 1.11 1.0
	190.500 212.725 212.725	47.625 66.675 66.675	49.212 66.675 66.675	34.925 53.975 53.975	3.5 7.0 7.0	3.3 3.3 3.3	296 000 475 000 570 000	465 000 700 000 810 000	1 800 1 700 1 700	2 400 2 400 2 200	71450 938 HH 224346	71750 932 HH 224310	132 141 143	125 128 131	171 187 192	181 193 202		.3 40. .3 46. .3 47.	0.33	1.4 1.8 1.8	0.79 1.0 1.0	3.37 6.01 7.01	1.71 4.11 3.06
115.087 117.475	190.500 180.975	47.625 34.925	49.212 31.750	34.925 25.400	3.5 3.5	3.3 3.3	296 000 174 000	465 000 254 000	1 800 1 800	2 400 2 400	71453 68462	71750 68712	133 132	126 125	171 163	181 172	3.5 3 3.5 3			1.4 1.2	0.79 0.66		1.71 1.05

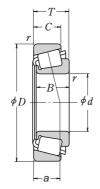
- Notes ** The maximum outside diameter is listed and its tolerance is negative (See Table 7.4.2 on Pages A136 and A137).
 - ▲ The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.

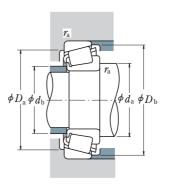




C 240 C 241

Bore Diameter 120.000 - 165.100 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	0	0.4	<i>Y</i> ₁

Static Equivalent Load

 $P_0 = 0.5F_r + Y_0 F_a$

When $F_r > 0.5F_r + Y_0F_a$, use $P_0 = F_r$ The values of \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are

given in the table below.

	Boundary Dimensions (mm)						Basic Load Ratings (N)		Limiting Speeds (min ⁻¹)		Bearing I	Abutment and Fille (mm))			Constant	Axial Load Factors		Mass (kg)		
d	D	T	В	С	1	Cup r in.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	d_{a}	$d_{ m b}$	$D_{\rm a}$	$D_{ m b}$	Cone ($\gamma_{ m a}$ max.	. ,	nm) a	e	Y_1	Y_0		prox. CUP
120.000	170.000 174.625	25.400 35.720	25.400 36.512	19.050 27.783	3.3 3.5	3.3 1.5	130 000 212 000	219 000 385 000	1 900 1 900	2 600 2 600	▲ JL 724348 * M 224748	▲ JL 724314 M 224710	132 135	127 129	156 163	163 168				0.46 0.33	1.3 1.8	0.72 0.99	1.08 1.9	0.591 0.866
120.650	182.562 206.375	39.688 47.625	38.100 47.625	33.338 34.925	3.5 3.3	3.3 3.3	228 000 320 000	445 000 530 000	1 800 1 600	2 400 2 200	48282 795	48220 792	136 139	133 134	168 186	176 198			34.2 15.7	0.31 0.46	2.0 1.3	1.1 0.72	2.56 4.44	1.14 1.9
123.825 125.000	182.562 175.000	39.688 25.400	38.100 25.400	33.338 18.288	3.5 3.3	3.3 3.3	228 000 134 000	445 000 232 000	1 800 1 800	2 400 2 400	48286 ▲ JL 725346	48220 ▲ JL 725316	139 138	133 133	168 161	176 168			34.2 34.3	0.31 0.48	2.0 1.3	1.1 0.69	2.37 1.19	1.14 0.573
127.000	165.895 182.562 196.850 215.900	18.258 39.688 46.038 47.625	17.462 38.100 46.038 47.625	13.495 33.338 38.100 34.925	1.5 3.5 3.5 3.5	1.5 3.3 3.3 3.3	84 500 228 000 315 000 287 000		1 900 1 800 1 700 1 500	2 600 2 400 2 200 2 000	LL 225749 48290 67388 74500	LL 225710 48220 67322 74850	135 141 144 148	132 135 138 141	158 168 180 196	160 176 189 208	3.5 3.5	3.3	34.2		1.8 2.0 1.7 1.2	1.1 0.96	2.19	0.288 1.14 1.46 1.99
128.588 130.000	206.375 206.375	47.625 47.625	47.625 47.625	34.925 34.925	3.3 3.5	3.3 3.3	320 000 320 000	530 000 530 000	1 600 1 600	2 200 2 200	799 797	792 792	146 148	140 141	186 186	198 198				0.46 0.46	1.3 1.3	0.72 0.72		1.9 1.9
130.175	203.200 206.375	46.038 47.625	46.038 47.625	38.100 34.925	3.5 3.5	3.3 3.3	315 000 320 000	560 000 530 000	1 700 1 600	2 200 2 200	67389 799 A	67320 792	146 148	141 142	183 186	191 198			39.7 15.7	0.34 0.46	1.7 1.3	0.96 0.72	3.51 3.74	2.06 1.9
133.350	177.008 190.500 196.850 215.900	25.400 39.688 46.038 47.625	26.195 39.688 46.038 47.625	20.638 33.338 38.100 34.925	1.5 3.5 3.5 3.5	1.5 3.3 3.3 3.3	124 000 240 000 315 000 287 000	258 000 485 000 560 000 495 000	1 800 1 700 1 700 1 500	2 400 2 200 2 200 2 000	L 327249 48385 67390 74525	L 327210 48320 67322 74850	143 148 149 152	141 142 143 146	167 177 180 196	171 184 189 208	3.5 3.5	3.3	29.5 35.9 39.7 48.4	0.32	1.7 1.9 1.7 1.2		1.18 2.58 3.27 4.44	0.55 1.16 1.46 1.99
136.525	190.500 217.488	39.688 47.625	39.688 47.625	33.338 34.925	3.5 3.5	3.3 3.3	216 000 287 000	440 000 495 000	1 700 1 500	2 200 2 000	48393 74537	48320 74856	151 155	144 148	177 197	184 210			35.9 18.4		1.9 1.2	1.0 0.68	2.31 4.19	1.16 2.13
139.700	187.325 215.900 254.000	28.575 47.625 66.675	29.370 47.625 66.675	23.020 34.925 47.625	1.5 3.5 7.0	1.5 3.3 3.3	153 000 287 000 515 000	305 000 495 000 830 000	1 700 1 500 1 300	2 200 2 000 1 800	LM 328448 74550 99550	LM 328410 74850 99100	149 158 170	147 151 156	176 196 227	182 208 238	3.5	3.3	81.7 18.4 55.3	0.49	1.7 1.2 1.5	0.93 0.68 0.81	1.59 3.93 9.99	0.67 1.99 3.83
142.875	200.025	41.275	39.688	34.130	3.5	3.3	227 000	460 000	1 600	2 200	48685	48620	158	151	185	193			37.6		1.8	0.98	2.63	1.19
146.050	193.675 236.538 254.000	28.575 57.150 66.675	28.575 56.642 66.675	23.020 44.450 47.625	1.5 3.5 7.0	1.5 3.3 3.3	170 000 455 000 515 000	355 000 720 000 830 000	1 600 1 400 1 300	2 200 1 900 1 800	36690 HM 231140 99575	36620 HM 231110 99100	155 164 175	154 160 162	182 217 227	188 224 238	3.5	3.3	33.5 15.9 55.3		1.6 1.9 1.5	0.90 1.0 0.81	1.64 6.07 9.24	0.725 2.93 3.83
149.225 152.400	254.000 254.000	66.675 66.675	66.675 66.675	47.625 47.625	7.0 7.0	3.3 3.3	515 000 515 000	830 000 830 000	1 300 1 300	1 800 1 800	99587 99600	99100 99100	178 181	165 167	227 227	238 238			55.3 55.3		1.5 1.5	0.81 0.81	8.86 8.46	3.83 3.83
158.750 165.100	225.425 247.650	41.275 47.625	39.688 47.625	33.338 38.100	3.5 3.5	3.3 3.3	240 000 345 000	540 000 705 000	1 400 1 300	1 900 1 700	46780 67780	46720 67720	176 185	169 179	209 229	218 240			14.3	0.38 0.44	1.6 1.4	0.86 0.75	3.69 5.83	1.66 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 C184 and C185.

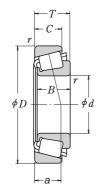


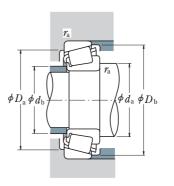


C 242 C 243



Bore Diameter 170.000 - 206.375 mm





Dynamic Equivalent Load

P = X	$F_{\rm r} + YF_{\rm a}$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F$	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 \emph{e} , \emph{Y}_1 , and \emph{Y}_0 are given in the table below.

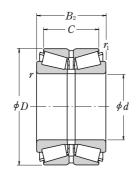
		7	Dimensions nm)		Cono	Cun	Basic Loa	nd Ratings	Limiting S		Bearing) Numbers		Abutmer	t and Fill (mn				Eff. Load Centers	Constant		Load		ass kg)
d	D	T	В	С		Cup Y in.	C_{r}	$C_{0\mathrm{r}}$	Grease	Oil	CONE	CUP	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m b}$	D_{a}	$D_{ m b}$	Cone (${m \gamma}_{ m a}$ max.	up	(mm) a	e	Y_1	Y_0	ap CONE	prox. CUP
170.000	230.000 240.000	39.000 46.000	38.000 44.500	31.000 37.000	3.0 3.0	2.5 2.5	278 000 380 000	520 000 720 000	1 300 1 300	1 800 1 800	▲ JHM 534149 ▲ JM 734449	▲ JHM 534110 ▲ JM 734410	184 185	178 180	217 222	224 232		2.5 2.5	43.2 50.5	0.38 0.44	1.6 1.4	0.86 0.75	3.1 4.42	1.3 2.02
174.625	247.650	47.625	47.625	38.100	3.5	3.3	345 000	705 000	1 300	1 700	67787	67720	192	185	229	240	3.5	3.3	52.4	0.44	1.4	0.75	4.88	2.33
177.800	227.012 247.650 260.350	30.162 47.625 53.975	30.162 47.625 53.975	23.020 38.100 41.275	1.5 3.5 3.5	1.5 3.3 3.3	181 000 345 000 455 000	415 000 705 000 835 000	1 300 1 300 1 200	1 800 1 700 1 700	36990 67790 M 236849	36920 67720 M 236810	189 194 195	186 188 192	214 229 241	221 240 249	1.5 3.5 3.5	3.3	42.9 52.4 47.5	0.44 0.44 0.33	1.4 1.4 1.8	0.75 0.75 0.99	2.1 4.56 6.49	0.907 2.33 2.86
190.000 190.500 200.000	260.000 266.700 300.000	46.000 47.625 65.000	44.000 46.833 62.000	36.500 38.100 51.000	3.0 3.5 3.5	2.5 3.3 2.5	370 000 345 000 615 000	730 000 720 000 1 130 000	1 100 1 100 1 000	1 600 1 500 1 400	▲ JM 738249 67885 ▲ JHM 840449	▲ JM 738210 67820 ▲ JHM 840410	206 209 223	200 203 215	242 246 273	252 259 289			56.4 57.9 73.1	0.48 0.48 0.52	1.3 1.3 1.2	0.69 0.69 0.63	4.73 5.4 10.3	2.2 2.64 5.19
203.200 206.375	282.575 282.575	46.038 46.038	46.038 46.038	36.512 36.512	3.5 3.5	3.3 3.3	365 000 365 000	800 000 800 000	1 000 1 000	1 400 1 400	67983 67985	67920 67920	222 224	216 219	260 260	275 275			61.9 61.9	0.51 0.51	1.2 1.2	0.65 0.65	6.03 5.66	2.82 2.82

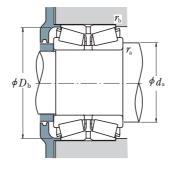


▲ The tolerances are listed in Tables 2, 3 and 4 on Pages C184 and C185.

■DOUBLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 40 – 90 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

			/ Dimension mm)	S			ad Ratings N)	Limiting (mi			Bearing Numbers	Abutmo	ent and F (m	illet Dim m)	ensions	Constant	,	Axial Loa Factors	d	Mass (kg)
<i>d</i>	D	B_2	С	γ min.	${m \gamma}_1$ min.	C_{r}	$C_{0\mathrm{r}}$	Grease	Oil		bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	${m \gamma}_{ m a}$ max.	${m r}_{ m b}$ max.	e	Y_2	Y_3	Y_0	approx.
40	80	45	37.5	1.5	0.6	109 000	140 000	3 700	5 100		HR 40 KBE 42+L	51	75	1.5	0.6	0.37	2.7	1.8	1.8	0.97
45	85 85	47 55	37.5 43.5	1.5 1.5	0.6 0.6	117 000 143 000	159 000 204 000	3 400 3 400	4 700 4 700		HR 45 KBE 42+L HR 45 KBE 52X+L	56 56	81 81	1.5 1.5	0.6 0.6	0.40 0.40	2.5 2.5	1.7 1.7	1.6 1.6	1.08 1.31
50	90 90 90 110	48 49 55 64	38.5 39.5 43.5 51.5	1.5 1.5 1.5 2.5	0.6 0.6 0.6 0.6	131 000 131 000 150 000 224 000	183 000 183 000 218 000 297 000	3 200 3 200 3 200 2 700	4 400 4 400 4 400 3 700	1	HR 50 KBE 042+L HR 50 KBE 42+L HR 50 KBE 52X+L HR 50 KBE 043+L	61 61 61 65	87 87 87 104	1.5 1.5 1.5 2	0.6 0.6 0.6 0.6	0.42 0.42 0.42 0.35	2.4 2.4 2.4 2.9	1.6 1.6 1.6 2.0	1.6 1.6 1.6 1.9	1.20 1.22 1.39 2.77
55	100 100 100 120	51 52 60 70	41.5 42.5 48.5 57	2 2 2 2.5	0.6 0.6 0.6 0.6	162 000 162 000 188 000 256 000	226 000 226 000 274 000 342 000	2 900 2 900 2 900 2 500	3 900 3 900 3 900 3 400	1	HR 55 KBE 042+L HR 55 KBE 1003+L HR 55 KBE 52X+L HR 55 KBE 43+L	67 67 67 70	96 96 97 113	2 2 2 2	0.6 0.6 0.6 0.6	0.40 0.40 0.40 0.35	2.5 2.5 2.5 2.9	1.7 1.7 1.7 2.0	1.6 1.6 1.6 1.9	1.59 1.63 1.88 3.52
60	110 110 130	53 66 74	43.5 54.5 59	2 2 3	0.6 0.6 1	178 000 225 000 298 000	246 000 335 000 405 000	2 700 2 700 2 300	3 600 3 600 3 200	1	HR 60 KBE 042+L HR 60 KBE 52X+L HR 60 KBE 43+L	72 72 78	105 106 122	2 2 2.5	0.6 0.6 1	0.40 0.40 0.35	2.5 2.5 2.9	1.7 1.7 2.0	1.6 1.6 1.9	2.03 2.52 4.40
65	120 120 120 140	56 57 73 79	46.5 47.5 61.5 63	2 2 2 3	0.6 0.6 0.6 1	210 000 210 000 269 000 340 000	300 000 300 000 405 000 465 000	2 400 2 400 2 400 2 100	3 200 3 200 3 300 2 900	1	HR 65 KBE 42+L HR 65 KBE 1202+L HR 65 KBE 52X+L HR 65 KBE 43+L	77 77 77 83	115 115 117 132	2 2 2 2.5	0.6 0.6 0.6 1	0.40 0.40 0.40 0.35	2.5 2.5 2.5 2.9	1.7 1.7 1.7 2.0	1.6 1.6 1.6 1.9	2.58 2.61 3.35 5.42
70	125 125 125 150	57 59 74 83	46.5 48.5 61.5 67	2 2 2 3	0.6 0.6 0.6 1	227 000 227 000 270 000 390 000	325 000 325 000 410 000 535 000	2 300 2 300 2 300 2 000	3 100 3 100 3 100 2 700	ļ	HR 70 KBE 042+L HR 70 KBE 42+L HR 70 KBE 52X+L HR 70 KBE 43+L	82 82 82 88	120 120 121 142	2 2 2 2.5	0.6 0.6 0.6 1	0.42 0.42 0.42 0.35	2.4 2.4 2.4 2.9	1.6 1.6 1.6 2.0	1.6 1.6 1.6 1.9	2.79 2.85 3.58 6.45
75	130 130 160	62 74 87	51.5 61.5 69	2 2 3	0.6 0.6 1	245 000 283 000 435 000	365 000 440 000 600 000	2 200 2 200 1 900	3 000 3 000 2 500	1	HR 75 KBE 42+L HR 75 KBE 52X+L HR 75 KBE 043+L	87 87 93	126 127 151	2 2 2.5	0.6 0.6 1	0.44 0.44 0.35	2.3 2.3 2.9	1.6 1.6 2.0	1.5 1.5 1.9	3.15 3.73 7.66
80	140 140 140 170	61 64 78 92	49 51.5 63.5 73	2.5 2.5 2.5 3	0.6 0.6 0.6 1	269 000 269 000 330 000 475 000	390 000 390 000 505 000 655 000	2 000 2 000 2 000 1 700	2 800 2 800 2 800 2 400	ļ	HR 80 KBE 042+L HR 80 KBE 42+L HR 80 KBE 52X+L HR 80 KBE 043+L	95 95 95 98	134 134 136 161	2 2 2 2.5	0.6 0.6 0.6 1	0.42 0.42 0.42 0.35	2.4 2.4 2.4 2.9	1.6 1.6 1.6 2.0	1.6 1.6 1.6 1.9	3.70 3.70 4.59 9.02
85	150 150 180	70 86 98	57 69 77	2.5 2.5 4	0.6 0.6 1	315 000 360 000 530 000	465 000 555 000 745 000	1 900 1 900 1 600	2 600 2 600 2 200	1	HR 85 KBE 42+L HR 85 KBE 52X+L HR 85 KBE 043+L	100 100 106	143 144 169	2 2 3	0.6 0.6 1	0.42 0.42 0.35	2.4 2.4 2.9	1.6 1.6 2.0	1.6 1.6 1.9	4.69 5.70 10.8
90	160 160 160	71 74 94	58 61 77	2.5 2.5 2.5	0.6 0.6 0.6	345 000 345 000 440 000	510 000 510 000 700 000	1 800 1 800 1 800	2 400 2 400 2 400	1	HR 90 KBE 042+L HR 90 KBE 42+L HR 90 KBE 52X+L	105 105 105	152 152 154	2 2 2	0.6 0.6 0.6	0.42 0.42 0.42	2.4 2.4 2.4	1.6 1.6 1.6	1.6 1.6 1.6	5.53 5.71 7.26

Remark For other double-row tapered roller bearings not listed above, please contact NSK.

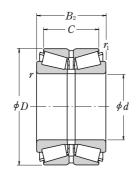


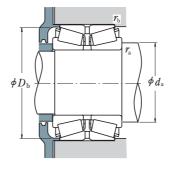


C 246 C 247

DOUBLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 90 - 120 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

			y Dimension mm)	ns			oad Ratings (N)	Limiting (mir		Descine Number	Abutmo	ent and F (m	illet Dim im)	ensions	Constant	A	Axial Load Factors		Mass (kg)
<i>d</i>	D	B_2	С	γ min.	${m \gamma}_1$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	${m \gamma}_{\rm a}$ max.	${m \gamma}_{ m b}$ max.	e	Y_2	Y_3	Y_0	approx.
90	190 190	102 144	81 115	4 4	1 1	595 000 770 000	845 000 1 180 000	1 600 1 600	2 100 2 200	HR 90 KBE 043+L HR 90 KBE 1901+L	111 111	178 179	3	1	0.35 0.35	2.9 2.9	2.0 2.0	1.9 1.9	12.7 17.9
95	170 170 200	78 100 108	63 83 85	3 3 4	1 1 1	385 000 495 000 640 000	570 000 800 000 910 000	1 700 1 700 1 500	2 300 2 300 2 000	HR 95 KBE 42+L HR 95 KBE 52+L HR 95 KBE 43+L	113 113 116	161 163 187	2.5 2.5 3	1 1 1	0.42 0.42 0.35	2.4 2.4 2.9	1.6 1.6 2.0	1.6 1.6 1.9	6.75 8.60 14.7
100	165 180 180	52 81 81	46 64 65	2.5 3 3	0.6 1 1	222 000 435 000 435 000	340 000 665 000 665 000	1 700 1 600 1 600	2 300 2 200 2 200	100 KBE 31+L HR100 KBE 1805+L HR100 KBE 042+L	115 118 118	156 170 170	2 2.5 2.5	0.6 1 1	0.33 0.42 0.42	3.0 2.4 2.4	2.0 1.6 1.6	2.0 1.6 1.6	4.04 8.16 8.13
	180 180 180	82 83 105	66 67 85	3 3 3	1 1 1	435 000 435 000 555 000	665 000 665 000 905 000	1 600 1 600 1 600	2 200 2 200 2 200	HR100 KBE 1801+L HR100 KBE 42+L HR100 KBE 1802+L	118 118 118	170 170 173	2.5 2.5 2.5	1 1 1	0.42 0.42 0.42	2.4 2.4 2.4	1.6 1.6 1.6	1.6 1.6 1.6	8.22 8.7 10.6
	180 180 215	107 110 112	87 90 87	3 3 4	1 1 1	555 000 555 000 725 000	905 000 905 000 1 050 000	1 600 1 600 1 400	2 200 2 200 1 900	HR100 KBE 52X+L HR100 KBE 1804+L HR100 KBE 043+L	118 118 121	173 173 200	2.5 2.5 3	1 1 1	0.42 0.42 0.35	2.4 2.4 2.9	1.6 1.6 2.0	1.6 1.6 1.9	10.7 11 18.1
105	190 190 190 225	88 117 115 116	70 96 95 91	3 3 3 4	1 1 1	480 000 620 000 620 000 780 000	735 000 1 020 000 1 020 000 1 130 000	1 500 1 500 1 500 1 300	2 000 2 000 2 000 1 800	HR105 KBE 42X+L HR105 KBE 1902+L HR105 KBE 52+L HR105 KBE 043+L	123 123 123 126	179 182 182 209	2.5 2.5 2.5 3	1 1 1	0.42 0.42 0.42 0.35	2.4 2.4 2.4 2.9	1.6 1.6 1.6 2.0	1.6 1.6 1.6 1.9	9.76 13.4 13.1 20.4
110	180 180 180	56 70 125	50 56 100	2.5 2.5 2.5	0.6 0.6 0.6	264 000 340 000 550 000	400 000 555 000 1 060 000	1 500 1 500 1 500	2 000 2 000 2 100	110 KBE 31+L 110 KBE 031+L 110 KBE 1802+L	125 125 125	172 172 172	2 2 2	0.6 0.6 0.6	0.39 0.39 0.26	2.6 2.6 3.8	1.7 1.7 2.6	1.7 1.7 2.5	5.11 6.33 11.4
	200 200 200	90 92 120	72 74 100	3 3 3	1 1 1	540 000 540 000 685 000	840 000 840 000 1 130 000	1 400 1 400 1 400	1 900 1 900 1 900	HR110 KBE 42+L HR110 KBE 42X+L HR110 KBE 2001+L	128 128 128	190 190 193	2.5 2.5 2.5	1 1 1	0.42 0.42 0.42	2.4 2.4 2.4	1.6 1.6 1.6	1.6 1.6 1.6	11.2 11.5 15.4
	200 240	121 118	101 93	3 4	1 1.5	685 000 830 000	1 130 000 1 190 000	1 400 1 200	1 900 1 700	HR110 KBE 52X+L HR110 KBE 043+L	128 131	193 223	2.5 3	1 1.5	0.42 0.35	2.4 2.9	1.6 2.0	1.6 1.9	15.2 23.6
120	180 180 200	46 58 62	41 46 55	2.5 2.5 2.5	0.6 0.6 0.6	184 000 260 000 310 000	296 000 450 000 500 000	1 500 1 500 1 400	2 000 2 000 1 800	120 KBE 30+L 120 KBE 030+L 120 KBE 31+L	135 135 135	172 172 190	2 2 2	0.6 0.6 0.6	0.40 0.39 0.39	2.5 2.6 2.6	1.7 1.7 1.7	1.6 1.7 1.7	3.75 4.64 7.35
	200 200 215	78 100 97	62 84 78	2.5 2.5 3	0.6 0.6 1	415 000 515 000 575 000	690 000 885 000 900 000	1 400 1 400 1 300	1 900 1 800 1 800	120 KBE 031+L 120 KBE 2001+L HR120 KBE 42X+L	135 135 138	190 193 204	2 2 2.5	0.6 0.6 1	0.39 0.37 0.44	2.6 2.7 2.3	1.7 1.8 1.6	1.7 1.8 1.5	8.97 11.3 13.7
	215 260 260	132 128 188	109 101 145	3 4 4	1 1 1	750 000 915 000 1 320 000	1 270 000 1 310 000 2 110 000	1 300 1 100 1 100	1 800 1 500 1 500	 HR120 KBE 52X+L HR120 KBE 43+L HR120 KBE 2601+L	138 141 141	207 240 242	2.5 3 3	1 1 1	0.44 0.35 0.35	2.3 2.9 2.9	1.6 2.0 2.0	1.5 1.9 1.9	18.8 29.4 44.6

Remark For other double-row tapered roller bearings not listed above, please contact NSK.

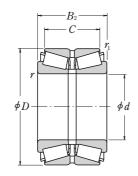


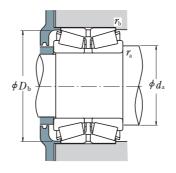


C 248 C 249

■DOUBLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 125 – 150 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

			y Dimension (mm)	S			ad Ratings	Limiting (min		Bearing Numbers	Abutm	ent and F (m	Fillet Dim	ensions	Constant	A	Axial Loa Factors	d	Mass (kg)
d	D	B_2	С	γ min.	${m \gamma}_1$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	${m \gamma}_{\rm a}$ max.	${m r}_{ m b}$ max.	e	Y_2	Y_3	Y_0	approx.
125	210	110	88	4	1	560 000	1 030 000	1 300	1 800	125 KBE 2101+L	146	201	3	1	0.43	2.3	1.6	1.5	14.5
130	230 230 280	98 100 137	78.5 80.5 107.5	4 4 5	1 1 1.5	640 000 640 000 940 000	1 010 000 1 010 000 1 350 000	1 200 1 200 1 000	1 600 1 600 1 400	HR130 KBE 42+L HR130 KBE2301+L 130 KBE 43+L	151 151 157	220 220 258	3 3 4	1 1 1.5	0.44 0.44 0.36	2.3 2.3 2.8	1.6 1.6 1.9	1.5 1.5 1.8	15.8 15.9 35
	230 230 230	145 145 150	115 117.5 120	4 4 4	1 1 1	905 000 905 000 905 000	1 580 000 1 580 000 1 580 000	1 200 1 200 1 200	1 700 1 700 1 700	HR130 KBE 2302+L HR130 KBE 52+L HR130 KBE 2303+L	151 151 151	221 222 221	3 3 3	1 1 1	0.44 0.44 0.44	2.3 2.3 2.3	1.6 1.6 1.6	1.5 1.5 1.5	24.1 23.8 24.2
140	210 210 210	53 66 106	47 53 94	2.5 2.5 2.5	0.6 1 0.6	282 000 305 000 555 000	495 000 530 000 1 200 000	1 200 1 200 1 300	1 700 1 700 1 700	140 KBE 30+L 140 KBE 030+L 140 KBE2101+L	155 155 155	202 202 202	2 2 2	0.6 1 0.6	0.39 0.40 0.33	2.6 2.5 3.0	1.7 1.7 2.0	1.7 1.6 2.0	6.02 7.02 12.3
	225 225 225	68 84 85	61 68 68	3 3 3	1 1 1	400 000 490 000 490 000	630 000 850 000 850 000	1 200 1 200 1 200	1 600 1 600 1 600	140 KBE 31+L 140 KBE 031+L 140 KBE2201+L	158 158 158	216 215 215	2.5 2.5 2.5	1 1 1	0.39 0.39 0.39	2.6 2.6 2.6	1.7 1.7 1.7	1.7 1.7 1.7	9.31 11.6 11.7
	230 230 240	120 140 132	94 110 106	3 3 4	1 1 1.5	685 000 820 000 685 000	1 270 000 1 550 000 1 360 000	1 200 1 200 1 100	1 600 1 600 1 500	140 KBE 2301+L 140 KBE 2302+L 140 KBE 2401+L	158 158 161	220 221 227	2.5 2.5 3	1 1 1.5	0.33 0.35 0.44	3.0 2.9 2.3	2.0 2.0 1.5	2.0 1.9 1.5	17.6 20.7 22.7
	250 250 300	102 153 145	82.5 125.5 115.5	4 4 5	1 1 1.5	670 000 1 040 000 1 030 000	1 030 000 1 830 000 1 480 000	1 100 1 100 1 000	1 500 1 500 1 300	HR140 KBE 42+L HR140 KBE 52X+L 140 KBE 43+L	161 161 167	237 241 275	3 3 4	1 1 1.5	0.44 0.44 0.36	2.3 2.3 2.8	1.6 1.6 1.9	1.5 1.5 1.8	18.9 29.6 42.6
150	225 225 250	56 70 80	50 56 71	3 3 3	1 1 1	300 000 395 000 510 000	545 000 685 000 810 000	1 200 1 200 1 100	1 600 1 600 1 400	150 KBE 30+L 150 KBE 030+L 150 KBE 31+L	168 168 168	213 215 240	2.5 2.5 2.5	1 1 1	0.35 0.35 0.40	2.9 2.9 2.5	2.0 2.0 1.7	1.9 1.9 1.6	7.41 8.70 14.2
	250 250 260	100 115 150	80 95 115	3 3 4	1 1 1	630 000 745 000 815 000	1 090 000 1 320 000 1 520 000	1 100 1 100 1 100	1 400 1 500 1 400	150 KBE 031+L 150 KBE2502+L 150 KBE2601+L	168 168 171	238 238 242	2.5 2.5 3	1 1 1	0.39 0.37 0.43	2.6 2.7 2.3	1.7 1.8 1.6	1.7 1.8 1.5	17.8 20.9 30.0
	270 270 270 320	109 164 174 154	87 130 140 120	4 4 4 5	1 1 1 1.5	830 000 1 210 000 1 210 000 1 420 000	1 330 000 2 150 000 2 150 000 2 130 000	1 000 1 000 1 000 900	1 400 1 400 1 400 1 200	HR150 KBE 42+L HR150 KBE 52X+L HR150 KBE 2701+L HR150 KBE 43+L	171 171 171 177	253 257 257 295	3 3 3 4	1 1 1 1.5	0.44 0.44 0.44 0.35	2.3 2.3 2.3 2.9	1.6 1.6 1.6 2.0	1.5 1.5 1.5 1.9	24.3 37.3 39.7 53.4

Remark For other double-row tapered roller bearings not listed above, please contact NSK.

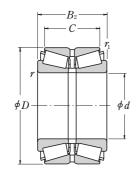


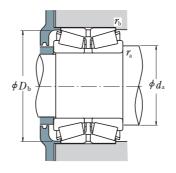


C 250 C 251

DOUBLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 160 – 200 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/F$	r _r ≦e	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

			y Dimensior mm)	ıs			oad Ratings (N)	Limiting (mir		Danis a Novela	Abutm	ent and F (m	illet Dim im)	ensions	Constant	,	Axial Loa Factors	d	Mass (kg)
d	D	B_2	С	γ min.	${\pmb \gamma}_1$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	r a max.	$m{r}_{ m b}$ max.	e	Y_2	Y_3	Y_0	approx.
160	240 240 240	60 75 110	53 60 90	3 3 3	1 1 1	355 000 395 000 650 000	580 000 710 000 1 290 000	1 100 1 100 1 100	1 500 1 500 1 500	160 KBE 30+L 160 KBE 030+L 160 KBE 2401+L	178 178 178	231 230 232	2.5 2.5 2.5	1 1 1	0.37 0.40 0.38	2.7 2.5 2.6	1.8 1.7 1.8	1.8 1.6 1.7	8.56 10.5 16.2
	270 270 270	86 108 140	76 86 120	3 3 3	1 1 1	540 000 775 000 990 000	885 000 1 380 000 1 880 000	1 000 1 000 1 000	1 300 1 300 1 300	160 KBE 31+L 160 KBE 031+L 160 KBE2701+L	178 178 178	255 256 261	2.5 2.5 2.5	1 1 1	0.40 0.39 0.39	2.5 2.6 2.6	1.7 1.7 1.7	1.6 1.7 1.7	18.6 23.1 30.6
	280 290 290 340	150 115 178 160	125 91 144 126	4 4 4 5	1 1 1 1.5	1 100 000 800 000 1 360 000 1 310 000	2 020 000 1 220 000 2 440 000 1 920 000	1 000 900 1 000 800	1 300 1 300 1 300 1 100	160 KBE 2801+L 160 KBE 42+L HR160 KBE 52X+L 160 KBE 43+L	181 181 181 187	266 275 277 314	3 3 4	1 1 1 1.5	0.32 0.43 0.44 0.36	3.2 2.3 2.3 2.8	2.1 1.6 1.6 1.9	2.1 1.5 1.5 1.8	35.9 28.2 47.3 60.4
165	290	150	125	4	1	1 140 000	2 130 000	900	1 300	165 KBE 2901+L	186	272	3	1	0.33	3.1	2.1	2.0	39.5
170	250 260 260	85 67 84	65 60 67	3 3 3	1 1 1	435 000 400 000 575 000	845 000 700 000 1 030 000	1 000 1 000 1 000	1 400 1 300 1 300	170 KBE 2501+L 170 KBE 30+L 170 KBE 030+L	188 188 188	241 248 249	2.5 2.5 2.5	1 1 1	0.44 0.40 0.39	2.3 2.5 2.6	1.5 1.7 1.7	1.5 1.6 1.7	12.3 11.8 14.4
	280 280 280 310	88 110 150 192	78 88 130 152	3 3 5	1 1 1 1.5	630 000 820 000 1 110 000 1 590 000	1 040 000 1 450 000 2 160 000 2 910 000	900 900 1 000 900	1 300 1 300 1 300 1 200	170 KBE 31+L 170 KBE 031+L 170 KBE 2802+L HR170 KBE 52X+L	188 188 188 197	266 268 269 297	2.5 2.5 2.5 4	1 1 1 1.5	0.39 0.39 0.39 0.44	2.6 2.6 2.6 2.3	1.7 1.7 1.7 1.6	1.7 1.7 1.7 1.5	19.7 24.2 34.6 57.3
180	280 280 300	74 93 96	66 74 85	3 3 4	1 1 1.5	455 000 655 000 725 000	810 000 1 220 000 1 210 000	900 900 900	1 300 1 200 1 200	180 KBE 30+L 180 KBE 030+L 180 KBE 31+L	198 198 201	265 265 284	2.5 2.5 3	1 1 1.5	0.40 0.35 0.39	2.5 2.9 2.6	1.7 2.0 1.7	1.6 1.9 1.7	15.4 14.4 24.8
	300 320 320 340	120 127 192 180	96 99 152 140	4 5 5 5	1.5 1.5 1.5 1.5	940 000 895 000 1 640 000 1 410 000	1 690 000 1 390 000 3 050 000 2 510 000	900 800 900 800	1 200 1 200 1 200 1 100	180 KBE 031+L 180 KBE 42+L HR180 KBE 52X+L 180 KBE3401+L	201 207 207 207	287 300 308 305	3 4 4 4	1.5 1.5 1.5 1.5	0.39 0.44 0.45 0.43	2.6 2.3 2.2 2.3	1.7 1.5 1.5 1.6	1.7 1.5 1.5 1.5	31.1 36.5 59.2 68.1
190	290 290 320	75 94 104	67 75 92	3 3 4	1 1 1.5	490 000 670 000 800 000	845 000 1 230 000 1 380 000	900 900 800	1 200 1 200 1 100	190 KBE 30+L 190 KBE 030+L 190 KBE 31+L	208 208 211	279 279 301	2.5 2.5 3	1 1 1.5	0.39 0.40 0.40	2.6 2.5 2.5	1.7 1.7 1.7	1.7 1.6 1.6	16.2 20.1 30.9
	320 340 340	130 133 204	104 105 160	4 5 5	1.5 1.5 1.5	1 070 000 990 000 1 910 000	1 960 000 1 580 000 3 550 000	800 800 800	1 100 1 100 1 100	190 KBE 031+L 190 KBE 42+L HR190 KBE 52X+L	211 217 217	302 320 327	3 4 4	1.5 1.5 1.5	0.39 0.40 0.44	2.6 2.5 2.3	1.7 1.7 1.6	1.7 1.6 1.5	39.0 43.9 70.8
200	310 320 330	152 146 180	123 110 140	3 5 5	1 1.5 1.5	1 300 000 990 000 1 390 000	2 740 000 2 120 000 2 730 000	800 800 800	1 100 1 100 1 100	HR200 KBE 3101+L 200 KBE 3201+L 200 KBE 3301+L	218 227 227	301 301 316	2.5 4 4	1 1.5 1.5	0.43 0.52 0.42	2.3 1.9 2.4	1.6 1.3 1.6	1.5 1.3 1.6	40.1 41.6 54.4
	340 340 360 360	112 140 142 218	100 112 110 174	4 4 5 5	1.5 1.5 1.5 1.5	940 000 1 260 000 1 100 000 2 070 000	1 670 000 2 250 000 1 780 000 3 850 000	800 800 700 800	1 000 1 000 1 000 1 000	200 KBE 31+L 200 KBE 031+L 200 KBE 42+L HR200 KBE 52+L	221 221 227 227	321 324 338 344	3 3 4 4	1.5 1.5 1.5 1.5	0.40 0.39 0.40 0.41	2.5 2.6 2.5 2.5	1.7 1.7 1.7 1.7	1.6 1.7 1.6 1.6	38.8 47.0 52.6 88.3

Remark For other double-row tapered roller bearings not listed above, please contact NSK.

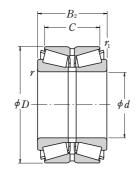
C 252 C 253

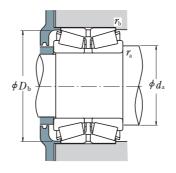




■DOUBLE-ROW TAPERED ROLLER BEARINGS

Bore Diameter 206 – 260 mm





Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

			y Dimensior (mm)	IS			ad Ratings	Limiting (mir		Descriptor Novemberry	Abutm	ent and F (m	illet Dim im)	ensions	Constant		xial Loa Factors	d	Mass (kg)
<i>d</i>	D	B_2	С	γ min.	${m \gamma}_1$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	Grease	Oil	Bearing Numbers	$d_{ m a}$ min.	$D_{ m b}$ min.	$m{\gamma}_{\mathrm{a}}$ max.	${m r}_{ m b}$ max.	e	Y_2	Y_3	Y_0	approx.
206	283	102	83	4	1.5	580 000	1 430 000	900	1 200	206 KBE 2801+L	227	275	3	1.5	0.51	2.0	1.3	1.3	18.1
210	355	116	103	4	1.5	905 000	1 520 000	700	1 000	210 KBE 31+L	231	338	3	1.5	0.46	2.2	1.5	1.4	41.7
220	300 340 340	110 90 113	88 80 90	3 4 4	1 1.5 1.5	730 000 695 000 920 000	1 710 000 1 280 000 1 830 000	800 700 700	1 100 1 000 1 000	220 KBE 3001+L 220 KBE 30+L 220 KBE 030+L	238 241 241	292 324 327	2.5 3 3	1 1.5 1.5	0.37 0.40 0.40	2.7 2.5 2.5	1.8 1.7 1.7	1.8 1.6 1.6	21.2 27.9 34.7
	370 370 400	120 150 158	107 120 122	5 5 5	1.5 1.5 1.5	1 110 000 1 460 000 1 390 000	1 940 000 2 760 000 2 300 000	700 700 600	1 000 1 000 900	220 KBE 31+L 220 KBE 031+L 220 KBE 42+L	247 247 247	345 349 371	4 4 4	1.5 1.5 1.5	0.39 0.39 0.40	2.6 2.6 2.5	1.7 1.7 1.7	1.7 1.7 1.6	48.3 60.2 74.2
240	360 360 400	92 115 128	82 92 114	4 4 5	1.5 1.5 1.5	780 000 1 020 000 1 180 000	1 490 000 2 040 000 2 190 000	700 700 600	900 900 900	240 KBE 30+L 240 KBE 030+L 240 KBE 31+L	261 261 267	344 344 380	3 3 4	1.5 1.5 1.5	0.39 0.35 0.43	2.6 2.9 2.3	1.7 2.0 1.6	1.7 1.9 1.5	30.1 37.3 60.0
	400 400	160 209	128 168	5 5	1.5 1.5	1 620 000 2 220 000	3 050 000 4 450 000	600 600	900 900	240 KBE 031+L 240 KBE 4003+L	267 267	378 384	4 4	1.5 1.5	0.39 0.33	2.6 3.0	1.7 2.0	1.7 2.0	73.6 96.4
250	380	98	87	4	1	795 000	1 460 000	600	900	250 KBE 3801+L	271	365	3	1	0.40	2.5	1.7	1.6	35.5
260	400 400 440	104 130 144	92 104 128	5 5 5	1.5 1.5 1.5	895 000 1 210 000 1 540 000	1 670 000 2 460 000 2 760 000	600 600 600	800 800 800	260 KBE 30+L 260 KBE 030+L 260 KBE 31+L	287 287 287	379 382 416	4 4 4	1.5 1.5 1.5	0.40 0.40 0.39	2.5 2.5 2.6	1.7 1.7 1.7	1.6 1.6 1.7	43.4 54.1 82.5
	440 440	172 180	145 144	5 5	1.5 1.5	1 870 000 2 110 000	3 500 000 4 150 000	600 600	800 800	260 KBE 4401+L 260 KBE 031+L	287 287	414 416	4 4	1.5 1.5	0.38 0.39	2.6 2.6	1.8 1.7	1.7 1.7	98.1 104.0

Remark For other double-row tapered roller bearings not listed above, please contact NSK.





C 254 C 255



INTRODUCTION	· C 258
TECHNICAL DATA	
Free Space of Spherical Roller Bearings	· C 260
Measuring Bearing Clearance	· C 262
BEARING TABLES	
Spherical Roller Bearings	
Cylindrical Bores, Tapered Bores	
Bore Diameter 20 – 1400 mm	· C 266





DESIGN, TYPES, AND FEATURES

Shown in the figures, types EA, C, CD, CA, which are designed for high load capacity, are available. Types EA, C and CD have pressed steel cages, and type CA has machined brass cages. 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.

When bearings with a hole for a locking pin to prevent outer ring rotation are required, please inform NSK.



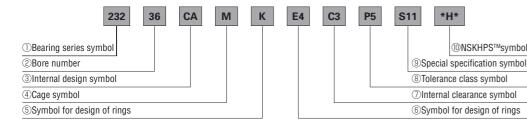




Formulation of Bearing Numbers

Spherical Roller Bearings

Bearing number example



(1) Bearing series symbol 239, 230, 240, 231, 241, 222, 232, 213, 223 : Spherical Roller Bearings

②Bore number Bore number indicates bore diameter. Bore number X 5 (mm)

3 Internal design symbol EA, CA: High Load Capacity

4 Cage symbol M: Machined Brass Cage(for CA Design)

Omitted: Pressed Steel Cage(for EA Design)

56Symbol for K: Tapered Bore of Inner Ring(Taper 1: 12) design of rings K30: Tapered Bore of Inner Ring(Taper 1:30)

E4: Lubricating groove in outside surface and Holes in outer ring

7 Internal clearance symbol Omitted: CN clearance, C3: Clearance greater than CN,

C4: Clearance greater than C3, C5: Clearance greater than C4

Omitted: ISO Normal, P6: ISO Class 6, P5: ISO Class 5, P4: ISO Class 4 ®Tolerance class symbol

Special specification S11; Dimensional Stabiliging Treatment Working Temperature Lower than 200°C

(Omitted for EA Design) symbol **®NSKHPS™** Symbol *H*: NSKHPS™ Symbol

Tolerance Class : ISO Normal



Table 1 Dimensions of Oil Grooves

;	and Holes	3	Units : mm				
Nominal	Width B	Oil Groove	Hole Diameter	Nominal Out			
over	incl.	Width ${\it W}$	$d_{ extsf{OH}}$	(m			
18	30	5	2.5	over	inc		
30	40	6 7	3	_	180		
40	50	7	4	180	250		
50	65	8	5	250	31		
65	80	10	6 8	315	400		
80	100	12	8	400	500		
100	120	15	10	500	630		
120	160	20	12	630	800		
160	200	25	15	800	1000		
200	250	30	20	1000	1250		
250	315	35	20	4050	400		

Table 2 Number of Oil Holes

	and Holes	3	Units : mm			
	Width B	Oil Groove	Hole Diameter		er Ring Dia D	Number
over	incl.	Width W	$d_{ extsf{OH}}$			of Holes
18	30	5	2.5	over	incl.	
30	40	6 7	3	_	180	4
40	50	/	4	180	250	6
50	65	8	5	250	315	6
65	80	10	6 8	315	400	6
80	100	12		400	500	6
100	120	15	10	500	630	8
120 160	160	20	12 15	630	800	8
	200	25	_	800	1000	8
200	250	30	20	1000	1250	8
250 315	315 400	35 40	20 25	1250	1600	8
400		40	25	1600	2000	8

NSKHPS™ Spherical Roller Bearings

Features

Compared to the conventional bearing



1. Improved reliability

Bearing life has increased by a maximum of 2 times compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology.

2. High temperature dimensional stabilizing treatment comes standard High temperature dimensional stabilization of up to 200°C has been achieved through the application of NSK's proprietary material heat treatment technology.

TOLERANCES AND RUNNING ACCURACY

SPHERICAL ROLLER BEARINGS.......Table 7.2 (Pages A128 to A131)

NSKHPS SPHERICAL ROLLER BEARINGS Tolerance for Dimensions : ISO Normal Running Accuracy: ISO Normal

RECOMMENDED FITS

SPHERICAL ROLLER BEARINGS...... Table 8.3 (Page A164) Table 8.5 (Page A165)

INTERNAL CLEARANCES

SPHERICAL ROLLER BEARINGS...... Table 8.16 (Page A172)

NSKHPS SPHERICAL ROLLER BEARINGS INTERNAL CLEARANCE SYMBOL: CN. C3. C4

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 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 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 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. By the way, this bearing is used in plumber

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

Table 1 Free Space of Spherical Roller Bearing (EA, C, CD, and CA)

Units: cm3

BEARINGS TABLE

Dogwing	Bearing Free Space								
Bearing Bore No.			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	48 1 030		030 1 900 2 550 3 550		4 700				
52	1 530	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.



NSK

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

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 (Δ_r) . (Fig. 1)

1.2 Bearing Outside Diameter Is Larger Than 200

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 (Δ_{z}), take that value measured between 2 rows of just top of bearing and outer ring as respectively Δ_{rT_1} and Δ_{rT_2} and that value measured just at top of the bearing as

$$\Delta_{rT} = 1/2 (\Delta_{rT1} + \Delta_{rT2})$$

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 Δ_{rL1} and Δ_{rL2} . The internal clearance on the left side of the bearing is Δ_{rl} :

$$\Delta_{rL} = 1/2 (\Delta_{rL1} + \Delta_{rL2})$$

Take that measurement between 2 rows of rollers of right side respectively as Δ_{rR1} and Δ_{rR2} . The internal clearance of the right side of the bearing is

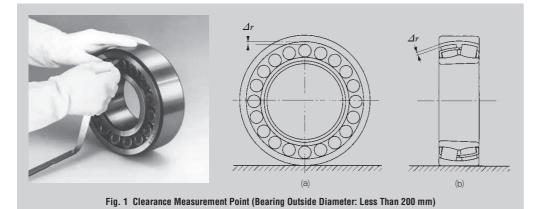
$$\Delta_{rR} = 1/2 \left(\Delta_{rR1} + \Delta_{rR2} \right)$$

The internal bearing clearance (Δ_r) is given by the following equation:

$$\Delta_r = 1/2 \left(\Delta_{rT} + \Delta_{rL} + \Delta_{rR} \right)$$

2. Measuring Bearing Clearance When Mounted on Shaft or Sleeve

Basically, the measurement of the clearance is taken 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 but



the measurement point varies slightly depending on the size of the outer ring outside diameter.

2.1 Bearing Outside Diameter Is Smaller Than 200

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 (Δ_{rs}).(Fig. 3)

2.2 Bearing Outside Diameter Is Larger Than 200

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 (Δ_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 Δ_{rs1} and Δ_{rss} while that value measured at the exact bottom of the bearing is Δ_{rs} .

$$\Delta_{rS} = 1/2 \left(\Delta_{rS1} + \Delta_{rS2} \right)$$

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 Δ_{rI1} and Δ_{rI2} and the internal clearance of left side of bearing as

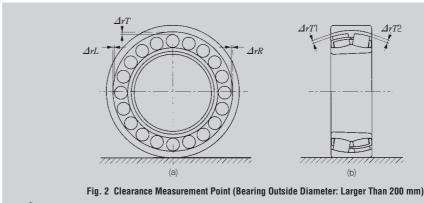
$$\Delta_{rL} = 1/2 (\Delta_{rL1} + \Delta_{rL2})$$

The internal clearances measured between 2 rows of rollers on the right side respectively as Δ_{rR1} and Δ_{rR2} . The internal clearance of right side of bearing is Δ_{rR} .

$$\Delta_{rR} = 1/2 \left(\Delta_{rR1} + \Delta_{rR2} \right)$$

The internal bearing clearance (Δ) is given by the following equation:

$$\Delta_r = 1/2 \left(\Delta_{rS} + \Delta_{rL} + \Delta_{rR} \right)$$



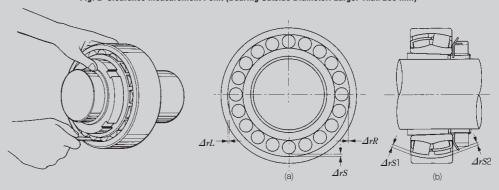


Fig. 3 Clearance Measurement Point



BEARINGS TABLE

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 wintout 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

Internal Clearance Adjustment of Tapered-Bore Bearings

maximum clearance reduction amount.

Perform the adjustment by measuring the clearance reduction amount with the thickness

- 1. For measurement position and measured point, refer to Section 2.(Page C262) 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 hvdraulic 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 B	ore Diameter	Reduction	n in Radial		Axial M	ovement		Minimum Permissible					
d	(mm)		rance	Tanor	1 : 12	Tanor	1:30	Res	dual Cleara	ance			
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	0.120	0.150	2.2	2.4	5.5	6.75	0.110	0.180	0.280			
355	400	0.140	0.170	2.4	3.0	6.0	7.5	0.120	0.180	0.330			
333	400	0.150	0.130	2.4	3.0	0.0	7.5	0.130	0.200	0.550			
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	1000	0.340	0.460	5.5	7.4	14.0	18.5	0.310	0.470	0.730			
1000	1120	0.370	0.500	5.9	8.0	15.0	20.0	0.360	0.530	0.800			
Damarka	The values for	uadiration is		-1 -1			NT -1						

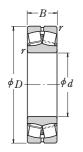
Remarks The values for reduction in radial internal clearance are for bearings with CN clearance.

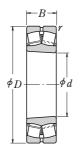
For bearings with C3 or C4 Clearance, the maximum values listed should be used for the reduction in radial internal clearance.

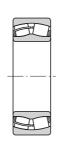


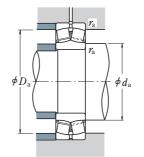
C 264 C 265

SPHERICAL ROLLER BEARINGS Bore Diameter 20 - 55 mm









Dynamic Equivalent Load P = XF + YF

1 -21	rilla		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Cylindrical Bore

Tapered Bore

Without an Oil Groove or Holes

В	oundary [(m		ons	Basic Load			Speeds (min ⁻¹)		Bearing	Numbers		Abutment	and Fillet D (mm)	Dimension	S	Constant		xial Lo		Mass (kg)
d	D	B	γ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	ra max.	$\max_{}$	a min.	${m \gamma}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
20	52	15	1.1	29 300	26 900	10 000	_	6 300	21304CDE4	21304CDKE4	27	28	45	42	1	0.31	3.2	2.1	2.1	0.17
25	52 62	18 17	1 1.1	37 500 43 000	37 000 40 500	10 000 9 000	_	7 100 5 300	22205CE4 21305CDE4	22205CKE4 21305CDKE4	31 32	31 34	46 55	45 51	1	0.35 0.29	2.9 3.4	1.9 2.3	1.9 2.3	0.17 0.26
30	62 72	20 19	1 1.1	50 000 55 000	50 000 54 000	8 500 7 500		6 000 4 500	22206CE4 21306CDE4	22206CKE4 21306CDKE4	36 37	37 40	56 65	54 59	1	0.33 0.28	3.1 3.6	2.1 2.4	2.0 2.3	0.27 0.39
35	72 80	23 21	1.1 1.5	69 000 71 500	71 000 76 000	7 500 7 100	=	5 300 4 000	22207CE4 21307CDE4	22207CKE4 21307CDKE4	42 44	43 47	65 71	63 67	1 1.5	0.32 0.28	3.1 3.6	2.1 2.4	2.0 2.4	0.42 0.53
40	80 90 90	23 23 33	1.1 1.5 1.5	113 000 118 000 170 000	99 500 111 000 153 000	7 100 6 700 5 600	12 000 11 000 9 000	6 700 6 000 5 300	* 22208EAE4 * 21308EAE4 * 22308EAE4	*22208EAKE4 *21308EAKE4 *22308EAKE4	47 49 49	49 54 52	73 81 81	70 75 77	1 1.5 1.5	0.28 0.25 0.35	3.6 3.9 2.8	2.4 2.7 1.9	2.4 2.6 1.9	0.50 0.73 0.98
45	85 100 100	23 25 36	1.1 1.5 1.5	118 000 149 000 207 000	111 000 144 000 195 000	6 300 6 000 5 000	11 000 9 000 8 000	6 000 5 000 4 500	*22209EAE4 *21309EAE4 *22309EAE4	*22209EAKE4 *21309EAKE4 *22309EAKE4	52 54 54	54 65 59	78 91 91	75 89 86	1 1.5 1.5	0.25 0.23 0.34	3.9 4.3 2.9	2.7 2.9 2.0	2.6 2.8 1.9	0.55 0.96 1.34
50	90 110 110	23 27 40	1.1 2 2	124 000 178 000 246 000	119 000 174 000 234 000	6 000 5 300 4 800	9 500 8 000 7 100	5 600 4 500 4 300	*22210EAE4 *21310EAE4 *22310EAE4	*22210EAKE4 *21310EAKE4 *22310EAKE4	57 60 60	60 72 64	83 100 100	81 98 93	1 2 2	0.24 0.23 0.35	4.3 4.4 2.8	2.9 3.0 1.9	2.8 2.9 1.9	0.61 1.21 1.78
55	100 120 120	25 29 43	1.5 2 2	149 000 178 000 292 000	144 000 174 000 292 000	5 300 5 300 4 300	9 000 8 000 6 000	5 300 4 500 3 800	*22211EAE4 *21311EAE4 *22311EAE4	* 22211EAKE4 * 21311EAKE4 * 22311EAKE4	64 65 65	65 72 73	91 110 110	89 98 103	1.5 2 2	0.23 0.23 0.34	4.3 4.4 2.9	2.9 3.0 2.0	2.8 2.9 1.9	0.81 1.58 2.3

Note (1) The suffix K represents bearings with tapered bores (taper 1:12).

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.

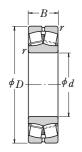
The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).

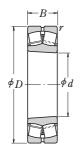
3. For the dimensions od adapters and withdrawal sleeves, refer to Pages C348 – C349, and C356.

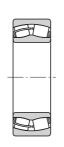


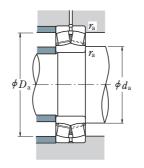


Bore Diameter 60 - 90 mm









Abutment and Fillet Dimensions

Dynamic Equivalent Load $P - XF \perp VF$

$\Gamma = \Lambda$	$r_r + r_a$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

Constant

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

Mass

Axial Load

Cylindrical Bore

Boundary Dimensions

Tapered Bore

Basic Load Ratings

Without an Oil Groove or Holes

Speeds

D	B			(N)				bearing Numbers			(mm)						- 1	(kg)	
	D		$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	d min.	a max.	max.) _a min.	r _a max.	e	Y_2	Y_3	Y_0	approx.
95 110 130 130	26 28 31 46	1.1 1.5 2.1 2.1	98 500 178 000 238 000 340 000	141 000 174 000 244 000 340 000	4 800 5 300 4 800 4 000	8 000 6 700 5 600	3 600 4 800 3 800 3 600	23012CE4 *22212EAE4 *21312EAE4 *22312EAE4	23012CKE4 *22212EAKE4 *21312EAKE4 *22312EAKE4	67 69 72 72	68 72 87 79	88 101 118 118	85 98 117 111	1 1.5 2 2	0.26 0.23 0.22 0.34	3.9 4.4 4.5 3.0	2.6 3.0 3.0 2.0	2.5 2.9 3.0 1.9	0.68 1.1 1.98 2.89
120	31	1.5	221 000	230 000	4 800	7 500	4 300	*22213EAE4	*22213EAKE4	74	80	111	107	1.5	0.24	4.2	2.8	2.7	1.51
140	33	2.1	264 000	275 000	4 500	6 000	3 600	*21313EAE4	*21313EAKE4	77	94	128	126	2	0.22	4.6	3.1	3.0	2.45
140	48	2.1	375 000	380 000	3 800	5 000	3 200	*22313EAE4	*22313EAKE4	77	84	128	119	2	0.33	3.0	2.0	2.0	3.52
125	31	1.5	225 000	232 000	4 500	7 100	4 000	* 22214EAE4	*22214EAKE4	79	84	116	111	1.5	0.23	4.3	2.9	2.8	1.58
150	35	2.1	310 000	325 000	4 300	5 600	3 200	* 21314EAE4	*21314EAKE4	82	101	138	135	2	0.22	4.6	3.1	3.0	3.0
150	51	2.1	425 000	435 000	3 600	4 800	3 000	* 22314EAE4	*22314EAKE4	82	91	138	129	2	0.33	3.0	2.0	2.0	4.28
130	31	1.5	238 000	244 000	4 300	6 700	4 000	*22215EAE4	*22215EAKE4	84	87	121	117	1.5	0.22	4.5	3.0	3.0	1.64
160	37	2.1	310 000	325 000	4 000	5 600	3 200	*21315EAE4	*21315EAKE4	87	101	148	134	2	0.22	4.6	3.1	3.0	3.64
160	55	2.1	485 000	505 000	3 400	4 300	2 800	*22315EAE4	*22315EAKE4	87	97	148	137	2	0.33	3.0	2.0	2.0	5.26
140	33	2	264 000	275 000	4 000	6 000	3 600	*22216EAE4	*22216EAKE4	90	94	130	126	2	0.22	4.6	3.1	3.0	2.01
170	39	2.1	355 000	375 000	3 800	4 800	3 000	*21316EAE4	*21316EAKE4	92	109	158	146	2	0.23	4.4	3.0	2.9	4.32
170	58	2.1	540 000	565 000	3 200	3 800	2 600	*22316EAE4	*22316EAKE4	92	103	158	145	2	0.33	3.0	2.0	2.0	6.23
150	36	2	310 000	325 000	4 000	5 600	3 400	*22217EAE4	*22217EAKE4	95	101	140	135	2	0.22	4.6	3.1	3.0	2.54
180	41	3	360 000	395 000	3 800	5 000	3 000	*21317EAE4	*21317EAKE4	99	108	166	142	2.5	0.24	4.3	2.9	2.8	5.2
180	60	3	600 000	630 000	3 000	3 400	2 400	*22317EAE4	*22317EAKE4	99	110	166	155	2.5	0.33	3.1	2.1	2.0	7.23
160 160 190 190	40 52.4 43 64	2 2 3 3	360 000 340 000 415 000 665 000	395 000 490 000 450 000 705 000	3 800 2 800 3 600 2 800	5 000 	3 200 1 800 2 800 2 400	*22218EAE4 23218CE4 *21318EAE4 *22318EAE4	*22218EAKE4 23218CKE4 *21318EAKE4 *22318EAKE4	100 100 104 104	108 105 115 115	150 150 176 176	142 138 152 163	2 2 2.5 2.5	0.24 0.32 0.24 0.33	4.3 3.2 4.3 3.1	2.9 2.1 2.9 2.1	2.8 2.1 2.8 2.0	3.3 4.51 6.1 8.56
	110 130 130 120 140 140 125 150 150 130 160 170 170 150 180	110 28 130 31 130 46 120 31 140 33 140 48 125 31 150 35 150 51 130 31 160 37 160 55 140 33 170 39 170 58 150 36 180 41 180 60	95	95 26 1.1 98 500 110 28 1.5 178 000 130 31 2.1 238 000 130 46 2.1 340 000 120 31 1.5 221 000 140 33 2.1 264 000 140 48 2.1 375 000 150 35 2.1 310 000 150 35 2.1 310 000 150 51 2.1 425 000 130 31 1.5 238 000 160 37 2.1 310 000 160 37 2.1 310 000 160 55 2.1 485 000 170 39 2.1 355 000 170 58 2.1 540 000 150 36 2 310 000 180 41 3 360 000 180 41 3 360 000 160	95 26 1.1 98 500 141 000 110 28 1.5 178 000 174 000 130 31 2.1 238 000 244 000 130 46 2.1 340 000 340 000 120 31 1.5 221 000 230 000 140 33 2.1 264 000 275 000 140 48 2.1 375 000 380 000 150 35 2.1 310 000 325 000 150 35 2.1 310 000 325 000 150 37 2.1 310 000 325 000 160 37 2.1 310 000 325 000 160 37 2.1 310 000 325 000 170 39 2.1 355 000 375 000 170 39 2.1 355 000 375 000 180 41 3 360 000 395 000 180 41 3 36	95 26 1.1 98 500 141 000 4 800 110 28 1.5 178 000 174 000 5 300 130 31 2.1 238 000 244 000 4 800 130 46 2.1 340 000 340 000 4 800 140 33 2.1 264 000 275 000 4 500 140 48 2.1 375 000 380 000 3 800 125 31 1.5 225 000 232 000 4 500 150 35 2.1 310 000 325 000 4 300 150 51 2.1 425 000 435 000 3 600 130 31 1.5 238 000 244 000 4 300 160 37 2.1 310 000 325 000 4 000 160 37 2.1 310 000 325 000 4 000 170 39 2.1 355 000 375 000 3 800 170 58	95 26 1.1 98 500 141 000 4 800 — 110 28 1.5 178 000 174 000 5 300 8 000 130 31 2.1 238 000 244 000 4 800 6 700 130 46 2.1 340 000 340 000 4 000 5 600 120 31 1.5 221 000 230 000 4 500 6 000 140 33 2.1 264 000 275 000 4 500 6 000 140 48 2.1 375 000 380 000 3 800 5 000 125 31 1.5 225 000 232 000 4 500 7 100 150 35 2.1 310 000 325 000 4 300 5 600 150 51 2.1 425 000 435 000 3 600 4 800 160 37 2.1 310 000 325 000 4 000 5 600 160 55 2.1 485 000	95 26 1.1 98 500 141 000 4 800 — 3 600 110 28 1.5 178 000 174 000 5 300 8 000 4 800 130 31 2.1 238 000 244 000 4 800 6 700 3 800 130 46 2.1 340 000 340 000 4 000 5 600 3 600 140 33 2.1 264 000 275 000 4 500 6 000 3 600 140 48 2.1 375 000 380 000 4 500 5 000 3 200 140 48 2.1 375 000 232 000 4 500 5 600 3 200 150 51 2.1 425 000 435 000 3 600 4 800 5 600 3 200 150 51 2.1 425 000 435 000 3 600 4 800 3 200 160 55 2.1 310 000 325 000 4 000 5 600 3 200 170 58 2.1 540 000 565 000 3 200 3 800 5 000 3 200 170 58 2.1 540 000 565 000 3 200 3 800 5 000 3 200 170 58 2.1 540 000 565 000 3 200 3 800 5 000 3 200 170 58 2.1 540 000 565 000 3 200 3 200 3 800 5 000 3 200 170 58 2.1 540 000 565 000 3 200 3 800 5 000 3 200 170 58 2.1 540 000 565 000 3 200 3 800 5 000 3 200 170 58 2.1 540 000 565 000 3 200 3 800 5 000 3 200 180 41 3 3 360 000 325 000 3 800 5 000 3 200 180 41 3 3 360 000 325 000 3 800 5 000 3 200 180 41 3 3 360 000 325 000 3 800 5 000 3 200 3 800 5 000 3 200 180 41 3 3 360 000 325 000 3 800 5 000 3 200 3 800 5 000 3 200 180 41 3 3 360 000 325 000 3 800 5 000 3 200 3 800 5 000 3 200 180 60 3 600 000 335 000 3 800 5 000 3 200 180 60 3 600 000 630 000 3 800 5 000 3 200 180 60 3 600 000 335 000 3 800 5 000 3 200 180 60 3 3 400 000 4450 000 5 800 4500 2 800	95	95	95 26 1.1 98 500 141 000 4 800 — 3 600 23012CE4 23012CKE4 67 110 28 1.5 178 000 174 000 5 300 8 000 4 800 *22212EAE4 *22212EAKE4 69 130 31 2.1 238 000 244 000 4 800 6 700 3 800 *21312EAE4 *21312EAKE4 72 130 46 2.1 340 000 340 000 4 000 5 600 3 600 *22312EAE4 *22312EAKE4 72 130 31 1.5 221 000 230 000 4 800 7 500 4 300 *22312EAE4 *22312EAKE4 72 140 33 2.1 264 000 275 000 4 500 6 000 3 600 *21313EAE4 *22312EAKE4 77 140 48 2.1 375 000 380 000 3 800 5 000 3 200 *22313EAE4 *22313EAKE4 77 140 48 2.1 375 000 380 000 3 800 5 000 3 200 *22313EAE4 *22313EAKE4 77 140 48 2.1 310 000 325 000 4 300 5 600 3 200 *22313EAE4 *22313EAKE4 77 140 33 1.5 225 000 23 000 4 500 7 100 4 000 *22214EAE4 *22313EAKE4 77 140 48 2.1 310 000 325 000 4 300 5 600 3 200 *21313EAE4 *22313EAKE4 79 150 35 2.1 310 000 325 000 4 300 5 600 3 200 *21314EAE4 *22313EAKE4 82 150 51 2.1 425 000 435 000 3 600 4 800 3 000 *22314EAE4 *22313EAKE4 82 150 55 2.1 405 000 325 000 4 300 5 600 3 200 *22314EAE4 *22313EAKE4 82 160 55 2.1 405 000 505 000 3 400 4 300 2 800 *22315EAE4 *22315EAKE4 87 160 55 2.1 405 000 505 000 3 400 4 300 2 800 *22315EAE4 *22315EAKE4 87 160 55 2.1 405 000 505 000 3 800 4 800 3 000 *22315EAE4 *22315EAKE4 87 160 55 2.1 405 000 505 000 3 800 4 800 3 000 *22315EAE4 *22315EAKE4 87 160 55 2.1 540 000 505 000 3 800 4 800 3 000 *22315EAE4 *22315EAKE4 87 170 58 2.1 540 000 565 000 3 800 4 800 3 000 *2316EAE4 *22315EAKE4 92 150 36 2.1 540 000 565 000 3 800 5 000 3 800 \$200 *22315EAE4 *22315EAKE4 92 150 36 000 3 350 000 3 300 3 300 \$200 *22315EAE4 *22315EAKE4 92 150 36 000 3 300 300 300 300 \$200 \$23315EAE4 *22315EAKE4 99 180 400 400 400 400 400 400 400 400 400 4	95 26 1.1 98 500 141 000 4 800 — 3 600 23012CE4 2212EAE4 67 68 110 28 1.5 178 000 174 000 5 500 8 000 4 800 *2212EAE4 *22212EAE4 69 72 87 130 31 2.1 238 000 244 000 4 000 5 600 3 600 *22312EAE4 *21312EAEE4 72 87 130 46 2.1 340 000 340 000 4 000 5 600 3 600 *22312EAE4 *21312EAEE4 72 87 130 31 1.5 221 000 230 000 4 500 6 000 3 600 *22312EAE4 *21312EAEE4 72 79 140 33 2.1 264 000 275 000 4 500 5 000 3 200 *22313EAE4 *21313EAEE4 77 94 140 48 2.1 375 000 380 000 3 800 5 5000 3 200 *22313EAE4 *21313EAEE4 77 94 140 48 2.1 375 000 380 000 3 800 5 5000 3 200 *22313EAE4 *22313EAEE4 77 94 150 150 51 2.1 425 000 435 000 4 800 5 600 3 200 *22313EAE4 *21313EAEE4 82 101 150 51 2.1 425 000 435 000 3 800 4 800 3 200 *22313EAE4 *22313EAEE4 82 101 150 51 2.1 425 000 435 000 3 400 4 800 3 200 *22313EAE4 *22313EAEE4 82 101 160 57 2.1 310 000 325 000 4 000 5 600 3 200 *22313EAE4 *22313EAEE4 82 101 160 57 2.1 310 000 325 000 4 000 5 600 3 200 *22313EAE4 *22313EAEE4 82 101 160 37 2.1 310 000 325 000 4 000 5 600 3 200 *22313EAE4 *22313EAEE4 82 101 160 37 2.1 310 000 325 000 4 000 5 600 3 200 *22313EAEE4 *22313EAEE4 82 101 160 37 2.1 310 000 325 000 4 000 5 600 3 200 *22313EAEE4 *22313EAEE4 87 101 160 37 2.1 355 000 375 000 3 800 4 800 3 200 *22313EAEE4 *22313EAEE4 87 101 160 37 2.1 355 000 375 000 3 800 4 800 3 200 *22313EAEE4 *22313EAEE4 87 101 160 37 2.1 355 000 375 000 3 800 4 800 3 200 *22313EAEE4 *22313EAEE4 87 101 160 37 2.1 355 000 375 000 3 800 4 800 3 200 *22313EAEE4 *22313EAEE4 87 101 160 37 2.1 355 000 375 000 3 800 4 800 3 200 *22313EAEE4 *22313EAEE4 87 101 160 37 2.1 355 000 375 000 3 800 5 500 3 300 *22313EAEE4 822313EAEE4 92 103 180 60 3 600 000 600 000 600 000 3 600 4 800 3 200 *22313EAEE4 822313EAEE4 92 103 180 60 3 600 000 600 0	95	95	95 26 1.1 98 500 141 000 4 800 500 4800 4800 23012CE4 23012CRE4 67 68 88 85 1 110 28 1.5 178 000 174 000 5 300 800 4800 22212EA4 22312EAK4 69 772 101 99 1.5 120 31 2.1 288 000 24 000 4800 6700 3800 22312EA4 22312EAK4 72 79 118 111 2 12 12 12 12 12 12 12 12 12 12 12	95	95 26 1.1 98 500 141 000 4 800	15	STATES S

Bearing

Numbers

Note (1) The suffix K represents bearings with tapered bores (taper 1:12).





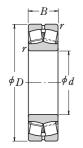
Remarks 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.

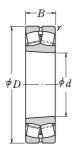
When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.

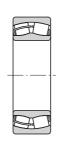
The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads($> 0.10C_r$).

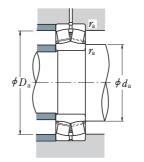
^{3.} For the dimensions od adapters and withdrawal sleeves, refer to Pages C349 – C350, and C356.

Bore Diameter 95 - 110 mm









Dynamic Equivalent Load $P - XF \perp VF$

$\Gamma = \Lambda$	$r_r + r_a$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Cylindrical Bore

Tapered Bore

Without an Oil Groove or Holes

В	oundary [(m		ns	Basic Load	-		Speeds (min ⁻¹)		Bearing	Numbers		Abutment and Fillet Dimensions (mm)		S	Constant		xial Lo Factor		Mass (kg)	
d	D	B	γ min.	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	$d_{ m a}$ max.	\mathcal{L} max.) _a min.	${\it r}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
95	170 170 200	43 55.6 45	2.1 2.1 3	415 000 370 000 430 000	450 000 525 000 435 000	3 800 2 600 3 600	4 500 — 4 800	3 000 1 700 1 500	*22219EAE4 23219CAME4 *21319CAME4	*22219EAKE4 23219CAMKE4 *21319CAMKE4	107 107 109	115 — —	158 158 186	152 146 172	2 2 2.5	0.24 0.32 0.22	4.3 3.1 4.6	2.9 2.1 3.1	2.8 2.0 3.0	4.04 5.33 6.92
	200 200	45 67	3	345 000 735 000	435 000 780 000	3 600 2 600	3 000	1 500 2 200	21319CE4 *22319EAE4	21319CKE4 *22319EAKE4	109 109	127 121	186 186	172 172	2.5 2.5	0.22 0.33	4.6 3.1	3.1 2.1	3.0 2.0	6.92 9.91
100	150 150 165	37 50 52	1.5 1.5 2	212 000 276 000 345 000	335 000 470 000 530 000	3 200 2 800 2 800	_ _ _	2 200 1 800 1 700	23020CDE4 24020CE4 23120CE4	23020CDKE4 24020CK30E4 23120CKE4	109 109 110	112 110 113	141 141 155	136 132 144	1.5 1.5 2	0.22 0.30 0.30	4.6 3.4 3.4	3.1 2.3 2.3	3.0 2.2 2.2	2.31 3.08 4.38
	165 180 180	65 46 60.3	2 2.1 2.1	345 000 455 000 525 000	535 000 490 000 605 000	2 400 3 600 2 800	4 300 3 800	1 700 2 800 1 600	24120CAME4 *22220EAE4 *23220CAME4	24120CAMK30E4 *22220EAKE4 *23220CAMKE4	110 112 112	119 —	155 168 168	143 160 155	2 2 2	0.35 0.24 0.32	2.9 4.3 3.2	1.9 2.9 2.1	1.9 2.8 2.1	5.42 4.84 6.6
	180 215 215 215 215	60.3 47 47 73	2.1 3 3 3	420 000 495 000 395 000 750 000	605 000 485 000 485 000 785 000	2 800 3 400 3 400 2 600	4 500 	1 600 1 400 1 400 1 700	23220CE4 *21320CAME4 21320CE4 *22320CAME4(²)	23220CKE4 * 21320CAMKE4 21320CKE4 * 22320CAMKE4(²)	112 114 114 114	118 — 133 —	168 201 201 201	155 184 184 184	2 2.5 2.5 2.5	0.32 0.21 0.21 0.33	3.2 4.7 4.7 3.0	2.1 3.2 3.2 2.0	2.1 3.1 3.1 2.0	6.6 8.46 8.46 12.7
110	170 170 180	45 60 56	2 2 2	293 000 380 000 480 000	465 000 645 000 630 000	3 200 2 800 3 200	4 000	2 000 1 600 1 600	23022CDE4 24022CE4 *23122CAME4	23022CDKE4 24022CK30E4 *23122CAMKE4	120 120 120	124 121 —	160 160 170	153 148 158	2 2 2	0.24 0.32 0.28	4.2 3.1 3.5	2.8 2.1 2.4	2.8 2.1 2.3	3.76 4.96 5.7
	180 180 180	56 69 69	2 2 2	385 000 575 000 460 000	630 000 750 000 750 000	3 200 2 200 2 200	3 400	1 600 1 600 1 600	23122CE4 *24122CAME4 24122CE4	23122CKE4 *24122CAMK30E4 24122CK30E4	120 120 120	127 — 123	170 170 170	158 154 154	2 2 2	0.28 0.36 0.36	3.5 2.8 2.8	2.4 1.9 1.9	2.3 1.8 1.8	5.7 6.84 6.84
	200 200 200	53 69.8 69.8	2.1 2.1 2.1	605 000 645 000 515 000	645 000 760 000 760 000	3 400 2 600 2 200	3 400 3 400 —	2 600 1 500 1 500	*22222EAE4 *23222CAME4 23222CE4	*22222EAKE4 *23222CAMKE4 23222CKE4	122 122 122	129 — 130	188 188 188	178 170 170	2 2 2	0.25 0.34 0.34	4.0 3.0 3.0	2.7 2.0 2.0	2.6 1.9 1.9	6.99 9.54 9.54
	240 240	50 80	3	565 000 925 000	545 000 980 000	3 000 2 200	4 300 3 000	1 300 1 500	*21322CAME4 *22322CAME4(²)	*21322CAMKE4 *22322CAMKE4(²)	124 124	=	226 226	206 206	2.5 2.5	0.22 0.33	4.6 3.1	3.1 2.1	3.0 2.0	11.2 17.6

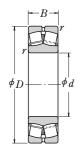
Notes (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).

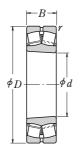
(2) EA is also available. Load rating of EA is around 10% higher than CAM's, please consult NSK.

- **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($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).
 - 3. For the dimensions od adapters and withdrawal sleeves, refer to Pages C351, and C357.

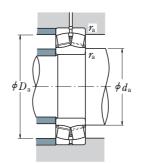


Bore Diameter 120 - 130 mm









Abutment and Fillet Dimensions

Dynamic Equivalent Load $P - XF \perp VF$

$\Gamma = \Lambda$	$r_r + I r_a$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

Constant

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Mass

Axial Load

Cylindrical Bore

Boundary Dimensions

Tapered Bore

Basic Load Ratings

Without an Oil Groove or Holes

Speeds

	ы	unuany 1 m)	nm)	UIIS		V)		(min ⁻¹)		Dearing	Nullibers		Abutillelit	(mm)	DIIIIGIISIOII	5	Constant		Factors	au S	(kg)
	d	D	B	r	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference	Limiting	Speeds Grease	Cylindrical Bore	Tapered Bore(1)		d_{a}) _a .	$\boldsymbol{\gamma}_{\mathrm{a}}$	e	Y_2	Y_3	Y_0	approx.
	120	180 180 180	46 46 60	min. 2 2 2	395 000 315 000 480 000	525 000 525 000 680 000	3 200 3 200 2 600	4 500 3 600	1 800 1 800 1 500	*23024CAME4 23024CDE4 *24024CAME4	*23024CAMKE4 23024CDKE4 *24024CAMK30E4	min. 130 130 130	134 —	170 170 170	min. 163 163 158	2 2 2 2	0.22 0.22 0.32	4.5 4.5 3.2	3.0 3.0 2.1	2.9 2.9 2.1	4.11 4.11 5.33
		180 200 200	60 62 62	2 2 2	395 000 580 000 465 000	705 000 720 000 720 000	2 600 2 800 2 800	3 600	1 500 1 400 1 400	24024CE4 *23124CAME4 23124CE4	24024CK30E4 *23124CAMKE4 23124CKE4	130 130 130	131 — 138	170 190 190	158 175 175	2 2 2	0.32 0.29 0.29	3.2 3.5 3.5	2.1 2.4 2.4	2.1 2.3 2.3	5.33 7.85 7.85
		200 200 215	80 80 58	2 2 2.1	695 000 575 000 685 000	905 000 950 000 765 000	2 000 2 000 3 200	3 000	1 400 1 400 2 400	*24124CAME4 24124CE4 *22224EAE4	*24124CAMK30E4 24124CK30E4 *22224EAKE4	130 130 132	— 136 142	190 190 203	171 171 190	2 2 2	0.37 0.37 0.25	2.7 2.7 3.9	1.8 1.8 2.7	1.8 1.8 2.6	10 10 8.8
		215 215 260	76 76 86	2.1 2.1 3	790 000 630 000 1060 000	970 000 970 000 1 120 000	2 200 2 000 1 900	3 000 — 2 800	1 300 1 300 1 400	*23224CAME4 23224CE4 *22324CAME4(²)	* 23224CAMKE4 23224CKE4 * 22324CAMKE4(²)	132 132 134	140 —	203 203 246	182 182 222	2 2 2.5	0.34 0.34 0.32	2.9 2.9 3.1	2.0 2.0 2.1	1.9 1.9 2.0	12.1 12.1 22.2
	130	200 200 200	52 52 69	2 2 2	500 000 400 000 620 000	655 000 655 000 865 000	3 000 3 000 2 200	3 800 — 3 200	1 700 1 700 1 400	*23026CAME4 23026CDE4 *24026CAME4	*23026CAMKE4 23026CDKE4 *24026CAMK30E4	140 140 140	147 —	190 190 190	180 180 175	2 2 2	0.23 0.23 0.31	4.3 4.3 3.2	2.9 2.9 2.2	2.8 2.8 2.1	5.98 5.98 7.84
		200 210 210	69 64 64	2 2 2	495 000 630 000 505 000	865 000 825 000 825 000	2 200 2 600 2 600	3 400	1 400 1 300 1 300	24026CE4 *23126CAME4 23126CE4	24026CK30E4 *23126CAMKE4 23126CKE4	140 140 140	143 — 149	190 200 200	175 184 184	2 2 2	0.31 0.28 0.28	3.2 3.6 3.6	2.2 2.4 2.4	2.1 2.4 2.4	7.84 8.69 8.69
		210 210 230	80 80 64	2 2 3	735 000 590 000 820 000	1 010 000 1 010 000 940 000	1 800 1 800 2 800	2 800 2 600	1 300 1 300 2 200	*24126CAME4 24126CE4 *22226EAE4	*24126CAMK30E4 24126CK30E4 *22226EAKE4	140 140 144	— 146 152	200 200 216	180 180 204	2 2 2.5	0.35 0.35 0.26	2.9 2.9 3.8	1.9 1.9 2.6	1.9 1.9 2.5	10.7 10.7 11
_		230 230 280 280	80 80 93 93	3 3 4 4	875 000 700 000 1 240 000 995 000	1 080 000 1 080 000 1 350 000 1 350 000	2 000 2 000 1 800 1 800	2 800 	1 200 1 200 1 300 1 300	*23226CAME4 23226CE4 *22326CAME4 22326CE4	*23226CAMKE4 23226CKE4 *22326CAMKE4 22326CKE4	144 144 148 148	150 — 166	216 216 262 262	196 196 236 236	2.5 2.5 3 3	0.34 0.34 0.34 0.34	2.9 2.9 2.9 2.9	2.0 2.0 2.0 2.0	1.9 1.9 1.9 1.9	14.3 14.3 28.1 28.1
	130	215 215 215 260 200 200 200 210 210 210 230 230 230 280	58 76 76 86 52 52 52 69 64 64 64 80 80 80 93	2.1 2.1 2.1 3 2 2 2 2 2 2 2 2 3	790 000 630 000 1060 000 500 000 400 000 620 000 495 000 630 000 505 000 735 000 590 000 820 000 875 000 700 000 1 240 000 995 000	765 000 970 000 970 000 1 120 000 655 000 655 000 865 000 825 000 825 000 1 010 000 1 010 000 940 000 1 080 000 1 350 000	3 200 2 200 2 000 1 900 3 000 2 200 2 600 2 600 2 800 1 800 2 800 2 000 1 800 1 800 1 800	3 000 3 000 2 800 3 800 3 200 2 800 2 800 2 800 2 600 ———————————————————————————————————	2 400 1 300 1 300 1 400 1 700 1 700 1 400 1 400 1 300 1 300 1 300 2 200 1 200 1 200 1 300	* 22224EAE4 * 23224CAME4 23224CE4 * 22324CAME4(2) * 23026CAME4 23026CDE4 * 24026CAME4 24026CE4 * 23126CAME4 23126CE4 * 24126CAME4 24126CE4 * 22226EAE4 * 23226CAME4 23226CAME4 23226CAME4 23226CAME4	*22224EAKE4 *23224CAMKE4 23224CKE4 *22324CAMKE4 23026CAMKE4 23026CDKE4 *24026CAMK30E4 24026CK30E4 *23126CAMK4 23126CKE4 *24126CAMK30E4 24126CK30E4 *22226EAKE4 *23226CAMKE4 23226CAMKE4 23226CAMKE4 23226CAMKE4 23226CAMKE4	132 132 134 140 140 140 140 140 140 140 144 144 14	142	203 203 203 246 190 190 200 200 200 216 216 216 262 262	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	90 82 82 82 80 80 75 75 75 75 84 84 80 96 96 96 36 36 36 36	90 2 82 2 82 2 82 2 2.5 80 2 80 2 75 2 84 2 84 2 84 2 80 2 64 2 80 2 80 2 80 3 80 3 80 3 80 3 80 3 80 3 80 3	90 2 0.25 82 2 0.34 82 2 0.34 22 2.5 0.32 80 2 0.23 80 2 0.23 75 2 0.31 75 2 0.31 75 2 0.31 84 2 0.28 84 2 0.28 80 2 0.35 80 2 0.35 04 2.5 0.26 96 2.5 0.34 96 2.5 0.34 36 3 0.34 36 3 0.34	90 2 0.25 3.9 82 2 0.34 2.9 82 2 0.34 2.9 22 2.5 0.32 3.1 80 2 0.23 4.3 80 2 0.23 4.3 75 2 0.31 3.2 75 2 0.31 3.2 75 2 0.31 3.2 84 2 0.28 3.6 84 2 0.28 3.6 80 2 0.35 2.9 04 2.5 0.26 3.8 96 2.5 0.34 2.9 96 2.5 0.34 2.9 36 3 0.34 2.9	90 2 0.25 3.9 2.7 82 2 0.34 2.9 2.0 82 2 0.34 2.9 2.0 22 2.5 0.32 3.1 2.1 80 2 0.23 4.3 2.9 80 2 0.23 4.3 2.9 75 2 0.31 3.2 2.2 84 2 0.28 3.6 2.4 84 2 0.28 3.6 2.4 80 2 0.35 2.9 1.9 90 2 0.35 2.9 1.9 04 2.5 0.26 3.8 2.6 96 2.5 0.34 2.9 2.0 36 3 0.34 2.9 2.0 36 3 0.34 2.9 2.0 36 3 0.34 2.9 2.0	90 2 0.25 3.9 2.7 2.6 82 2 0.34 2.9 2.0 1.9 82 2 0.34 2.9 2.0 1.9 22 2.5 0.32 3.1 2.1 2.0 80 2 0.23 4.3 2.9 2.8 80 2 0.23 4.3 2.9 2.8 80 2 0.23 4.3 2.9 2.8 75 2 0.31 3.2 2.2 2.1 75 2 0.31 3.2 2.2 2.1 75 2 0.31 3.2 2.2 2.1 84 2 0.28 3.6 2.4 2.4 84 2 0.28 3.6 2.4 2.4 80 2 0.35 2.9 1.9 1.9 90 2.5 0.26 3.8 2.6 2.5 96 <

Bearing

Notes (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).

Numbers

- **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($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).
 - 3. For the dimensions od adapters and withdrawal sleeves, refer to Pages C351, and C357.

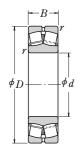


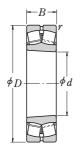
⁽²⁾ EA is also available. Load rating of EA is around 10% higher than CAM's, please consult NSK.

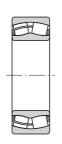
Mass

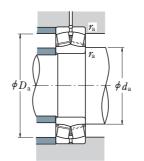
SPHERICAL ROLLER BEARINGS

Bore Diameter 140 - 150 mm









Abutment and Fillet Dimensions

Dynamic Equivalent Load $P - XF \perp VF$

$\Gamma = \Lambda$	$r_r + r_a$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

Constant

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Axial Load

Cylindrical Bore

Boundary Dimensions

Tapered Bore

Basic Load Ratings

Without an Oil Groove or Holes

Speeds

	(mm) (N)			1)	Th	(min ⁻¹)		3				(mm)					Factors	3	(kg)	
d	D	B	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	ra max.	max.) _a min.	r a max.	e	Y_2	Y_3	Y_0	approx.
140	210 210 210	53 53 69	2 2 2	525 000 420 000 635 000	715 000 715 000 905 000	2 800 2 800 2 200	3 800	1 600 1 600 1 300	*23028CAME4 23028CDE4 *24028CAME4	*23028CAMKE4 23028CDKE4 *24028CAMK30E4	150 150 150	157	200 200 200	190 190 186	2 2 2	0.22 0.22 0.29	4.5 4.5 3.4	3.0 3.0 2.3	2.9 2.9 2.2	6.49 6.49 8.37
	210 225 225	69 68 68	2 2.1 2.1	525 000 725 000 580 000	945 000 945 000 945 000	2 200 2 400 2 400	3 200	1 300 1 200 1 200	24028CE4 *23128CAME4 23128CE4	24028CK30E4 *23128CAMKE4 23128CKE4	150 152 152	154 — 158	200 213 213	186 198 198	2 2 2	0.29 0.28 0.28	3.4 3.6 3.6	2.3 2.4 2.4	2.2 2.3 2.3	8.37 10.5 10.5
	225 225 250	85 85 68	2.1 2.1 3	835 000 670 000 835 000	1 160 000 1 160 000 945 000	1 600 1 600 2 600	2 600 — 3 200	1 200 1 200 1 400	*24128CAME4 24128CE4 *22228CAME4	*24128CAMK30E4 24128CK30E4 *22228CAMKE4	152 152 154	 156 	213 213 236	193 193 219	2 2 2.5	0.35 0.35 0.25	2.9 2.9 4.0	1.9 1.9 2.7	1.9 1.9 2.6	13 13 14.5
	250 250 250	68 88 88	3 3	645 000 1 040 000 835 000	930 000 1 300 000 1 300 000	2 600 1 800 1 800	2 600	1 400 1 100 1 100	22228CDE4 *23228CAME4 23228CE4	22228CDKE4 *23228CAMKE4 23228CKE4	154 154 154	167 — 163	236 236 236	219 213 213	2.5 2.5 2.5	0.25 0.35 0.35	4.0 2.9 2.9	2.7 1.9 1.9	2.6 1.9 1.9	14.5 18.8 18.8
	300 300	102 102	4 4	1 450 000 1 160 000	1 590 000 1 590 000	1 700 1 700	2 400 —	1 200 1 200	*22328CAME4 22328CE4	*22328CAMKE4 22328CKE4	158 158	_ 177	282 282	253 253	3	0.35 0.35	2.9 2.9	1.9 1.9	1.9 1.9	35.4 35.4
150	225 225 225	56 56 75	2.1 2.1 2.1	590 000 470 000 740 000	815 000 815 000 1 090 000	2 600 2 600 1 900	3 600 3 000	1 400 1 400 1 200	*23030CAME4 23030CDE4 *24030CAME4	*23030CAMKE4 23030CDKE4 *24030CAMK30E4	162 162 162	168 —	213 213 213	203 203 198	2 2 2	0.22 0.22 0.30	4.6 4.6 3.4	3.1 3.1 2.3	3.0 3.0 2.2	7.9 7.9 10.5
	225 250 250	75 80 80	2.1 2.1 2.1	590 000 905 000 725 000	1 090 000 1 180 000 1 180 000	1 900 2 200 2 200	2 800	1 200 1 100 1 100	24030CE4 *23130CAME4 23130CE4	24030CK30E4 *23130CAMKE4 23130CKE4	162 162 162	165 — 174	213 238 238	198 218 218	2 2 2	0.30 0.30 0.30	3.4 3.4 3.4	2.3 2.3 2.3	2.2 2.2 2.2	10.5 15.8 15.8
	250 250 270	100 100 73	2.1 2.1 3	1 070 000 890 000 955 000	1 450 000 1 530 000 1 120 000	1 400 1 400 2 400	2 400 — 3 000	1 100 1 100 1 300	*24130CAME4 24130CE4 *22230CAME4	*24130CAMK30E4 24130CK30E4 *22230CAMKE4	162 162 164	169 —	238 238 256	212 212 236	2 2 2.5	0.38 0.38 0.26	2.6 2.6 3.9	1.8 1.8 2.6	1.7 1.7 2.5	19.8 19.8 18.4
	270 270 270 320	73 96 96 108	3 3 4	765 000 1 220 000 975 000 1 530 000	1 120 000 1 560 000 1 560 000 1 690 000	2 400 1 700 1 700 1 600	2 400 2 200	1 300 1 100 1 100 1 100	22230CDE4 *23230CAME4 23230CE4 *22330CAME4	22230CDKE4 *23230CAMKE4 23230CKE4 *22330CAMKE4	164 164 164 168	179 — 176 —	256 256 256 302	236 230 230 270	2.5 2.5 2.5 3	0.26 0.35 0.35 0.35	3.9 2.9 2.9 2.9	2.6 1.9 1.9 1.9	2.5 1.9 1.9 1.9	18.4 24.2 24.2 41.5
Not	o (1)	The cuff	fiv K or K	30 rangaanta has	ringe with tane	rad haras (tana	r 1:12 or 1:20\			Pamarke 1 The hea	ringe done	tod by an	netorick (*	c) are NCK	UDCTM hoo	ringe and	l an ail	aroovo	and ho	loc are stands

Bearing

Numbers

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).

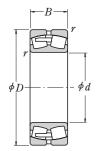
- **Remarks** 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.
 - 2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.
 - The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).

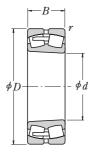


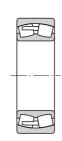


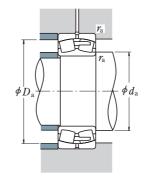
^{3.} For the dimensions od adapters and withdrawal sleeves, refer to Pages C352, and C357 – C358.

Bore Diameter 160 - 170 mm









Abutment and Fillet Dimensions

Dynamic Equivalent Load $P - XF \perp VF$

$\Gamma = \Lambda$	$r_r + r_a$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

Constant

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

Axial Load

Mass

C۱	/lind	rical	Bore

Boundary Dimensions

Tapered Bore

Basic Load Ratings

Without an Oil Groove and Holes

Speeds

	ounuary 1 m	ım)	UIIS	Dasic Loa	√)		(min ⁻¹)		Dearing	Nullipers		Abutillelit	(mm)	וווופוופוופווטווו	3	Constant		Factors		(kg)
d	D	B	r	$C_{\rm r}$	C_{0r}	Thermal Reference	Limiting	•	Cylindrical Bore	Tapered Bore(1)		ļ _a) _a	$r_{\rm a}$	e	Y_2	Y_3	Y_0	approx.
			min.			Speed	Mechanical	Grease			min.	max.	max.	min.	max.					
160	220 240 240	45 60 60	2 2.1 2.1	450 000 675 000 540 000	675 000 955 000 955 000	3 000 2 400 2 400	3 200 3 200 —	1 400 1 300 1 300	*23932CAME4 *23032CAME4 23032CDE4	*23932CAMKE4 *23032CAMKE4 23032CDKE4	170 172 172	 179	210 228 228	203 216 216	2 2 2	0.18 0.22 0.22	5.6 4.5 4.5	3.8 3.0 3.0	3.7 2.9 2.9	4.97 9.66 9.66
	240 240 270	80 80 86	2.1 2.1 2.1	845 000 680 000 1 070 000	1 260 000 1 260 000 1 400 000	1 800 1 800 2 000	2 8 <u>00</u> 2 600	1 100 1 100 1 000	*24032CAME4 24032CE4 *23132CAME4	* 24032CAMK30E4 24032CK30E4 * 23132CAMKE4	172 172 172	177 —	228 228 258	212 212 234	2 2 2	0.30 0.30 0.30	3.4 3.4 3.4	2.3 2.3 2.3	2.2 2.2 2.2	12.7 12.7 20.3
	270 270 270	86 109 109	2.1 2.1 2.1	855 000 1 240 000 1 040 000	1 400 000 1 670 000 1 760 000	2 000 1 300 1 300	2 200	1 000 1 000 1 000	23132CE4 *24132CAME4 24132CE4	23132CKE4 *24132CAMK30E4 24132CK30E4	172 172 172	185 — 179	258 258 258	234 229 229	2 2 2	0.30 0.39 0.39	3.4 2.6 2.6	2.3 1.7 1.7	2.2 1.7 1.7	20.3 25.4 25.4
	290 290 290	80 80 104	3 3 3	1 140 000 910 000 1 370 000	1 320 000 1 320 000 1 770 000	2 200 2 200 1 500	2 800 2 200	1 200 1 200 1 000	*22232CAME4 22232CDE4 *23232CAME4	* 22232CAMKE4 22232CDKE4 * 23232CAMKE4	174 174 174	190 —	276 276 276	255 255 245	2.5 2.5 2.5	0.26 0.26 0.34	3.8 3.8 2.9	2.6 2.6 2.0	2.5 2.5 1.9	23.1 23.1 30.5
	290 340	104 114	3 4	1 100 000 1 700 000	1 770 000 1 900 000	1 500 1 400	2 200	1 000 1 100	23232CE4 *22332CAME4	23232CKE4 *22332CAMKE4	174 178	189 —	276 322	245 287	2.5 3	0.34 0.35	2.9 2.9	2.0 1.9	1.9 1.9	30.5 49.3
170	230 260 260	45 67 67	2 2.1 2.1	450 000 795 000 640 000	680 000 1 090 000 1 090 000	3 000 2 200 2 200	3 600 3 000 —	1 400 1 200 1 200	*23934CAME4 *23034CAME4 23034CDE4	*23934CAMKE4 *23034CAMKE4 23034CDKE4	180 182 182	_ 191	220 248 248	213 233 233	2 2 2	0.17 0.23 0.23	5.8 4.3 4.3	3.9 2.9 2.9	3.8 2.8 2.8	5.38 13 13
	260 260 280	90 90 88	2.1 2.1 2.1	1 030 000 825 000 1 180 000	1 520 000 1 520 000 1 570 000	1 600 1 600 1 800	2 4 <u>00</u> 2 600	1 000 1 000 1 000	*24034CAME4 24034CE4 *23134CAME4	*24034CAMK30E4 24034CK30E4 *23134CAMKE4	182 182 182	188 —	248 248 268	228 228 245	2 2 2	0.31 0.31 0.29	3.2 3.2 3.5	2.2 2.2 2.3	2.1 2.1 2.3	17.3 17.3 21.8
	280 280 280	88 109 109	2.1 2.1 2.1	940 000 1 280 000 1 080 000	1 570 000 1 770 000 1 860 000	1 800 1 200 1 200	2 200	1 000 1 000 1 000	23134CE4 *24134CAME4 24134CE4	23134CKE4 *24134CAMK30E4 24134CK30E4	182 182 182	194 — 190	268 268 268	245 239 239	2 2 2	0.29 0.37 0.37	3.5 2.7 2.7	2.3 1.8 1.8	2.3 1.8 1.8	21.8 26.6 26.6
	310 310 310	86 86 110	4 4 4	1 240 000 990 000 1 500 000	1 500 000 1 500 000 1 910 000	2 000 2 000 1 400	2 600 2 200	1 100 1 100 900	*22234CAME4 22234CDE4 *23234CAME4	* 22234CAMKE4 22234CDKE4 * 23234CAMKE4	188 188 188	206 —	292 292 292	270 270 261	3 3 3	0.26 0.26 0.34	3.8 3.8 2.9	2.6 2.6 2.0	2.5 2.5 1.9	28.8 28.8 36.4
	310 360	110 120	4 4	1 200 000 1 970 000	1 910 000 2 110 000	1 400 1 300	2 000	900 1 000	23234CE4 *22334CAME4	23234CKE4 * 22334CAMKE4	188 188	201	292 342	261 304	3	0.34 0.35	2.9 2.9	2.0 1.9	1.9 1.9	36.4 57.9
		120	4	1 970 000		1 300	2 000				188		342	304	3	0.35	2.9	1.9	_	

Bearing

Numbers

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).





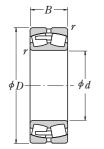
Remarks 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.

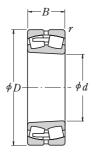
When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.

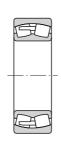
The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).

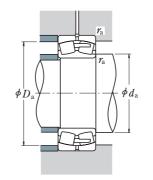
^{3.} For the dimensions od adapters and withdrawal sleeves, refer to Pages C352, and C358.

Bore Diameter 180 – 190 mm









Dynamic Equivalent Load $P - XF \perp VF$

P = X	$\mathbf{r}_{r} + \mathbf{r} \mathbf{r}_{a}$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

В	oundary (m	Dimensionm)	ons	Basic Loa	•		Speeds (min ⁻¹)		Bearing	Numbers		Abutment	and Fillet I	Dimension	S	Constant		xial Lo		Mass (kg)
d	D	B	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	$d_{ m a}$ max.	max.	O _a min.	${\pmb r}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
180	250 280 280	52 74 74	2 2.1 2.1	590 000 935 000 750 000	890 000 1 270 000 1 270 000	2 600 2 000 2 000	3 000 2 800 —	1 200 1 200 1 200	*23936CAME4 *23036CAME4 23036CDE4	*23936CAMKE4 *23036CAMKE4 23036CDKE4	190 192 192	_ 202	240 268 268	230 249 249	2 2 2	0.18 0.24 0.24	5.5 4.2 4.2	3.7 2.8 2.8	3.6 2.8 2.8	7.64 17.1 17.1
	280 280 300	100 100 96	2.1 2.1 3	1 210 000 965 000 1 320 000	1 750 000 1 750 000 1 760 000	1 500 1 500 1 700	2 200 — 2 200	950 950 900	*24036CAME4 24036CE4 *23136CAME4	*24036CAMK30E4 24036CK30E4 *23136CAMKE4	192 192 194	200	268 268 286	245 245 260	2 2 2.5	0.32 0.32 0.30	3.1 3.1 3.4	2.1 2.1 2.3	2.0 2.0 2.2	22.7 22.7 27.5
	300 300 300	96 118 118	3 3 3	1 050 000 1 490 000 1 190 000	1 760 000 2 040 000 2 040 000	1 700 1 100 1 100	2 000	900 900 900	23136CE4 *24136CAME4 24136CE4	23136CKE4 * 24136CAMK30E4 24136CK30E4	194 194 194	206 — 202	286 286 286	260 255 255	2.5 2.5 2.5	0.30 0.37 0.37	3.4 2.7 2.7	2.3 1.8 1.8	2.2 1.8 1.8	27.5 33.1 33.1
	320 320 320	86 86 112	4 4 4	1 280 000 1 020 000 1 620 000	1 540 000 1 540 000 2 110 000	2 000 2 000 1 300	2 600 2 000	1 100 1 100 850	*22236CAME4 22236CDE4 *23236CAME4	*22236CAMKE4 22236CDKE4 *23236CAMKE4	198 198 198	2 <u>12</u>	302 302 302	278 278 274	3 3	0.26 0.26 0.33	3.9 3.9 3.0	2.6 2.6 2.0	2.6 2.6 2.0	30.2 30.2 38.9
	320 380	112 126	4 4	1 300 000 2 170 000	2 110 000 2 340 000	1 300 1 200	2 000	850 950	23236CE4 *22336CAME4	23236CKE4 *22336CAMKE4	198 198	211 —	302 362	274 322	3	0.33 0.34	3.0 2.9	2.0	2.0 1.9	38.9 67
190	260 290 290	52 75 100	2 2.1 2.1	575 000 970 000 1 220 000	875 000 1 350 000 1 840 000	2 600 2 000 1 400	3 000 2 600 2 200	1 200 1 100 900	*23938CAME4 *23038CAME4 *24038CAME4	*23938CAMKE4 *23038CAMKE4 *24038CAMK30E4	200 202 202	_ _ _	250 278 278	240 261 253	2 2 2	0.18 0.24 0.31	5.7 4.2 3.2	3.8 2.8 2.2	3.7 2.8 2.1	8.03 17.6 24
	290 320 320	100 104 104	2.1 3 3	975 000 1 480 000 1 190 000	1 840 000 2 020 000 2 020 000	1 400 1 600 1 600	2 200 —	900 850 850	24038CE4 *23138CAME4 23138CE4	24038CK30E4 * 23138CAMKE4 23138CKE4	202 204 204	210 — 219	278 306 306	253 276 276	2 2.5 2.5	0.31 0.31 0.31	3.2 3.3 3.3	2.2 2.2 2.2	2.1 2.2 2.2	24 34.5 34.5
	320 320 340	128 128 92	3 3 4	1 710 000 1 370 000 1 420 000	2 330 000 2 330 000 1 730 000	1 000 1 000 1 800	1 900 — 2 400	850 850 1 000	*24138CAME4 24138CE4 *22238CAME4	*24138CAMK30E4 24138CK30E4 *22238CAMKE4	204 204 208	2 <u>11</u>	306 306 322	269 269 296	2.5 2.5 3	0.40 0.40 0.26	2.5 2.5 3.8	1.7 1.7 2.6	1.6 1.6 2.5	41.5 41.5 35.5
	340 340 400	120 120 132	4 4 5	1 800 000 1 440 000 2 370 000	2 350 000 2 350 000 2 590 000	1 200 1 200 1 200	1 900 1 900	800 800 900	*23238CAME4 23238CE4 *22338CAME4	* 23238CAMKE4 23238CKE4 * 22338CAMKE4	208 208 212	222 —	322 322 378	288 288 338	3 3 4	0.35 0.35 0.34	2.9 2.9 2.9	1.9 1.9 2.0	1.9 1.9 1.9	47.6 47.6 77.6

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).

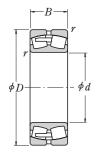
- **Remarks** 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.
 - 2. When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.
 - The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).

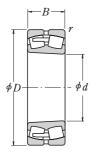


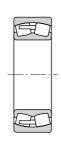


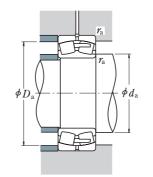
^{3.} For the dimensions od adapters and withdrawal sleeves, refer to Pages C352, and C358.

Bore Diameter 200 – 220 mm









Dynamic Equivalent Load

P = X	$F_{\rm r} + Y F_{\rm a}$	
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/$
v	17	v

 $\begin{array}{c|ccccc} X & Y & X & Y \\ \hline 1 & Y_3 & 0.67 & Y_2 \end{array}$

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

В	oundary (m	Dimensionm)	ons	Basic Loa	•		Speeds (min ⁻¹)		Bearing	Numbers		Abutment	and Fillet I	Dimension	S	Constant		xial Lo Factor		Mass (kg)
d	D	B	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	$d_{ m a}$ max.	max.	O _a min.	${\it r}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
200	280 310 310	60 82 109	2.1 2.1 2.1	710 000 1 180 000 1 420 000	1 060 000 1 700 000 2 120 000	2 400 1 800 1 300	2 600 2 400 2 000	1 100 1 000 850	*23940CAME4 *23040CAME4 *24040CAME4	*23940CAMKE4 *23040CAMKE4 *24040CAMK30E4	212 212 212	=	268 298 298	258 279 271	2 2 2	0.20 0.25 0.32	5.1 4.0 3.1	3.4 2.7 2.1	3.3 2.6 2.0	11 22.6 30.4
	310 340 340	109 112 112	2.1 3 3	1 140 000 1 700 000 1 360 000	2 120 000 2 330 000 2 330 000	1 300 1 500 1 500	2 000	850 800 800	24040CE4 *23140CAME4 23140CE4	24040CK30E4 *23140CAMKE4 23140CKE4	212 214 214	223 — 232	298 326 326	271 293 293	2 2.5 2.5	0.32 0.31 0.31	3.1 3.2 3.2	2.1 2.2 2.2	2.0 2.1 2.1	30.4 42.7 42.7
	340 340 360	140 140 98	3 3 4	1 960 000 1 570 000 1 620 000	2 660 000 2 670 000 2 010 000	950 950 1 700	1 800 — 2 200	800 800 950	*24140CAME4 24140CE4 *22240CAME4	*24140CAMK30E4 24140CK30E4 *22240CAMKE4	214 214 218	226 —	326 326 342	290 290 315	2.5 2.5 3	0.39 0.39 0.26	2.6 2.6 3.8	1.8 1.8 2.6	1.7 1.7 2.5	51.3 51.3 42.6
	360 360 420	128 128 138	4 4 5	2 070 000 1 660 000 2 500 000	2 750 000 2 750 000 2 990 000	1 100 1 100 1 000	1 800 — 1 700	750 750 850	*23240CAME4 23240CE4 *22340CAME4	*23240CAMKE4 23240CKE4 *22340CAMKE4	218 218 222	237 —	342 342 398	307 307 352	3 3 4	0.34 0.34 0.34	2.9 2.9 2.9	2.0 2.0 2.0	1.9 1.9 1.9	57.1 57.1 92.6
220	300 340 340	60 90 118	2.1 3 3	785 000 1 360 000 1 640 000	1 240 000 1 980 000 2 490 000	2 200 1 600 1 200	2 600 2 200 1 900	1 000 950 750	*23944CAME4 *23044CAME4 *24044CAME4	*23944CAMKE4 *23044CAMKE4 *24044CAMK30E4	232 234 234		288 326 326	278 302 296	2 2.5 2.5	0.18 0.24 0.31	5.7 4.1 3.2	3.8 2.8 2.1	3.7 2.7 2.1	12.2 29.7 40.5
	340 370 370	118 120 120	3 4 4	1 360 000 1 960 000 1 570 000	2 600 000 2 710 000 2 710 000	1 200 1 300 1 300	1 800	750 710 710	24044CE4 *23144CAME4 23144CE4	24044CK30E4 *23144CAMKE4 23144CKE4	234 238 238	244 — 254	326 352 352	296 320 320	2.5 3 3	0.31 0.30 0.30	3.2 3.3 3.3	2.1 2.2 2.2	2.1 2.2 2.2	40.5 53 53
	370 370 400	150 150 108	4 4 4	2 250 000 1 800 000 1 960 000	3 200 000 3 200 000 2 430 000	850 850 1 500	1 600 — 2 000	710 710 850	*24144CAME4 24144CE4 *22244CAME4	*24144CAMK30E4 24144CK30E4 *22244CAMKE4	238 238 238	 248 	352 352 382	313 313 348	3 3 3	0.39 0.39 0.27	2.6 2.6 3.7	1.7 1.7 2.5	1.7 1.7 2.4	66.7 66.7 59
	400 400 460	144 144 145	4 4 5	2 520 000 2 020 000 2 940 000	3 400 000 3 400 000 3 400 000	1 000 850 950	1 600 — 1 600	670 670 750	*23244CAME4 23244CE4 *22344CAME4	*23244CAMKE4 23244CKE4 *22344CAMKE4	238 238 242	260 —	382 382 438	337 337 391	3 3 4	0.35 0.35 0.33	2.9 2.9 3.0	1.9 1.9 2.0	1.9 1.9 2.0	80.4 80.4 116

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).

Remarks 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.

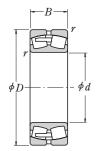
 When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.

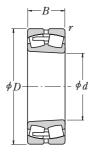
The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads($> 0.10C_r$).

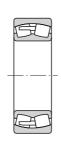
3. For the dimensions od adapters and withdrawal sleeves, refer to Pages C353, and C359.

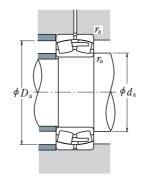


Bore Diameter 240 - 280 mm









Abutment and Fillet Dimensions

Dynamic Equivalent Load $P - XF \perp VF$

$\Gamma = \Lambda$	$r_r + r_a$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

Constant

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Axial Load

Mass

Cylindrical Bore

Boundary Dimensions

Tapered Bore

Basic Load Ratings

Without an Oil Groove and Holes

Speeds

D	(mm) (N)		•	<u></u>	(min ⁻¹)		Dearing	Nullibels		Abutillelli	(mm)	Dilliciisioi	15	Constant		Factors		(kg)		
d	D	B	γ min.	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	$d_{ m a}$ max.	$\max_{} I$	D _a min.	$m{\gamma}_{\mathrm{a}}$ max.	e	Y_2	Y_3	Y_0	approx.
240	320 360 360	60 92 118	2.1 3 3	795 000 1 450 000 1 730 000	1 300 000 2 140 000 2 730 000	1 900 1 500 1 100	2 600 2 200 1 800	950 850 710	*23948CAME4 *23048CAME4 *24048CAME4	*23948CAMKE4 *23048CAMKE4 *24048CAMK30E4	252 254 254	_ _ _	308 346 346	298 324 317	2 2.5 2.5	0.17 0.24 0.29	6.0 4.2 3.4	4.0 2.8 2.3	3.9 2.7 2.2	13.3 32.6 43.4
	360 400 400	118 128 128	3 4 4	1 390 000 2 230 000 1 790 000	2 730 000 3 100 000 3 100 000	1 100 1 200 1 200	1 700	710 670 670	24048CE4 *23148CAME4 23148CE4	24048CK30E4 *23148CAMKE4 23148CKE4	254 258 258	265 — 275	346 382 382	317 347 347	2.5 3 3	0.29 0.30 0.30	3.4 3.3 3.3	2.3 2.2 2.2	2.2 2.2 2.2	43.4 66.9 66.9
	400 400 440	160 160 120	4 4 4	2 660 000 2 130 000 2 340 000	3 800 000 3 800 000 2 890 000	750 750 1 400	1 500 — 1 800	670 670 750	*24148CAME4 24148CE4 *22248CAME4	*24148CAMK30E4 24148CK30E4 *22248CAMKE4	258 258 258	268 —	382 382 422	341 341 383	3 3 3	0.38 0.38 0.27	2.7 2.7 3.7	1.8 1.8 2.5	1.8 1.8 2.4	79.5 79.5 80.2
	440 500	160 155	4 5	3 050 000 3 250 000	4 050 000 3 800 000	850 850	1 500 1 500	630 670	*23248CAME4 *22348CAME4	*23248CAMKE4 *22348CAMKE4	258 262	_	422 478	372 423	3 4	0.37 0.32	2.7 3.2	1.8 2.1	1.8 2.1	106 147
260	360 400 400	75 104 140	2.1 4 4	1 170 000 1 780 000 2 270 000	1 870 000 2 580 000 3 500 000	1 800 1 300 950	2 200 1 900 1 600	850 800 630	*23952CAME4 *23052CAME4 *24052CAME4	*23952CAMKE4 *23052CAMKE4 *24052CAMK30E4	272 278 278	_ _ _	348 382 382	333 356 348	2 3 3	0.19 0.25 0.32	5.4 4.1 3.1	3.6 2.7 2.1	3.5 2.7 2.1	23 46.6 62.6
	440 440 480	144 180 130	4 4 5	2 700 000 3 200 000 2 720 000	3 750 000 4 700 000 3 400 000	1 100 630 1 200	1 500 1 300 1 700	600 600 670	*23152CAME4 *24152CAME4 *22252CAME4	*23152CAMKE4 *24152CAMK30E4 *22252CAMKE4	278 278 282	_ _ _	422 422 458	380 371 418	3 3 4	0.32 0.39 0.27	3.2 2.6 3.7	2.1 1.7 2.5	2.1 1.7 2.5	88.2 109 104
	480 540	174 165	5 6	3 400 000 3 900 000	4 550 000 4 600 000	800 750	1 400 1 400	560 630	*23252CAME4 *22352CAME4	*23252CAMKE4 *22352CAMKE4	282 288	_	458 512	406 462	4 5	0.37 0.32	2.7 3.2	1.8 2.1	1.8 2.1	137 180
280	380 420 420	75 106 140	2.1 4 4	1 160 000 1 930 000 2 350 000	1 950 000 2 950 000 3 800 000	1 600 1 200 850	2 000 1 800 1 500	800 710 600	*23956CAME4 *23056CAME4 *24056CAME4	*23956CAMKE4 *23056CAMKE4 *24056CAMK30E4	292 298 298		368 402 402	351 377 369	2 3 3	0.18 0.24 0.31	5.7 4.2 3.3	3.9 2.8 2.2	3.8 2.7 2.2	24.5 50.5 66.4
	460 460 500	146 180 130	5 5 5	2 790 000 3 300 000 2 850 000	4 000 000 5 000 000 3 650 000	1 000 600 1 100	1 500 1 300 1 600	560 560 630	*23156CAME4 *24156CAME4 *22256CAME4	*23156CAMKE4 *24156CAMK30E4 *22256CAMKE4	302 302 302	_ _ _	438 438 478	400 392 439	4 4 4	0.30 0.37 0.25	3.3 2.7 4.0	2.2 1.8 2.7	2.2 1.8 2.6	94.3 115 110
	500 580	176 175	5 6	3 600 000 4 350 000	4 900 000 5 150 000	750 710	1 300 1 300	530 560	*23256CAME4 *22356CAME4	*23256CAMKE4 *22356CAMKE4	302 308	=	478 552	425 496	4 5	0.35 0.31	2.9 3.2	1.9 2.1	1.9 2.1	147 221

Bearing

Numbers

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).





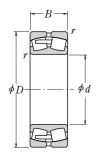
Remarks 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.

^{2.} When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.

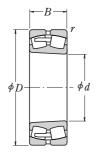
The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).

^{3.} For the dimensions od adapters and withdrawal sleeves, refer to Pages C353, and C359.

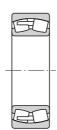
Bore Diameter 300 – 380 mm



Cylindrical Bore

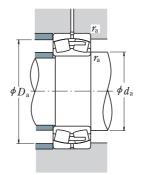


Tapered Bore





Without an Oil Groove and Holes



Dynamic Equivalent Load $P - XF \perp VF$

P = X	$\mathbf{r}_{r} + \mathbf{r} \mathbf{r}_{a}$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

В	,	Dimensionm)	ons	Basic Loa	ŭ		Speeds (min ⁻¹)		Bearing	Numbers	,	Abutment	and Fillet (mm)	Dimension	S	Constant		xial Loa Factors		Mass (kg)
d	D	B	γ min.	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	ļ _a max.	$\max_{} L$	O _a min.	${m \gamma}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
300	420 460 460	90 118 160	3 4 4	1 540 000 2 400 000 2 890 000	2 490 000 3 700 000 4 600 000	1 500 1 100 800	1 800 1 600 1 400	710 670 530	*23960CAME4 *23060CAME4 *24060CAME4	*23960CAMKE4 *23060CAMKE4 *24060CAMK30E4	314 318 318	=	406 442 442	386 413 400	2.5 3 3	0.19 0.24 0.32	5.2 4.2 3.1	3.5 2.8 2.1	3.4 2.7 2.0	38.2 70.5 93.6
	500 500 540 540	160 200 140 192	5 5 5	3 350 000 3 900 000 3 250 000 4 250 000	4 800 000 5 800 000 4 250 000 5 900 000	900 530 1 000 670	1 400 1 200 1 500 1 200	500 500 600 480	*23160CAME4 *24160CAME4 *22260CAME4 *23260CAME4	*23160CAMKE4 *24160CAMK30E4 *22260CAMKE4 *23260CAMKE4	322 322 322 322	_ _ _	478 478 518 518	433 423 473 458	4 4 4 4	0.31 0.38 0.25 0.35	3.3 2.6 4.0 2.9	2.2 1.8 2.7 1.9	2.2 1.7 2.6 1.9	125 152 139 189
320	440 480 480	90 121 160	3 4 4	1 620 000 2 450 000 3 050 000	2 750 000 3 850 000 5 050 000	1 400 1 000 710	1 700 1 600 1 300	670 630 500	*23964CAME4 *23064CAME4 *24064CAME4	*23964CAMKE4 *23064CAMKE4 *24064CAMK30E4	334 338 338	=	426 462 462	406 432 422	2.5 3 3	0.18 0.24 0.31	5.5 4.2 3.3	3.7 2.8 2.2	3.6 2.8 2.2	40.6 75.6 99.7
	540 540 580 580	176 218 150 208	5 5 5 5	3 850 000 4 400 000 3 750 000 4 850 000	5 500 000 6 650 000 4 850 000 6 900 000	800 500 950 600	1 300 1 100 1 400 1 100	480 480 530 450	*23164CAME4 *24164CAME4 *22264CAME4 *23264CAME4	* 23164CAMKE4 * 24164CAMK30E4 * 22264CAMKE4 * 23264CAMKE4	342 342 342 342	_ _ _	518 518 558 558	466 456 508 488	4 4 4 4	0.31 0.39 0.26 0.36	3.2 2.6 3.9 2.8	2.1 1.7 2.6 1.9	2.1 1.7 2.6 1.8	162 196 174 239
340	460 520 520	90 133 180	3 5 5	1 670 000 2 850 000 3 650 000	2 840 000 4 400 000 6 050 000	1 300 950 670	1 700 1 500 1 200	630 560 480	*23968CAME4 *23068CAME4 *24068CAME4	*23968CAMKE4 *23068CAMKE4 *24068CAMK30E4	354 362 362	_	446 498 498	427 465 454	2.5 4 4	0.18 0.24 0.32	5.7 4.2 3.2	3.8 2.8 2.1	3.7 2.8 2.1	42.4 101 135
	580 580 620	190 243 224	5 5 6	4 500 000 5 300 000 4 400 000	6 600 000 7 900 000 7 800 000	710 450 480	1 200 1 000 —	430 430 400	*23168CAME4 *24168CAME4 23268CAME4	*23168CAMKE4 *24168CAMK30E4 23268CAMKE4	362 362 368	=	558 558 592	499 489 521	4 4 5	0.31 0.40 0.36	3.2 2.5 2.8	2.1 1.7 1.9	2.1 1.7 1.8	206 257 295
360	480 540 540	90 134 180	3 5 5	1 730 000 2 990 000 3 650 000	3 050 000 4 700 000 6 100 000	1 200 900 630	1 700 1 400 1 200	600 530 450	*23972CAME4 *23072CAME4 *24072CAME4	*23972CAMKE4 *23072CAMKE4 *24072CAMK30E4	374 382 382	=	466 518 518	447 485 476	2.5 4 4	0.17 0.24 0.32	6.0 4.2 3.2	4.1 2.8 2.1	4.0 2.8 2.1	44.7 106 139
	600 600 650	192 243 232	5 5 6	4 800 000 5 250 000 4 800 000	7 100 000 8 000 000 8 550 000	670 430 450	1 100 1 000 —	400 400 380	*23172CAME4 *24172CAME4 23272CAME4	*23172CAMKE4 *24172CAMK30E4 23272CAMKE4	382 382 388	=	578 578 622	520 507 549	4 4 5	0.31 0.40 0.36	3.2 2.5 2.8	2.2 1.7 1.9	2.1 1.7 1.8	217 264 342
380	520 560 560	106 135 180	4 5 5	2 340 000 3 150 000 3 850 000	4 100 000 5 100 000 6 600 000	1 100 850 600	1 500 1 400 1 200	530 530 430	*23976CAME4 *23076CAME4 *24076CAME4	*23976CAMKE4 *23076CAMKE4 *24076CAMK30E4	398 402 402	=	502 538 538	482 506 496	3 4 4	0.18 0.22 0.29	5.5 4.5 3.4	3.7 3.0 2.3	3.6 3.0 2.3	65.4 113 148
	620 620 680	194 243 240	5 5 6	4 000 000 4 350 000 5 150 000	7 600 000 8 450 000 9 200 000	530 360 430	_ _ _	400 400 360	23176CAME4 24176CAME4 23276CAME4	23176CAMKE4 24176CAMK30E4 23276CAMKE4	402 402 408	=	598 598 652	540 529 578	4 4 5	0.30 0.38 0.35	3.3 2.6 2.9	2.2 1.8 1.9	2.2 1.7 1.9	229 275 372
Not	o (1)	The cuff	fiv K or K	20 rangaanta har	ringe with tane	rad haras (tana	r 1:12 or 1:20)			Remarks 1 The her	ringe dono	tod by an	actorick (s	k) ara NCV	UDCIM hos	ringe and	l an ail	aroovo	and ho	loc are etan

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).





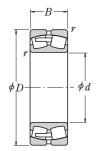
Remarks 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.

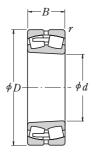
^{2.} When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.

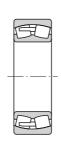
The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).

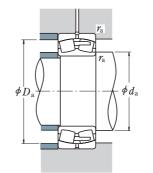
^{3.} For the dimensions od adapters and withdrawal sleeves, refer to Pages C354, and C360.

Bore Diameter 400 - 460 mm









Dynamic Equivalent Load

P = X	$F_{\rm r} + YF_{\rm a}$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

Cylindrical Bore

Tapered Bore

Without an Oil Groove and Holes

E	Soundary	Dimensi	ons		ad Ratings	Speeds (min ⁻¹) Thermal		(min ⁻¹)			Bearing	Numbers	/	Abutment	and Fillet	Dimension	S	Constant		xial Loa Factors		Mass (kg)
d	D	В	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	d min.	a max.	max.	O _a min.	${m \gamma}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.		
400	540 600 600	106 148 200	4 5 5	2 370 000 3 700 000 4 500 000	4 250 000 5 900 000 7 600 000	1 000 800 560	1 400 1 300 1 100	530 480 400	*23980CAME4 *23080CAME4 *24080CAME4	*23980CAMKE4 *23080CAMKE4 *24080CAMK30E4	418 422 422		522 578 578	501 540 527	3 4 4	0.18 0.23 0.31	5.7 4.4 3.3	3.9 3.0 2.2	3.8 2.9 2.2	69.1 146 193		
	650 650 720	200 250 256	6 6 6	4 150 000 4 950 000 5 800 000	7 900 000 10 100 000 10 400 000	500 320 380	_ _ _	380 380 340	23180CAME4 24180CAME4 23280CAME4	23180CAMKE4 24180CAMK30E4 23280CAMKE4	428 428 428		622 622 692	569 551 610	5 5 5	0.29 0.37 0.36	3.4 2.7 2.8	2.3 1.8 1.9	2.3 1.8 1.9	257 316 449		
420	560 620 620	106 150 200	4 5 5	2 340 000 2 910 000 3 750 000	4 250 000 5 850 000 8 100 000	1 000 670 480	1 400 — —	500 450 380	* 23984CAME4 23084CAME4 24084CAME4	*23984CAMKE4 23084CAMKE4 24084CAMK30E4	438 442 442	_ _ _	542 598 598	521 562 549	3 4 4	0.17 0.23 0.31	6.0 4.3 3.2	4.0 2.9 2.2	3.9 2.8 2.1	71.6 151 199		
	700 700 760	224 280 272	6 6 7.5	5 000 000 6 000 000 6 450 000	9 400 000 12 000 000 11 700 000	480 280 360	_ _ _	340 340 320	23184CAME4 24184CAME4 23284CAME4	23184CAMKE4 24184CAMK30E4 23284CAMKE4	448 448 456	_ _ _	672 672 724	607 598 644	5 5 6	0.31 0.38 0.35	3.3 2.6 2.9	2.2 1.8 1.9	2.2 1.7 1.9	341 421 534		
440	600 650 650	118 157 212	4 6 6	2 190 000 3 150 000 4 150 000	4 800 000 6 350 000 9 100 000	630 630 450	_ _ _	450 430 360	23988CAME4 23088CAME4 24088CAME4	23988CAMKE4 23088CAMKE4 24088CAMK30E4	458 468 468	_ _ _	582 622 622	555 587 576	3 5 5	0.18 0.23 0.31	5.7 4.3 3.2	3.9 2.9 2.1	3.8 2.8 2.1	96.3 173 237		
	720 720 790	226 280 280	6 6 7.5	5 300 000 6 000 000 6 900 000	10 300 000 12 100 000 12 800 000	430 280 340	_ _ _	320 320 300	23188CAME4 24188CAME4 23288CAME4	23188CAMKE4 24188CAMK30E4 23288CAMKE4	468 468 476		692 692 754	627 617 669	5 5 6	0.3 0.37 0.35	3.3 2.7 2.9	2.2 1.8 1.9	2.2 1.8 1.9	360 433 594		
460	620 680 680	118 163 218	4 6 6	2 220 000 3 450 000 4 500 000	4 950 000 7 100 000 9 950 000	600 600 430	_ _ _	430 400 340	23992CAME4 23092CAME4 24092CAME4	23992CAMKE4 23092CAMKE4 24092CAMK30E4	478 488 488		602 652 652	575 615 604	3 5 5	0.17 0.22 0.29	5.9 4.6 3.4	4.0 3.1 2.3	3.9 3.0 2.3	100 201 266		
	760 760 830	240 300 296	7.5 7.5 7.5	5 700 000 6 300 000 7 350 000	10 900 000 12 400 000 13 700 000	430 280 320	_ _ _	300 300 280	23192CAME4 24192CAME4 23292CAME4	23192CAMKE4 24192CAMK30E4 23292CAMKE4	496 496 496	_	724 724 794	661 646 702	6 6 6	0.31 0.39 0.36	3.3 2.6 2.8	2.2 1.7 1.9	2.2 1.7 1.8	423 512 691		

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).





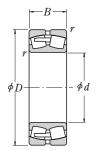
Remarks 1. The bearings denoted by an asterisk (*) are NSKHPS™ bearings and an oil groove and holes are standard for them.

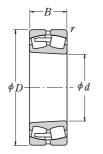
^{2.} When making a selection of the recommended fit (Tolerance of shaft) on Page A164, in case of NSKHPS™ bearings, the conditions are different.

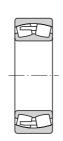
The segmentations are: Light Loads($\leq 0.05C_r$); Normal Loads(0.05 to 0.10 C_r); and Heavy Loads(>0.10 C_r).

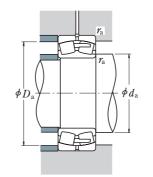
^{3.} For the dimensions od adapters and withdrawal sleeves, refer to Pages C354 – C355, and C360 – C361.

Bore Diameter 480 – 560 mm









Dynamic Equivalent Load $P - XF \perp VF$

$\Gamma = \Lambda$	$r_r + r_a$		
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/I$	7 _r >
X	Y	X	
1	Y_3	0.67	

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

Cylindrical	Bore
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Tapered Bore

Without an Oil Groove and Holes

В	oundary (n	Dimensi	ons		d Ratings		Speeds (min ⁻¹)		Bearing	Numbers	А	butment	and Fillet	Dimension	S	Constant		xial Lo Factor		Mass (kg)
d	D	В	γ min.	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	$d_{arepsilon}$ min.	max.	max.	D _a min.	γ _a max.	e	Y_2	Y_3	Y_0	approx.
480	650 700 700	128 165 218	5 6 6	2 580 000 3 800 000 4 600 000	5 850 000 7 950 000 10 200 000	560 560 400	_ _ _	400 400 320	23996CAME4 23096CAME4 24096CAME4	23996CAMKE4 23096CAMKE4 24096CAMK30E4	502 508 508		628 672 672	602 633 625	4 5 5	0.18 0.22 0.30	5.7 4.6 3.4	3.8 3.1 2.3	3.7 3.0 2.2	121 211 270
	790 790 870	248 308 310	7.5 7.5 7.5	6 050 000 7 150 000 7 850 000	11 700 000 14 600 000 14 400 000	400 240 300	_ _ _	300 300 260	23196CAME4 24196CAME4 23296CAME4	23196CAMKE4 24196CAMK30E4 23296CAMKE4	516 516 516	_ _ _	754 754 834	688 670 733	6 6 6	0.31 0.39 0.36	3.3 2.6 2.8	2.2 1.7 1.9	2.2 1.7 1.8	475 567 795
500	670 720 720	128 167 218	5 6 6	2 460 000 3 750 000 4 450 000	5 550 000 8 100 000 9 900 000	560 530 400	_ _ _	400 380 300	239/500CAME4 230/500CAME4 240/500CAME4	239/500CAMKE4 230/500CAMKE4 240/500CAMK30E4	522 528 528	_	648 692 692	622 655 643	4 5 5	0.17 0.21 0.30	6.0 4.8 3.4	4.0 3.2 2.3	3.9 3.1 2.2	124 220 276
	830 830 920	264 325 336	7.5 7.5 7.5	6 850 000 8 000 000 9 000 000	13 400 000 16 000 000 16 600 000	360 220 280	_ _ _	280 280 260	231/500CAME4 241/500CAME4 232/500CAME4	231/500CAMKE4 241/500CAMK30E4 232/500CAMKE4	536 536 536	=	794 794 884	720 703 773	6 6 6	0.31 0.39 0.38	3.2 2.6 2.7	2.2 1.7 1.8	2.1 1.7 1.8	567 666 969
530	710 780 780	136 185 250	5 6 6	2 930 000 4 400 000 5 400 000	6 800 000 9 200 000 11 800 000	500 500 360	_ _ _	360 340 280	239/530CAME4 230/530CAME4 240/530CAME4	239/530CAMKE4 230/530CAMKE4 240/530CAMK30E4	552 558 558	=	688 752 752	659 706 690	4 5 5	0.17 0.22 0.31	6.0 4.6 3.3	4.0 3.1 2.2	3.9 3.0 2.2	149 298 390
	870 870 980	272 335 355	7.5 7.5 9.5	7 150 000 8 500 000 10 100 000	14 100 000 17 500 000 18 800 000	340 200 260	_ _ _	260 260 240	231/530CAME4 241/530CAME4 232/530CAME4	231/530CAMKE4 241/530CAMK30E4 232/530CAMKE4	566 566 574		834 834 936	758 740 824	6 6 8	0.30 0.38 0.38	3.3 2.6 2.7	2.2 1.8 1.8	2.2 1.7 1.7	628 773 1 170
560	750 820 820	140 195 258	5 6 6	3 100 000 5 000 000 5 950 000	7 250 000 10 700 000 13 300 000	480 450 340	_ _ _	340 320 260	239/560CAME4 230/560CAME4 240/560CAME4	239/560CAMKE4 230/560CAMKE4 240/560CAMK30E4	582 588 588		728 792 792	697 742 729	4 5 5	0.16 0.22 0.30	6.1 4.5 3.3	4.1 3.0 2.2	4.0 2.9 2.2	172 344 440
	920 920 1 030	280 355 365	7.5 7.5 9.5	7 850 000 9 400 000 10 900 000	15 500 000 19 600 000 20 500 000	320 190 240	_ _ _	240 240 220	231/560CAME4 241/560CAME4 232/560CAME4	231/560CAMKE4 241/560CAMK30E4 232/560CAMKE4	596 596 604	=	884 884 986	804 782 870	6 6 8	0.30 0.39 0.36	3.4 2.6 2.8	2.3 1.8 1.9	2.2 1.7 1.8	727 886 1 320

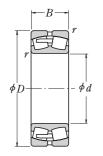
Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).

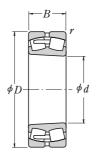
Remark For the dimensions od adapters and withdrawal sleeves, refer to Pages C355, and C361.





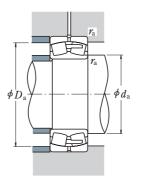
Bore Diameter 600 – 750 mm





Cylindrical Bore

Tapered Bore



Dynamic Equivalent Load $P = XF_r + YF_s$

P = X	$\mathbf{r}_{r} + \mathbf{r} \mathbf{r}_{a}$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

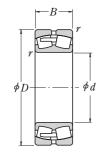
Е	oundary (m	Dimensionm)	ons		nd Ratings		Speeds (min ⁻¹)		Bearing	Numbers		Abutment	and Fillet (mm)	Dimension	s	Constant		xial Loa Factors		Mass (kg)
d	D	B	γ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	min.	$l_{ m a}$ max.	$\max_{} I$	O _a min.	${\pmb \gamma}_{\rm a}$ max.	e	Y_2	Y_3	Y_0	approx.
600	800 870 870	150 200 272	5 6 6	3 450 000 5 450 000 6 600 000	8 100 000 12 200 000 15 100 000	450 400 300		320 300 240	239/600CAME4 230/600CAME4 240/600CAME4	239/600CAMKE4 230/600CAMKE4 240/600CAMK30E4	622 628 628	=	778 842 842	745 794 772	4 5 5	0.17 0.21 0.30	5.9 4.8 3.3	3.9 3.3 2.2	3.9 3.2 2.2	205 389 529
	980 980 1 090	300 375 388	7.5 7.5 9.5	8 750 000 10 400 000 12 700 000	17 500 000 21 900 000 24 900 000	280 170 200	_ _ _	220 220 200	231/600CAME4 241/600CAME4 232/600CAME4	231/600CAMKE4 241/600CAMK30E4 232/600CAMKE4	636 636 644		944 944 1 046	856 836 923	6 6 8	0.30 0.39 0.36	3.4 2.6 2.8	2.3 1.8 1.9	2.2 1.7 1.8	898 1 050 1 590
630	850 920 920	165 212 290	6 7.5 7.5	4 000 000 5 900 000 7 550 000	9 350 000 12 700 000 17 700 000	400 400 280	_ _ _	300 280 220	239/630CAME4 230/630CAME4 240/630CAME4	239/630CAMKE4 230/630CAMKE4 240/630CAMK30E4	658 666 666	_	822 884 884	786 835 815	5 6 6	0.18 0.22 0.30	5.6 4.7 3.3	3.8 3.1 2.2	3.7 3.1 2.2	259 468 637
	1 030 1 030 1 150	315 400 412	7.5 7.5 12	9 600 000 11 300 000 13 400 000	19 400 000 23 900 000 25 600 000	260 160 200	_ _ _	200 200 180	231/630CAME4 241/630CAME4 232/630CAME4	231/630CAMKE4 241/630CAMK30E4 232/630CAMKE4	666 666 684	=	994 994 1 096	900 876 970	6 6 10	0.30 0.38 0.36	3.4 2.7 2.8	2.3 1.8 1.9	2.2 1.7 1.8	1 040 1 250 1 850
670	900 980 980	170 230 308	6 7.5 7.5	4 350 000 6 850 000 8 450 000	10 300 000 15 000 000 19 500 000	380 360 260	_ _ _	260 240 200	239/670CAME4 230/670CAME4 240/670CAME4	239/670CAMKE4 230/670CAMKE4 240/670CAMK30E4	698 706 706	=	872 944 944	836 891 868	5 6 6	0.17 0.22 0.30	5.8 4.7 3.3	3.9 3.1 2.2	3.8 3.1 2.2	300 571 773
	1 090 1 090 1 220	336 412 438	7.5 7.5 12	10 600 000 12 400 000 14 900 000	21 600 000 26 500 000 28 700 000	240 150 180	_ _ _	190 190 170	231/670CAME4 241/670CAME4 232/670CAME4	231/670CAMKE4 241/670CAMK30E4 232/670CAMKE4	706 706 724	=	1 054 1 054 1 166	952 934 1 024	6 6 10	0.30 0.37 0.37	3.3 2.7 2.7	2.2 1.8 1.8	2.2 1.8 1.8	1 230 1 440 2 210
710	950 1 030 1 030	180 236 315	6 7.5 7.5	4 800 000 7 100 000 8 850 000	11 700 000 15 800 000 20 700 000	360 340 240	_ _ _	240 240 190	239/710CAME4 230/710CAME4 240/710CAME4	239/710CAMKE4 230/710CAMKE4 240/710CAMK30E4	738 746 746	_	922 994 994	883 936 916	5 6 6	0.17 0.22 0.29	5.8 4.6 3.4	3.9 3.1 2.3	3.8 3.0 2.2	352 647 861
	1 150 1 280	438 450	9.5 12	13 900 000 15 700 000	30 500 000 30 500 000	130 170		170 160	241/710CAME4 232/710CAME4	241/710CAMK30E4 232/710CAMKE4	754 764	_	1 106 1 226	981 1 080	8 10	0.38 0.36	2.6 2.8	1.8 1.9	1.7 1.8	1 730 2 470
750	1 000 1 090 1 090 1 360	185 250 335 475	6 7.5 7.5 15	5 250 000 7 750 000 10 100 000 17 700 000	12 800 000 17 200 000 24 000 000 35 500 000	320 320 220 150	_ _ _ _	220 220 180 140	239/750CAME4 230/750CAME4 240/750CAME4 232/750CAME4	239/750CAMKE4 230/750CAMKE4 240/750CAMK30E4 232/750CAMKE4	778 786 786 814	_ _ _	972 1 054 1 054 1 296	931 990 969 1 148	5 6 6 12	0.17 0.22 0.29 0.36	6.0 4.6 3.4 2.8	4.1 3.1 2.3 1.9	4.0 3.0 2.2 1.8	398 768 1 030 2 980

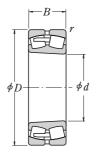
Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).





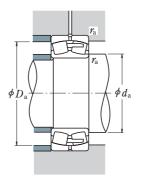
Bore Diameter 800 - 1400 mm





Cylindrical Bore

Tapered Bore



Dynamic Equivalent Load $P = XF_r + YF_o$

P = X	$\mathbf{r}_{r} + \mathbf{r}_{a}$		
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r >
X	Y	X	
1	Y_3	0.67	

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , \emph{Y}_{2} , \emph{Y}_{3} , and \emph{Y}_{0} are given in the table below.

E	Boundary (n	Dimensi	ons		ad Ratings N)		Speeds (min ⁻¹)		Bearing	Numbers	Abu	ıtment ar	nd Fillet Dime (mm)	nsions	Constar	t A	Axial Lo Factors		Mass (kg)
d	D	B	γ min.	$C_{\rm r}$	C_{0r}	Thermal Reference Speed	Limiting Mechanical	Speeds Grease	Cylindrical Bore	Tapered Bore(1)	$d_{ m a}$ min.	max.	$D_{ m a}$ max.	$oldsymbol{\gamma}_{ m a}$ nin. max	e	Y_2	Y_3	Y_0	approx.
800	1 060 1 150 1 150	195 258 345	6 7.5 7.5	5 600 000 8 350 000 10 900 000	13 700 000 19 100 000 26 300 000	300 300 200		220 200 160	239/800CAME4 230/800CAME4 240/800CAME4	239/800CAMKE4 230/800CAMKE4 240/800CAMK30E4	828 836 836	- 1	1 032 90 1 114 1 00 1 114 1 00	15 6	0.17 0.21 0.27	6.0 4.7 3.7	4.0 3.2 2.5	3.9 3.1 2.5	462 870 1 130
	1 280 1 420	375 488	9.5 15	13 800 000 20 300 000	29 200 000 41 000 000	190 130		150 130	231/800CAME4 232/800CAME4	231/800CAMKE4 232/800CAMKE4	844 864		1 236 1 12 1 356 1 2		0.28 0.35	3.6 2.8	2.4 1.9	2.3 1.9	1 870 3 250
850	1 120 1 220 1 220 1 500	200 272 365 515	6 7.5 7.5 15	6 100 000 9 300 000 11 600 000 22 300 000	15 200 000 21 400 000 28 300 000 45 500 000	280 280 190 120	_ _ _ _	190 180 150 120	239/850CAME4 230/850CAME4 240/850CAME4 232/850CAME4	239/850CAMKE4 230/850CAMKE4 240/850CAMK30E4 232/850CAMKE4	878 886 886 914	- 1 - 1	1 092 1 0- 1 184 1 1- 1 184 1 0- 1 436 1 2	09 6 93 6	0.16 0.21 0.28 0.35	6.2 4.8 3.6 2.8	4.2 3.2 2.4 1.9	4.1 3.1 2.4 1.9	523 1 020 1 350 3 890
900	1 180 1 280 1 280 1 580	206 280 375 515	6 7.5 7.5 15	6 600 000 9 850 000 12 800 000 23 400 000	16 700 000 22 800 000 31 500 000 47 500 000	260 260 170 120	_ _ _ _	180 160 140 110	239/900CAME4 230/900CAME4 240/900CAME4 232/900CAME4	239/900CAMKE4 230/900CAMKE4 240/900CAMK30E4 232/900CAMKE4	928 936 936 964	— 1 — 1	1 152	6 17 6	0.16 0.20 0.28 0.33	6.4 4.9 3.6 3.0	4.3 3.3 2.4 2.0	4.2 3.2 2.4 2.0	591 1 160 1 520 4 300
950	1 250 1 360 1 360 1 660	224 300 412 530	7.5 7.5 7.5 15	7 600 000 11 300 000 14 500 000 24 700 000	19 900 000 26 500 000 36 500 000 50 500 000	240 240 160 110	_ _ _ _	160 150 120 100	239/950CAME4 230/950CAME4 240/950CAME4 232/950CAME4	239/950CAMKE4 230/950CAMKE4 240/950CAMK30E4 232/950CAMKE4	986 986 986 1 014	- 1 - 1	1 214 1 10 1 324 1 20 1 324 1 2 1 596 1 4	11 6 19 6	0.16 0.21 0.28 0.32	6.3 4.8 3.6 3.1	4.2 3.2 2.4 2.1	4.1 3.2 2.3 2.1	732 1 400 1 880 4 800
1 000	1 320 1 420 1 420	236 308 412	7.5 7.5 7.5	8 200 000 11 900 000 15 300 000	21 700 000 28 100 000 38 500 000	220 220 150		150 140 110	239/1000CAME4 230/1000CAME4 240/1000CAME4	239/1000CAMKE4 230/1000CAMKE4 240/1000CAMK30E4	1 036 1 036 1 036	— 1	1 284 1 2 1 384 1 2 1 384 1 2	98 6	0.16 0.20 0.27	6.4 4.9 3.7	4.3 3.3 2.5	4.2 3.2 2.4	881 1 560 2 010
1 060	1 400 1 500 1 500	250 325 438	7.5 9.5 9.5	9 300 000 13 000 000 16 800 000	24 400 000 31 500 000 43 000 000	200 200 140		130 120 100	239/1060CAME4 230/1060CAME4 240/1060CAME4	239/1060CAMKE4 230/1060CAMKE4 240/1060CAMK30E4	1 096 1 104 1 104		1 364 1 30 1 456 1 30 1 456 1 30	88	0.16 0.21 0.28	6.1 4.9 3.6	4.1 3.3 2.4	4.0 3.2 2.4	1 030 1 790 2 410
1 120	1 580 1 580	345 462	9.5 9.5	15 400 000 18 700 000	38 000 000 49 500 000	180 120		110 95	230/1120CAME4 240/1120CAME4	230/1120CAMKE4 240/1120CAMK30E4	1 164 1 164		1 536 1 4 1 536 1 4		0.20 0.27	5.0 3.7	3.4 2.5	3.3 2.5	2 120 2 790
1 180	1 660	475	9.5	20 200 000	52 500 000	120	_	85	240/1180CAME4	240/1180CAMK30E4	1 224	— 1	1 616 1 4	94 8	0.27	3.7	2.5	2.4	3 180
1 250	1 750	500	9.5	21 000 000	59 500 000	110	_	75	240/1250CAME4	240/1250CAMK30E4			1 706 1 5		0.25	4.0	2.7	2.6	3 700
1 320	1 850	530	12	22 600 000	63 500 000	100	_	67 60	240/1320CAME4	240/1320CAMK30E4			1796 16		0.26	3.9	2.6	2.6	4 400
1 400	1 950	545	12	24 500 000	65 000 000	95	_	60	240/1400CAME4	240/1400CAMK30E4	1 454	<u> </u>	1 896 1 7	37 10	0.25	4.0	2.7	2.6	4 900

Note (1) The suffix K or K30 represents bearings with tapered bores (taper 1:12 or 1:30).







INTRODUCTION	C 296
BEARINGS TABLE	
SINGLE-DIRECTION THRUST BALL BARINGS	
With Flat Seat, Aligning Seat, or Aligning Seat Washer	
Bore Diameter 10 – 360 mm ·····	C 298
DOUBLE-DIRECTION THRUST BALL BEARINGS	
With Flat Seat, Aligning Seat, or Aligning Seat Washer	
Rore Diameter 10 – 190 mm	C 306





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
	511	_	_
Single-	512	532	532U
Direction	513	533	533U
	514	534	534U
Double-	522	542	542U
Direction	523	543	543U
Direction	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

THRUST BALL BEARINGS Table 7.6 (Pages A140 to A142)

RECOMMENDED FITS

THRUST BALL BEARINGS ·····Table 8.4 (Pages A164) Table 8.6 (Pages A165)

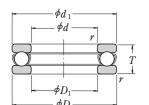
MINIMUM AXIAL LOAD

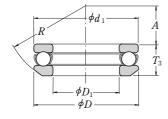
It is necessary to apply some axial load to thrust bearings to prevent slippage between the rolling elements and raceways. For more details, please refer to Page A198.

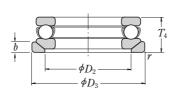


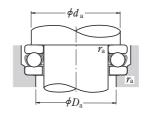
C 296 C 297

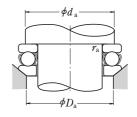
Bore Diameter 10 - 50 mm

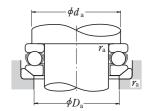












With Flat Seat

With Aligning Seat

With Aligning Seat Washer

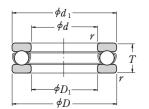
		Bounda	ry Dimensio	ons			ad Ratings N)		g Speeds		Bearing N	lumbers			I	Dimensio (mm)				Abutme Dimen				Mass(kg) approx.	
d	D	T	T_3	T_4	γ min.	$C_{\rm a}$	C_{0a}	Grease	Oil	With Flat Seat	With Aligning Seat	With Aligning Seat Washer	d_1	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	D_{a} max.	r _a max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
10	24 26	9 11	— 11.6	— 13	0.3 0.6	10 100 12 800	14 000 17 100	6 700 6 000	10 000 9 000	51100 51200	53200	 53200 U	24 26	11 12	— 18	 28	— 3.5	— 8.5	 22	18 20	16 16	0.3 0.6	0.019 0.028	 0.029	0.036
12	26 28	9 11	<u> </u>	 13	0.3 0.6	10 400 13 300	15 400 19 000	6 700 5 600	10 000 8 500	51101 51201		 53201 U	26 28	13 14	 20	30	 3.5	— 11.5	 25	20 22	18 18	0.3 0.6	0.021 0.031	 0.031	0.039
15	28 32	9 12	 13.3	 15	0.3 0.6	10 600 16 700	16 800 24 800	6 300 5 000	9 500 7 500	51102 51202	53202	 53202 U	28 32	16 17	 24	 35	<u> </u>	 12	 28	23 25	20 22	0.3 0.6	0.023 0.043	 0.048	 0.059
17	30 35	9 12	 13.2	 15	0.3 0.6	11 400 17 300	19 500 27 300	6 000 4 800	9 000 7 500	51103 51203		 53203 U	30 35	18 19	 26	— 38	<u> </u>	 16	 32	25 28	22 24	0.3 0.6	0.025 0.050	 0.055	0.069
20	35 40	10 14	— 14.7	 17	0.3 0.6	15 100 22 500	26 600 37 500	5 300 4 300	8 000 6 300	51104 51204	 53204	 53204 U	35 40	21 22	<u> </u>	<u>-</u>	 5	 18	— 36	29 32	26 28	0.3 0.6	0.037 0.077	0.080	 0.096
25	42 47 52 60	11 15 18 24	— 16.7 19.8 26.4	— 19 22 29	0.6 0.6 1 1	19 700 28 000 36 000 56 000	37 000 50 500 61 500 89 500	4 800 3 800 3 200 2 600	7 100 5 600 5 000 4 000	51105 51205 51305 51405	53205 53305 53405	53205 U 53305 U 53405 U	42 47 52 60	26 27 27 27	— 36 38 42	50 55 62	5.5 6 8	— 19 21 19	40 45 50	35 38 41 46	32 34 36 39	0.6 0.6 1	0.056 0.111 0.169 0.334	— 0.123 0.182 0.353	— 0.151 0.224 0.426
30	47 52 60 70	11 16 21 28	 17.8 22.6 30.1	20 25 33	0.6 0.6 1 1	20 600 29 500 43 000 73 000	42 000 58 000 78 500 126 000	4 300 3 400 2 800 2 200	6 700 5 300 4 300 3 400	51106 51206 51306 51406	53206 53306 53406	53206 U 53306 U 53406 U	47 52 60 70	32 32 32 32	 42 45 50	— 55 62 75	 5.5 7 9	— 22 22 20	45 50 56	40 43 48 54	37 39 42 46	0.6 0.6 1	0.064 0.137 0.267 0.519	— 0.154 0.28 0.535	 0.183 0.336 0.666
35	52 62 68 80	12 18 24 32	— 19.9 25.6 34	— 22 28 37	0.6 1 1 1.1	22 100 39 500 56 000 87 500	49 500 78 000 105 000 155 000	4 000 3 000 2 400 2 000	6 000 4 500 3 800 3 000	51107 51207 51307 51407	53207 53307 53407	53207 U 53307 U 53407 U	52 62 68 80	37 37 37 37	— 48 52 58	— 65 72 85	— 7 7.5 10	24 24 23	— 50 56 64	45 51 55 62	42 46 48 53	0.6 1 1	0.081 0.21 0.386 0.769		 0.292 0.488 0.967
40	60 68 78 90	13 19 26 36		23 31 42	0.6 1 1 1.1	27 100 47 500 70 000 103 000	63 000 98 500 135 000 188 000	3 600 2 800 2 200 1 700	5 300 4 300 3 400 2 600	51108 51208 51308 51408	53208 53308 53408	53208 U 53308 U 53408 U	60 68 78 90	42 42 42 42	55 60 65	72 82 95		— 28.5 28 26	— 56 64 72	52 57 63 70	48 51 55 60	0.6 1 1	0.12 0.27 0.536 1.1	0.289 0.581 1.12	 0.355 0.704 1.38
45	65 73 85 100	14 20 28 39	 21.3 30.1 42.4	24 33 46	0.6 1 1 1.1	28 100 48 000 80 500 128 000	69 000 105 000 163 000 246 000	3 400 2 600 2 000 1 600	5 000 4 000 3 000 2 400	51109 51209 51309 51409	53209 53309 53409	53209 U 53309 U 53409 U	65 73 85 100	47 47 47 47	— 60 65 72	78 90 105	— 7.5 10 12.5	26 25 29	56 64 80	57 62 69 78	53 56 61 67	0.6 1 1	0.143 0.31 0.672 1.46	0.333 0.702 1.53	 0.419 0.888 1.87
50	70 78 95 110	14 22 31 43	— 23.5 34.3 45.6	26 37 50	0.6 1 1.1 1.5	29 000 49 000 97 500 147 000	75 500 111 000 202 000 288 000	3 200 2 400 1 800 1 400	4 800 3 600 2 800 2 200	51110 51210 51310 51410	53210 53310 53410	53210 U 53310 U 53410 U	70 78 95 110	52 52 52 52	 62 72 80	82 100 115	7.5 11 14	— 32.5 28 35	 64 72 90	62 67 77 86	58 61 68 74	0.6 1 1 1.5	0.153 0.378 0.931 1.94	 0.404 1.01 1.98	 0.504 1.27 2.41

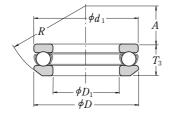


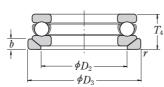


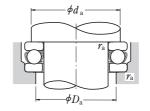
C 298 C 299

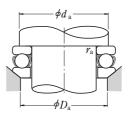
Bore Diameter 55 - 100 mm

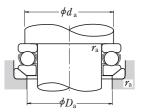










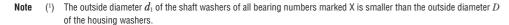


With Flat Seat

With Aligning Seat

With Aligning Seat Washer

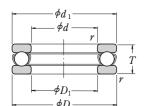
		Bounda	ry Dimensio	ns			nd Ratings	1	g Speeds in ⁻¹)		Bearing N	Numbers(1)				Dimensi (mm)				Abutm Dimen				Mass(kg) approx.	
d	D	T	T_3	T_4	γ min.	$C_{\rm a}$	C_{0a}	Grease	Oil	With Flat Seat	With Aligning Seat	With Aligning Seat Washer	d_1	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	$D_{ m a}$ max.	r _a max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
55	78 90 105 120	16 25 35 48	— 27.3 39.3 50.5	— 30 42 55	0.6 1 1.1 1.5	35 000 70 000 115 000 181 000	93 000 159 000 244 000 350 000	2 800 2 200 1 600 1 300	4 300 3 200 2 400 1 900	51111 51211 51311 51411	53211 53311 53411	53211 U 53311 U 53411 U	78 90 105 120	57 57 57 57	72 80 88	95 110 125	— 9 11.5 15.5	35 30 28	72 80 90	69 76 85 94	64 69 75 81	0.6 1 1 1.5	0.227 0.599 1.31 2.58	0.656 1.45 2.59	 0.819 1.78 3.16
60	85 95 110 130	17 26 35 51	— 28 38.3 54	— 31 42 58	1 1 1.1 1.5	41 500 71 500 119 000 202 000	113 000 169 000 263 000 395 000	2 600 2 000 1 600 1 200	4 000 3 000 2 400 1 800	51112 51212 51312 51412	53212 53312 53412	53212 U 53312 U 53412 U	85 95 110 130	62 62 62 62	78 85 95	100 115 135	— 9 11.5 16	— 32.5 41 34	72 90 100	75 81 90 102	70 74 80 88	1 1 1 1.5	0.281 0.673 1.4 3.16	— 0.731 1.51 3.2	0.897 1.83 3.91
65	90 100 115 140	18 27 36 56	— 28.7 39.4 60.2	— 32 43 65	1 1 1.1 2	42 000 75 500 123 000 234 000	117 000 189 000 282 000 495 000	2 400 1 900 1 500 1 100	3 800 2 800 2 400 1 700	51113 51213 51313 51413	53213 53313 53413	53213 U 53313 U 53413 U	90 100 115 140	67 67 67 68	82 90 100	105 120 145	— 9 12.5 17.5	— 40 38.5 40	80 90 112	80 86 95 110	75 79 85 95	1 1 1 2	0.324 0.756 1.54 4.1		
70	95 105 125 150	18 27 40 60	— 28.8 44.2 63.6	— 32 48 69	1 1 1.1 2	43 500 74 000 137 000 252 000	127 000 189 000 315 000 555 000	2 400 1 900 1 400 1 000	3 600 2 800 2 000 1 500	51114 51214 51314 51414	53214 53314 53414	53214 U 53314 U 53414 U	95 105 125 150	72 72 72 73	88 98 110	110 130 155	— 9 13 19.5	— 38 43 34	80 100 112	85 91 103 118	80 84 92 102	1 1 1 2	0.346 0.793 2.0 5.05		1.05 2.64 6.21
75	100 110 135 160	19 27 44 65	— 28.3 48.1 69	— 32 52 75	1 1 1.5 2	43 500 78 000 159 000 254 000	131 000 209 000 365 000 560 000	2 200 1 800 1 300 950	3 400 2 800 1 900 1 400	51115 51215 51315 51415	53215 53315 53415	53215 U 53315 U 53415 U	100 110 135 160	77 77 77 78	92 105 115	— 115 140 165	— 9.5 15 21	— 49 37 42	90 100 125	90 96 111 125	85 89 99 110	1 1 1.5 2	0.389 0.845 2.6 6.15	1.27 2.8 6.23	1.11 3.42 7.58
80	105 115 140 170	19 28 44 68	— 29.5 47.6 72.2	— 33 52 78	1 1 1.5 2.1	45 000 79 000 164 000 272 000	141 000 218 000 395 000 620 000	2 200 1 800 1 300 900	3 400 2 600 1 900 1 300	51116 51216 51316 51416	53216 53316 53416	53216 U 53316 U 53416 U	105 115 140 170	82 82 82 83	98 110 125	120 145 175	 10 15 22	46 50 36	90 112 125	95 101 116 133	90 94 104 117	1 1 1.5 2	0.417 0.931 2.74 7.21	1.01 2.94 7.33	1.23 3.55 8.9
85	110 125 150 180	19 31 49 72	— 33.1 53.1 77	— 37 58 83	1 1 1.5 2.1	46 500 96 000 207 000 310 000	150 000 264 000 490 000 755 000	2 200 1 600 1 100 850	3 200 2 400 1 700 1 300	51117 51217 51317 51417 X	53217 53317 53417 >	— 53217 U 53317 U (53417 XU	110 125 150 177	87 88 88 88	105 115 130	130 155 185	— 11 17.5 23	52 43 47	100 112 140	100 109 124 141	95 101 111 124	1 1 1.5 2	0.44 1.22 3.57 8.51	1.35 3.78 8.72	1.63 4.67 10.4
90	120 135 155 190	22 35 50 77	— 38.5 54.6 81.2	— 42 59 88	1 1.1 1.5 2.1	60 000 114 000 214 000 330 000	190 000 310 000 525 000 825 000	1 900 1 400 1 100 800	3 000 2 200 1 700 1 200	51118 51218 51318 51418 X	53218 53318 53418)	— 53218 U 53318 U (53418 XU	120 135 155 187	92 93 93 93	110 120 140	140 160 195	— 13.5 18 25.5	45 40 40	100 112 140	108 117 129 149	102 108 116 131	1 1 1.5 2	0.646 1.69 3.83 10.2	- 1.89 4.11 10.3	2.38 5.09 12.4
100	135 150 170 210	25 38 55 85	— 40.9 59.2 90	— 45 64 98	1 1.1 1.5 3	86 000 135 000 239 000 370 000	268 000 375 000 595 000 985 000	1 700 1 300 1 000 710	2 600 2 000 1 500 1 100	51120 51220 51320 51420 X	53220 53320 53420 >	53220 U 53320 U 53420 XU	135 150 170 205	102 103 103 103	125 135 155	155 175 220	— 14 18 27	52 46 50	112 125 160	121 130 142 165	114 120 128 145	1 1 1.5 2.5	0.96 2.25 4.98 14.8	 2.49 5.31 15	3.03 6.37 18.1

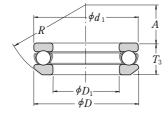


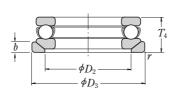


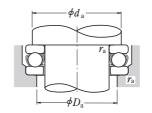


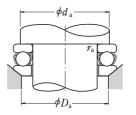
Bore Diameter 110 – 190 mm

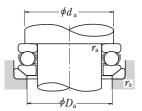












With Flat Seat

With Aligning Seat

With Aligning Seat Washer

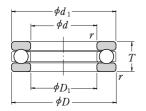
		Bounda	ry Dimensio	ons			ad Ratings	1	g Speeds in ⁻¹)	•	Bearing N	Numbers(1)			I	Dimensi (mm)					ent and			Mass(kg)	,
<i>d</i>	D	T	T_3	T_4	γ min.	$C_{\rm a}$	C_{0a}	Grease	Oil	With Flat Seat	With Aligning Seat	With Aligning Seat Washer	d_1	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	D_{a} max.	γ _a max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
110	145 160 190 230	25 38 63 95	— 40.2 67.2 99.7	— 45 72 109	1 1.1 2 3	88 000 136 000 282 000 415 000	288 000 395 000 755 000 1 150 000	1 700 1 300 900 630	2 400 1 900 1 300 950	51122 51222 51322 X 51422 X		53222 U 53322 XU 53322 XU 53422 XU		112 113 113 113	— 135 150 170	— 165 195 240	— 14 20.5 29	— 65 51 59	— 125 140 180	131 140 158 181	124 130 142 159	1 1 2 2.5	1.04 2.42 7.19 20	 2.65 7.55 20.5	— 3.2 9.1 24.3
120	155 170 210 250	25 39 70 102	— 40.8 74.1 107.3	 46 80 118	1 1.1 2.1 4	90 000 141 000 330 000 480 000	310 000 430 000 930 000 1 400 000	1 600 1 200 800 600	2 400 1 800 1 200 900	51124 51224 51324 X 51424 X	53324)			122 123 123 123	145 165 185	175 220 260	 15 22 32	61 63 70	125 160 200	141 150 173 196	134 140 157 174	1 1 2 3	1.12 2.7 9.7 26.2		
130	170 190 225 270	30 45 75 110	— 47.9 80.3 115.2	53 86 128	1 1.5 2.1 4	105 000 183 000 350 000 525 000	350 000 550 000 1 030 000 1 590 000	1 400 1 100 750 530	2 000 1 600 1 100 800	51126 51226 X 51326 X 51426 X	53326)	 (53226 XU (53326 XU (53426 XU	220	132 133 134 134	160 177 200	195 235 280	 17 26 38	— 67 53 58	140 160 200	154 166 186 212	146 154 169 188	1 1.5 2 3	1.68 3.95 12.1 32.3	 4.35 12.7 32.4	
140	180 200 240 280	31 46 80 112	— 48.6 84.9 117	55 92 131	1 1.5 2.1 4	107 000 186 000 370 000 550 000	375 000 575 000 1 130 000 1 750 000	1 300 1 000 670 530	2 000 1 500 1 000 800	51128 X 51228 X 51328 X 51428 X	53328)	 C 53228 XU C 53328 XU C 53428 XU	235	142 143 144 144	170 190 206	210 250 290	 17 26 38	— 87 68 83	160 180 225	164 176 199 222	156 164 181 198	1 1.5 2 3	1.83 4.3 14.2 34.7	 4.74 16.3 34.8	
150	190 215 250 300	31 50 80 120	53.3 83.7 125.9	 60 92 140	1 1.5 2.1 4	110 000 238 000 380 000 620 000	400 000 735 000 1 200 000 2 010 000	1 300 950 670 480	1 900 1 400 1 000 710	51130 X 51230 X 51330 X 51430 X	53330)	— (53230 XU (53330 XU (53430 XU	245	152 153 154 154	180 200 225	225 260 310	 20.5 26 41	— 79 89.5 69	160 200 225	174 189 209 238	166 176 191 212	1 1.5 2 3	1.95 5.52 15 43.5	 6.09 17.3 43.8	7.82 20.5 51.9
160	200 225 270 320	31 51 87 130	— 54.7 91.7 135.3	61 100 150	1 1.5 3 5	113 000 249 000 475 000 650 000	425 000 805 000 1 570 000 2 210 000	1 200 900 600 450	1 900 1 400 900 670	51132 X 51232 X 51332 X 51432 X	53332)	 (53232 XU (53332 XU (53432 XU	265	162 163 164 164	190 215 240	235 280 330	 21 29 41.5	— 74 77 84	160 200 250	184 199 225 254	176 186 205 226	1 1.5 2.5 4	2.07 6.04 19.6 52.7	 6.78 22.3 52.9	8.7 26.7 62
170	215 240 280 340	34 55 87 135	— 58.7 91.3 141	65 100 156	1.1 1.5 3 5	135 000 280 000 465 000 715 000	510 000 915 000 1 570 000 2 480 000	1 100 850 600 430	1 700 1 300 900 630	51134 X 51234 X 51334 X 51434 X	53334)	 (53234 XU (53334 XU (53434 XU	275	172 173 174 174	200 220 255	250 290 350	 21.5 29 46	91 105 74	180 225 250	197 212 235 269	188 198 215 241	1 1.5 2.5 4	2.72 7.41 20.3 61.2	— 8.21 23.2 61.3	— 10.5 28 73
180	225 250 300 360	34 56 95 140	— 58.2 99.3 148.3	66 109 164	1.1 1.5 3 5	136 000 284 000 480 000 750 000	530 000 955 000 1 680 000 2 730 000	1 100 800 560 400	1 700 1 200 850 600	51136 X 51236 X 51336 X 51436 X	53336)	 < 53236 XU < 53336 XU < 53436 XU	295	183 183 184 184	— 210 240 270	260 310 370	— 21.5 32 46.5	112 91 97	200 225 280	207 222 251 285	198 208 229 255	1 1.5 2.5 4	2.79 7.94 25.9 70.5	— 8.57 29.2 72.1	
190	240 270 320	37 62 105	— 65.7 111	— 73 121	1.1 2 4	172 000 320 000 550 000	655 000 1 110 000 1 960 000	1 000 750 500	1 600 1 100 750	51138 X 51238 X 51338 X		 (53238 XU (53338 XU		193 194 195	230 255	280 330	 23 33	98 104	200 250	220 238 266	210 222 244	1 2 3	3.6 11.8 36.5	— 12.9 38.1	 15.7 44.7

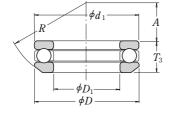
Note (1) The outside diameter d_1 of the shaft washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.

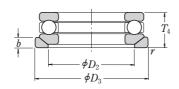


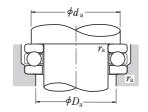


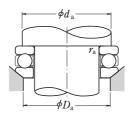
Bore Diameter 200 – 360 mm

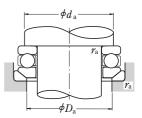












With Flat Seat

With Aligning Seat

With Aligning Seat Washer

		Bounda	ry Dimensio	ons			oad Ratings (N)	1	g Speeds in ⁻¹)		ŭ	lumbers(1)				Dimensi (mm)					nent and			Mass(kg)	
d	D	T	T_3	T_4	γ min.	$C_{\rm a}$	$C_{0\mathrm{a}}$	Grease	Oil	With Flat Seat	With Aligning Seat	With Aligning Seat Washer	d_1	D_1	D_2	D_3	b	A	R	$d_{ m a}$ min.	$D_{\rm a} \\ {\rm max.}$	${m \gamma}_{\rm a}$ max.	With Flat Seat	With Aligning Seat	With Aligning Seat Washer
200	250 280 340	37 62 110	— 65.3 118.4	— 74 130	1.1 2 4	173 000 315 000 600 000	675 000 1 110 000 2 220 000	1 000 710 480	1 500 1 100 710	51140 X 51240 X 51340 X				203 204 205	 240 270	 290 350	 23 38	— 125 92	225 250	230 248 282	220 232 258	1 2 3	3.75 12.3 43.6	— 13.4 46.2	— 16.1 54.8
220	270 300	37 63	— 65.6	— 75	1.1 2	179 000 325 000	740 000 1 210 000	950 670	1 500 1 000	51144 X 51244 X	53244 X	 53244 XU	267 297	223 224	 260	310	 25	118	 225	250 268	240 252	1 2	4.09 13.6	— 14.9	 18
240	300 340	45 78	— 81.6	92	1.5 2.1	229 000 420 000	935 000 1 650 000	850 560	1 200 850	51148 X 51248 X	53248 X	 53248 XU	297 335	243 244	 290	 350	30	122	 250	276 299	264 281	1.5 2	6.55 23.7	 25.6	30.7
260	320 360	45 79	— 82.8	93	1.5 2.1	233 000 435 000	990 000 1 800 000	800 560	1 200 850	51152 X 51252 X	53252 X	 53252 XU	317 355	263 264	305	 370	30	 152	 280	296 319	284 301	1.5 2	7.01 25.1	 27.3	 33.2
280	350 380	53 80	— 85	94	1.5 2.1	315 000 450 000	1 310 000 1 950 000	710 530	1 000 800	51156 X 51256 X	53256 X	 53256 XU	347 375	283 284	 325	390	 31	143	 280	322 339	308 321	1.5 2	12 27.1	 30.3	_ 37
300	380 420	62 95	 100.5	112	2 3	360 000 540 000	1 560 000 2 410 000	600 450	900 670	51160 X 51260 X	53260 X	 53260 XU	376 415	304 304	360	— 430	 34	 164	 320	348 371	332 349	2 2.5	17.2 43.5	 47.7	— 56.1
320	400 440	63 95	 100.5	112	2	365 000 585 000	1 660 000 2 680 000	600 450	900 670	51164 X 51264 X	53264 X	 53264 XU	396 435	324 325	380	— 450	 36	 157	 320	368 391	352 369	2 2.5	18.6 45	— 49.9	— 59.4
340	420 460	64 96	 100.3	113	2 3	375 000 595 000	1 760 000 2 800 000	560 430	850 630	51168 X 51268 X	53268 X	 53268 XU	416 455	344 345	400	 470	 36	 199	 360	388 411	372 389	2 2.5	19.9 47.9	 52.7	<u> </u>
360	440 500	65 110	 116.7	130	2 4	385 000 705 000	1 860 000 3 500 000	560 380	800 560	51172 X 51272 X	53272 X	 53272 XU	436 495	364 365	430	 510	 43	 172	 360	408 442	392 418	2	21.5 68.8	— 76.3	90.9

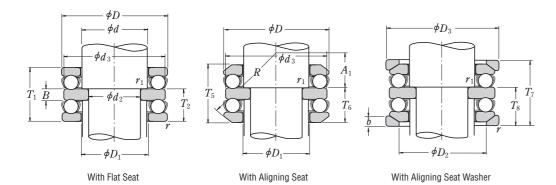


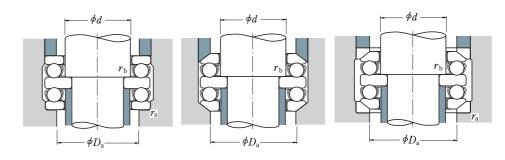


Note (1) The outside diameter d_1 of the shaft washers of all bearing numbers marked X is smaller than the outside diameter Dof the housing washers.

DOUBLE-DIRECTION THRUST BALL BEARINGS

Bore Diameter 10 – 55 mm





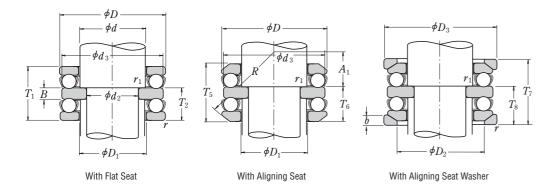
		В		Dimensi	ons			Basic Loa	nd Ratings	Limiting (mi		Bearin	g Numbers						Dimensio (mm)	ons						nent an	d Fillet (mm)	I	Mass(kg approx.	
d_2	d	D	T_1	T_5	T_7	γ min.	${m r}_1$ min.	$C_{\rm a}$	C_{0a}	Grease	Oil	With Flat Seat	With Aligning Seat	With Aligning Seat Washer	d_3	D_1	D_2 D_3	T_2	T_6	T_8	В	b	A_1	R		${\pmb{\gamma}}_a$ max.		With Flat Seat	With Aligning Seat	With Aligning Seat Washer
10	15	32	22	24.6	28	0.6	0.3	16 700	24 800	4 800	7 100	52202	54202	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
15	20 25	40 60	26 45	27.4 49.8	32 55	0.6 1	0.3 0.6	22 500 56 000	37 500 89 500	4 000 2 400	6 000 3 600	52204 52405	54204 54405	54204 U 54405 U	40 60	22 27	30 42 42 62	16 28		19 33	6 11	5 8	16 15	36 50		0.6 1	0.3 0.6	0.148 0.641		0.185 0.825
20	25 25 30		28 34 52	31.4 37.6 56.2	36 42 62	0.6 1 1	0.3 0.3 0.6	28 000 36 000 73 000	50 500 61 500 126 000	3 400 3 000 2 200	5 300 4 500 3 200	52205 52305 52406	54205 54305 54406	54205 U 54305 U 54406 U	47 52 70	27 27 32	36 50 38 55 50 75	17 21 32	22.8	21.5 25 37	7 8 12	5.5 6 9	16.5 18 16	40 45 56	36 38 50	0.6 1 1	0.3 0.3 0.6		0.35	0.293 0.434 1.27
25	30 30 35	52 60 80	29 38 59	32.6 41.2 63	37 46 69	0.6 1 1.1	0.3 0.3 0.6	29 500 43 000 87 500	58 000 78 500 155 000	3 200 2 600 1 800	5 000 4 000 2 800	52206 52306 52407	54206 54306 54407	54206 U 54306 U 54407 U	52 60 80	32 32 37	42 55 45 62 58 85			22 27.5 41.5		5.5 7 10	20 19.5 18.5	45 50 64	42 45 58	0.6 1 1	0.3 0.3 0.6		0.288 0.511 1.47	
30	35 35 40	62 68 68	34 44 36	37.8 47.2 38.6	42 52 44	1 1 1	0.3 0.3 0.6	39 500 56 000 47 500	78 000 105 000 98 500	2 800 2 400 2 600	4 300 3 600 3 800	52207 52307 52208	54207 54307 54208	54207 U 54307 U 54208 U	62 68 68	37 37 42	48 65 52 72 55 72			25 31 26.5	8 10 9	7 7.5 7	21 21 25	50 56 56	48 52 55	1 1 1	0.3 0.3 0.6	0.71		0.915
	40 40	78 90	49 65	54 69.4	59 77	1 1.1	0.6 0.6	70 000 103 000	135 000 188 000	2 000 1 700	3 000 2 400	52308 52408	54308 54408	54308 U 54408 U	78 90	42 42	60 82 65 95	30 40	5 33 42.2	35.5 46	12 15	8.5 12	23.5 22	64 72	60 65	1 1	0.6 0.6	1.04 1.98	1.13 2.02	1.38 2.54
35	45 45 45		37 52 72	39.6 56.2 78.8	45 62 86	1 1 1.1	0.6 0.6 0.6	48 000 80 500 128 000	105 000 163 000 246 000	2 400 1 900 1 500	3 600 2 800 2 200	52209 52309 52409	54209 54309 54409	54209 U 54309 U 54409 U	73 85 100	47 47 47	60 78 65 90 72 105	23 32 44		27 37 51.5	12	7.5 10 12.5	23 21 23.5	56 64 80	60 65 72	1 1 1	0.6 0.6 0.6	0.606 1.28 2.71	0.652 1.34 2.85	0.823 1.71 3.53
40	50 50 50	78 95 110	39 58 78	42 64.6 83.2	47 70 92	1 1.1 1.5	0.6 0.6 0.6	49 000 97 500 147 000	111 000 202 000 288 000	2 400 1 700 1 400	3 400 2 600 2 000	52210 52310 52410	54210 54310 54410	54210 U 54310 U 54410 U	78 95 110	52 52 52	62 82 72 100 80 115			28 42 55	9 14 18		30.5 23 30	64 72 90	62 72 80	1 1 1.5	0.6 0.6 0.6	0.697 1.78 3.51	0.75 1.94 3.59	0.949 2.46 4.45
45	55 55 55		45 64 87	49.6 72.6 92	55 78 101	1 1.1 1.5	0.6 0.6 0.6	70 000 115 000 181 000	159 000 244 000 350 000	2 000 1 500 1 200	3 000 2 400 1 800	52211 52311 52411	54211 54311 54411	54211 U 54311 U 54411 U	90 105 120	57 57 57	72 95 80 110 88 125		5 29.8 5 43.8 5 56	32.5 46.5 60.5	15		32.5 25.5 22.5	72 80 90	72 80 88	1 1 1.5	0.6 0.6 0.6	1.11 2.43 4.66	1.22 2.7 4.68	1.55 3.35 5.82
50	60 60 60 65	130	46 64 93 101	50 70.6 99 109.4	56 78 107 119	1 1.1 1.5 2	0.6 0.6 0.6 1	71 500 119 000 202 000 234 000	169 000 263 000 395 000 495 000	1 900 1 500 1 100 1 000	3 000 2 200 1 700 1 600	52212 52312 52412 52413	54212 54312 54412 54413	54212 U 54312 U 54412 U 54413 U	95 110 130 140	62 62 62 68	78 100 85 115 95 135 100 145	57	5 42.8 60	33 46.5 64 71		9 11.5 16 17.5	30.5 36.5 28 34	72 90 100 112		1 1 1.5 2	0.6 0.6 0.6 1	1.22 2.59 5.74 7.41	1.33 2.82 5.82 7.66	1.66 3.45 7.24 9.47
55	65 65 70	115	47 65 47	50.4 71.8 50.6	57 79 57	1 1.1 1	0.6 0.6 1	75 500 123 000 74 000	189 000 282 000 189 000	1 900 1 500 1 800	2 800 2 200 2 800	52213 52313 52214	54213 54313 54214		100 115 105	67 67 72	82 105 90 120 88 110	40	5 30.2 43.4 5 30.3	33.5 47 33.5	10 15 10	9 12.5 9	38.5 34.5 36.5	80 90 80	82 90 88	1 1 1	0.6 0.6 1	1.34 2.8 1.44	1.45 3.06 1.59	1.81 3.8 1.95
	70 70		72 107	80.4 114.2	88 125	1.1 2	1 1	137 000 252 000	315 000 555 000	1 300 1 000	2 000 1 500	52314 52414	54314 54414	54314 U 54414 U	125 150	72 73	98 130 110 155	44 65	48.2 5 69.1	52 74.5		13 19.5	39 28.5	100 112	98 110	1 2	1	3.67 8.99	4.07 9.12	4.95 11.3

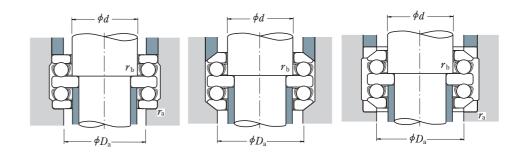




DOUBLE-DIRECTION THRUST BALL BEARINGS

Bore Diameter 60 - 130 mm





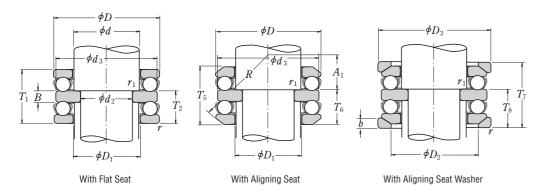
		Во		Dimensi	ons				ad Ratings	Limiting (mi	•	Bearing	Numbers(1)					D	imensio (mm)	ns					nent and			Mass(kg)	
d_2	d	D	T_1	T_5	T_7	γ min.	${\cal Y}_1$ min.	$C_{\rm a}$	$C_{0\mathrm{a}}$	Grease	Oil	With Flat Seat	With t Aligning Seat	With Aligning Seat Washer	d_3	D_1	D_2 D_3	T_2	T_6	T_8	B b	A_1	R	D_{a} max.	${\pmb{\gamma}}_a$ max.	$m{r}_{ m b}$ max.	With Flat Seat		With Aligning Seat Washer
60	75 75 75	110 135 160	47 79 115	49.6 87.2 123	57 95 135	1 1.5 2	1 1 1	78 000 159 000 254 000	209 000 365 000 560 000	1 800 1 200 900	2 600 1 800 1 400	52215 52315 52415	54215 54315 54415	54215 U 54315 U 54415 U	110 135 160	77	92 115 105 140 115 165	48.5	29.8 52.6 74.5	56.5	10 9. 18 15 26 21	32.5	5 90 5 100 5 125		1.5		1.54 4.74 10.8	5.14	
65	80 80 80 85	115 140 170 180	48 79 120 128	51 86.2 128.4 138	58 95 140 150	1 1.5 2.1 2.1	1 1 1 1.1	79 000 164 000 272 000 310 000	218 000 395 000 620 000 755 000	1 700 1 200 850 800	2 600 1 800 1 300 1 200		54216 54316 54416 X 54417 X	54216 U 54316 U 54416 U 54417 XU	115 140 170 179.5	83	98 120 110 145 125 175 130 185	73.5	30.5 52.1 77.7 83.5	83.5		30.5	90 5 112 5 125 5 140	125	2	1 1 1	1.66 4.99 12.6 15.4	1.78 5.39 12.8 15.8	
70	85 85 90	125 150 190	55 87 135	59.2 95.2 143.4	67 105 157	1 1.5 2.1	1 1 1.1	96 000 207 000 330 000	264 000 490 000 825 000	1 500 1 100 750	2 200 1 600 1 100	52217 52317 52418)		54217 U 54317 U 54418 XU	125 150 189.5	88	105 130 115 155 140 195	33.5 53 82.5	35.6 57.1 86.7	62	12 11 19 17. 30 25.	5 39	5 100 112 5 140	115		1 1 1	2.26 6.38 17.5	2.45 6.8 18.1	3.02 10.5 22.5
75 80	90 90 100	135 155 210	62 88 150	69 97.2 160	76 106 176	1.1 1.5 3	1 1 1.1	114 000 214 000 370 000	310 000 525 000 985 000	1 400 1 100 670	2 000 1 600 1 000		54218 54318 X 54420 X	54218 U 54318 U 54420 XU	135 155 209.5	93	110 140 120 160 155 220		41.5 58.1 96.5	62.5	14 13. 19 18 33 27	36.5	100 5 112 5 160		1.5	1	3.09 6.79 26.8		
85 90	100 100 110	150 170 230	67 97 166	72.8 105.4 —	81 115 —	1.1 1.5 3	1 1 1.1	135 000 239 000 415 000	375 000 595 000 1 150 000	1 300 950 600	1 900 1 500 900	52220 52320 52422		54220 U 54320 U —	150 170 229		125 155 135 175 — —	41 59 101.5	43.9 63.2 —	48 68 —	15 14 21 18 37 —	49 42 —	112 125 —	135	1 1.5 2.5		4.08 8.82 35.6		
95	110 110 120		67 110 177	71.4 118.4 —	81 128 —	1.1 2 4	1 1 1.5	136 000 282 000 515 000	395 000 755 000 1 540 000	1 200 850 560	1 800 1 300 850		54222 X 54322 X X —	54222 U 54322 XU —	189.5		135 165 150 195 — —		43.2 71.2 —	48 76 —	15 14 24 20. 40 —	62 5 47 —	125 140 —		2	1 1 1.5	4.39 12.7 47.6		5.94 16.6 —
100	120 120 130	170 210 270		71.6 131.2 —	82 143 —	1.1 2.1 4	1.1 1.1 1.5	141 000 330 000 525 000	430 000 930 000 1 590 000	1 200 750 530	1 800 1 100 800		54224 X 54324 X X —	54224 U 54324 XU —	209.5		145 175 165 220 — —	75	43.3 79.1 —		15 15 27 22 42 —	58.5 58 —	5 125 160 —		2	1 1 1.5	4.92 17.6 57.8	5.4 16.4 —	6.68 22.9 —
110	130 130 140	190 225 280	80 130 196	85.8 — —	96 —	1.5 2.1 4	1.1 1.1 1.5	183 000 350 000 550 000	550 000 1 030 000 1 750 000	1 000 710 500	1 500 1 100 750	52226) 52326) 52428)		54226 XU — —	224	133 134 144		49 80 120	51.9 —	57 — —	18 17 30 — 44 —	63 —	140 —	160 169 198	2	1 1 1.5	7.43 21.5 62.4	8.24 —	10.2 — —
120	140 140 150	200 240 300	81 140 209	86.2 —	99 —	1.5 2.1 4	1.1 1.1 2	186 000 370 000 620 000	575 000 1 130 000 2 010 000	1 000 670 480	1 500 1 000 710	52228) 52328) 52430)		54228 XU — —	199.5 239 299	143 144 153		49.5 85.5 127.5	_	58.5 — —	18 17 31 — 46 —	83.8 —	5 160 —	181	2	1 1 2	8.01 24.8 77.8	8.87 —	11.2 —
130	150 150 160	215 250 320	89 140 226	95.6 — —	109 —	1.5 2.1 5	1.1 1.1 2	238 000 380 000 650 000	735 000 1 200 000 2 210 000	900 630 430	1 300 950 630	52230) 52330) 52432)		54230 XU — —	249	153 154 164	180 225 — —	85.5	57.8 — —	64.5 — —	20 20. 31 — 50 —	5 74.5 —	5 160 —	191	2	1 1 2	10.4 30.3 93.6	11.5 —	15 — —

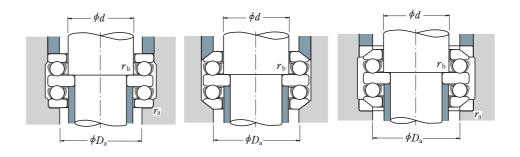
Note (1) The outside diameter d_3 of the central washers of all bearing numbers marked X is smaller than the outside diameter D of the housing washers.





Bore Diameter 135 – 190 mm





		В		/ Dimens mm)	ions				oad Ratings	Limiting (mir		Bearing N	lumbers(1)					[Dimensio (mm)	ns						ent and F sions (m			ass(kg) pprox.	
d_2	d	D	T_1	T_5	T_7	γ min.	${m r}_1$ min.	C_{a}	C_{0a}	Grease	Oil	With Flat Seat	With Aligning Seat	With Aligning Seat Washer	d_3	D_1	D_2 D_3	T_2	T_6	T_8	В	b	A_1	R	D_{a} max.	r _a in max. In		With lat Seat A		With Aligning Seat Washer
135	170	340	236	_	_	5	2.1	715 000	2 480 000	400	600	52434 X	_	_	339	174		143	_	_	50	_	_	_	240	4 2	2 1	10	_	_
140	160 160 180	225 270 360	90 153 245	97.4 — —	110 —	1.5 3 5	1.1 1.1 3	249 000 475 000 750 000	805 000 1 570 000 2 730 000	850 600 380	1 300 900 560	52232 X 52332 X 52436 X		54232 XU — —	224.5 269 359	163 164 184	190 235 — —	55 93 148.5	58.7 — 5 —	65 — —	20 33 52	21 — —	70 — —	160 — —	205	1.5 1 2.5 1 4 2		35.1	12.7 — —	16.5 —
150	170 170 180 180	240 280 250 300	97 153 98 165	104.4 — 102.4 —	117 — 118 —	1.5 3 1.5 3	1.1 1.1 2 2	280 000 465 000 284 000 480 000	915 000 1 570 000 955 000 1 680 000	800 560 800 530	1 200 850 1 200 800	52334 X	54236 X	54234 XU 	279	173 174 183 184	200 250 — — 210 260 — —	59 93 59.5 101	62.7 — 61.7 —	69 — 69.5 —	33 21	_	87 — 108.5 —	200	215 210	1.5 1 2.5 1 1.5 2 2.5 2	2	40.8 14.8	15.2 — 16.1 —	19.8 — 20.6 —
160	190 190	270 320	109 183	116.4 —	131	2 4	2	320 000 550 000	1 110 000 1 960 000	710 480	1 100 710	52238 X 52338 X	54238 X —	54238 XU —	269 319	194 195	230 280 — —	66.5 111.5	, ,	77.5 —	24 40	23	93.5 —		230 244	2 2 3		4.0	22.2 —	29.8 —
170	200 200	280 340	109 192	115.6 —	133	2 4	2	315 000 600 000	1 110 000 2 220 000	710 450	1 000 670	52240 X 52340 X	54240 X —	54240 XU —	279 339	204 205	240 290 — —	66.5 117	69.8 —	78.5 —	24 42	23	120.5 —	225 —	240 258	2 2 3 2		70.4	23.2	30.6
190	220	300	110	115.2	134	2	2	325 000	1 210 000	670	1 000	52244 X	54244 X	54244 XU	299	224	260 310	67	69.6	79	24	25	114	225	260	2 2	2	25.2	27.8	34.1

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.





C 310 C 311

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9.	THRUST CYLINDRICAL ROLLER BEARINGS	
	INTRODUCTION	C 31
	REARINGS TARI E	

THRUST CYLINDRICAL ROLLER BEARINGS







C 312 C 313

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 (Pages A164) Table 8.6 (Pages 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 contact NSK.

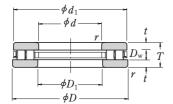


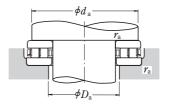


C 315 C 314

■THRUST CYLINDRICAL ROLLER BEARINGS

Bore Diameter 35 - 130 mm





	Boundary [(m				d Ratings		g Speeds nin ⁻¹)	Bearing Numbers			ensions nm)			tment and nensions (r		Mass (kg)
d	D	T	γ min.	$C_{\rm a}$	$C_{0\mathrm{a}}$	Grease	Oil	bearing Numbers	d_1	D_1	$D_{ m w}$	t	$d_{ m a}$ min.	$D_{ m a}$ max.	$oldsymbol{\gamma}_a$ max.	approx.
35 40	80 78	32 22	1.1 1	95 500 63 000	247 000 194 000	1 000 1 200	3 000 3 600	35 TMP 14 40 TMP 93	80 78	37 42	12 8	10 7	71 71	46 48	1 1	0.97 0.525
45	65 85	14 24	0.6 1	33 000 71 000	100 000 233 000	1 700 1 100	5 000 3 400	45 TMP 11 45 TMP 93	65 85	47 47	6 8	4 8	60 78	49 53	0.6 1	0.144 0.665
50	110 95	27 27	1.1 1.1	139 000 113 000	470 000 350 000	900 1 000	2 800 3 000	50 TMP 74 50 TMP 93	109 93	52 52	11 11	8	100 89	61 57	1 1	1.52 0.94
55	105	30	1.1	134 000	450 000	900	2 600	55 TMP 93	105	55.2	11	9.5	98	63	1	1.28
60	95 110	26 30	1 1.1	99 000 139 000	325 000 480 000	1 000 850	3 000 2 600	60 TMP 12 60 TMP 93	95 110	62 62	10 11	8 9.5	88 103	67 68	1 1	0.735 1.36
65	100 115	27 30	1 1.1	110 000 145 000	325 000 515 000	950 850	2 800 2 600	65 TMP 12 65 TMP 93	100 115	67 65.2	12.5 11	7.25 9.5	93 108	71 73	1 1	0.805 1.44
70	150 125	36 34	2 1.1	259 000 191 000	935 000 635 000	670 750	2 000 2 200	70 TMP 74 70 TMP 93	149 125	72 72	15 14	10.5 10	137 117	84 78	2 1	3.8 1.95
75	100 135	19 36	1 1.5	63 500 209 000	221 000 735 000	1 100 710	3 400 2 200	75 TMP 11 75 TMP 93	100 135	77 77	8 14	5.5 11	96 125	79 84	1 1.5	0.41 2.42
80	115 140	28 36	1 1.5	120 000 208 000	420 000 740 000	900 710	2 600 2 000	80 TMP 12 80 TMP 93	115 138	82 82	11 14	8.5 11	109 130	86 91	1 1.5	1.02 2.54
85	110 125 150	19 31 39	1 1 1.5	75 000 151 000 257 000	298 000 485 000 995 000	1 100 800 630	3 200 2 400 1 900	85 TMP 11 85 TMP 12 85 TMP 93	110 125 148	87 88 87	7.5 14 14	5.75 8.5 12.5	105 118 140	89 92 95	1 1 1.5	0.46 1.36 3.2
90	120 155	22 39	1 1.5	96 000 250 000	370 000 885 000	950 630	3 000 1 900	90 TMP 11 90 TMP 93	119 155	91.5 90.2	9 16	6.5 11.5	114 144	95 101	1 1.5	0.725 3.3
100	170	42	1.5	292 000	1 110 000	560	1 700	100 TMP 93	170	103	16	13	159	110	1.5	4.25
110	160 190	38 48	1.1 2	228 000 390 000	855 000 1 490 000	630 500	1 900 1 500	110 TMP 12 110 TMP 93	160 190	113 113	15 19	11.5 14.5	150 179	119 120	1 2	2.66 6.15
120	170 210	39 54	1.1 2.1	233 000 505 000	895 000 1 930 000	600 450	1 800 1 400	120 TMP 12 120 TMP 93	170 210	123 123	15 22	12 16	160 199	129 129	1 2	2.93 8.55
130	190 225 270	45 58 85	1.5 2.1 4	300 000 585 000 895 000	1 090 000 2 370 000 3 300 000	530 430 320	1 600 1 300 950	130 TMP 12 130 TMP 93 130 TMP 94	187 225 270	133 133 133	19 22 32	13 18 26.5	177 214 254	142 140 150	1.5 2 3	4.5 10.4 26.2

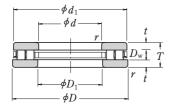
Remark For cylindrical roller thrust bearings not listed adove, please contact NSK.

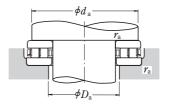




■THRUST CYLINDRICAL ROLLER BEARINGS

Bore Diameter 140 – 320 mm





		Dimensions im)			ad Ratings	-	Speeds in ⁻¹)	Bearing Number				ensions mm)			tment and I lensions (n		Mass (kg)
d	D	T	γ min.	$C_{\rm a}$	C_{0a}	Grease	Oil		boaring Numbers	$d_{\scriptscriptstyle 1}$	D_1	$D_{ m w}$	t	$d_{ m a}$ min.	D_{a} max.	$oldsymbol{\gamma}_{a}$ max.	approx.
140	200 240 280	46 60 85	2 2.1 4	285 000 610 000 990 000	1 120 000 2 360 000 3 800 000	500 400 300	1 500 1 200 900		140 TMP 12 140 TMP 93 140 TMP 94	197 240 280	143 143 143	17 25 32	14.5 17.5 26.5	188 226 262	153 154 158	2 2 3	4.85 12.2 27.5
150	215 250	50 60	2 2.1	375 000 635 000	1 500 000 2 510 000	480 400	1 400 1 200		150 TMP 12 150 TMP 93	215 250	153 153	19 25	15.5 17.5	202 236	163 165	2 2	6.15 12.8
160	200 270	31 67	1 3	173 000 745 000	815 000 3 150 000	630 360	1 900 1 100		160 TMP 11 160 TMP 93	200 265	162 164	11 25	10 21	191 255	168 173	1 2.5	2.21 16.9
170	240 280	55 67	1.5 3	485 000 800 000	1 960 000 3 500 000	430 340	1 300 1 000		170 TMP 12 170 TMP 93	237 280	173 173	22 25	16.5 21	227 265	182 183	1.5 2.5	8.2 17.7
180	300 360	73 109	3 5	1 000 000 1 640 000	4 000 000 6 200 000	320 240	950 710		180 TMP 93 180 TMP 94	300 354	185 189	32 45	20.5 32	284 335	194 205	2.5 4	22.5 58.2
190	270 320	62 78	3 4	705 000 1 080 000	2 630 000 4 500 000	360 300	1 100 900		190 TMP 12 190 TMP 93	266 320	195 195	30 32	16 23	255 303	200 205	2.5 3	11.8 27.6
200	250 340	37 85	1.1 4	365 000 1 180 000	1 690 000 5 150 000	500 280	1 500 800		200 TMP 11 200 TMP 93	247 340	203 205	17 32	10 26.5	242 322	207 218	1 3	4.1 34.5
220	270 300	37 63	1.1 2	385 000 770 000	1 860 000 3 100 000	480 340	1 500 1 000		220 TMP 11 220 TMP 12	267 297	223 224	17 30	10 16.5	262 287	227 232	1 2	4.5 13.5
240	300 340	45 78	1.5 2.1	435 000 965 000	2 160 000 4 100 000	400 280	1 200 850		240 TMP 11 240 TMP 12	297 335	243 244	18 32	13.5 23	288 322	251 258	1.5 2	7.2 23.3
260	320 360	45 79	1.5 2.1	460 000 995 000	2 350 000 4 350 000	400 280	1 200 850		260 TMP 11 260 TMP 12	317 355	263 264	18 32	13.5 23.5	308 342	272 276	1.5 2	7.75 25.2
280	350 380	53 80	1.5 2.1	545 000 1 050 000	2 800 000 4 750 000	340 260	1 000 800		280 TMP 11 280 TMP 12	347 375	283 284	20 32	16.5 24	335 362	294 296	1.5 2	11.6 27.2
300	380 420	62 95	2 3	795 000 1 390 000	4 000 000 6 250 000	300 220	900 670		300 TMP 11 300 TMP 12	376 415	304 304	25 38	18.5 28.5	365 398	315 322	2 2.5	16.7 42
320	400 440	63 95	2 3	820 000 1 420 000	4 250 000 6 550 000	300 220	900 670		320 TMP 11 320 TMP 12	396 435	324 325	25 38	19 28.5	385 418	335 340	2 2.5	18 44.5

Remark For cylindrical roller thrust bearings not listed adove, please contact NSK.







10. THRUST TAPERED ROLLER BEARINGS

NTRODUCTION	C 32
BEARINGS TABLE	
THRUST TAPERED ROLLER BEARINGS	
Rore Diameter 101 600mm - 600mm	ር 30







C 320 C 321

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

TABLE 8.4 (Page A164)
Table 8.6 (Page 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.

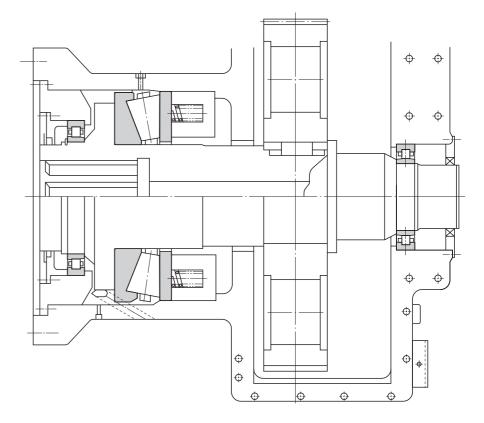


Figure 2 Thrust Tapered Roller Bearing in Heavy Duty Extruder



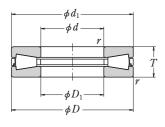


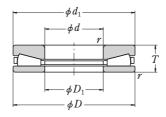
BEARINGS TABLE **NSK**

TT, TTF Types

Bore Diameter 101.600 – 168.275 mm

■THRUST TAPERED ROLLER BEARINGS





TT

TTF

Boundary Dimensions (mm/inch)				Basic Load Ratings (kN)			Dimen (mr		Corner Radius of Shaft	Mass (kg)	
d	D	T	γ min.	C_{a}	$C_{0\mathrm{a}}$		Bearing Numbers	D_1	d_1	or Housing $oldsymbol{\gamma}_a$ max.	approx.
101.600 4.0000	215.900 8.5000	46.038 1.8125	3.3	710	2 900		*101TT2151	103.200	214.300	3.3	8.9
111.760 4.4000	223.520 8.8000	55.880 2.2000	3.3	790	2 920		*111TT2251	113.300	221.900	3.3	11.2
114.300 4.5000	250.825 9.8750	53.975 2.1250	4.0	970	4 100		*114TT2551	114.500	250.825	4.0	14.4
127.000 5.0000	266.700 10.5000	58.738 2.3125	4.8	1 040	4 350		*127TT2551	128.600	265.100	4.8	17.3
	266.700 10.5000	58.738 2.3125	4.8	1 030	4 500		*127TTF2651	128.600	265.100	4.8	17.3
128.575 5.0620	265.100 10.4370	63.500 2.5000	6.4	1 040	4 350		*128TT2651	128.900	265.100	6.4	18.2
130	250	70	2.1	1 100	4 100		130TTF2501	130.3	250	2	17
135 150	245 300	65 90	2.1 5	855 1 470	3 100 6 300		135TT2401 150TTF3001	135.3 152	245 306	2 4	14.5 34.2
152.400 6.0000	317.500 12.5000	69.850 2.7500	6.4	1 470	6 300		*152TTF3151	152.700	315.900	6.4	28.9
	317.500 12.5000	69.850 2.7500	6.4	1 550	6 700		*152TT3152	152.400	317.500	6.4	28.9
165.100 6.5000	311.150 12.2500	88.900 3.5000	6.4	1 560	5 250		*165TT3151	165.400	311.150	6.4	33
168.275 6.6250	304.800 12.0000	69.850 2.7500	6.4	1 230	5 000		*168TTF3051	169.000	302.500	6.4	24.1

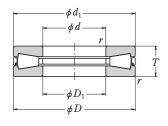
* Bearings marked * are inch design.

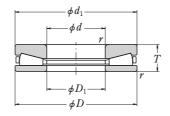


■THRUST TAPERED ROLLER BEARINGS

TT, TTF Types

Bore Diameter 170 – 241.300 mm





TT

TTF

Boundary Dimensions (mm/inch)			Basic Lo	Rearing Numbers	Dimensions (mm)		Corner Radius of Shaft	Mass (kg)			
d	D	T	γ min.	C_{a}	C_{0a}		Bearing Numbers	D_1	d_1	or Housing $oldsymbol{\mathcal{T}}_a$ max.	approx.
170	320	100	5	1 650	5 550		170TT3201	170.5	320	4	39.3
174.625 6.8750	358.775 14.1250	82.550 3.2500	6.4	1 740	7 400		*174TT3551	174.625	358.775	6.4	43.3
	358.775 14.1250	82.550 3.2500	6.4	1 740	7 400		*174TTF3551	174.625	358.775	6.4	43.3
177.800 7.0000	368.300 14.5000	82.550 3.2500	8.0	1 900	8 250		*177TT3651	180.400	365.800	8.0	45.9
203.200 8.0000	419.100 16.5000	92.075 3.6250	9.7	2 530	11 300		*203TT4151	205.600	416.700	9.7	66.1
	419.100 16.5000	92.075 3.6250	9.7	2 530	11 300		*203TTF4153A	203.200	419.100	9.7	66.1
	419.100 16.5000	120.650 4.7500	9.7	2 530	11 300		*203TT4152	205.600	416.700	9.7	86.6
	419.100 16.5000	120.650 4.7500	9.7	2 530	11 300		*203TTF4152	205.600	416.700	9.7	86.6
206.375 8.1250	419.100 16.5000	120.370 4.7390	C10	2 590	11 700		*206TT4151	206.375	419.100	6	85.5
228.600 9.0000	482.600 19.0000	104.775 4.1250	11.2	3 350	16 400		*228TT4851	228.900	482.600	11.2	101
	482.600 19.0000	104.775 4.1250	11.2	3 350	16 400		*228TTF4851	230.600	480.600	11.2	101
234.950 9.2500	546.100 21.5000	127.000 5.0000	15.9	4 600	21 400		*234TT5451	237.000	544.000	15.9	165
241	404	110	4	2 200	8 650		241TTF4002	241	404	3	61.8
241.300 9.5000	496.888 19.5625	129.000 5.0787	C8	3 450	16 700		*241TT4952	241.300	496.888	5	130

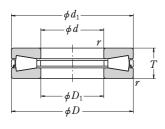
ote * Bearings marked * are inch design.



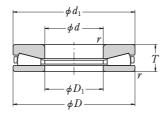


TT, TTF Types

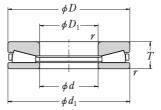
Bore Diameter 254.000 - 600 mm



TT



TTF



TTF-1

	Boundary Dimensions (mm/inch)				ad Ratings kN)			nsions im)	Corner Radius of Shaft	Mass (kg)
<i>d</i>	D	T	r min.	$C_{\rm a}$	$C_{0\mathrm{a}}$	Bearing Numbers	D_1	d_1	or Housing $oldsymbol{\mathcal{Y}}_a$ max.	approx.
254.000 10.0000	539.750 21.2500	117.475 4.6250	11.2	3 950	18 600	*254TTF5351	254.000	539.750	11.2	142
260	360	75	2.1	1 110	4 650	260TTF3601	260.3	360	2	24.8
273.050 10.7500	552.450 21.7500	133.350 5.2500	C8	4 400	20 700	*273TT5551	273.050	552.450	5	164
279.400 11.0000	603.250 23.7500	136.525 5.3750	11.2	5 400	25 200	*279TT6051	279.700	603.250	11.2	208
330 340 350	440 460 460	85 96 85	3 3 2	1 300 1 690 1 370	6 300 7 750 6 600	330TTF4401 340TTF4603 350TTF4602A(1)	331 340 351	440 460 450	2.5 2.5 2	38.5 49.2 40.4
360	470 600	85 120	4 4	1 440 3 700	6 950 20 100	360TTF4701 360TTF6201	360.4 366	470 620	3 3	41.4 148
380	550	110	4	2 760	12 100	380TTF5501	381	550	3	92.9
406.400 16.0000	711.200 28.0000	146.050 5.7500	9.7	5 900	28 600	*406TT7151	406.800	711.200	9.7	266
	838.200 33.0000	177.800 7.0000	12.7	8 950	46 500	*406TT8351	406.800	837.800	12.7	510
431.800 17.0000	863.600 34.0000	228.600 9.0000	10.4	15 100	69 500	*431TTF8651	435.000	862.000	10.4	683
440 450 460	600 570 580	105 100 90	4 3 3	2 720 2 170 1 890	13 900 10 500 9 550	440TTF6001 450TTF5701 460TTF5801	440 455 465	600 569 579	3 2.5 2.5	93.3 65.4 60
500 508	630 730.25	82 120.65	3 6	2 020 4 900	11 600 26 100	500TTF6301 508TT7301	505 509	628 730.25	2.5 5	64.3 177
508.000 20.0000	990.600 39.0000	196.850 7.7500	12.7	12 000	65 000	*508TT9951	508.000	990.600	12.7	760
558	780	120	9.5	4 800	25 500	558TT7801	558	780	8	190
558.800 22.0000	1 066.800 42.0000	285.750 11.2500	10.4	21 100	94 500	*558TTF1051	561.980	1 065.219	10.4	1 260
560 600	670 710	85 86	3	1 950 1 900	10 700 10 700	560TTF6701 600TTF7101	565 604	668 710	2.5 2.5	61.4 66.2



⁽¹⁾ For this bearing, the dimensional symbols are defined by Figure TTF-1.

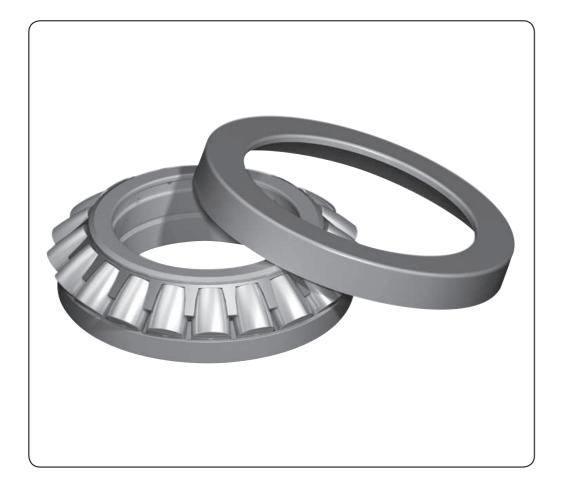






11. THRUST SPHERICAL ROLLER BEARINGS

NTRODUCTIONC 332
BEARINGS TABLE
THRUST SPHERICAL ROLLER BEARINGS
Bore Diameter 60mm – 500mm ······ C 334







C 330 C 331



DESIGN, TYPES, AND FEATURES

THRUST SPHERICAL ROLLER BEARINGS

These are thrust bearings containing convex rollers. They have a self-aligning 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 BEARINGSTable 7.8 (Pages A145)

RECOMMENDED FITS

THRUST SPHERICAL ROLLER BEARINGSTable 8.4 (Pages A164)

Table 8.6 (Pages 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.

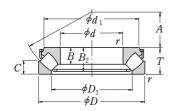
MINIMUM AXIAL LOAD

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.

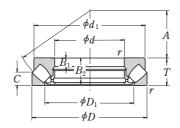




Bore Diameter 60 - 200 mm

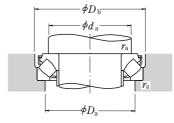


Boundary Dimensions

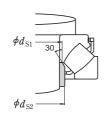


Limiting

Basic Load Ratings



Dimensions



Spacer Sleeve

Dynamic Equivalent Load $P = 1.2F_{\rm r} + F_{\rm a}$ Static Equivalent Load $P_0 = 2.8F_r + F_a$ However, $F_{\rm r}/F_{\rm a} \leq$ 0.55 must be satisfied.

Abutment and Fillet

Mass

	(m	m)		Dasic Load	-	Speeds	Bearing						ons (mm)			ons (mr		(kg)			
d	D	T	r min.	$C_{\rm a}$	C_{0a}	(min ⁻¹) Oil	Numbers		d_1	D_1	B,B_1	B_2	С	A	$d_{ m S1}$ max.	$d_{ m S2}$ max.	$d_{ m a}^{(1)}$ min.	D_{a} max.	$D_{ m b}$ min.	$oldsymbol{\gamma}_{\mathrm{a}}$ max.	approx.
60 65	130 140	42 45	1.5 2	330 000 405 000	885 000 1 100 000	2 600 2 400	29412 E 29413 E		114.5 121.5	89 93	27 29.5	38 40.5	20 22	38 42	67 72	67 72		108 115	133 143	1.5 2	2.55 3.2
70 75	150 160	48 51	2 2	450 000 515 000	1 240 000 1 430 000	2 400 2 200	29414 E 29415 E		131.5 138	102 107	31 33.5	43 46	24 25	44 47	78 83	78 83	105 115	125 132	153 163	2	3.9 4.65
80 85	170 150 180	54 39 58	2.1 1.5 2.1	575 000 330 000 630 000	1 600 000 1 040 000 1 760 000	2 000 2 400 1 900	29416 E 29317 E 29417 E		148 134.5 156.5	114.5 112 124	35 24.5 37	48.5 35.5 51.5	27 19 28	50 50 54	89 91 95	89 91 95	115	140 135 150	173 153 183	2 1.5 2	5.55 2.7 6.55
90	155 190	39 60	1.5 2.1	350 000 695 000	1 080 000 1 950 000	2 200 1 800	29318 E 29418 E		139.5 165.5	118 129.5	24.5 39	35 54.5	19 29	52 56	97 100	97 100		140 157	158 193	1.5 2	2.83 7.55
100	170 210	42 67	1.5 3	410 000 840 000	1 280 000 2 400 000	2 000 1 600	29320 E 29420 E		152 185	128 144	26.2 43	38 59.5	20.8 33	58 62	107 111	107 111		150 175	173 214	1.5 2.5	3.6 10.3
110	190 230	48 73	2 3	530 000 1 010 000	1 710 000 2 930 000	1 800 1 500	29322 E 29422 E		169.5 200	142.5 157	30.3 47	43.5 64.5	24 36	64 69	117 121	117 129		165 190	193 234	2 2.5	5.25 13.3
120	210 250	54 78	2.1 4	645 000 1 160 000	2 100 000 3 400 000	1 600 1 400	29324 E 29424 E		187.5 215	156.5 171	34 50.5	48.5 69.5	27 38	70 74	130 132	130 142		180 205	214 254	2	7.3 16.6
130	225 270	58 85	2.1 4	740 000 1 330 000	2 450 000 3 900 000	1 500 1 200	29326 E 29426 E		203.5 235	168.5 185	37 54	53.5 74.5	28 42	76 81	141 143	143 153		195 225	229 275	2	8.95 21.1
140	240 280	60 85	2.1 4	840 000 1 370 000	2 810 000 4 200 000	1 400 1 200	29328 E 29428 E		216.5 244.5	179 195.5	38.5 54	54 74.5	30 42	82 86	148 153	154 162		205 235	244 285	2	10.4 22.2
150	250 300	60 90	2.1 4	870 000 1 580 000	2 900 000 4 900 000	1 400 1 100	29330 E 29430 E		224 266	190 209	38 58	54.5 81	29 44	87 92	158 164	163 175		215 250	254 306	2	10.8 27.3
160	270 320	67 95	3 5	1 010 000 1 740 000	3 400 000 5 400 000	1 300 1 100	29332 E 29432 E		243 278	203 224.5	42 60.5	60 84.5	33 46	92 99	169 175	176 189		235 265	275 326	2.5 4	14.3 32.1
170	280 340	67 103	3 5	1 050 000 1 680 000	3 500 000 5 800 000	1 200 1 000	29334 E 29434		252 310	214.5 243	42.2 37	60.5 99	32 50	96 104	178 —	188 —		245 285	285 —	2.5 4	14.8 43.5
180	300 360	73 109	3 5	1 230 000 1 870 000	4 200 000 6 500 000	1 100 900	29336 E 29436		270 330	227 255	46 39	65.5 105	36 52	103 110	189 —	195 —		260 300	306	2.5 4	19 52
190	320 380	78 115	4 5	1 370 000 2 100 000	4 700 000 7 450 000	1 100 850	29338 E 29438		288.5 345	244 271	49 41	69 111	38 55	110 117	200	211 —		275 320	326 —	3 4	23 60
200	280 340 400	48 85 122	2 4 5	540 000 1 570 000 2 290 000	2 310 000 5 450 000 8 150 000	1 500 1 000 800	29240 29340 E 29440		266 306.5 365	236 257 280	15 53.5 43	46 75 117	24 41 59	108 116 122	211 —	224 —	265	255 295 335	346	2 3 4	8.55 28.5 69

Note (1) For heavy load applications, a d_a value should be chosen which is large enough to support the shaft washer rib.



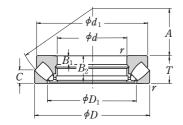
C 334 C 335



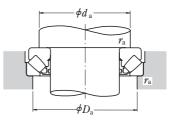
THRUST SPHERICAL ROLLER BEARINGS

Boundary Dimensions

Bore Diameter 220 – 420 mm



Basic Load Ratings



Dimensions

Dynamic Equivalent Load $P = 1.2F_{\rm r} + F_{\rm a}$ Static Equivalent Load $P_0 = 2.8F_r + F_a$ However, $F_{\rm r}/F_{\rm a}\!\leq\!0.55$ must be satisfied.

Mass

Abutment and Fillet

	(m	m)		1)	۷)	Speeds	Bearing	ng (mm) Dimensions (mm)				(kg)						
<i>d</i>	D	T	γ min.	C_{a}	C_{0a}	(min ⁻¹) Oil	Numbers		d_1	D_1	B_1	B_2	С	A	$d_{ m a}^{(1)}$ min.	D_{a} max.	r a max.	approx.
220	300 360 420	48 85 122	2 4 6	560 000 1 340 000 2 350 000	2 500 000 5 200 000 8 650 000	1 400 950 800	29244 29344 29444		285 335 385	254 280 308	15 29 43	46 81 117	24 41 58	117 125 132	260 285 310	275 315 355	2 3 5	9.2 33 74
240	340 380 440	60 85 122	2.1 4 6	800 000 1 360 000 2 420 000	3 450 000 5 400 000 9 100 000	1 200 950 750	29248 29348 29448		325 355 405	283 300 326	19 29 43	57 81 117	30 41 59	130 135 142	285 300 330	305 330 375	2 3 5	16.5 35.5 79
260	360 420 480	60 95 132	2.1 5 6	855 000 1 700 000 2 820 000	3 850 000 6 800 000 10 700 000	1 200 800 710	29252 29352 29452		345 390 445	302 329 357	19 32 48	57 91 127	30 45 64	139 148 154	305 330 360	325 365 405	2 4 5	18 48.5 105
280	380 440 520 520	60 95 145 145	2.1 5 6 6	885 000 1 830 000 3 400 000 3 950 000	4 100 000 7 650 000 13 100 000 14 900 000	1 100 800 630 630	29256 29356 29456 29456 EM		365 410 480 480	323 348 384 380	19 32 52 52	57 91 140 140	30 46 68 70	150 158 166 166	325 350 390 410	345 390 440 445	2 4 5 5	19 52.5 132 134
300	420 480 540	73 109 145	3 5 6	1 160 000 2 190 000 3 500 000	5 150 000 9 100 000 13 700 000	950 710 630	29260 29360 29460		400 450 500	353 379 402	21 37 52	69 105 140	38 50 70	162 168 175	355 380 410	380 420 460	2.5 4 5	30 74 140
320	440 500 580	73 109 155	3 5 7.5	1 190 000 2 230 000 3 650 000	5 450 000 9 400 000 14 600 000	950 670 560	29264 29364 29464		420 470 555	372 399 436	21 37 55	69 105 149	38 53 75	172 180 191	375 400 435	400 440 495	2.5 4 6	32.5 77 175
340	460 540 620	73 122 170	3 5 7.5	1 230 000 2 640 000 4 400 000	5 750 000 11 200 000 17 400 000	900 630 530	29268 29368 29468		440 510 590	395 428 462	21 41 61	69 117 164	37 59 82	183 192 201	395 430 465	420 470 530	2.5 4 6	33.5 103 218
360	500 560 640 640	85 122 170 170	4 5 7.5 7.5	1 550 000 2 670 000 4 200 000 5 450 000	7 300 000 11 500 000 17 200 000 20 400 000	800 600 500 500	29272 29372 29472 29472 EM		480 525 610 580	423 448 480 474	25 41 61 61	81 117 164 164	44 59 82 83	194 202 210 210	420 450 485 495	455 495 550 550	3 4 6 6	51 107 228 220
380	520 600 670	85 132 175	4 6 7.5	1 620 000 3 300 000 4 800 000	7 800 000 14 500 000 19 500 000	800 560 480	29276 29376 29476		496 568 640	441 477 504	27 44 63	81 127 168	42 63 85	202 216 230	440 480 510	475 525 575	3 5 6	52 140 254
400	540 620 710	85 132 185	4 6 7.5	1 640 000 3 250 000 5 400 000	8 000 000 14 500 000 22 100 000	750 530 450	29280 29380 29480		517 590 680	460 494 536	27 44 67	81 127 178	42 64 89	212 225 236	460 500 540	490 550 610	3 5 6	55 150 306
420	580 650 730	95 140 185	5 6 7.5	2 010 000 3 500 000 5 650 000	9 800 000 15 700 000 23 500 000	670 500 450	29284 29384 29484		553 620 700	489 520 556	30 48 67	91 135 178	46 68 89	225 235 244	490 525 560	525 575 630	4 5 6	72 170 323

Limiting

Note (1) For heavy load applications, a d_a value should be chosen which is large enough to support the shaft washer rib.

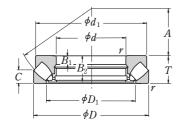


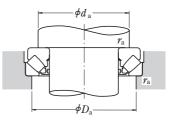


C 336 C 337



Bore Diameter 440 – 500 mm





Dynamic Equivalent Load $P = 1.2F_{\rm r} + F_{\rm a}$ Static Equivalent Load $P_0 = 2.8F_r + F_a$ However, $F_r/F_a \le 0.55$ must be satisfied.

	Boundary Dimensions (mm)			Basic Load Ratings (N)		Limiting Speeds Bearing				Dimer (m				Abut Dim	Mass (kg)		
d	D	T	γ min.	$C_{\rm a}$	C_{0a}	(min ⁻¹) Oil	Numbers	d_1	D_1	B_1	B_2	С	A	$d_{ m a}^{(1)}$ min.	D_{a} max.	r a max.	approx.
440	600 680 780 780	95 145 206 206	5 6 9.5 9.5	2 030 000 3 750 000 6 550 000 8 000 000	10 100 000 16 700 000 27 200 000 31 500 000	670 480 400 400	29288 29388 29488 29488 EM	575 645 745 710	508 548 588 577	30 49 74 74	91 140 199 199	49 70 100 101	235 245 260 257	510 550 595 605	545 600 670 675	4 5 8	77 190 407 402
460	620 710 800	95 150 206	5 6 9.5	2 060 000 4 100 000 6 750 000	10 300 000 18 400 000 28 600 000	670 450 380	29292 29392 29492	592 666 765	530 567 608	30 51 74	91 144 199	46 72 100	245 257 272	530 575 615	570 630 690	4 5 8	80 210 420
480	650 730 850	103 150 224	5 6 9.5	2 370 000 4 150 000 7 200 000	12 100 000 19 000 000 31 000 000	600 450 360	29296 29396 29496	624 690 810	556 590 638	33 51 81	99 144 216	55 72 108	259 270 280	555 595 645	595 650 730	4 5 8	97 215 545
500	670 750 870	103 150 224	5 6 9.5	2 390 000 4 350 000 7 850 000	12 400 000 20 400 000 33 000 000	600 450 340	292/500 293/500 294/500	645 715 830	574 611 661	33 51 81	99 144 216	55 74 107	268 280 290	575 615 670	615 670 750	4 5 8	100 220 560

Note (1) For heavy load applications, a d_a value should be chosen which is large enough to support the shaft washer rib.





C 338 C 339



12. NEEDLE ROLLER BEARINGS

DESIGN AND TYPES

For needle roller bearings, there are many designs and types bearings.

Specified catalog, NSK Needle Roller Bearings CAT.No.E1419 lists bearings shown in Table 1. For details, please refer individual specified catalog. For bearing selection, please contact NSK.



Table 1 Types of Needle Roller Bearings

Cage & Needle Roller Assemblies	FWJ FBN, FBNP WJC WJ FWJC
Drawn Cup Needle Roller Bearings	FJ, FJH FJL MFJ, MFJH MFJL J,JH MJ, MJH MJ, MJH F, FH MF, MFH YH B, BH M, MH YH FJT, FJTT FJP IR MFJLT MFJLT MFJLT MFJLT MFJLT
Solid Needle Roller Bearings	RNA 48 RNA 49 RNA 59 RNA 69 HJ RNAF RNATT
Thrust Needle Roller Bearings Thurst raceway washers	FNTA
Needle Rollers	A Type F Type P Type (Pleas refer to 8350 page) T Type C M Type M Type
Cam Followers Roller Followers	FCR FCJS FYCJS FYCJS FYCJS YCR YCRS
Needle Roller Bearings For Universal Joints	ZY NSA NSA
Drawn Cup Roller Clutches	RC FC RCB FCB

C 340 C 341

13. BALL BEARING UNITS

DESIGN, 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

C 342 C 343

14. PLUMMER BLOCKS

DESIGN, TYPES AND FEATURES

There are numerous types and sizes of plummer blocks.

SN 5B

SN 6B

SN 30B

SN 31B

SN 2B

SN 3B

SN 2BC

SN 3BC

SD 30S SD 31S SD 5

SD 6

SD 2

SD3

SD 2C

SD 3C

 $V \cdot C$



These are the most common type.

Models SN30 and SN31 are for medium loads.

SN 5 SN 6

SN 30

SN 31

SN 2

SN 3

SN 2C

SN 3C

SG 5

SD31TS

SD32TS

For types SN2C and SN3C, the bore diameters on the two sides are different.



Dustproof plummer blocks have a combination of oil seals, labyrinth seals, and oil groove seals, therefore, they are suitable for environments with much dust and other foreign matter.



they are suitable for high speed applications.

These are provided with labyrinth seals, so



These have the same dimensions as those of types SN5 and SN6. To increase the bearing box strength, no material is removed from the top or bottom of the base, so mounting holes can be drilled anywhere.



These are large and made for heavy loads. The standard ones have double seals and four mounting bolt holes. For types SD2C and SD3C, the bore diameters on the two sides are different.



Single-piece plummer blocks (integrated type roller bearing unit)have higher rigidity and precision than split type plummer blocks.

C 345



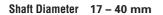
15. ACCESSORIES FOR ROLLING BEARINGS

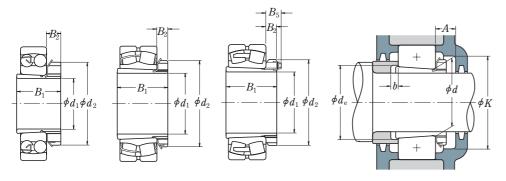
ADAPTERS FOR ROLLING BEARINGS	Shaft Diameter 17 – 470mm·····	C 34
WITHDRAWAL SLEEVES	onar Diameter 17 47 onni	0 04
FOR ROLLING BEARINGS	Shaft Diameter 35 – 480mm	C 35
NUTS FOR ROLLING BEARIN	VGS	C 36
STOPPERS FOR ROLLING B	EARINGS	C 36
LOCK-WASHERS FOR ROLL	ING BEARINGS	C 36

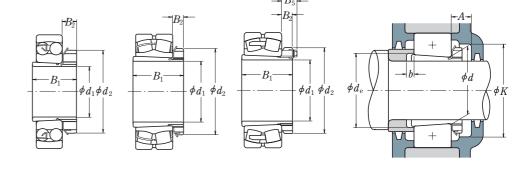




Shaft Diameter 45 - 60 mm







Shaft	Nominal Bearing	N		Dimen:			Adapter	Abu	tment D (mr		ons	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm)	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	$\begin{array}{c} A \\ \text{min.} \end{array}$	$K \atop { m min.}$	$d_{ m e}$ min.	$b \atop { m min.}$	approx.
17	20 20 20 20	1204K + H 204X 2204K + H 304X 1304K + H 304X 2304K + H2304X	24 28 28 31	32 32 32 32	7 7 7 7	_ _ _	A 204X A 304X A 304X A 2304X	14 14 14 14	39 39 39 39	23 24 24 24	5 5 8 5	0.045 0.045 0.045 0.050
20	25 25 25	1205K + H 205X 2205K + H 305X 1305K + H 305X	26 29 29	38 38 38	8 8 8	_	A 205X A 305X A 305X	15 15 15	45 45 45	28 29 29	5 5 6	0.065 0.075 0.075
	25 25	21305C DKE4 + H 305X 2305K + H2305X	29 35	38 38	8	_	A 305X A2305X	15 15	45 45	29 29	6 5	0.075 0.090
25	30 30 30	1206K + H 206X 2206K + H 306X 1306K + H 306X	27 31 31	45 45 45	8 8 8	_	A 206X A 306X A 306X	15 15 15	50 50 50	33 34 34	5 5 6	0.10 0.11 0.11
	30 30	21306C DKE4 + H 306X 2306K + H2306X	31 38	45 45	8	_	A 306X A2306X	15 15	50 50	34 35	6 5	0.11 0.125
30	35 35 35	1207K + H 207X 2207K + H 307X 1307K + H 307X	29 35 35	52 52 52	9 9 9	_	A 207X A 307X A 307X	17 17 17	58 58 58	38 39 39	5 5 7	0.125 0.145 0.145
	35 35	21307C DKE4 + H 307X 2307K + H2307X	35 43	52 52	9 9	_	A 307X A2307X	17 17	58 58	39 40	7 5	0.145 0.16
35	40 40 40	1208K + H 208X 2208K + H 308X 1308K + H 308X	31 36 36	58 58 58	10 10 10	_	A 208X A 308X A 308X	17 17 17	65 65 65	44 44 44	5 5 5	0.175 0.19 0.19
	40 40 40	21308E AKE4 + H 308X 2308K + H2308X 22308E AKE4 + H2308X	36 46 46	58 58 58	10 10 10	_	A 308X A 2308X A 2308X	17 17 17	65 65 65	44 45 45	5 5 5	0.19 0.225 0.225
40	45 45 45	1209K + H 209X 2209K + H 309X 1309K + H 309X	33 39 39	65 65 65	11 11 11	_	A 209X A 309X A 309X	17 17 17	72 72 72	49 49 49	5 8 5	0.225 0.26 0.26
	45 45 45	21309E AKE4 + H 309X 2309K + H2309X 22309E AKE4 + H2309X	39 50 50	65 65 65	11 11 11	_	A 309X A2309X A2309X	17 17 17	72 72 72	49 50 50	5 5 5	0.26 0.30 0.30

Shaft	Nominal Bearing			Dimens (mr			Adapter	Abu	tment D		ons	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm)	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	$\begin{array}{c} A \\ \text{min.} \end{array}$	$K \atop {\rm min.}$	$d_{ m e}$ min.	$_{\min .}^{\textit{b}}$	approx.
45	50 50 50	1210K + H 210X 2210K + H 310X 1310K + H 310X	35 42 42	70 70 70	12 12 12	_	A 210X A 310X A 310X	19 19 19	76 76 76	53 54 54	5 10 5	0.275 0.30 0.30
	50 50 50	21310E AKE4 + H 310X 2310K + H2310X 22310E AKE4 + H2310X	42 55 55	70 70 70	12 12 12	_ _ _	A 310X A2310X A2310X	19 19 19	76 76 76	54 56 56	5 5 5	0.30 0.35 0.35
50	55 55 55	1211K + H 211X 2211K + H 311X 22211E AKE4 + H 311X	37 45 45	75 75 75	12 12 12	_ _ _	A 211X A 311X A 311X	19 19 19	85 85 85	60 60 60	6 11 11	0.305 0.35 0.35
	55 55 55 55	1311K + H 311X 21311E AKE4 + H 311X 2311K + H2311X 22311E AKE4 + H2311X	45 45 59 59	75 75 75 75	12 12 12 12	_ _ _	A 311X A 311X A2311X A2311X	19 19 19 19	85 85 85 85	60 60 61 61	6 6 6	0.35 0.35 0.40 0.40
55	60 60 60	1212K + H 212X 2212K + H 312X 22212E AKE4 + H 312X	38 47 47	80 80 80	13 13 13	_	A 212X A 312X A 312X	20 20 20	90 90 90	64 65 65	5 9 9	0.365 0.40 0.40
	60 60 60	1312K + H 312X 21312E AKE4 + H 312X 2312K + H2312X 22312E AKE4 + H2312X	47 47 62 62	80 80 80 80	13 13 13 13	_ _ _	A 312X A 312X A2312X A2312X	20 20 20 20	90 90 90 90	65 65 66 66	5 5 5 5	0.40 0.40 0.45 0.45
60	65 65 65	1213K + H 213X 2213K + H 313X 22213E AKE4 + H 313X	40 50 50	85 85 85	14 14 14	_	A 213X A 313X A 313X	21 21 21	96 96 96	70 70 70	5 8 8	0.40 0.45 0.45
	65 65 65 65	1313K + H 313X 21313E AKE4 + H 313X 2313K + H2313X 22313E AKE4 + H2313X	50 50 65 65	85 85 85 85	14 14 14 14	_ _ _	A 313X A 313X A2313X A2313X	21 21 21 21	96 96 96 96	70 70 72 72	5 5 5 5	0.45 0.45 0.55 0.55
	70 70 70	22214E AKE4 + H 314X 21314E AKE4 + H 314X 22314E AKE4 + H2314X	52 52 68	92 92 92	14 14 14	_	A 314X A 314X A2314X	21 21 21	96 96 96	70 70 72	8 5 5	0.65 0.65 0.80

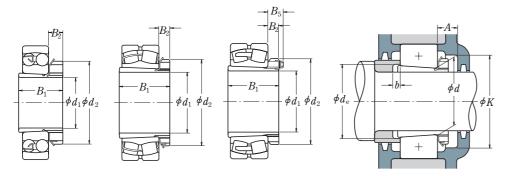
Remark The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

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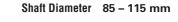


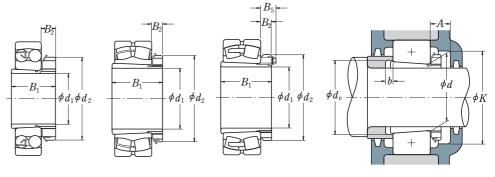
Shaft Diameter 65 - 80 mm



Shaft	Nominal Bearing			Dimens (mr			Adapter	Abu	tment D (mr		ons	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm)	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	$\underset{\rm min.}{A}$	$K \atop { m min.}$	$d_{ m e}$ min.	$b_{ m min.}$	approx.
65	75 75 75	1215K + H 215X 2215K + H 315X 22215E AKE4 + H 315X	43 55 55	98 98 98	15 15 15	_	A 215X A 315X A 315X	23 23 23	110 110 110	80 80 80	5 12 12	0.70 0.85 0.85
	75 75 75 75	1315K + H 315X 21315E AKE4 + H 315X 2315K + H2315X 22315E AKE4 + H2315X	55 55 73 73	98 98 98 98	15 15 15 15		A 315X A 315X A 2315X A 2315X	23 23 23 23	110 110 110 110	80 80 82 82	5 5 5	0.85 0.85 1.05 1.05
70	80 80 80	1216K + H 216X 2216K + H 316X 22216E AKE4 + H 316X	46 59 59	105 105 105	17 17 17	_	A 216X A 316X A 316X	25 25 25	120 120 120	85 86 86	5 12 12	0.85 1.05 1.05
	80 80 80 80	1316K + H 316X 21316E AKE4 + H 316X 2316K + H2316X 22316E AKE4 + H2316X	59 59 78 78	105 105 105 105	17 17 17 17	_ _ _	A 316X A 316X A2316X A2316X	25 25 25 25	120 120 120 120	86 86 87 87	5 5 5	1.05 1.05 1.3 1.3
75	85 85 85	1217K + H 217X 2217K + H 317X 22217E AKE4 + H 317X	50 63 63	110 110 110	18 18 18	_	A 217X A 317X A 317X	27 27 27	128 128 128	90 91 91	6 12 12	1.0 1.2 1.2
	85 85 85 85	1317K + H 317X 21317E AKE4 + H 317X 2317K + H2317X 22317E AKE4 + H2317X	63 63 82 82	110 110 110 110	18 18 18 18	_ _ _	A 317X A 317X A2317X A2317X	27 27 27 27	128 128 128 128	91 91 94 94	6 6 6	1.2 1.2 1.45 1.45
80	90 90 90	1218K + H 218X 2218K + H 318X 22218E AKE4 + H 318X	52 65 65	120 120 120	18 18 18	_	A 218X A 318X A 318X	28 28 28	139 139 139	95 96 96	6 10 10	1.15 1.4 1.4
	90 90 90	1318K + H 318X 21318E AKE4 + H 318X 2318K + H2318X	65 65 86	120 120 120	18 18 18		A 318X A 318X A2318X	28 28 28	139 139 139	96 96 99	6 6 6	1.4 1.4 1.7
	90 90	23218C KE4 + H2318X 22318E AKE4 + H2318X	86 86	120 120	18 18	_	A2318X A2318X	28 28	139 139	99 99	6 6	1.7 1.7







Shaft	Nominal Bearing	Nominal Numbers		Dimen (mr			Adapter Sleeve	Abu	tment D (mr		ons	Mass (kg)
Diameter (mm) d_1	(mm) d	Applicable Bearings	B_1	d_2	B_2	B_5	Numbers	$\begin{array}{c} A \\ \text{min.} \end{array}$	$K \atop {\rm min.}$	$d_{ m e}$ min.	$_{\min .}^{\textit{b}}$	approx.
85	95 95 95	1219K + H 219X 2219K + H 319X 22219E AKE4 + H 319X	55 68 68	125 125 125	19 19 19	_	A 219X A 319X A 319X	29 29 29	145 145 145	101 102 102	7 9 9	1.35 1.55 1.55
	95 95 95 95	1319K + H 319X 21319C KE4 + H 319X 2319K + H2319X 22319E AKE4 + H2319X	68 68 90 90	125 125 125 125	19 19 19 19	_ _ _	A 319X A 319X A2319X A2319X	29 29 29 29	145 145 145 145	102 102 105 105	7 7 7 7	1.55 1.55 1.9 1.9
90	100 100 100	1220K + H 220X 2220K + H 320X 22220E AKE4 + H 320X	58 71 71	130 130 130	20 20 20	_	A 220X A 320X A 320X	30 30 30	150 150 150	106 107 107	7 8 8	1.45 1.7 1.7
	100 100 100	1320K + H 320X 21320C KE4 + H 320X 2320K + H2320X	71 71 97	130 130 130	20 20 20	_	A 320X A 320X A 2320X	30 30 30	150 150 150	107 107 110	7 7 7	1.7 1.7 2.15
	100 100	23220C KE4 + H2320X 22320E AKE4 + H2320X	97 97	130 130	20 20	_	A2320X A2320X	30 30	150 150	110 110	7 7	2.15 2.15
100	110 110 110	23122C KE4 + H3122X 1222K + H 222X 2222K + H 322X	81 63 77	145 145 145	21 21 21	_	A3122X A 222X A 322X	32 32 32	170 170 170	117 116 117	7 7 6	2.25 1.95 2.3
	110 110 110	22222E AKE4 + H 322X 1322K + H 322X 2322K + H2322X	77 77 105	145 145 145	21 21 21	_	A 322X A 322X A 2322X	32 32 32	170 170 170	117 117 121	6 9 7	2.3 2.3 2.75
	110 110	23222C KE4 + H2322X 22322E AKE4 + H2322X	105 105	145 145	21 21	_	A2322X A2322X	32 32	170 170	121 121	17 7	2.75 2.75
110	120 120 120	23024C DKE4 + H3024 23124C KE4 + H3124 22224E AKE4 + H3124	72 88 88	145 155 155	22 22 22	_	A 3024 A 3124 A 3124	33 33 33	180 180 180	127 128 128	7 7 11	1.95 2.65 2.65
	120 120	23224C KE4 + H2324 22324E AKE4 + H2324	112 112	155 155	22 22	_	A 2324 A 2324	33 33	180 180	131 131	17 7	3.2 3.2
115	130 130 130	23026C DKE4 + H3026 23126C KE4 + H3126 22226E AKE4 + H3126	80 92 92	155 165 165	23 23 23	_	A 3026 A 3126 A 3126	34 34 34	190 190 190	137 138 138	8 8 8	2.85 3.65 3.65
	130 130	23226C KE4 + H2326 22326C KE4 + H2326	121 121	165 165	23 23	_	A 2326 A 2326	34 34	190 190	142 142	21 8	4.6 4.6

Remark The suffix X represents adapter sleeves having narrow slits, for which washers with straight tabs should be used.

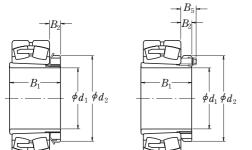


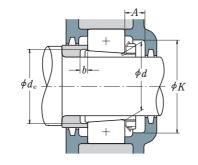
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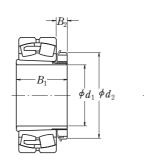
Shaft Diameter 180 – 260 mm

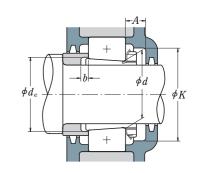


Shaft Diameter 125 – 170 mm









Shaft	Nominal Bearing			Dimen:			Adapter	Abu	tment D (mr		ons	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm)	Nominal Numbers Applicable Bearings	B_1	d_2	B_2	B_5	Sleeve Numbers	$\begin{array}{c} A \\ \text{min.} \end{array}$	K min.	$d_{ m e}$ min.	$b \atop { m min.}$	approx.
125	140 140 140	23028C DKE4 + H3028 23128C KE4 + H3128 22228C DKE4 + H3128	82 97 97	165 180 180	24 24 24	_	A 3028 A 3128 A 3128	36 36 36	205 205 205	147 149 149	8 8 8	3.15 4.35 4.35
	140 140	23228C KE4 + H2328 22328C KE4 + H2328	131 131	180 180	24 24	_	A 2328 A 2328	36 36	205 205	152 152	22 8	5.55 5.55
135	150 150 150	23030C DKE4 + H3030 23130C KE4 + H3130 22230C DKE4 + H3130	87 111 111	180 195 195	26 26 26	_	A 3030 A 3130 A 3130	37 37 37	220 220 220	158 160 160	8 8 15	3.9 5.5 5.5
	150 150	23230C KE4 + H2330 22330C AKE4 + H2330	139 139	195 195	26 26	_	A 2330 A 2330	37 37	220 220	163 163	20 8	6.6 6.6
140	160 160 160	23932C AKE4 + H3932 23032C DKE4 + H3032 23132C KE4 + H3132	78 93 119	190 190 210	28 28 28	_	A 3932 A 3032 A 3132	39 39 39	205 230 230	168 168 170	8 8 8	4.64 5.2 7.65
	160 160 160	22232C DKE4 + H3132 23232C KE4 + H2332 22332C AKE4 + H2332	119 147 147	210 210 210	28 28 28	_	A 3132 A 2332 A 2332	39 39 39	230 230 230	170 174 174	14 18 8	7.65 9.15 9.15
150	170 170 170	23934B CAKE4 + H3934 23034C DKE4 + H3034 23134C KE4 + H3134	79 101 122	200 200 220	29 29 29	_	A 3934 A 3034 A 3134	40 40 40	215 250 250	179 179 180	8 8 8	5.07 6.0 8.4
	170 170 170	22234C DKE4 + H3134 23234C KE4 + H2334 22334C AKE4 + H2334	122 154 154	220 220 220	29 29 29	_	A 3134 A 2334 A 2334	40 40 40	250 250 250	180 185 185	10 18 8	8.4 10 10
160	180 180 180	23936C AKE4 + H3936 23036C DKE4 + H3036 23136C KE4 + H3136	87 109 131	210 210 230	30 30 30	_	A 3936 A 3036 A 3136	41 41 41	230 260 260	189 189 191	8 8 8	5.87 6.85 9.5
	180 180 180	22236C DKE4 + H3136 23236C KE4 + H2336 22336C AKE4 + H2336	131 161 161	230 230 230	30 30 30	_	A 3136 A 2336 A 2336	41 41 41	260 260 260	191 195 195	18 22 8	9.5 11.5 11.5
170	190 190 190	23938C AKE4 + H3938 23038C AKE4 + H3038 23138C KE4 + H3138	89 112 141	220 220 240	31 31 31	_	A 3938 A 3038 A 3138	43 43 43	240 270 270	199 199 202	9 9 9	6.35 7.45 11
	190 190 190	22238C AKE4 + H3138 23238C KE4 + H2338 22338C AKE4 + H2338	141 169 169	240 240 240	31 31 31		A 3138 A 2338 A 2338	43 43 43	270 270 270	202 206 206	21 21 9	11 12.5 12.5

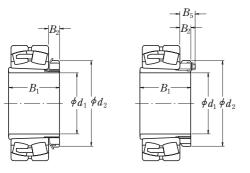
Shaft Diameter	Nominal Bearing	Nominal Numbers		Dimen (mr			Adapter Sleeve	Abu	tment D (mr		ons	Mass (kg)
d_1	(mm) <i>d</i>	Applicable Bearings	B_1	d_2	B_2	B_5	Numbers	$\begin{array}{c} A \\ \text{min.} \end{array}$	$_{\min .}^{K}$	$d_{ m e}$ min.	$_{\min .}^{\textit{b}}$	approx.
180	200 200 200	23940C AKE4 + H3940 23040C AKE4 + H3040 23140C KE4 + H3140	98 120 150	240 240 250	32 32 32	=	A 3940 A 3040 A 3140	46 46 46	260 280 280	210 210 212	10 10 10	8.0 9.2 12
	200 200 200	22240C AKE4 + H3140 23240C KE4 + H2340 22340C AKE4 + H2340	150 176 176	250 250 250	32 32 32	_	A3140 A2340 A2340	46 46 46	280 280 280	212 216 216	24 20 10	12 14 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	A 3148	60	340	254	19	17.5
	240	23248C AKE4 + H2348	196	300	34	46	A 2348	60	340	257	6	19.5
	240	22348C AKE4 + H2348	196	300	34	46	A 2348	60	340	257	11	19.5
240	260	23952C AKE4 + H3952	116	310	34	46	A 3952	60	330	272	11	13.4
	260	23052C AKE4 + H3052	147	310	34	46	A 3052	60	370	272	13	15.5
	260	23152C AKE4 + H3152	187	330	36	49	A 3152	60	370	276	11	22
	260	22252C AKE4 + H3152	187	330	36	49	A 3152	60	370	276	25	22
	260	23252C AKE4 + H2352	208	330	36	49	A 2352	60	370	278	2	24
	260	22352C AKE4 + H2352	208	330	36	49	A 2352	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

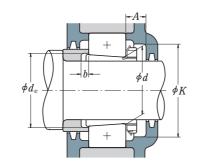
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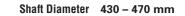
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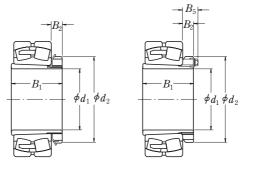
Shaft Diameter 280 - 410 mm

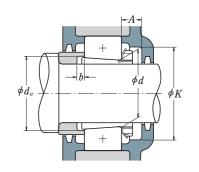




Shaft	Nominal Bearing	Nominal Numbers		Dimens (mr			Adapter Sleeve	Abu	tment D		ons	Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm)	Applicable Bearings	B_1	d_2	B_2	B_5	Numbers	$\begin{array}{c} A \\ \text{min.} \end{array}$	$K \atop { m min.}$	$d_{ m e}$ min.	$b \atop { m min.}$	approx.
280	300	23960C AKE4 + 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	400 400 400 400	23980C AKE4 + H3980 23080C AKE4 + H3080 23180C AKE4 + H3180 23280C AKE4 + H3280	168 210 272 328	470 470 520 520	52 52 62 62	66 66 82 82	A3980 A3080 A3180 A3280	86 86 86	500 580 580 580	417 417 421 427	15 15 15 15	35.2 41.5 70.5 81
400	420 420 420 420	23984C AKE4 + H3984 23084C AKE4 + H3084 23184C AKE4 + H3184 23284C AKE4 + H3284	168 212 304 352	490 490 540 540	52 52 70 70	66 66 90 90	A3984 A3084 A3184 A3284	86 86 86	520 600 600 600	437 437 443 448	16 16 16 16	36.6 43.5 84 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	Nominal Bearing Bore Dia.	Nominal Numbers	Dimensions (mm)			Adapter Sleeve	Abu	tment D (mr		ons	Mass (kg)	
Diameter (mm)	(mm) d	Applicable Bearings	B_1	d_2	B_2	B_5	Numbers	$\begin{array}{c} A \\ \text{min.} \end{array}$	$K \atop { m min.}$	$d_{ m e}$ min.	$_{\min .}^{\textit{b}}$	approx.
430	460	23992C AKE4 + H3992	189	540	60	77	A 3992	99	570	478	17	62
	460	23092C AKE4 + H3092	234	540	60	77	A 3092	99	650	478	17	69.5
	460	23192C AKE4 + H3192	326	580	75	95	A 3192	99	650	485	17	116
	460	23292C AKE4 + H3292	382	580	75	95	A 3292	99	650	491	17	132
450	480	23996C AKE4 + H3996	200	560	60	77	A 3996	99	600	499	18	67.5
	480	23096C AKE4 + H3096	237	560	60	77	A 3096	99	690	499	18	73.5
	480	23196C AKE4 + H3196	335	620	75	95	A 3196	99	690	505	18	133
	480	23296C AKE4 + H3296	397	620	75	95	A 3296	99	690	512	18	152
470	500	239/500C AKE4 + H39/500	208	580	68	85	A 39/500	109	620	519	18	74.6
	500	230/500C AKE4 + H30/500	247	580	68	85	A 30/500	109	700	519	18	82
	500	231/500C AKE4 + H31/500	356	630	80	100	A 31/500	109	700	527	18	143
	500	232/500C AKE4 + H32/500	428	630	80	100	A 32/500	109	700	534	18	166



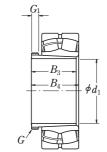


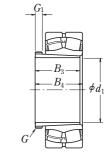
C 354 C 355

Shaft Diameter 90 – 135 mm

■WITHDRAWAL SLEEVES FOR ROLLING BEARINGS

Shaft Diameter 35 - 85 mm





Shaft	Nominal Bearing		Screw Thread	D	imensions (mm)		Mass (kg)
Diameter (mm) d_1	Bore Dia.	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	approx.
35 40	40 40 45 45	21308EAKE4 + AH 308 22308EAKE4 + AH 2308 21309EAKE4 + AH 309 22309EAKE4 + AH 2309	M 45 × 1.5 M 45 × 1.5 M 50 × 1.5 M 50 × 1.5	29 40 31 44	6 7 6 7	32 43 34 47	0.09 0.13 0.11 0.165
45	50	21310EAKE4 + AHX 310	M 55 × 2	35	7	38	0.16
	50	22310EAKE4 + AHX 2310	M 55 × 2	50	9	53	0.235
50	55	22211EAKE4 + AHX 311	M 60 × 2	37	7	40	0.19
	55	21311EAKE4 + AHX 311	M 60 × 2	37	7	40	0.19
	55	22311EAKE4 + AHX 2311	M 60 × 2	54	10	57	0.285
55	60	22212EAKE4 + AHX 312	M 65 × 2	40	8	43	0.215
	60	21312EAKE4 + AHX 312	M 65 × 2	40	8	43	0.215
	60	22312EAKE4 + AHX 2312	M 65 × 2	58	11	61	0.34
60	65	22213EAKE4 + AH 313	M 75 × 2	42	8	45	0.255
	65	21313EAKE4 + AH 313	M 75 × 2	42	8	45	0.255
	65	22313EAKE4 + AH 2313	M 75 × 2	61	12	64	0.395
65	70	22214EAKE4 + AH 314	M 80 × 2	43	8	47	0.28
	70	21314EAKE4 + AH 314	M 80 × 2	43	8	47	0.28
	70	22314EAKE4 + AHX 2314	M 80 × 2	64	12	68	0.53
70	75	22215EAKE4 + AH 315	M 85 × 2	45	8	49	0.315
	75	21315EAKE4 + AH 315	M 85 × 2	45	8	49	0.315
	75	22315EAKE4 + AHX 2315	M 85 × 2	68	12	72	0.605
75	80	22216EAKE4 + AH 316	M 90 × 2	48	8	52	0.365
	80	21316EAKE4 + AH 316	M 90 × 2	48	8	52	0.365
	80	22316EAKE4 + AHX 2316	M 90 × 2	71	12	75	0.665
80	85	22217EAKE4 + AHX 317	M 95 × 2	52	9	56	0.48
	85	21317EAKE4 + AHX 317	M 95 × 2	52	9	56	0.48
	85	22317EAKE4 + AHX 2317	M 95 × 2	74	13	78	0.745
85	90	22218EAKE4 + AHX 318	M 100 x 2	53	9	57	0.52
	90	21318EAKE4 + AHX 318	M 100 x 2	53	9	57	0.52
	90	23218CKE4 + AHX 3218	M 100 x 2	63	10	67	0.58
	90	22318EAKE4 + AHX 2318	M 100 x 2	79	14	83	0.845

Shaft	Nominal Bearing		Screw Thread	D	imensions (mm)		Mass (kg)
Diameter d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	approx.
90	95	22219EAKE4 + AHX 319	M 105 × 2	57	10	61	0.595
	95	21319CKE4 + AHX 319	M 105 × 2	57	10	61	0.595
	95	22319EAKE4 + AHX 2319	M 105 × 2	85	16	89	0.89
95	100	21320CKE4 + AHX 3120	M 110 × 2	64	11	68	0.70
	100	22220EAKE4 + AHX 320	M 110 × 2	59	10	63	0.66
	100	21320CKE4 + AHX 320	M 110 × 2	59	10	63	0.66
	100	23220CKE4 + AHX 3220	M 110 × 2	73	11	77	0.77
	100	22320EAKE4 + AHX 2320	M 110 × 2	90	16	94	1.0
105	110	23122CKE4 + AHX 3122	M 120 × 2	68	11	72	0.76
	110	22222EAKE4 + AHX 3122	M 120 × 2	68	11	72	0.76
	110	24122CK30E4 + AH 24122	M 115 × 2	82	13	91	0.73
	110	23222CKE4 + AHX 3222	M 125 × 2	82	11	86	1.04
	110	22322EAKE4 + AHX 2322	M 125 × 2	98	16	102	1.35
115	120	23024C DKE4 + AHX 3024	M 130 × 2	60	13	64	0.75
	120	24024C K30E4 + AH 24024	M 125 × 2	73	13	82	0.70
	120	23124C KE4 + AHX 3124	M 130 × 2	75	12	79	0.95
	120	22224EAKE4 + AHX 3124	M 130 × 2	75	12	79	0.95
	120	24124CK30E4 + AH 24124	M 130 × 2	93	13	102	1.02
	120	23224CKE4 + AHX 3224	M 135 × 2	90	13	94	1.3
	120	22324EAKE4 + AHX 2324	M 135 × 2	105	17	109	1.6
125	130	23026C DKE4 + AHX 3026	M 140 × 2	67	14	71	0.95
	130	24026C K30E4 + AH 24026	M 135 × 2	83	14	93	0.89
	130	23126C KE4 + AHX 3126	M 140 × 2	78	12	82	1.08
	130	22226E AKE4 + AHX 3126	M 140 × 2	78	12	82	1.08
	130	24126C K30E4 + AH 24126	M 140 × 2	94	14	104	1.14
	130	23226C KE4 + AHX 3226	M 145 × 2	98	15	102	1.58
	130	22326C KE4 + AHX 2326	M 145 × 2	115	19	119	1.97
135	140	23028C DKE4 + AHX 3028	M 150 x 2	68	14	73	1.01
	140	24028C K30E4 + AH 24028	M 145 x 2	83	14	93	0.96
	140	23128C KE4 + AHX 3128	M 150 x 2	83	14	88	1.28
	140	22228CDKE4 + AHX 3128	M 150 × 2	83	14	88	1.28
	140	24128CK30E4 + AH 24128	M 150 × 2	99	14	109	1.3
	140	23228CKE4 + AHX 3228	M 155 × 3	104	15	109	1.84
	140	22328CKE4 + AHX 2328	M 155 × 3	125	20	130	2.33



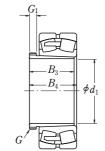


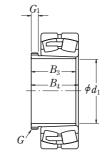
C 357 C 356

Shaft Diameter 190 – 260 mm

■WITHDRAWAL SLEEVES FOR ROLLING BEARINGS

Shaft Diameter 145 – 180 mm





Shaft	Nominal Bearing		Screw Thread	С	imensions (mm)		Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	approx.
145	150	23030CDKE4 + AHX 3030	M 160 × 3	72	15	77	1.15
	150	24030CK30E4 + AH 24030	M 155 × 3	90	15	101	1.11
	150	23130CKE4 + AHX 3130	M 165 × 3	96	15	101	1.79
	150	22230C DKE4 + AHX 3130	M 165 × 3	96	15	101	1.79
	150	24130C K30E4 + AH 24130	M 160 × 3	115	15	126	1.63
	150	23230C KE4 + AHX 3230	M 165 × 3	114	17	119	2.22
	150	22330C AKE4 + AHX 2330	M 165 × 3	135	24	140	2.82
150	160	23032CDKE4 + AH 3032	M 170 × 3	77	16	82	2.05
	160	24032CK30E4 + AH 24032	M 170 × 3	95	15	106	2.28
	160	23132CKE4 + AH 3132	M 180 × 3	103	16	108	3.2
	160	22232C DKE4 + AH 3132	M 180 × 3	103	16	108	3.2
	160	24132C K30E4 + AH 24132	M 170 × 3	124	15	135	3.03
	160	23232C KE4 + AH 3232	M 180 × 3	124	20	130	4.1
	160	22332C AKE4 + AH 2332	M 180 × 3	140	24	146	4.7
160	170	23034C DKE4 + AH 3034	M 180 × 3	85	17	90	2.45
	170	24034C K30E4 + AH 24034	M 180 × 3	106	16	117	2.74
	170	23134C KE4 + AH 3134	M 190 × 3	104	16	109	3.4
	170	22234C DKE4 + AH 3134	M 190 × 3	104	16	109	3.4
	170	24134C K30E4 + AH 24134	M 180 × 3	125	16	136	3.26
	170	23234C KE4 + AH 3234	M 190 × 3	134	24	140	4.8
	170	22334C AKE4 + AH 2334	M 190 × 3	146	24	152	5.25
170	180	23036C DKE4 + AH 3036	M 190 × 3	92	17	98	2.8
	180	24036C K30E4 + AH 24036	M 190 × 3	116	16	127	3.19
	180	23136C KE4 + AH 3136	M 200 × 3	116	19	122	4.2
	180	24136CK30E4 + AH 24136	M 190 × 3	134	16	145	3.74
	180	22236CDKE4 + AH 2236	M 200 × 3	105	17	110	3.75
	180	23236CKE4 + AH 3236	M 200 × 3	140	24	146	5.3
	180	22336CAKE4 + AH 2336	M 200 × 3	154	26	160	5.85
180	190	23038CAKE4 + AH 3038	Tr 205 × 4	96	18	102	3.35
	190	24038CK30E4 + AH 24038	M 200 × 3	118	18	131	3.47
	190	23138CKE4 + AH 3138	Tr 210 × 4	125	20	131	4.9
	190	24138C K30E4 + AH 24138	M 200 × 3	146	18	159	4.38
	190	22238C AKE4 + AH 2238	Tr 210 × 4	112	18	117	4.25
	190	23238C KE4 + AH 3238	Tr 210 × 4	145	25	152	5.9
	190	22338C AKE4 + AH 2338	Tr 210 × 4	160	26	167	6.65

Shaft	Nominal Bearing		Screw Thread	D	imensions (mm)		Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	approx.
190	200	23040CAKE4 + AH 3040	Tr 215 × 4	102	19	108	3.8
	200	24040CK30E4 + AH 24040	Tr 210 × 4	127	18	140	3.92
	200	23140CKE4 + AH 3140	Tr 220 × 4	134	21	140	5.5
	200	24140CK30E4 + AH 24140	Tr 210 × 4	158	18	171	5.0
	200	22240CAKE4 + AH 2240	Tr 220 × 4	118	19	123	4.7
	200	23240CKE4 + AH 3240	Tr 220 × 4	153	25	160	6.7
	200	22340CAKE4 + AH 2340	Tr 220 × 4	170	30	177	7.55
200	220	23044CAKE4 + AH 3044	Tr 235 × 4	111	20	117	7.4
	220	24044CK30E4 + AH 24044	Tr 230 × 4	138	20	152	8.23
	220	23144CKE4 + AH 3144	Tr 240 × 4	145	23	151	10.5
	220 220 220 220	24144CK30E4 + AH 24144 22244CAKE4 + AH 2244 23244CKE4 + AH 2344 22344CAKE4 + AH 2344	Tr 230 × 4 Tr 240 × 4 Tr 240 × 4 Tr 240 × 4	170 130 181 181	20 20 30 30	184 136 189 189	10.3 9.1 13.5 13.5
220	240	23048C AKE4 + AH 3048	Tr 260 × 4	116	21	123	8.75
	240	24048C K30E4 + AH 24048	Tr 250 × 4	138	20	153	9.0
	240	23148C KE4 + AH 3148	Tr 260 × 4	154	25	161	12
	240 240 240 240	24148CK30E4 + AH 24148 22248CAKE4 + AH 2248 23248CAKE4 + AH 2348 22348CAKE4 + AH 2348	Tr 260 × 4 Tr 260 × 4 Tr 260 × 4 Tr 260 × 4	180 144 189 189	20 21 30 30	195 150 197 197	12.6 11 15.5 15.5
240	260	23052CAKE4 + AH 3052	Tr 280 × 4	128	23	135	10.5
	260	24052CAK30E4 + AH 24052	Tr 270 × 4	162	22	178	11.7
	260	23152CAKE4 + AH 3152	Tr 290 × 4	172	26	179	16
	260	24152CAK30E4 + AH 24152	Tr 280 × 4	202	22	218	15.5
	260	22252CAKE4 + AH 2252	Tr 290 × 4	155	23	161	14
	260	23252CAKE4 + AH 2352	Tr 290 × 4	205	30	213	19.5
	260	22352CAKE4 + AH 2352	Tr 290 × 4	205	30	213	19.5
260	280	23056C AKE4 + AH 3056	Tr 300 × 4	131	24	139	12
	280	24056C AK30E4 + AH 24056	Tr 290 × 4	162	22	179	12.6
	280	23156C AKE4 + AH 3156	Tr 310 × 5	175	28	183	17.5
	280	24156C AK30E4 + AH 24156	Tr 300 × 4	202	22	219	16.8
	280	22256C AKE4 + AH 2256	Tr 310 × 5	155	24	163	15
	280	23256C AKE4 + AH 2356	Tr 310 × 5	212	30	220	21.5
	280	22356C AKE4 + AH 2356	Tr 310 × 5	212	30	220	21.5



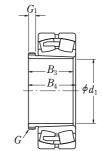


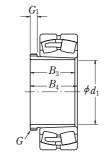
C 358 C 359

Shaft Diameter 400 – 480 mm

■WITHDRAWAL SLEEVES FOR ROLLING BEARINGS

Shaft Diameter 280 - 380 mm





Shaft	Nominal Bearing		Screw Thread	D	imensions		Mass (kg)
Diameter (mm) d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	approx.
280	300	23060CAKE4 + AH 3060	Tr 320 × 5	145	26	153	14.5
	300	24060CAK30E4 + AH 24060	Tr 310 × 5	184	24	202	15.5
	300	23160CAKE4 + AH 3160	Tr 330 × 5	192	30	200	21
	300	24160CAK30E4 + AH 24160	Tr 320 × 5	224	24	242	20.3
	300	22260CAKE4 + AH 2260	Tr 330 × 5	170	26	178	18
	300	23260CAKE4 + AH 3260	Tr 330 × 5	228	34	236	20
300	320	23064CAKE4 + AH 3064	Tr 345 × 5	149	27	157	16
	320	24064CAK30E4 + AH 24064	Tr 330 × 5	184	24	202	16.4
	320	23164CAKE4 + AH 3164	Tr 350 × 5	209	31	217	24.5
	320	24164CAK30E4 + AH 24164	Tr 340 × 5	242	24	260	23.5
	320	23264CAKE4 + AH 3264	Tr 350 × 5	246	36	254	25
320	340	23068CAKE4 + AH 3068	Tr 365 × 5	162	28	171	19.5
	340	24068CAK30E4 + AH 24068	Tr 360 × 5	206	26	225	21.2
	340	23168CAKE4 + AH 3168	Tr 370 × 5	225	33	234	29
	340	24168CAK30E4 + AH 24168	Tr 360 × 5	269	26	288	28.3
	340	23268CAKE4 + AH 3268	Tr 370 × 5	264	38	273	35.5
340	360	23072CAKE4 + AH 3072	Tr 385 × 5	167	30	176	21
	360	24072CAK30E4 + AH 24072	Tr 380 × 5	206	26	226	22.5
	360	23172CAKE4 + AH 3172	Tr 400 × 5	229	35	238	33
	360	24172CAK30E4 + AH 24172	Tr 380 × 5	269	26	289	30
	360	23272CAKE4 + AH 3272	Tr 400 × 5	274	40	283	41.5
360	380	23076CAKE4 + AH 3076	Tr 410 × 5	170	31	180	23.5
	380	24076CAK30E4 + AH 24076	Tr 400 × 5	208	28	228	24.1
	380	23176CAKE4 + AH 3176	Tr 420 × 5	232	36	242	35.5
	380	24176CAK30E4 + AH 24176	Tr 400 × 5	271	28	291	32.1
	380	23276CAKE4 + AH 3276	Tr 420 × 5	284	42	294	45.5
380	400	23080CAKE4 + AH 3080	Tr 430 × 5	183	33	193	27.5
	400	24080CAK30E4 + AH 24080	Tr 420 × 5	228	28	248	28
	400	23180CAKE4 + AH 3180	Tr 440 × 5	240	38	250	39.5
	400	24180CAK30E4 + AH 24180	Tr 420 × 5	278	28	298	34.8
	400	23280CAKE4 + AH 3280	Tr 440 × 5	302	44	312	51.5

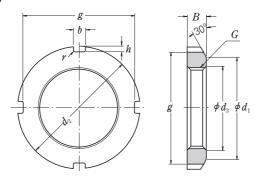
Shaft	Nominal Bearing		Screw Thread	D	imensions (mm)	3	Mass (kg)
Diameter d_1	Bore Dia. (mm) d	Nominal Numbers Applicable Bearings	G	B_3	G_1	B_4	approx.
400	420	23084CAKE4 + AH 3084	Tr 450 × 5	186	34	196	29
	420	24084CAK30E4 + AH 24084	Tr 440 × 5	230	30	252	29.8
	420	23184CAKE4 + AH 3184	Tr 460 × 5	266	40	276	46.5
	420	24184CAK30E4 + AH 24184	Tr 440 × 5	310	30	332	41.4
	420	23284CAKE4 + AH 3284	Tr 460 × 5	321	46	331	59
420	440	23088CAKE4 + AHX 3088	Tr 470 × 5	194	35	205	42
	440	24088CAK30E4 + AH 24088	Tr 460 × 5	242	30	264	33
	440	23188CAKE4 + AHX 3188	Tr 480 × 5	270	42	281	50
	440	24188CAK30E4 + AH 24188	Tr 460 × 5	310	30	332	43.5
	440	23288CAKE4 + AHX 3288	Tr 480 × 5	330	48	341	64
440	460	23092CAKE4 + AHX 3092	Tr 490 × 5	202	37	213	46
	460	24092CAK30E4 + AH 24092	Tr 480 × 5	250	32	273	35.9
	460	23192CAKE4 + AHX 3192	Tr 510 × 6	285	43	296	58
	460	24192CAK30E4 + AH 24192	Tr 480 × 5	332	32	355	49.7
	460	23292CAKE4 + AHX 3292	Tr 510 × 6	349	50	360	74.5
460	480	23096CAKE4 + AHX 3096	Tr 520 × 6	205	38	217	51
	480	24096CAK30E4 + AH 24096	Tr 500 × 5	250	32	273	37.5
	480	23196CAKE4 + AHX 3196	Tr 530 × 6	295	45	307	63
	480	24196CAK30E4 + AH 24196	Tr 500 × 5	340	32	363	53
	480	23296CAKE4 + AHX 3296	Tr 530 × 6	364	52	376	82
480	500	230/500CAKE4 + AHX 30/500	Tr 540 × 6	209	40	221	54.5
	500	240/500CAK30E4 + AH 240/500	Tr 530 × 6	253	35	276	41.9
	500	231/500CAKE4 + AHX 31/500	Tr 550 × 6	313	47	325	71
	500	241/500CAK30E4 + AH 241/500	Tr 530 × 6	360	35	383	61.2
	500	232/500CAKE4 + AHX 32/500	Tr 550 × 6	393	54	405	94.5





C 361 C 360

(For Adapters and Shafts)



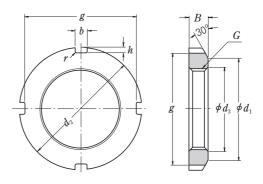
Nut with Washer

		Nut With Wallion			Uni	its:mm	
		Nut Series AN			Reference		
nal	Screw Threads	Basic Dimensions	Mass	Adapter (1)	Machar	Choft	

							Reference						
Nominal Numbers	Screw Threads G	d_2	d_1	g g	asic Di b	mensio <i>h</i>	ns d_3	В	r max.	Mass (kg) approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Washer Numbers	Shaft Dia.
AN 02 AN 03 AN 04	M 15×1 M 17×1 M 20×1	25 28 32	21 24 26	21 24 28	4 4 4	2 2 2	15.5 17.5 20.5	5 5 6	0.4 0.4 0.4	0.010 0.013 0.019	— 04	AW 02 X AW 03 X AW 04 X	15 17 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 3 3	56	11	0.5	0.158	11	AW 11 X	55
AN 12	M 60×2	80	73	74	7		61	11	0.5	0.174	12	AW 12 X	60
AN 13	M 65×2	85	79	79	7		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

				Nut	Series	AN						Reference	
Nominal Numbers	Screw Threads G	d_2	d_1	g g	asic Di b	mensio $\it h$	ns d_3	В	r max.	Mass (kg) approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Washer Numbers	Shaft Dia.
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 AN 30 AN 31	M 145×2 M 150×2 M 155×3	190 195 200	172 171 182	178 183 186	14 14 16	6 6 7	146 151 156.5	24 24 25	0.7 0.7 0.7	2.0 2.03 2.21		AW 29 AW 30	145 150 —
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 <i>i</i>	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

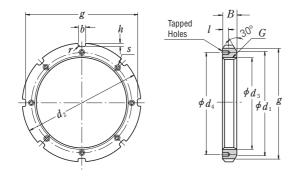
Note (1) Series AN is applicable to adapter sleeve Series A31 and A23. Series ANL is applicable to adapter sleeve Series A30.

Remark The basic design and dimensions of screw threads are in accordance with JIS B 0205.





(For Adapters and Shafts)



Nut with Stopper

		Units : mr														: mm			
								Nut Serie	s AN							R	eferer	се	
Nom Numl		Screw Threads G	d_2	d_1	Bas g	sic Di	mens <i>h</i>	sions d_3	В	r max.	l		pped Holes ew Threads (S)	d_4	Mass (kg) approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Stop Num		Shaft Dia.
AN AN AN	44 48 52		280 300 330		260 280 306	20 20 24	10 10 12	222 242 262	32 34 36	0.8 0.8 0.8	15 15 18	M M	8×1.25 8×1.25 10×1.5	238 258 281	5.2 5.95 8.05	44 48 52	AL AL AL	44 44 52	220 240 260
AN AN AN	60	Tr 280×4 Tr 300×4 Tr 320×5	350 380 400		326 356 376	24 24 24	12 12 12	282 302 322.5	38 40 42	0.8 0.8 0.8	18 18 18	M	10×1.5 10×1.5 10×1.5	301 326 345	9.05 11.8 13.1	56 60 64	AL AL AL	52 60 64	280 300 320
AN AN AN	72	Tr 340×5 Tr 360×5 Tr 380×5	440 460 490	420	410 430 454	28 28 32	15 15 18	342.5 362.5 382.5	55 58 60	1 1 1	21 21 21	M	12×1.75 12×1.75 12×1.75	372 392 414	23.1 25.1 31	68 72 76	AL AL AL	68 68 76	340 360 380
AN AN AN	84	Tr 400×5 Tr 420×5 Tr 440×5	520 540 560	490	484 504 520	32	18 18 20	402.5 422.5 442.5	70	1 1 1	27 27 27	M	16×2 16×2 16×2	439 459 477		80 84 88	AL AL AL	80 80 88	400 420 440
AN AN AN	92 96 100	Tr 480×5	580 620 630	540 560 580	540 580 584	36 36 40	20 20 23	462.5 482.5 502.5	75 75 80	1 1 1	27 27 27	M	16×2 16×2 16×2	497 527 539	50.5 62 63.5	92 96 /500	AL AL AL	88 96 100	460 480 500

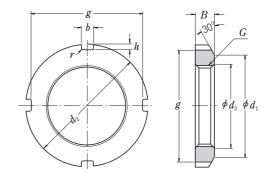
AN 100	Tr 500×5	630	580	584	40	23	502.5	80	1	27	М	16×2	539	63.5	/500	AL 100	500
						Nu	t Series <i>i</i>	ANL									
ANL 48 ANL 52	Tr 220×4 Tr 240×4 Tr 260×4 Tr 280×4	290 310	242 270 290 310	242 270 290 310	20 20	9 10 10 10	222 242 262 282		0.8 0.8 0.8 0.8		M M M	6×1 8×1.25 8×1.25 8×1.25	273	3.1 5.15 5.65 6.8	44 48 52 56	ALL 44 ALL 48 ALL 48 ALL 56	220 240 260 280
ANL 64	Tr 300×4 Tr 320×5 Tr 340×5	380	336 356 376	336 356 376	24	12 12 12	302 322.5 342.5	42	0.8 0.8 1	15 15 15	M M M	8×1.25 8×1.25 8×1.25		9.6 9.95 11.7	60 64 68	ALL 60 ALL 64 ALL 64	300 320 340
ANL 76	Tr 360×5 Tr 380×5 Tr 400×5	450	394 422 442	422	28	13 14 14	362.5 382.5 402.5	48		15 18 18	Μ	8×1.25 10×1.5 10×1.5	374 398 418	12 14.9 16.9	72 76 80	ALL 72 ALL 76 ALL 76	360 380 400
ANL 88	Tr 420×5 Tr 440×5 Tr 460×5	520	462 490 510	462 490 510	32	14 15 15	422.5 442.5 462.5	60	1 1 1	18 21 21	Μ	10×1.5 12×1.75 12×1.75	438 462 482	17.4 26.2 28	84 88 92	ALL 84 ALL 88 ALL 88	420 440 460
	Tr 480×5 Tr 500×5	560 580	530 550	530 550		15 15	482.5 502.5		1 1	21 21		12×1.75 12×1.75		29.5 33.5	96 /500	ALL 96 ALL 96	480 500

(1) Series AN is applicable to adapter sleeve Series A31, A32 and A23. Series ANL is applicable to adapter sleeve Series Note

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 $B\ 0205$.

(For Withdrawal Sleeves)



Unite : mm

														l	Units : mm
				Nut	Serie	s HN							Refer	ence	
Nominal	Screw			Bas	ic Dir	nens	ions			Mass		W	ithdrawal Sle	eeve Numbers	
Numbers	Threads G	d_2	d_1	g	b	h	d_3	В	γ max.	(kg) approx.	A	AH 31	AH 22	AH 32	AH 23
HN 42 HN 44 HN 48	Tr 210×4 Tr 220×4 Tr 240×4	270 280 300		250 260 280	20	10 10 10	222		0.8 0.8 0.8	4.75 5.35 6.2	AH AH AH	3138 3140 3144	AH 2238 AH 2240 AH 2244	AH 3238 AH 3240	AH 2338 AH 2340 AH 2344
HN 52 HN 58 HN 62	Tr 260×4 Tr 290×4 Tr 310×5	330 370 390		306 346 366	24		262 292 312.5	40	0.8 0.8 0.8	8.55 11.8 13.4	AH AH AH	3148 3152 3156	AH 2248 AH 2252 AH 2256	_ _ _	AH 2348 AH 2352 AH 2356
HN 66 HN 70 HN 74	Tr 330×5 Tr 350×5 Tr 370×5	420 450 470	410	390 420 440	28	15 15 15	332.5 352.5 372.5	52 55 58	1 1 1	20.4 25.2 28.2	AH AH AH	3160 3164 3168	AH 2260 AH 2264	AH 3260 AH 3264 AH 3268	_ _ _
HN 80 HN 84 HN 88	Tr 400×5 Tr 420×5 Tr 440×5	520 540 560	490	484 504 520	32	18	402.5 422.5 442.5	62 70 70	1 1 1	40 46.9 48.5	AH AH AH	3172 3176 3180		AH 3272 AH 3276 AH 3280	_
HN 92 HN 96 HN 102	Tr 460×5 Tr 480×5 Tr 510×6	580 620 650	560	540 580 604	36 36 40		462.5 482.5 513	75 75 80	1 1 1	55 67 75	AH	3184 X 3188 X 3192		AH 3284 AHX 3288 AHX 3292	_
HN 106 HN 110	Tr 530×6 Tr 550×6	670 700		624 654			533 553	80 80	1	78 92.5		X 3196 X 31/500	_	AHX 3296 AHX 32/500	_
				Nut S	Series	s HN	L				А	H 30	AH 2		
HNL41 HNL43 HNL47	Tr 205×4 Tr 215×4 Tr 235×4	250 260 280	242	234 242 262	20	8 9 9	207 217 237	30	0.8 0.8 0.8	3.45 3.7 4.6	AH	3038 3040 3044	AH 238 AH 240 AH 244		
HNL52 HNL56 HNL60	Tr 260×4 Tr 280×4 Tr 300×4	310 330 360	310	290 310 336	24	10 10 12	262 282 302	38	0.8 0.8 0.8	5.8 6.7 9.6	AH	3048 3052 3056	AH 248 AH 252 AH 256		
HNL64 HNL69 HNL73	Tr 320×5 Tr 345×5 Tr 365×5	380 410 430	384	356 384 404	28	13	322.5 347.5 367.5	42 45 48	1 1 1	10.3 11.5 14.2	AH	3060 3064 3068	_		
HNL77 HNL82 HNL86	Tr 385×5 Tr 410×5 Tr 430×5	450 480 500	452	422 452 472	32 32	14	387.5 412.5 432.5	48 52 52	1 1 1	15 19 19.8	АН	3072 3076 3080	_		
HNL90 HNL94 HNL98	Tr 450×5 Tr 470×5 Tr 490×5	520 540 580		490 510 550	32 32 36		452.5 472.5 492.5	60 60 60	1 1 1	23.8 25 34	AH	3084 X 3088 X 3092			
HNL 104 HNL 108		600 630	570 590	570 590		15 20	523 543	68 68	1	37 43.5		X 3096 X 30/500			



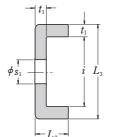
- **Remarks** 1. The basic design and dimensions of screw threads are in accordance with JIS B 0216.
 - 2. The number of notches in the nut may be bigger than that shown in the above figure.

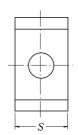


C 365 C 364



(Combination of Withdrawal Sleeves and Nuts)





								Units : mn
				Stopper Se	eries AL			Reference
Nominal Numbers			Basic	Dimensions	3		Mass (kg) per 100 pcs	Nut Numbers
	t_1	S	L_2	s_1	i	L_3	approx.	Wat Wallibold
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 Se	ries 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

Nominal Numbers			Witho	Irawal Sleeve Nu	mbers		
	AH 30	AH 31	AH 2	AH 22	AH 32	AH 3	AH 23
AN 09 AN 10 AN 11	_ _ _		AH 208 AH 209 AH 210			AH 308 AH 309 AHX 310	AH 2308 AH 2309 AHX 2310
AN 12 AN 13 AN 14	_ _ _		AH 211 AH 212 —			AHX 311 AHX 312	AHX 2311 AHX 2312 —
AN 15 AN 16 AN 17	=		AH 213 AH 214 AH 215			AH 313 AH 314 AH 315	
AN 18 AN 19 AN 20	_ _ _		AH 216 AH 217 AH 218		_	AH 316 AHX 317 AHX 318	AHX 2317
AN 21 AN 22 AN 23	_ _ _		AH 219 AH 220 AH 221		AHX 3220	AHX 319 AHX 320 AHX 321	AHX 2319 AHX 2320 —
AN 24 AN 25 AN 26	_	_	AH 222 — AH 224		AHX 3222	AHX 322 AHX 324	AHX 2322 —
AN 27 AN 28 AN 29	AHX 3026	AHX 3126	AH 226		AHX 3224 AHX 3226	AHX 326	AHX 2324 AHX 2326
AN 30 AN 31 AN 32	AHX 3028 — AHX 3030	AHX 3128 — —	AH 228 — AH 230		AHX 3228	AHX 328 — —	AHX 2328
AN 33 AN 34 AN 36	AH 3032	AHX 3130 — AH 3132	— AH 232 AH 234		AHX 3230 — AH 3232	AHX 330 — AH 332	_
AN 38 AN 40	AH 3036 —	AH 3134 AH 3136	AH 236 —	AH 2236	AH 3234 AH 3236	AH 334 —	AH 2334 AH 2336

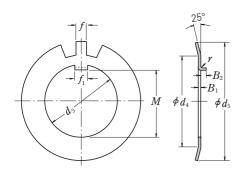
Reference



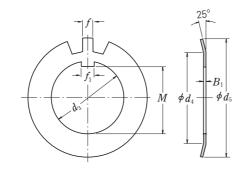


C 366 C 367





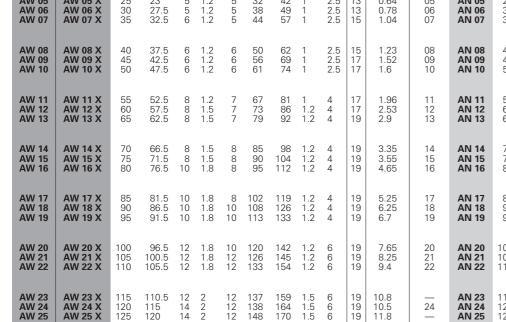
Bent-Tab



Straight-Tab

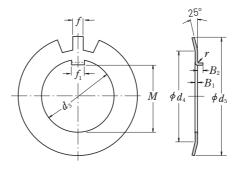
- 1	Ini:	ts.	•	mm

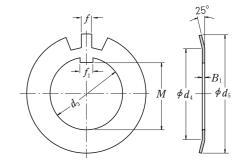
Nomina	al Numbers				L	.ock-w	asher S	Series A	W				F	Reference	
Bent-Tab	Straight-Tab	d_3	M	f_1	Basic B_1	Dimen	sions d_4	d_5	Ben Y	it-Tab B_2	No. of Teeth	Mass (kg) per 100 pcs approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Nut Numbers	Shaft Dia.
AW 02	AW 02 X	15	13.5	4	1	4	21	28	1	2.5	13	0.253	<u></u>	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		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		AN 24	120
AW 25	AW 25 X	125	120	14	2	12	148	170	1.5	6	19	11.8		AN 25	125





Remark Lock-washers with straight tabs shall be used with adapter sleeves having narrow slits, and for those having wide slits, either type of lock-washer may be used.





Straight-Tab Bent-Tab

Units: mm

Nomina	ıl Numbers				L	.ock-w	asher S	Series A	W				F	Reference	
Bent-Tab	Straight-Tab	d_3	M	f_1	Basic B_1	Dimen	sions d_4	d_5	Ben Y	t-Tab B_2	No. of Teeth	Mass (kg) per 100 pcs approx.	Adapter (¹) Sleeve Bore Dia. Numbers	Nut Numbers	Shaft Dia.
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 30 AW 31	AW 29 X AW 30 X AW 31 X	145 150 155	140 145 147.5	16 16 16	2 2 2.5	14 14 16	172 171 182	202 205 212	1.5 1.5 1.5	8 8 8	19 19 19	16.8 15.9 20.9	30 —	AN 29 AN 30 AN 31	145 150 155
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
						Wash	ner Seri	es 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

(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, and for those having wide slits, either type of lock-washer may be used.





INDUSTRY SOLUTIONS



Part D

INDUSTRY SOLUTIONS

1.	AIR TURBINE BEARINGS FUR DE	ENTAL HANDPIEGES D 004
2.	PUMPS & COMPRESSORS	D 010
3.	AGRICULTURAL MACHINERY	D 026
4.	CONSTRUCTION MACHINERY	D 034
5 .	MINING MACHINERY	D 040
6.	RAILWAY ROLLING STOCK	D 048
7.	PAPERMAKING MACHINES	D 066
8.	WIND POWER INDUSTRY	D 086
9.	STEEL INDUSTRY	D 094

Wind Power Industry

Air Turbine Bearings for Dental Handpieces

NSK Bearings: Ten Times Higher Corrosion Resistance Improves Bearing Replacement Cycle



Α	Product	Line that	Matches	Specific	Applications
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Outstanding Features of Dental Handpiece Bearings	06
Formulation of Bearings for Numbers D 00	07
Line-up	30

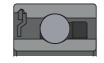
Mining Machinery

Railway Rolling Stock

Outstanding Features of Dental Handpiece Bearings

This bearing series has been developed to cover the wide range of sizes and shapes used in the air-turbine market (43 types in total)

· Bearing-type



Deep groove type



Angular type



Integral angular type



Integral + shield angular type

Shape



Smooth type







Groove type

Special type

Long Life and High Corrosion Resistance ES1 Stainless Steel Bearing

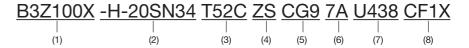
NSK has developed a high corrosion resistant material called ES1 that is highly suitable for manufacturing dental handpiece bearings. ES1 has made it possible to improve the life of bearings significantly and assure highly effective sterilization with no cross-contamination. The use of ES1 has improved the bearing material, and as a result, the bearing has far superior corrosion resistance than the conventional SUS440C stainless steel bearings. The electrical and chemical verification result of our anodic polarization measurement confirms that the current density (corrosion rate) in the passive state range of ES1 bearing is about one-tenth lower than conventional stainless steel bearings, which proves that ES1 has superior corrosion resistance.

Ultra-high Speed Rotation

To maintain ultra-high speed rotation and long rolling life of air turbine bearings, it is particularly necessary to produce a high precision cage based on the optimal design. NSK makes continuous efforts to optimize the design and improve the precision of cage parts for ultra-high speed rotation. As a result, we have been successful in maintaining a stable number of revolutions even at 500,000rpm.

Formulation of Bearings for Numbers

Please use the following example product code of an NSK standard dental handpiece bearing (Smooth type 100 series) as a guide to select a bearing according to requirements such as bearing width, material, and lubricant to be used.



(1) B3Z100X: Model name indicating basic bearing number for air turbine

(2) -H-20SN34: Ceramic ball (-H-26: Optional stainless steel ball)

(3) T52C: Torlon® polyamide-imide cage

C, J, P, etc.: Cage type Single shield (4) ZS:

(5) CG9: RIC 0.008mm to 0.010mm (Recommended by NSK)

Special tolerance class (ABEC7+ID: ABEC9) (6) 7A:

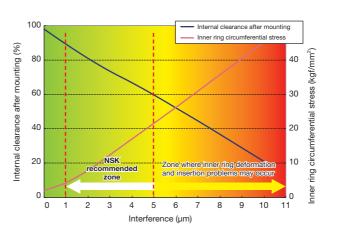
(7) U438: Special specification for air turbine

(8) CF1X: Special oil (Food grade) or BF7N: Special grease

Importance of a Perfect Fitting

To get optimal performance out of air turbine bearings, the bearings must be correctly fitted on the shaft and in the housing. To provide this optimal performance, Class ABEC9 tolerance (from -0.0025mm to 0mm) is used for the inner ring bore of NSK bearings. NSK can supply bearings with two classifications of ring bore diameter tolerance (from -0.0025 to -0.00125, and from -0.00125 to 0mm). This choice of tolerance makes it easy to stabilize the bearing fitting on the shaft. A stable fitting reduces air turbine vibrations, noises, and irregularities in the revolutions per minute, thereby assuring long life.

 Shaft material: Martensitic stainless steel (SUS400 family) (Please contact NSK to use bearings for shafts made of stainless steel other than martensitic stainless steel.)



D 006

Railway Rolling Stock

Railway Rolling Stock

Wind Power Industry

Steel Industry

Line-up

■ A Product Line that Matches Specific Applications

Bearing Series	Width	Deep Groove	Angular Con	tact Bearing		Integral	Bearing	
	Width	Bearing	Inner Ring Counterbore	Outer Ring Counterbore	Inner Ring (Counterbore	Outer Ring (Counterbore
100 Series (Smooth type)	2.380mm (0.0937")							
Width		B3Z- 100X	BH3Z- 101X	BH3Z- 102X	BH3Z- 103X		BH3Z- 104X	
6.380mm	2.779mm (0.1094")							
9 19		B3Z- 100	BH3Z- 101A	BH3Z- 102A	BH3Z- 103A	BH3Z- 103B	BH3Z- 104A	BH3Z- 104
150 Series (Groove type)	2.380mm (0.0937")							
Width		B3Z- 150X	BH3Z- 151X	BH3Z- 152X	BH3Z- 153X		BH3Z- 154X	
y6.350mm	2.779mm (0.1094")							
		B3Z- 150	BH3Z- 151A	BH3Z- 152A	BH3Z- 153A	BH3Z- 153B	BH3Z- 154A	BH3Z- 154
200 Series (Flange type)	2.380mm (0.0937")							
		FBC3Z-200X	FBH3Z- 201X	FBH3Z- 202X	FBH3Z- 203X		FBH3Z- 204X	
e6.550mm e3.175mm	2.779mm (0.1094")							
		FBC3Z- 200	FBH3Z- 201A	FBH3Z- 202A	FBH3Z- 203A	FBH3Z- 203B	FBH3Z- 204A	FBH3Z- 204
250 Series	2.779mm (0.1094")							
ф6.3		FBC3Z- 250	FBH3Z- 251A	FBH3Z- 252A	FBH3Z- 253A	FBH3Z- 253B	FBH3Z- 254A	FBH3Z- 254

Standard Specifications

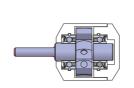
- · Ceramic ball bearings
- To maximize bearing performance, NSK has adopted ABEC9(P2) grade tolerance for the inner ring bore diameter. The tolerance of other parts is ABEC7(P4) grade.
- NSK can supply bearings with two classifications of the inner ring bore diameter tolerance (from -0.0025 to -0.00125, and from -0.00125 to 0mm).
- NSK can manufacture bearings with custom laser markings upon request.
- NSK uses the high-safety low-viscosity lubricating oil CF1 as standard specification. Bearings with BF7 grease are also available.

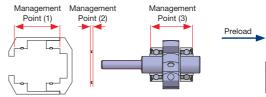
Optional Specifications

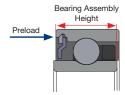
- Stainless steel ball bearings are also available.
- Bearings with different widths for the outer ring and inner ring are also available.

Preload Stabilization

Stabilization of preloading using a spring is extremely important for air turbine bearings. There are three management points ((1) to (3) below) for this task. For optimal performance of bearings, the bearing assembly height at the time of preloading is absolutely important. NSK can verify the design setting value of the bearing assembly height at your company to assure stable preloading.







D 008

Bearings for Pumps & Compressors

NSK high performance rolling element bearings for pumps and compressors deliver reliable and energy efficient operation with long life.



Bearings for Pumps A Product Line that Matches Specific Applications

Bearings Table

NSKHPS™ / High Load Capacity Single-Row Angular Contact Ball Bearings
Bore Diameter 20 – 120 mm D 015
High Load Capacity Double-Row Angular Contact Ball Bearings Bore Diameter 25 – 65 mm
High Load Capacity Deep Groove Ball Bearings (Open Type) Bore Diameter 15 – 60 mm
Creep-Free Bearings™ Bore Diameter 10 – 45 mm

Bearings for Compressors A Product Line that Matches Specific Applications

Bearings Table

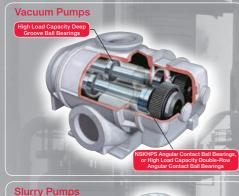
High Load Capacity Cylindrical Roller Bearings (L-PPS Cage) Bore Diameter 20 – 100 mm
NSKHPS™ Angular Contact Ball Bearings (L-PPS Cage) Bore Diameter 12 – 80 mm D 024
High-Speed Cylindrical Roller Bearings Bore Diameter 25 – 50 mm
High-Speed Angular Contact Ball Bearings Bore Diameter 20 – 50 mm

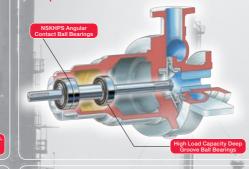
Agricultural Machinery

Railway Rolling Stock

■ A Product Line that Matches Specific Applications

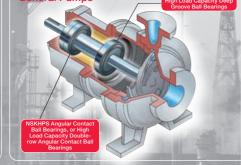
Advanced machined brass cage provide strength and endurance. Optimized internal geometries allow efficient lubricant flow through the bearing.

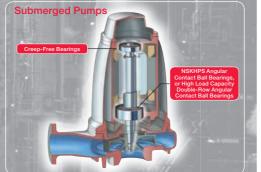




Pumps for Petroleum and Chemicals







Features of Bearings for Pumps



NSKHPS™ / High Load Capacity Single-Row Angular Contact **Ball Bearings**

- High load capacity angular contact ball bearings, adopting machined brass cages.
- Improved bearing life up to 90% longer than conventional bearings reduces maintenance frequency and improves



High Load Capacity Double-Row Angular Contact Ball Bearings

- High load capacity double-row angular contact ball bearings have advanced internal bearing geometry.
- Improved bearing life up to 50% longer than conventional bearings reduces maintenance frequency and improves reliability.



High Load Capacity Deep Groove Ball Bearings (Open Type)

- Open-type high load capacity deep groove ball bearings have advanced internal bearing geometry.
- Improved bearing life up to 70% longer than conventional bearings reduces maintenance frequency and improves reliability.



Creep-Free Bearings™

- Outer ring creep prevention is significantly improved with O-ring tension in the housing.
- Standard principal dimensions are maintained to eliminate the head for re-machining housings. Suitable as a bearing on the free side of motor-integrated pumps.

D 013

D 012

Railway Rolling Stock

INDUSTRY SOLUTIONS **NSK**

Features of Bearings for Pumps

NSKHPS™ / High Load Capacity Single-Row Angular Contact Ball Bearings

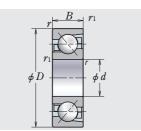
- Petroleum and Chemical industry (API standards*1, etc.)
- Paper and Pulp industry (ANSI standards², etc.)
- *1 Standards related to petroleum specified by the American Petroleum Institute
- *2 Standards of industrial products in the U.S. specified by the American National Standards Institute

High load capacity and outstanding lubrication performance. Enables reduced pump size and extended maintenance intervals.

- Bearing life: 90% longer
- Maximum rotational speed: 20% faster
- Universal arrangement as standard
- 40° contact angle

Axial Internal Clearance in Combined ACBBs

(Meas	ured C	learan	ice)	U	Init: µm
	nal bore er d (mm)	Cf	ΝB	G	A
Over	Incl.	Min.	Max.	Min.	Max.
12	18	17	25		
18	30	20	28	-2	6
30	50	24	32		
E0.	90	20	41	2	0





Bearing Number
Example: 7310 B EA MR SU GA
Contact angle symbol: 40°
Internal symbol: High load capacity
Cage symbol: Machined cage
Arrangement symbol: Universal arrangement (single unit)
Internal clearance symbol

		Bounda	ry Dimensio	ns (mm)		Basic Load	Ratings (N)	Limiting Sp	eeds (min ⁻¹)
Bearing Numbers	d	D	В	γ (min.)	$oldsymbol{\gamma}_1$ (min.)	$C_{\rm r}$	C_{0r}	Grease	Oil
*7304BEA	20	52	15	1.1	0.6	19 800	10 500	13 000	18 000
*7305BEA	25	62	17	1.1	0.6	27 200	14 900	10 000	15 000
*7206BEA	30	62	16	1	0.6	23 700	14 300	10 000	14 000
*7306BEA	30	72	19	1.1	0.6	36 500	20 600	9 000	13 000
*7207BEA	35	72	17	1.1	0.6	32 500	19 600	8 500	12 000
*7307BEA	35	80	21	1.5	1	40 500	24 400	8 000	11 000
*7208BEA	40	80	18	1.1	0.6	38 500	24 500	7 500	11 000
*7308BEA	40	90	23	1.5	1	53 000	33 000	7 100	10 000
*7209BEA	45	85	19	1.1	0.6	40 500	27 100	7 100	10 000
*7309BEA	45	100	25	1.5	1	62 500	39 500	6 300	9 000
*7210BEA	50	90	20	1.1	0.6	42 000	29 700	6 300	9 500
*7310BEA	50	110	27	2	1	78 000	50 500	5 600	8 000
*7211BEA	55	100	21	1.5	1	51 500	37 000	6 000	8 500
*7311BEA	55	120	29	2	1	89 000	58 500	5 000	7 500
*7212BEA	60	110	22	1.5	1	61 500	45 000	5 300	7 500
*7312BEA	60	130	31	2.1	1.1	102 000	68 500	4 800	6 700
*7213BEA	65	120	23	1.5	1	70 000	53 500	4 800	7 100
*7313BEA	65	140	33	2.1	1.1	114 000	77 000	4 300	6 300
*7214BEA	70	125	24	1.5	1	75 500	58 500	4 500	6 700
*7314BEA	70	150	35	2.1	1.1	124 000	87 500	4 000	6 000
*7215BEA	75	130	25	1.5	1	78 500	63 500	4 300	6 300
*7315BEA	75	160	37	2.1	1.1	134 000	98 500	3 800	5 600
*7216BEA	80	140	26	2	1	87 500	70 000	4 000	6 000
*7316BEA	80	170	39	2.1	1.1	144 000	110 000	3 600	5 300
7217BEA	85	150	28	2	1	96 000	81 500	3 800	5 600
7317BEA	85	180	41	3	1.1 1	157 000	133 000	3 400 3 600	5 000
7218BEA 7318BEA	90 90	160 190	30 43	2 3	1.1	109 000 169 000	93 500 146 000	3 200	5 300 4 500
7318BEA 7219BEA	95	170	43 32	2.1	1.1	123 000	107 000	3 400	5 000
7219BEA 7319BEA	95	200	32 45	3	1.1	180 000	160 000	3 000	4 500
73 19BEA 7220BEA	100	180	34	2.1	1.1	136 000	122 000	3 200	4 500
7220BEA 7320BEA	100	215	47	3	1.1	202 000	187 000	2 800	4 000
7320BEA 7221BEA	105	190	36	2.1	1.1	148 000	133 000	3 000	4 500
7221BEA 7321BEA	105	225	49	3	1.1	213 000	203 000	2 600	4 000
7321BEA 7222BEA	110	200	38	2.1	1.1	154 000	144 000	2 800	4 300
7322BEA	110	240	50	3	1.1	226 000	226 000	2 600	3 800
7322BEA 7224BEA	120	215	40	2.1	1.1	179 000	177 000	2 600	3 800
7324BEA	120	260	55	3	1.1	238 000	250 000	2 200	3 400
						1			

Remarks

*NSKHPS™ angular contact ball bearings with running accuracy to ISO tolerance class 5 and dimensional accuracy to ISO tolerance

No asterisk refers to high load capacity angular contact ball bearings with running accuracy P6 and dimensional accuracy P6.

D 014

D 015

Features of Bearings for Pumps

High Load Capacity Double-Row Angular Contact Ball Bearings

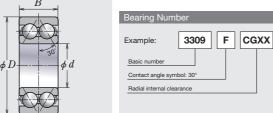
- Paper and Pulp industry (ANSI standards, etc.)Water/Sewage and Irrigation, etc.

Improved bearing life and thrust load capacity.

Enables reduced pump size and extended maintenance intervals.

- Bearing life: 50% longer
- Thrust load capacity: Twice as high as conventional bearings
- Improved installation with advanced lead in chamfer
- Class P6 as standard





Decring Numbers	Во	oundary Dimensions (n	Basic Load	Basic Load Ratings (N)		
Bearing Numbers	d	D	В	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)	
3305F	25	62	25.4	30 500	20 500	
3306F	30	72	30.2	39 500	27 300	
3307F	35	80	34.9	49 500	35 000	
3308F	40	90	36.5	60 500	44 000	
3309F	45	100	39.7	66 500	49 500	
3310F	50	110	44.4	85 500	64 500	
3311F	55	120	49.2	106 000	82 000	
3312F	60	130	54	122 000	95 500	
3313F	65	140	58.7	138 000	109 000	

High Load Capacity Deep Groove Ball Bearings (Open Type)

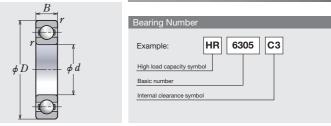
- Petroleum and Chemical industry (API standards, etc.)
- Paper and Pulp industry (ANSI standards, etc.)
- Semi-conductor and Liquid Crystal Panel (vacuum pumps)

High load capacity. Enables reduced pump size and extended maintenance intervals.

• Bearing life: 70% longer



INDUSTRY SOLUTIONS



Danis - Norskans		Boundary Dim	Basic Load	Ratings (N)		
Bearing Numbers	d	D	B	$m{r}$ (min.)	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)
HR 6202	15	35	11	0.6	8 550	3 950
HR 6302	15	42	13	1.0	13 300	5 900
HR 6203	17	40	12	0.6	11 300	5 350
HR 6303	17	47	14	1.0	15 600	7 100
HR 6304	20	52	15	1.1	18 200	9 050
HR 6205	25	52	15	1.0	15 300	8 100
HR 6305	25	62	17	1.1	23 700	12 200
HR 6206	30	62	16	1.0	23 300	12 800
HR 6306	30	72	19	1.1	29 800	15 800
HR 6207	35	72	17	1.1	28 300	16 000
HR 6307	35	80	21	1.5	39 500	21 500
HR 6208	40	80	18	1.1	32 500	19 900
HR 6308	40	90	23	1.5	47 000	26 200
HR 6209	45	85	19	1.1	36 500	22 600
HR 6309	45	100	25	1.5	57 000	34 500
HR 6210	50	90	20	1.1	39 000	25 800
HR 6310	50	110	27	2.0	66 500	40 500
HR 6211	55	100	21	1.5	48 000	32 000
HR 6311	55	120	29	2.0	78 000	46 000
HR 6212	60	110	22	1.5	58 000	38 000

D 016

D 017

NSK

Railway Rolling Stock

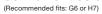
Wind Power Industry

■Features of Bearings for Pumps

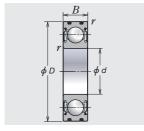
Creep-Free Bearings™

• Water/Sewage and Irrigation, etc.

Outer ring creep prevention is significantly improved with O-ring tension in the housing. Standard principal dimensions are maintained to eliminate the need for re-machining housings, providing a convenient solution to reduce costs.







Danis Marchan		Boundary Dim	ensions (mm)		Basic Load	Ratings (N)
Bearing Numbers	d	D	В	γ (min.)	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)
6000	10	26	8	0.3	4 550	1 970
6200	10	30	9	0.6	5 100	2 390
6300	10	35	11	0.6	8 100	3 450
6001	12	28	8	0.3	5 100	2 370
6201	12	32	10	0.6	6 800	3 050
6301	12	37	12	1.0	9 700	4 200
6002	15	32	9	0.3	5 600	2 830
6202	15	35	11	0.6	7 650	3 750
6302	15	42	13	1.0	11 400	5 450
6003	17	35	10	0.3	6 000	3 250
6203	17	40	12	0.6	9 550	4 800
6303	17	47	14	1.0	13 600	6 650
6004	20	42	12	0.6	9 400	5 000
6204	20	47	14	1.0	12 800	6 600
6304	20	52	15	1.1	15 900	7 900
6005	25	47	12	0.6	10 100	5 850
6205	25	52	15	1.0	14 000	7 850
6305	25	62	17	1.1	20 600	11 200
6006	30	55	13	1.0	13 200	8 300
6206	30	62	16	1.0	19 500	11 300
6306	30	72	19	1.1	26 700	15 000
6007	35	62	14	1.0	16 000	10 300
6207	35	72	17	1.1	25 700	15 300
6307	35	80	21	1.5	33 500	19 200
6008	40	68	15	1.0	16 800	11 500
6208	40	80	18	1.1	29 100	17 900
6308	40	90	23	1.5	40 500	24 000
6009	45	75	16	1.0	20 900	15 200
6209	45	85	19	1.1	31 500	20 400
6309	45	100	25	1.5	53 000	32 000

D 018

Railway Rolling Stock

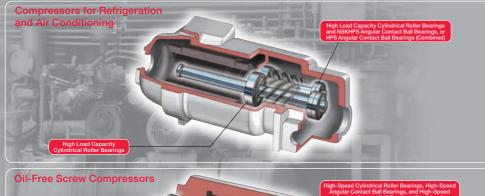
Railway Rolling Stock

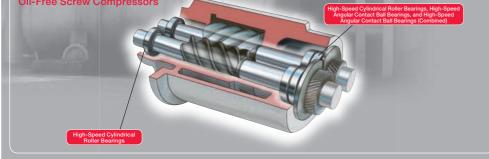
D 021

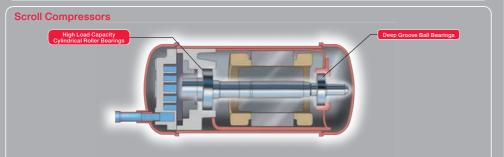
Compressors

■ A Product Line that Matches Specific Applications

L-PPS (Linear-Polyphenylene Sulfide) cages are chemically stable and resist wear better than steel or brass. Optimized internal geometries allow efficient lubricant flow through the bearing.







Features of Bearings for Compressors



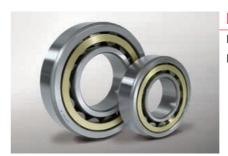
High Load Capacity Cylindrical Roller Bearings (L-PPS cage)

- High load capacity cylindrical roller bearings, adopting high performance L-PPS plastic cages.
 Heat-resistant L-PPS plastic cage delivers chemical
- stability that ensures strength with little to no deterioration, even in compressor oil, refrigeration machine oil, or ammonia refrigerant, while also providing excellent abrasion resistance.



NSKHPS™ Angular Contact Ball Bearings (L-PPS cage)

- High load capacity angular contact ball bearings, adopting high performance L-PPS plastic cages.
- Improved bearing life up to 90% longer than conventional bearings reduces maintenance frequency and improves reliability.



High-Speed Cylindrical Roller Bearings

- High-speed cylindrical roller bearings, adopting outerring guided machined brass cages.
- Class P5 tolerances as standard bearing precision ensure stable performance at high speeds.



High-Speed Angular Contact Ball Bearings

- High-speed angular contact ball bearings, adopting outer-ring guided machined brass cages.
- Class P5 tolerances as standard bearing precision ensures stable performance at high speeds.

Example 2 Features of Bearings for compressors

High Load Capacity Cylindrical Roller Bearings (L-PPS Cage)

• Refrigeration and air conditioning screw

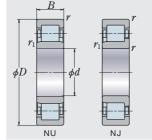
Air and gas screw compressors

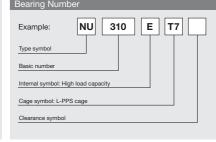
Outstanding load capacity and lubrication performance—allowing for reduced compressor size and extended maintenance intervals.



Decring Numbers		Bound	ary Dimensio	ns (mm)		Basic Load	Ratings (N)
Bearing Numbers	d	D	В	γ (min.)	\mathcal{Y}_1 (min.)	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)
NU (NJ) 204ET7	20	47	14	1	0.6	25 700	22 600
NU (NJ) 304ET7	20	52	15	1.1	0.6	31 500	26 900
NU (NJ) 2204ET7	20	47	18	1	0.6	30 500	28 300
NU (NJ) 2304ET7	20	52	21	1.1	0.6	42 000	39 000
NU (NJ) 205ET7	25	52	15	1	0.6	29 300	27 700
NU (NJ) 305ET7	25	62	17	1.1	1.1	41 500	37 500
NU (NJ) 2205ET7	25	52	18	1.	0.6	35 000	34 500
NU (NJ) 2305ET7	25	62	24	1.1	1.1	57 000	56 000
NU (NJ) 206ET7	30	62	16	1	0.6	39 000	37 500
NU (NJ) 306ET7	30	72	19	1.1	1.1	53 000	50 000
NU (NJ) 2206ET7	30	62	20	1	0.6	49 000	50 000
NU (NJ) 2306ET7	30	72	27	1.1	1.1	74 500	77 500
NU (NJ) 207ET7	35	72	17	1.1	0.6	50 500	50 000
NU (NJ) 307ET7	35	80	21	1.5	1.1	66 500	65 500
NU (NJ) 2207ET7	35	72	23	1.1	0.6	61 500	65 000
NU (NJ) 2307ET7	35	80	31	1.5	1.1	93 000	101 000
NU (NJ) 208ET7	40	80	18	1.1	1.1	55 500	55 500
NU (NJ) 308ET7	40	90	23	1.5	1.5	83 000	81 500
NU (NJ) 2208ET7	40	80	23	1.1	1.1	72 500	77 500
NU (NJ) 2308ET7	40	90	33	1.5	1.5	114 000	122 000
NU (NJ) 209ET7	45	85	19	1.1	1.1	63 000	66 500
NU (NJ) 309ET7	45	100	25	1.5	1.5	97 500	98 500
NU (NJ) 2209ET7	45	85	23	1.1	1.1	76 000	84 500
NU (NJ) 2309ET7	45	100	36	1.5	1.5	137 000	153 000
NU (NJ) 210ET7	50	90	20	1.1	1.1	69 000	76 500
NU (NJ) 310ET7	50	110	27	2	2	110 000	113 000
NU (NJ) 2210ET7	50	90	23	1.1	1.1	86 500	97 000
NU (NJ) 2310ET7	50	110	40	2	2	163 000	187 000
NU (NJ) 211ET7	55	100	21	1.5	1.1	86 500	98 500
NU (NJ) 311ET7	55	120	29	2	2	137 000	143 000
NU (NJ) 2211ET7	55	100	25	1.5	1.1	101 000	122 000

Radial internal clearance Unit: µm									
Nominal bore diameter d (mm)			Non- interchangeable CC clearance						
Incl.	Min.	Max.	Min.	Max.					
24	20	45	20	30					
30	20	45	25	35					
40	25	50	25	40					
50	30	60	30	45					
65	40	70	35	50					
80	40	75	40	60					
100	50	85	45	70					
	al bore r d (mm) Incl. 24 30 40 50 65	al bore Intercha r d (mm) Intercha CN cle Incl. Min. 24 20 30 20 40 25 50 30 65 40 80 40	al bore Interchangeable of d (mm) Interchangeable CN clearance Incl. Min. Max. 24 20 45 30 20 45 40 25 50 50 30 60 65 40 70 80 40 75	al bore of d (mm) Interchangeable CN clearance Not interchangeable CC clearance Incl. Min. Max. Min. 24 20 45 20 30 20 45 25 40 25 50 25 50 30 60 30 65 40 70 35 80 40 75 40					





Danis Novebour		Bounda	ary Dimensio	ns (mm)	'	Basic Load	Ratings (N)
Bearing Numbers	d	D	В	𝒯 (min.)	$ m \emph{Y}_{1}$ (min.)	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)
NU (NJ) 2311ET7	55	120	43	2	2	201 000	233 000
NU (NJ) 212ET7	60	110	22	1.5	1.5	97 500	107 000
NU (NJ) 312ET7	60	130	31	2.1	2.1	150 000	157 000
NU (NJ) 2212ET7	60	110	28	1.5	1.5	131 000	157 000
NU (NJ) 2312ET7	60	130	46	2.1	2.1	222 000	262 000
NU (NJ) 213ET7	65	120	23	1.5	1.5	108 000	119 000
NU (NJ) 313ET7	65	140	33	2.1	2.1	181 000	191 000
NU (NJ) 2213ET7	65	120	31	1.5	1.5	149 000	181 000
NU (NJ) 2313ET7	65	140	48	2.1	2.1	233 000	265 000
NU (NJ) 214ET7	70	125	24	1.5	1.5	119 000	137 000
NU (NJ) 314ET7	70	150	35	2.1	2.1	205 000	222 000
NU (NJ) 2214ET7	70	125	31	1.5	1.5	156 000	194 000
NU (NJ) 2314ET7	70	150	51	2.1	2.1	274 000	325 000
NU (NJ) 215ET7	75	130	25	1.5	1.5	130 000	156 000
NU (NJ) 315ET7	75	160	37	2.1	2.1	240 000	263 000
NU (NJ) 2215ET7	75	130	31	1.5	1.5	162 000	207 000
NU (NJ) 2315ET7	75	160	55	2.1	2.1	330 000	395 000
NU (NJ) 216ET7	80	140	26	2	2	139 000	167 000
NU (NJ) 316ET7	80	170	39	2.1	2.1	256 000	282 000
NU (NJ) 2216ET7	80	140	33	2	2	186 000	243 000
NU (NJ) 2316ET7	80	170	58	2.1	2.1	355 000	430 000
NU (NJ) 217ET7	85	150	28	2	2	167 000	199 000
NU (NJ) 2217ET7	85	150	36	2	2	217 000	279 000
NU (NJ) 2317ET7	85	180	60	3	3	395 000	485 000
NU (NJ) 218ET7	90	160	30	2	2	182 000	217 000
NU (NJ) 2218ET7	90	160	40	2	2	242 000	315 000
NU (NJ) 2318ET7	90	190	64	3	3	435 000	535 000
NU (NJ) 220ET7	100	180	34	2.1	2.1	310 000	305 000
NU (NJ) 320ET7	100	215	47	3	3	380 000	425 000
NU (NJ) 2220ET7	100	180	46	2.1	2.1	335 000	445 000
NU (NJ) 2320ET7	100	215	73	3	3	570 000	715 000

Features of Bearings for compressors

NSKHPS™ Angular Contact Ball Bearings (L-PPS Cage)

• Refrigeration and air conditioning screw compressors

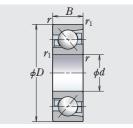
Air and gas screw compressors

Outstanding load capacity and lubrication performance—allowing for reduced compressor size and extended maintenance intervals.

- Bearing life: up to 90% longer
- Maximum rotational speed: up to 20% faster
- Universal arrangement as standard
- 40° contact angle



Axial i	nterna	l clear	ance	ι	Jnit: μm
Nominal bore diameter d (mm)		CI	ΝB	G	A
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



Bearing Nu	ımber					
Example:	7310 B EA T7 SU CNB					
Basic number						
Contact angle	symbol: 40°					
Internal symbo	l: High load capacity					
Cage symbol:	L-PPS cage					
Arrangement symbol: Universal arrangement (single unit)						
Internal clearar	nce symbol					

Bearing Numbers		Bounda	ry Dimensio	ons (mm)		Basic Load I	Ratings (N)	Maximum Rotational Speed (min ⁻¹)
	d	D	В	γ (min.)	$ ho_1$ (min.)	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)	Oil
7201BEA	12	32	10	0.6	0.3	8 150	3 750	30 000
7301BEA	12	37	12	1	0.6	11 100	4 950	26 000
7202BEA	15	35	11	0.6	0.3	9 800	4 800	26 000
7302BEA	15	42	13	1	0.6	14 300	6 900	22 000
7203BEA	17	40	12	0.6	0.3	11 600	6 100	22 000
7303BEA	17	47	14	1	0.6	16 800	8 300	20 000
7204BEA	20	47	14	1	0.6	15 600	8 150	19 000
7304BEA	20	52	15	1.1	0.6	19 800	10 500	18 000
7205BEA	25	52	15	1	0.6	17 600	10 200	17 000
7305BEA	25	62	17	1.1	0.6	27 200	14 900	15 000
7206BEA	30	62	16	1	0.6	23 700	14 300	14 000
7306BEA	30	72	19	1.1	0.6	36 500	20 600	13 000
7207BEA	35	72	17	1.1	0.6	32 500	19 600	12 000
7307BEA	35	80	21	1.5	1	40 500	24 400	11 000
7208BEA	40	80	18	1.1	0.6	38 500	24 500	11 000
7308BEA	40	90	23	1.5	1	53 000	33 000	10 000
7209BEA	45	85	19	1.1	0.6	40 500	27 100	10 000
7309BEA	45	100	25	1.5	1	62 500	39 500	9 000
7210BEA	50	90	20	1.1	0.6	42 000	29 700	9 500
7310BEA	50	110	27	2	1	78 000	50 500	8 000
7211BEA	55	100	21	1.5	1	51 500	37 000	8 500
7311BEA	55	120	29	2	1	89 000	58 500	7 500
7212BEA	60	110	22	1.5	1	61 500	45 000	7 500
7312BEA	60	130	31	2.1	1.1	102 000	68 500	6 700
7213BEA	65	120	23	1.5	1	70 000	53 500	7 100
7313BEA	65	140	33	2.1	1.1	114 000	77 000	6 300
7214BEA	70	125	24	1.5	1	75 500	58 500	6 700
7314BEA	70	150	35	2.1	1.1	124 000	87 500	6 000
7215BEA	75	130	25	1.5	1	78 500	63 500	6 300
7216BEA	80	140	26	2	1	87 500	70 000	6 000

High-Speed Cylindrical Roller Bearings

• Air (oil-free) screw compressors

High-speed cylindrical roller bearings, adopting outer-ring guided machined brass cages. d_mn: 1 300 000 (See Remarks 1 & 2) Bearing accuracy of more than Class P5 as standard.



INDUSTRY SOLUTIONS

Danis - Noveles		Bound	Basic Load	Ratings (N)			
Bearing Numbers	d	D	В		\mathcal{Y}_1 (min.)	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)
NU205EMM	25	52	15	1	0.6	29 300	27 700
NU206EMM	30	62	16	1	0.6	39 000	37 500
NU207EMM	35	72	17	1.1	0.6	50 500	50 000
NU208EMM	40	80	18	1.1	1.1	55 500	55 500
NU209EMM	45	85	19	1.1	1.1	63 000	66 500
NU210EMM	50	90	20	1.1	1.1	69 000	76 500

Remarks 1: Under general forced-lubrication condition

2: Contact NSK for maximum rotational speed, which can vary according to service conditions, and lubricating system.

High-Speed Angular Contact Ball Bearings

• Air (oil-free) screw compressors

High-speed angular contact bearings, adopting outer-ring guided machined brass cages. d_mn: 1 300 000 (See Remarks 1 & 2) Bearing accuracy of more than Class P5 as standard.



Decrine Numbers		Bound	ary Dimensio	ns (mm)		Basic Load Ratings (N)	
Bearing Numbers	d	D	В	𝒯 (min.)	\mathcal{Y}_1 (min.)	$C_{ m r}$ (dynamic)	$C_{0\mathrm{r}}$ (static)
20BA02A	20	47	14	1	0.6	13 600	7 550
25BA02A	25	52	15	1	0.6	15 400	9 500
30BA03B	30	72	19	1.5	0.6	31 500	19 000
35BA03B	35	80	21	1.5	0.6	39 000	24 000
40BA02A	40	80	18	1.5	0.6	34 500	24 100
45BA03A2	45	100	25	1.5	1	60 000	40 000
50BA03A1	50	110	27	1	2.5	70 000	47 500

Remarks 1: Under general forced-lubrication condition

2: Contact NSK for maximum rotational speed, which can vary according to service conditions, and lubricating system.

D 024 D 025

Bearings for Agricultural Machinery

NSK's high-performance bearings provide high reliability and efficiency for agricultural implements and machinery.



A Product Line that Matches Specific Applications

Bearings Table

Sealed Deep Groove Ball Bearings TM Series	D 032
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Line-up

■ A Product Line that Matches Specific Applications



Transmission/Differential Gear/Propeller Shaft



Needle Roller Bearings

Contact Ball Bearings







Thrust Ball Bearings



Long-Life Pinion Shaft with Cage and Rollers

HR Series Tapered Roller Bearings

Deep Groove Ball Bearings



TM Series Sealed Deep Groove Ball Bearings







Chassis Wheel/Steering

Implements

Agril Disc Hub



UR Bearing (Special Carbonitriding Heat-Treatment Technology)



Roller Bearings

Hub Unit Bearings (HUB I)



Hi-TF Bearings



Stock

Wind Power Industry

A Product Line that Matches Specific Applications

High-Performance Standard for Industial Machinery NSKHPS™ Deep Groove Ball Bearings/Cylindrical Roller Bearings/Spherical Roller Bearings Series



Features



NSKHPS™ Deep Groove Ball Bearings The new standard that defi nes the concept of standard bearings - NSKHPS™

Improved reliability

Bearing life has increased by a maximum of 2 times compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology. As a result, the NSKHPS™ bearings contribute to reducing maintenance cost and facilitate the downscaling of related equipment.

New product line-up

The standard dimensions are the same as for the standardsize bearings. NSK has expanded the line-up of NSKHPS™ bearings focusing on a wide range of sizes offering a high degree of versatility for various general-purpose applications

For the NSKHPS™ DGBBs dimensions table, please refer to Pages C020 to C035. Please refer to Page D038 for detailed information of NSKHPS™ CRBs and SRBs

High-Load Bearings (Tapered Roller Bearings/Deep Groove Ball Bearings) HR Series

The HR series of high-load bearings provides excellent performance in diverse applications.

Features

Higher load-carrying capacity and longer operating life.

Tapered roller bearings

Optimal cage design allows increased size and number of rollers.

Deep groove ball bearings

The standard dimensions are the same as for the standard-size bearings and feature designs with optimized ball diameter and quantity.

UR Bearing

Achieve long life by special carbonitriding heat treatment(UR) to through harden bearing steel.

Features

- Over 2 times bearing life to standard bearings under harsh and contaminated lubrication conditions.
- Additional longer life is available by the combination with High Capacity Standard Series.
- UR heat treatment is available to various types of bearing, because it is applied to through harden bearing steel, most popular material for rolling bearings





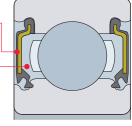


Sealed Deep Groove Ball Bearings TM Series

The TM series delivers longer operating life under environments contaminated with foreign particles by incorporating a special seal that prevents the entry of foreign particles and has been especially effective in agricultural machinery and automobile transmission systems.

Features

- Seal lip structure prevents entry of foreign matter while allowing entry of oil.
- Lower torque than conventional contact seal bearings.
- Sealed-in grease with a high affinity for gear oil to aid initial lubrication.



Bearing Series

TM302-TM314 / TM203-TM214

Major dimensions are the same as the Series 62 and Series 63 of deep groove ball bearings

Long-Life Pinion Shaft with Cage and Rollers

These bearings have improved durability and reliability and achieve long service life under harsh operating conditions, such as continuous operation for long periods of time, by utilizing a pinion shaft with a cage and rollers as a single assembly.

Features

 Special heat treatment and improved raceway surfaces extend service life by more than twofold.

Pinion shaft

- · Raceway polished to a mirror-smooth finish to ensure a sufficiently thick oil film.
- · Special heat treatment applied to pinion shaft as a measure against contaminated-lubricant conditions.

Cage and rollers

- · Roller running surface polished to a mirror-smooth finish to ensure a sufficiently
- · Special heat treatment applied to rollers as a measure against contaminatedlubricant conditions.



Comparison of life test results for conventional and newly developed bearing

Newly product

Corresponding size: Inscribed circle diameter up to 32 mm

HST Long-Life, High-Reliability Cage-Equipped Thrust Ball Bearings for Agricultural Machinery

Contributing to the Long Life and High Reliability of Agricultural Machinery by Increasing the Life of Bearings.

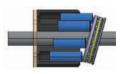
Features

Achieve the twice or more life compared with conventional bearings by adopting the Iona-life.

- Long-life Technology
- Uses EP steel, which is strong against sub-surface fatigue, For the inner and outer ring. Adopts a special heat treatment, which is resistant to surface fatigue, for the inner and outer ring and balls.
- High-reliability Cage

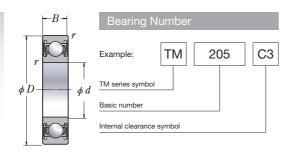
Improves the reliability of cage by utilizing a plastic cage which is resistant to cage load.





D 030

INDUSTRY SOLUTIONS



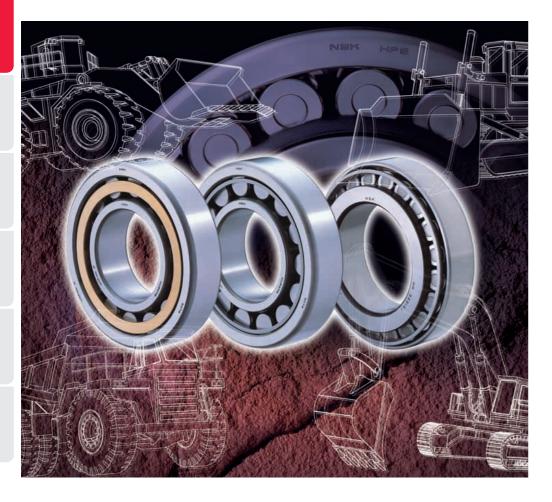
Design Numbers	Во	oundary Dimensions (m	Basic Load	Ratings (N)	
Bearing Numbers	d	D	B	$C_{\rm r}$	C_{0r}
TM203	17	40	12	9 550	4 800
TM303	17	47	14	13 600	6 650
TM204	20	47	14	12 800	6 600
TM304	20	52	15	15 900	7 900
TM2/22	22	50	14	12 900	6 800
TM3/22	22	56	16	18 400	9 250
TM205	25	52	15	14 000	7 850
TM305	25	62	17	20 600	11 200
TM2/28	28	58	16	16 600	9 500
TM3/28	28	68	18	26 700	14 000
TM206	30	62	16	19 500	11 300
TM306	30	72	19	26 700	15 000
TM2/32	32	65	17	20 700	11 600
TM3/32	32	75	20	29 400	17 000
TM207	35	72	17	25 700	15 300
TM307	35	80	21	33 500	19 200
TM208	40	80	18	29 100	17 800
TM308	40	90	23	40 500	24 000
TM209	45	85	19	31 500	20 400
TM309	45	100	25	53 000	32 000
TM210	50	90	20	35 000	23 200
TM310	50	110	27	62 000	38 500
TM211	55	100	21	43 500	29 300
TM311	55	120	29	71 500	44 500
TM212	60	110	22	52 500	36 000
TM312	60	130	31	82 000	52 000
TM213	65	120	23	57 500	40 000
TM313	65	140	33	92 500	60 000
TM214	70	125	24	62 000	44 000
TM314	70	150	35	104 000	68 000

Note Maximum continuous operating temperature for standard nitrile rubber seals is 110°C.

Wind Power Industry

Bearings for Construction Machinery

Long service life under harsh conditions—tough bearings reflect NSK's accumulated technological prowess.



A Product Line that Matches Specific Applications

Line-up D 036



Long-Life Pinion Shaft

with a Cage and Rollers

■ A Product Line that Matches Specific Applications

Line-up

Railway Rolling Stock

Wind Power Industry

NSKHPS™ Spherical Roller

Bearings





Hi-TF Bearings

Sealed Deep Groove Ball

Bearings TM Series

Series

Tapered Roller Bearings HR

NSKHPS™ Cylindrical Roller

Bearings

A Product Line that Matches Specific Applications

NSKHPS™ Spherical Roller Bearings

Features Compared to the conventional bearing:



1. Improved reliability

Bearing life has increased by a maximum of 2 times compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology.



2. High temperature dimensional stabilizing treatment comes standard

High temperature dimensional stabilization of up to 200°C has been achieved through the application of NSK's proprietary material heat treatment technology.

NSKHPS™ Cylindrical Roller Bearings

Features Compared to the conventional bearing:



1. Improved reliability

Bearing life has increased by a maximum of 60% compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology.



2. Wide-range product line-up

NSK has offerd the wide-range line-up of NSKHPS bearings with four types of cages focusing on a wide range of sizes offering a high degree of versatility for various generalpurpose applications.

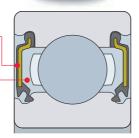
- · Pressed steel cage with high cost perfomance
- · Highly reliable machined brass cage
- · Polyamide resin cage that excels in heat resistance and chemical resistance

Sealed Deep Groove Ball Bearings TM Series

The TM series delivers longer operating life under environments contaminated with foreign particles by incorporating a special seal that prevents the entry of foreign particles and has been especially effective in agricultural machinery and automobile transmission systems.

Features

- Seal lip structure prevents entry of foreign matter while allowing entry of oil.
- Lower torque than conventional contact seal bearings.
- Sealed-in grease with a high affinity for gear oil to aid initial lubrication.



Bearing Series

TM302-TM314 / TM203-TM214

Major dimensions are the same as the Series 62 and Series 63 of deep groove ball bearings.

Tapered Roller Bearings HR Series

The HR series of high-load capacity, standard-size tapered roller bearings offer highload capacity for boosting the performance in diverse applications.

Features

number of rollers

Long-Life Pinion Shaft with Cage and Rollers

These bearings have improved durability and reliability and achieve long service life under harsh operating conditions, such as continuous operation for long periods of time, by utilizing a pinion shaft with a cage and rollers as a single assembly.

Features



Pinion shaft

- · Raceway polished to a mirror-smooth finish to ensure a sufficiently thick oil film.
- · Special heat treatment applied to pinion shaft as a measure against contaminated-lubricant conditions.

Cage and rollers

- · Roller running surface polished to a mirror-smooth finish to ensure a sufficiently thick oil film.
- Special heat treatment applied to rollers as a measure against contaminated-lubricant conditions.

Comparison of life test results for conventional and newly developed bearing



Hi-TF Bearings

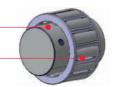
Bearings manufactured from NSK's Hi-TF material have been specifically designed for outstanding toughness under harsh operating conditions, surpassing even NSK's earlier TF bearings. Hi-TF bearings incorporating this new material and a new heattreatment technology provide long service life under contaminated lubrication conditions with superior resistance to wear, seizure, and heat. Hi-TF bearings are capable of handling the foreseeable needs of the future as well as meeting today's requirements.

Achieves longer bearing life even under harsh conditions with excellent resistance to wear, seizure, and heat



INDUSTRY SOLUTIONS





Corresponding size: Inscribed circle diameter up to 32 mm



D 038 D 039

Bearings for Mining Machinery

Tough bearings offer longer service life under demanding mining conditions through NSK's wealth of outstanding technologies.



A Product Line that Matches Specific Applications

Bearings Table

Super Long-Life Spherical Roller Bearings fo	r
Vibrating Equipment CA-VS3, CA-VS4 Series	D 046

Bearings for Mining Machinery EMM-VS Series of Cylindrical Roller Bearings for Vibrating Equipment D 047



Pumps & Compressors

Agricultural Machinery

Railway Rolling Stock

Wind Power Industry



Jaw Crusher

Work material is crushed between two opposing jaw plates. One plate opens and stationary jaw plate.





Cone Crusher

Material is fed into the crusher cavity and processed by the eccentric rotating action of the inner cone against the outer cone. Work can be reduced to a diameter ranging from 50 mm to 100 mm.





Vibrating Screen

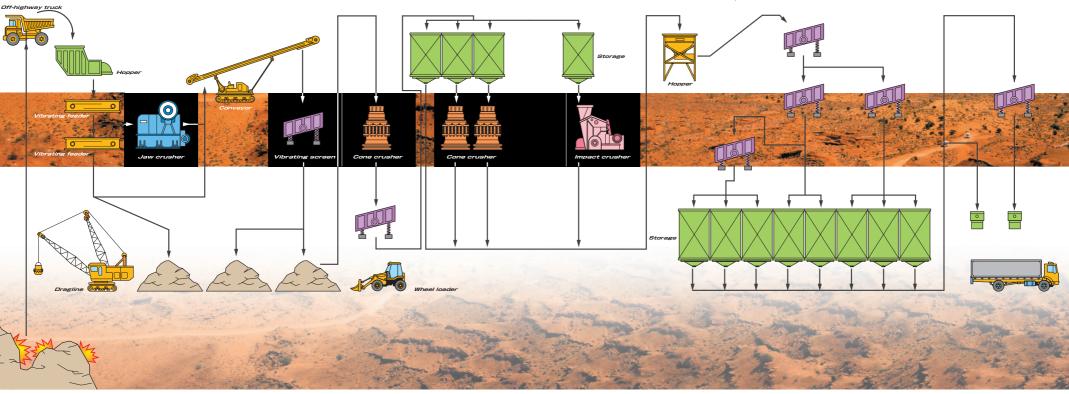
The vibrating screen consists of a case with a shaft and housing installed inside, with springs supporting the case. The swing and rotation of the shaft is produced by the attached unbalanced weight, which generates vibration. This vibration sifts the material set on the screen on the top of the case.





Impact Crusher

As indicated by its name, this machine crushes ore through impact, and steadily through sharp, repeated impact with a rapidly spinning hammer, steel plate, or stick.





NSKHPS™ Spherical Roller



NSKHPS™ Cylindrical Roller



Super Long-Life Spherical Roller Bearings for Vibrating Equipment CA-VS3,CA-VS4



Bearings for Mining Machinery EMM-VS Series of Cylindrical Roller Bearings for Vivrating Equipment



Plummer Block



Hi-TF Bearings

Wind Power Industry

A Product Line that Matches Specific Applications

NSKHPS™ Spherical Roller Bearings

Features Compared to the conventional bearing:



1. Improved reliability

Bearing life has increased by a maximum of 2 times compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology.



2. High temperature dimentional stabilizing treatment comes standard

High temperature dimensional stabilization of up to 200°C has been achieved through the application of NSK's proprietary material heat treatment technology.

NSKHPS™ Cylindrical Roller Bearings

Features Compared to the conventional bearing



1. Improved reliability

Bearing life has increased by a maximum of 60% compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology.



2. Wide-range product line-up

NSK has offerd the wide-range line-up of NSKHPS bearings with four types of cages focusing on a wide range of sizes offering a high degree of versatility for various generalpurpose applications.

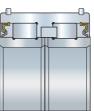
- · Pressed steel cage with high cost perfomance
- · Highly reliable machined brass cage
- · Polyamide resin cage that excels in heat resistance and chemical resistance

Full Complement Cylindrical Roller Bearings for Crane Sheaves

This cylindrical roller bearing incorporates seals to prevent the entry of foreign matter.

Features

- Improved seal: Contact seal increases resistance to entry of foreign matter or water.
- High load capacity: Larger radial load and axial load capacity compared to conventional sheave bearings.
- Corrosion resistance: Phosphate surface treatment improves resistance to rust.
- Easier grease replenishment: Sealed bearing includes inner ring holes to facilitate grease replenishment.
- Fewer mounted components: With snap rings for the outer ring, fewer components are required around the bearing, making for a more cost-effective sheave.



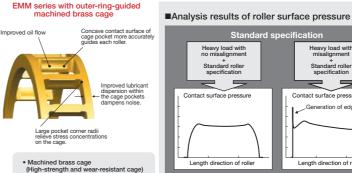
Spherical Roller Bearings CA-VS Series

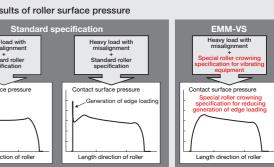
The CA series is a standard-size bearing with a machined brass cage, tough and wear-resistant capabilities, and is ideal for applications operating under heavy or shock load conditions. NSK offers the U15 and VS units specifically for vibrating screens, feeders, and other vibrating applications.

Features



Bearings for Mining Machinery EMM-VS Series of Cylindrical Roller Bearings for Vibrating Equipment





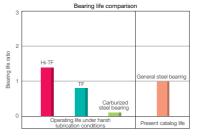
Hi-TF Bearings

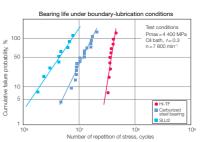
· Outer-ring-guided one-piece cage

Bearings manufactured from NSK's Hi-TF material have been specifically designed for outstanding toughness under harsh operating conditions, surpassing even NSK's earlier TF bearings. Hi-TF bearings incorporating this new material and a new heat-treatment technology provide long service life under contaminated lubrication conditions with superior resistance to wear, seizure, and heat. Hi-TF bearings are capable of handling the foreseeable needs of the future as well as meeting today's requirements.

Features

Achieves longer bearing life even under harsh conditions with excellent resistance to wear, seizure, and heat





Plummer Block

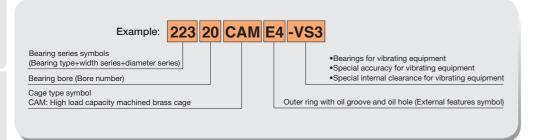
Plummer block housings can be used with high-capacity spherical roller bearings or self-aligning ball bearings. They are manufactured from high-strength cast iron as standard but are also available in cast steel or spheroidal graphite cast iron.



way Stock

D 044

Super Long-Life Spherical Roller Bearings for Vibrating Equipment CA-VS3, CA-VS4 Series



Dimensional Tolerance and Radial Clearance

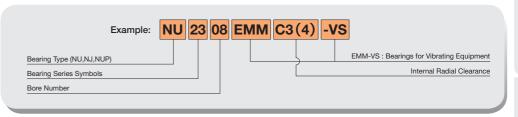
NSK's -VS3, VS4 specifications stabilize the load distribution by controlling the internal clearance and the dimensional tolerance of the bearing.

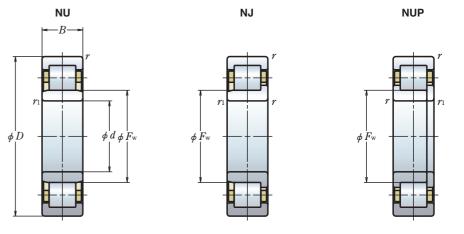
- VS3,VS4 series has succeeded to U15 specification (special tolerance for vibrating equipment) that has been adopted to spherical roller bearing CA-VS series. However to clarify the simplification of the suffix and the difference between new series and conventional series, suffix U15 is omitted.
- Number symbols (3 and 4) of VS3 and VS4 mean bearing internal clearance "C3U15 and C4U15"
- The dimensional tolerance bearing is set at 1/2 relative to the outer diameter tolerance and the internal diameter tolerance.
- The radial internal clearance is set at 2/3 relative to the standard.

Danier North	Basic Load	Ratings (kN)		Boundary diameter	y Dimensi	ons (mm) diameter			learance cal Bore)
Bearing Numbers	$C_{\rm r}$	$C_{0\mathrm{r}}$	d (mm)	tolerance (µm)	D (mm)	tolerance (µm)	$B \atop (\text{mm})$	VS3(µm)	VS4(μm)
22308CAME4-VS()	152	129	40		90		33	50 to 60	65 to 80
22309CAME4-VS()	185	167	45	0 -7	100		36	60 to 75	85 to 100
22310CAME4-VS()	232	211	50	,	110	_	40		
22311CAME4-VS()	261	241	55		120	-5 -13	43	75 to 90	100 to 120
22312CAME4-VS()	305	288	60		130		46		
22313CAME4-VS()	330	315	65	0	140		48		
22314CAME4-VS()	380	370	70	-9	150		51	90 to 110	120 to 145
22315CAME4-VS()	425	415	75		160	-5	55		
22316CAME4-VS()	485	480	80		170	-5 -18	58		
22317CAME4-VS()	520	510	85		180		60	110 to 135	150 to 180
22318CAME4-VS()	605	595	90		190		64		
22319CAME4-VS()	655	675	95	0	200		67		
22320CAME4-VS()	750	785	100	-12	215	-10	73		
22322CAME4-VS()	925	980	110		240	-23	80	135 to 160	180 to 210
22324CAME4-VS()	1 060	1 120	120		260		86		
22326CAME4-VS()	1 240	1 350	130		280		93	160 to 190	205 to 240
22328CAME4-VS()	1 450	1 590	140		300		102		
22330CAME4-VS()	1 530	1 690	150	0	320		108	190 to 220	240 to 280
22332CAME4-VS()	1 700	1 900	160	-15	340		114		
22334CAME4-VS()	1 970	2 110	170		360	-13	120	200 to 240	260 to 310
22336CAME4-VS()	2 170	2 340	180		380	-28	126		
22338CAME4-VS ()	2 370	2 590	190	-18	400		132	220 to 260	285 to 340

Remark VS(): Replace parentheses and indicate "VS3" or "VS4" when ordering

Bearings for Mining Machinery EMM-VS Series of Cylindrical Roller Bearings for Vibrating Equipment





			Bou	ndary Dim	nensions (r	mm)		Basic Load	Ratings (N)
Bearing I	Bearing Numbers		D	В	γ min.	${m \gamma}_1$ min.	$F_{ m w}$	$C_{\rm r}$	C_{0r}
NU2308EMMC3-VS	NU2308EMMC4-VS	40	90	33	1.5	1.5	52	114 000	122 000
NU2309EMMC3-VS	NU2309EMMC4-VS	45	100	36	1.5	1.5	58.5	137 000	153 000
NU2310EMMC3-VS	NU2310EMMC4-VS	50	110	40	2	2	65	163 000	187 000
NU2311EMMC3-VS	NU2311EMMC4-VS	55	120	43	2	2	70.5	201 000	233 000
NU2312EMMC3-VS	NU2312EMMC4-VS	60	130	46	2	2	77	222 000	262 000
NU2313EMMC3-VS	NU2313EMMC4-VS	65	140	48	2.1	2.1	82.5	233 000	265 000
NU2314EMMC3-VS	NU2314EMMC4-VS	70	150	51	2.1	2.1	89	274 000	325 000
NU2315EMMC3-VS	NU2315EMMC4-VS	75	160	55	2.1	2.1	95	330 000	395 000
NU2316EMMC3-VS	NU2316EMMC4-VS	80	170	58	2.1	2.1	101	355 000	430 000
NU2317EMMC3-VS	NU2317EMMC4-VS	85	180	60	3	3	108	395 000	485 000
NU2318EMMC3-VS	NU2318EMMC4-VS	90	190	64	3	3	113.5	435 000	535 000
NU2319EMMC3-VS	NU2319EMMC4-VS	95	200	67	3	3	121.5	460 000	585 000
NU2320EMMC3-VS	NU2320EMMC4-VS	100	215	73	3	3	127.5	570 000	715 000
NU2322EMMC3-VS	NU2322EMMC4-VS	110	240	80	3	3	143	675 000	880 000
NU2324EMMC3-VS	NU2324EMMC4-VS	120	260	86	3	3	154	795 000	1 030 000

Wind Power Industry

Steel Industry

Bearings for Railway Rolling Stock



A Product Line that Matches Specific Applications

Bearings Table

Axle Bearings	D 052
Gear Box Bearings	D 062
Traction Motor Bearings	D 064

INDUSTRY SOLUTIONS | NSK

These bearings must have high reliability, as they are one of the most important parts used in rolling stock.

There are three bearing types typically used in rolling stock; axle bearings, which carry the heavy weight of rolling stock on the shafts; traction motor bearings, which support the main shaft of the traction motor; and gearbox bearings, which transmit drive power from the traction motor to the axle shaft.

NSK supplies these specifically designed bearings for each application.



Axle Bearings

- · NSK has developed high-speed, lightweight, and lowmaintenance axle bearings.
- -Sealed-Clean Rotating End Cap Tapered Roller Bearings with Grease Lubrication
- -Sealed-Clean Rotating End Cap Cylindrical Roller Bearings with Grease Lubrication
- -Open-Type Cylindrical Roller Bearings (With oil bath or Grease Lubrication)
- -Open-Type Tapered Roller Bearing (With oil bath Lubrication)
- NSK offers axle bearings with sensors to provide higher
- NSK is certified by the AAR (Association of American Railways). Please ask NSK in detail.



Gear Box Bearings

- NSK bearings have higher seizure resistance under highspeed rotation due to our special designs.
- A high-toughness cage can be used in severe condition.



Traction Motor Bearings

- Designed for high-speed, inverter-controlled Traction Motors by adopting a dimension-stabilizing treatment. Application of long-life grease is recommended.
- NSK has two solutions to prevent electric current penetration (electrolytic corrosion) through the bearing. -Ceramic Insulated Bearings
- -PPS Molded Bearing
- High-capacity bearings are used in large traction motors in electric train locomotives.





D 050

D 051

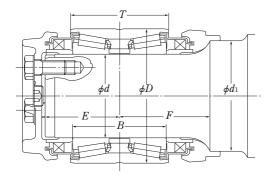
Pumps & Compressors

Railway Rolling Stock

Wind Power Industry

Axle Bearings

Sealed-Clean Rotating End Cap Tapered Roller Bearing

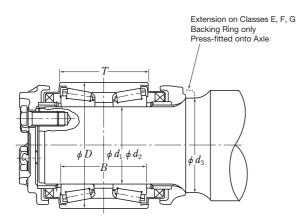


D : N I				Dimensions (mm)				Pacia Dynamia Load Pating (N)	Pagin Static Load Dating (N)	
Bearing Numbers	d	D	D T		d_1	E	F	Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)	
J-908	90	154	90	80	110	55	80	297 000	480 000	
J-318	110	175	130	125	155	105	135	470 000	940 000	
J-910	110	188	150	145	150	100	120	605 000	1 110 000	
J-901	110	190	150	145	150	100	120	605 000	1 110 000	
J-905	110	195	150	145	150	100	120	650 000	1 180 000	
J-909	110	205	140	130	150	85	105	745 000	1 270 000	
J-902	110	220	145	144	155	112	110	690 000	1 090 000	
J-900	115	210	150	145	144	98	117	710 000	1 250 000	
J-319	120	195	142	136	155	113	135	645 000	1 290 000	
J-904	120	220	145	145	155	120	117	750 000	1 250 000	
J-355	120	220	155	155	150	125	100	845 000	1 530 000	
J-907A	120	220	155	150	149	146.5	117	780 000	1 310 000	
J-320	130	208	152	146	165	115	139	660 000	1 350 000	
J-913	130	220	155	155	160	168	100	765 000	1 410 000	
J-920	130	220	155	155	171	115	140.7	820 000	1 550 000	
J-934	130	230	160	150	149	146.5	117	915 000	1 670 000	
J-937	130	230	160	150	160	149	117	915 000	1 670 000	
J-936B	130	240	165	160	160	203.5	117	1 040 000	1 800 000	
J-943	130	240	160	160	160	90	101	1 040 000	1 800 000	
J-921C	150	250	185	179.5	185	122	133	915 000	1 700 000	
J-942	185	280	160	155	225	_	115.5	915 000	1 900 000	

Wind Power Industry

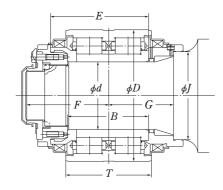
Axle Bearings

Sealed-Clean Rotating End Cap Tapered Roller Bearing AAR No.22



Class	Journal Size	Unit Number	Bearing Numbers				Basic Dynamic Load Rating	Basic Static Load Rating			
Olass	Journal Size	Onit Number	bearing Numbers	$d_{\scriptscriptstyle 1}$ (bearing) maxmin.	$oldsymbol{d}_2$ (axle) maxmin.	mm(upper line) / $\frac{1}{1}$	T	В	d_3	N (lbf)	N (lbf)
В	4 1/4 X 8	J-371	HM120848R HM120817XDR	101.625-101.600 4.001-4.000	101.702-101.676 4.0040-4.0030	165.100 6 1/2	114.300 4 1/2	106.362 4 3/16	127.000 5	415 000 (93 000)	775 000 (174 000)
С	5 X 9	J-372	HM124646R HM124618XDR	119.087-119.062 4.6885-4.6875	119.164-119.139 4.6915-4.6905	195.262 7 11/16	142.875 5 5/8	136.525 5 3/8	149.225 5 7/8	585 000 (132 000)	1 140 000 (255 000)
D	5 1/2 X 10	J-373	HM127446R HM127415XDR	131.775-131.750 5.1880-5.1870	131.864-131.839 5.1915-5.1905	207.962 8 3/16	152.600 6	146.050 5 3/4	161.925 6 3/8	635 000 (143 000)	1 250 000 (282 000)
Е	6 X 11	J-374	HM129848R HM129814XDR	144.475-144.450 5.6880-5.6870	144.564-144.539 5.6915-5.6905	220.662 8 11/16	163.512 6 7/16	155.575 6 1/8	178.613-178.562 7.032-7.030	665 000 (149 000)	1 350 000 (305 000)
F	6 1/2 X12	J-375	HM133444R HM133416XDR	157.175-157.150 6.1880-6.1870	157.264-157.239 6.1915-6.1905	252.412 9 15/16	184.150 7 1/4	177.800 <mark>7</mark>	191.313-191.262 7.532-7.530	905 000 (204 000)	1 840 000 (415 000)
G	7 X 12	J-376	HM136948R HM136916XDR	177.812-177.787 7.0005-6.9995	177.902-177.876 7.0040-7.0030	276.225 10 7/8	185.725 7.312	180.075 7 1/8	203.251-203.200 8.002-8.000	1 010 000 (227 000)	2 170 000 (485 000)

Sealed-Clean Rotating End Cap Cylindrical Roller Bearing



				Dimension	ns (mm)				Basic Dynamic	Basic Static
Bearing Numbers	d	D	T	В	J	E	F	G	Load Rating (N)	Load Rating (N)
J-580A	100	195	150	175	130	_	120	105	670 000	1 040 000
J-447B	110	220	160	154	170	_	135	140	875 000	1 370 000
J-577	110	220	170	182	140	210	128	112	875 000	1 370 000
J-504	120	195	140	134	155	176	135	132	545 000	915 000
120JRF11	120	215	146	146	_	_	_	_	830 000	1 350 000
J-809	120	220	145	145	155	171	145	117	700 000	1 120 000
J-805	120	220	155	157	150	190	113	100	765 000	1 250 000
J-806	120	220	160	172	160	200	128	112	765 000	1 250 000
J-810A	120	220	160	185.5	145	_	128	104	765 000	1 250 000
J-811	120	220	160	204	150	242	128	112	815 000	1 320 000
J-817	120	220	175	175	144	197	118	113	850 000	1 430 000
J-605	120	220	175	182	140	210	128	112	850 000	1 430 000
J-803	120	220	175	182	150	210	128	112	850 000	1 430 000
J-594	120	230	150	142	155	171	145	113	830 000	1 290 000
J-574	120	240	160	162	168	193	158	113	935 000	1 420 000
J-574A	120	240	160	162	168	196	120	125	935 000	1 420 000
J-480B	120	240	160	164	150	197	128	112	935 000	1 450 000
J-556B	120	240	170	180	168	218	130	125	1 020 000	1 580 000
J-802	120	240	170	182	150	205	128	112	1 020 000	1 580 000
J130-20DR	130	220	124	124	_	_	_	_	805 000	1 320 000
J-814	130	230	160	185.5	155	_	128	104	800 000	1 340 000
J-816	130	240	160	160	160	188	100	112	825 000	1 310 000
J-807	130	240	160	160	160	188	118	112	825 000	1 310 000
J-801	130	240	160	160	165	188	116	105	825 000	1 310 000
J-589	130	240	160	160	170	188	131	116	825 000	1 310 000
J-567	130	250	170	170	165	208	95	135	1 030 000	1 610 000
J-578	130	260	175	182	160	212.5	128	112	1 030 000	1 610 000
J-555	130	260	180	182	160	215	128	112	1 030 000	1 610 000
160JRT02	160	280	159	180	_	_	_	_	1 060 000	1 730 000

D	056

Mining Machinery

Railway Rolling Stock

Papermaking Machines

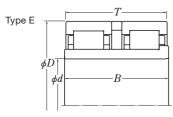
Wind Power Industry

Steel Industry

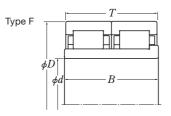
Air Turbine Dental Handpieces

INDUSTRY SOLUTIONS **NSK**

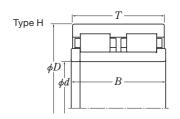
Open Type Cylindrical Roller Bearings



Bearing Numbers		Dimensi	ons (mm)	Basic Dynamic Load Rating	Basic Dynamic Load Rating Basic Static Load Rating		
bearing Numbers	d	D	T	B	(N)	(N)	
85JRJ02	85	150	120.0	125	365 000	585 000	
90JRJ01	90	160	118.5	130	355 000	530 000	
110JRJ01	110	200	150.0	160	625 000	995 000	
2J110-2	110	220	180.0 (80x2)	190	875 000	1 370 000	
120JRJ01	120	220	180.0	183	850 000	1 430 000	
2J120-1	120	240	180.0 (80x2)	190	935 000	1 450 000	
2J120-3M	120	240	180.0 (80x2)	180	935 000	1 450 000	

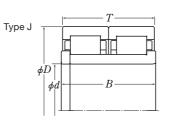


Bearing Numbers		Dimensio	ons (mm)	Basic Dynamic Load Rating	Basic Static Load Rating	
bearing Numbers	d	D	T	B	(N)	(N)
2J110-1 120JRJ02A	110 120	225 240	70×2 160	150 180	935 000 935 000	1 430 000 1 450 000

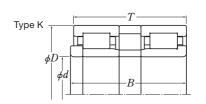


Pooring Number		Dimensio	ns (mm)	Basic Dynamic Load Rating	Basic Static Load Rating	
Bearing Number	d	D	T	B	(N)	(N)
JC14	130	260	160	160	1 140 000	1 840 000

Pagring Numbers		Dimensio	ons (mm)		Basic Dynamic Load Rating	Basic Static Load Rating
Bearing Numbers	d	D	T	В	(N)	(N)
95JRT02	95	170	115	125	440 000	685 000
95JRT01	95	190	125	130	800 000	1 340 000
20100-1	100	200	170	170	650 000	1 030 000
20110-1	110	220	180	185	875 000	1 370 000
120JRT04	120	220	160	165	810 000	1 340 000
20120-11	120	220	180	183	850 000	1 430 000
JC34	120	230	165	170	945 000	1 460 000
120JRT01	120	240	180	185	935 000	1 450 000
20120-4	120	240	180	185	935 000	1 450 000
JC38A	125	235	165	170	945 000	1 470 000
JC39A	125	236	165	175.5	960 000	1 500 000
130JRT08	130	235	165	170	895 000	1 520 000
20130-7	130	240	180	185	915 000	1 490 000
130JRT01	130	260	180	185	1 030 000	1 610 000
20130-6	130	260	180	185	1 030 000	1 610 000
JC37A	130	265	166	166	1 140 000	1 700 000
20140-1	140	250	155	160	865 000	1 480 000
170JRT01	170	340	230	230	1 660 000	2 760 000

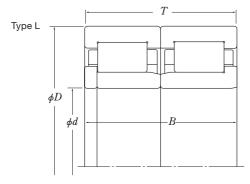


Pagring Numbers		Dimensio	ons (mm)	Basic Dynamic Load Rating	Basic Static Load Rating	
Bearing Numbers	d	D	T	B	(N)	(N)
JC27X JC400K	120 120	230 230	150 150	177 177	935 000 885 000	1 440 000 1 340 000



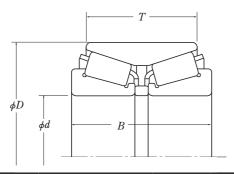
Bearing Number		Dimensi	ons (mm)		Basic Dynamic Load Rating Basic Static Load Ratin		
bearing Number	d	D	T	B	(N)	(N)	
J130-5/U130- 5DB+KL38	130	240	198 (80×2)	204	880 000	1 450 000	

Open Type Cylindrical Roller Bearing



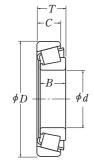
Bearing Numbers		Dimensi	ions (mm)		Basic Dynamic Load Rating	Basic Static Load Rating
bearing Numbers	d	D	T	В	(N)	(N)
J110-2/U110-4DB	110	215	73 × 2	73 × 2	800 000	1 240 000
42724T/152724T	120	240	80×2	80×2	910 000	1 400 000
J120-1C/U120-2C	120	240	80×2	80×2	960 000	1 500 000
J120-1D/U120-2D	120	240	80×2	80×2	960 000	1 500 000
42726TT/152726TT	130	250	80×2	80×2	1 030 000	1 610 000
J130-3/U130-4	130	250	80×2	80×2	1 030 000	1 610 000
JC130M	130	250	160	160	1 030 000	1 610 000
J130-18/U130-16	130	220	62×2	62×2	785 000	1 340 000
J130-16/U130-14	130	220	73×2	73×2	860 000	1 510 000
J150-5/U150-2	150	270	160 (80 × 2)	160 (80 × 2)	1 020 000	1 700 000

Open Type Tapered Roller Bearing



Bearing Numbers		Dimensio	ns (mm)		Basic Dynamic Load Rating	Basic Static Load Rating
bearing Numbers	d	D	T	В	(N)	(N)
110KBE2201+L	110	220	115	145	820 000	1 350 000
120KBE2001+L	120	200	84	100	515 000	865 000
120KBE52X+L	120	215	109	132	720 000	1 170 000
JT21	120	220	130	155	860 000	1 480 000
JT21A	120	220	130	155	860 000	1 480 000
JT21B	120	220	130	155	860 000	1 480 000
130KBE2302+L	130	230	115	145	850 000	1 480 000
140KBE2302+L	140	230	110	140	820 000	1 550 000
140KBE2701+L	140	270	95	120	870 000	1 440 000
150KBE2502+L	150	250	95	115	745 000	1 320 000
160KBE2701A+L	160	270	120	140	860 000	1 510 000
170KBE2802A+L	170	280	130	150	1 110 000	2 160 000
180KBE3401+L	180	340	140	180	1 410 000	2 510 000

Tapered Roller Bearings



Descripe a Newskawa		Din	nensions (m	m)		Basic Dynamic Load	Basic Static Load	A 1: +: (1)
Bearing Numbers	d	D	T	В	С	Rating (N)	Rating (N)	Application(1)
QT30	60	130	33.5	31	22	127 000	139 000	Gear (P)
30312DQWAP6	60	130	33.5	31	22	127 000	139 000	Gear (P)
30313DQWAP6U1	65	140	36	33	23	147 000	163 000	Gear (P)
QT9	70	150	38	35	25	165 000	185 000	Gear (P)
QT9A	70	150	38	35	25	165 000	185 000	Gear (P)
QT9B-2	70	150	38	35	25	165 000	185 000	Gear (P)
QT9F	70	150	38	35	25	165 000	185 000	Gear (P)
QT9J	70	150	38	35	25	165 000	185 000	Gear (P)
R70-25	70	150	38	35	25	165 000	185 000	Gear (P)
30314DAQWAP6A	70	150	38	35	25	165 000	185 000	Gear (P)
30314QWAP6	70	150	38	35	30	194 000	218 000	Gear (P)
QT31	70	150	40	37	27	172 000	198 000	Gear (P)
QT7A	75	160	40	37	27	189 000	224 000	Gear (P)
30315DXQWAP6	75	160	40	37	26	189 000	224 000	Gear (P)
30315QWAP6	75	160	40	37	31	209 000	233 000	Gear (P)
R80-1	80	170	42.5	39	28	196 000	222 000	Gear (P)
QT4A	80	170	42.5	39	28	208 000	241 000	Gear (P)
30316QWAP6	80	170	42.5	39	33	235 000	265 000	Gear (P)
30317DQWAP6A	85	180	44.5	41	29	233 000	269 000	Gear (P)
30317QWAP6A	85	180	44.5	41	34	262 000	300 000	Gear (P)
QT18	85	180	45.5	42	29	244 000	285 000	Gear (P)
30328QWAP6	140	300	67.75	62	53	600 000	740 000	Gear (G)
QT1(2)	190	280	49	46	36.5	605 000	1 240 000	Gear (G)
QT29 (³)	193.675	282.575	50.800	47.625	36.512	360 000	600 000	Gear (G)
QT26	195	280	58	60	41	410 000	780 000	Gear (G)
QT25	200	280	51	48	41	410 000	780 000	Gear (G)
32940QSA	200	280	51	48	41	410 000	780 000	Gear (G)
QT13(²)	200	290	49	46	36.5	625 000	1 330 000	Gear (G)
QT27	200	290	55	60	41	410 000	790 000	Gear (G)
QT34A	202	290	58	60	41	435 000	855 000	Gear (G)
QT33	205	283	51	48	41	415 000	795 000	Gear (G)
QT38	205	310	60	60	47	545 000	1 020 000	Gear (G)
R205-1	205	310	60	60	47	545 000	1 020 000	Gear (G)
R205-4	205	310	60	60	47	545 000	1 020 000	Gear (G)
QT5	210	320	70	66	56	665 000	1 180 000	Gear (G)
QT35 R215-3	215	315	65 65	70 70	49	595 000	1 130 000	Gear (G)
R215-3 ΩT32	215	315	65 65		49	595 000	1 130 000	Gear (G)
	218	315	65 51	70	49	595 000	1 130 000	Gear (G)
32944QWASA	220	300	51	48	41	425 000	855 000	Gear (G)
32052Q	260	400	87	82	71	1 130 000	2 020 000	Gear (G)

Notes (1) Gear (P): Pinion-Side Bearing of Gear Unit, Gear (G): Gear-Side Bearing of Gear Unit

(2) Double-Row Configuration

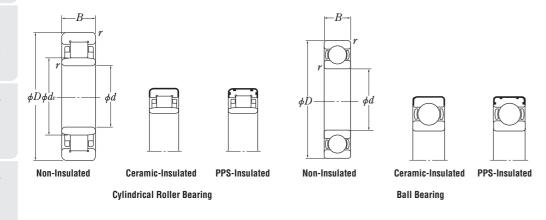
(3) Sizes have been converted to millimeters from inches.

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Steel Industry

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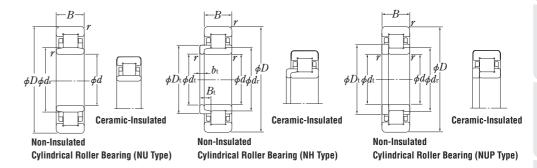
Bearings for Electric Car Traction Motors



	Loaded Side, Cylindrical		Din	nensions (n	nm)		Non-Loaded Side,	Dir	mensions (m	m)	
	Roller Bearings	d	D	B	$d_{ m r}$	γ (min.)	Ball Bearings	d	D	B	_
	NU210E (¹)	50	90	20	59.5	1.1	6016	80	125	22	
	NU212	60	110	22	73.5	1.5	6310	50	110	27	
	NU312	60	130	31	77.0	2.1	6310	50	110	27	
	NU213	65	120	23	79.6	1.5	6310	50	110	27	
	NU313	65	140	33	83.5	2.1	6311	55	120	29	
	NU214	70	125	24	84.5	1.5	6310	50	110	27	
							6311	55	120	29	
	NU314	70	150	35	90.0	2.1	6311	55	120	29	
	NU215	75	130	25	88.5	1.5	6311	55	120	29	
		7-	400	0.7	05.5	0.4	6312	60	130	31	
	NU315	75	160	37	95.5	2.1	6311	55	120	29	
•							6312 6314	60 70	130 150	31 35	
	NU415	75	190	45	104.5	3.0	6313	65	140	33	
	NU216	80	140	26	95.3	2.0	6312	60	130	31	
	NU316	80	170	39	103.0	2.1	6312	60	130	31	
	NU416	80	200	48	110.0	3.0	6313	65	140	33	
	NU217	85	150	28	101.8	2.0	6217	85	150	28	
	NU218	90	160	30	107.0	2.0	6218	90	160	30	
	NU219	95	170	32	113.5	2.1	6219	95	170	32	
			. 7 0	32			52.10	50	. 7 0	02	

Note (1) E: High-Capacity

Bearings for Electric Locomotive Trains Traction Motors



2xx Series (Free End-Bearings)

d	Boundar D	y Dimensio B	ns (mm) $d_{ m r}$	γ (min.)	Basic Numbers	Internal Design(1)	Basic Dynamic Load Rating (N)	Basic Static Load Rating (N)
120	215	40	143.5	2.1	NU224	E	320 000	395 000
130	230	40	153.5	3.0	NU226	E	345 000	425 000

Note (1) E: High-Capacity

3xx Series (Free End-Bearings)

	Boundar	y Dimensio	ns (mm)		Basic Numbers	Internal Design(1)	Basic Dynamic	Basic Static
d	D	B	$d_{ m r}$	γ (min.)	Dasic Nullibers	iliterilai Desigii()	Load Rating (N)	Load Rating (N)
90	190	43	113.5	3	NU318	Е	315 000	355 000
100	215	47	127.5	3	NU320	E	380 000	425 000
110	240	50	143.0	3	NU322	E	425 000	485 000
120	260	55	154.0	3	NU324	E	530 000	610 000
130	280	58	165.0	4	NU326	В	655 000	795 000
			167.0			E	615 000	735 000
140	300	62	180.0	4	NU328	E	665 000	795 000
			178.0			F	705 000	860 000
150	320	65	193.0	4	NU330	E	760 000	920 000
			193.0			EA	715 000	855 000
			190.5			J	800 000	985 000
			190.0			L	790 000	970 000
160	340	68	204.0	4	NU332	E	860 000	1 050 000
180	380	75	231.0	4	NU336	Е	985 000	1 230 000

Note (1) E, EA: High-Capacity Type B, F, J, L: Specific Types, respectively

3xx Series (NH Type, NUP Type)

			Dimensio	ns (mm)				Basic	Internal	Basic Dynamic Load Rating	Basic Static Load Rating
d , $d_{\rm t}$	D	B	$d_{ m r}$	D_{t}	B_{t}	$b_{ m t}$	γ (min.)	Numbers	Design(1)	(N)	(N)
80	170	39	101.0	111.8	17.0	11.0	2.1	NH316	Е	256 000	282 000
90	190	43	115.0	125.0	21.0	12.0	3.0	NH318	_	240 000	265 000
			113.5	124.2	18.5			14113 10	E	315 000	355 000
90	190	43	115.0	125.0	_	_	3.0	NUP318	В	240 000	265 000
			113.5	124.2				1401316	E	315 000	355 000
100	215	47	129.5	140.5	22.5	13.0	3.0		Α	310 000	355 000
			129.5	140.5	22.5			NH320	В	310 000	355 000
			127.5	139.0	20.5				E	380 000	425 000
110	240	50	143.0	155.0	22.0	14.0	3.0	NH322	E	425 000	485 000
120	260	55	154.0	168.5	23.5	14.0	3.0	NH324	_	475 000	550 000
130	280	58	167.0	182.0	24.0	14.0	4.0	NH326	_	560 000	665 000
				181.0				1411320	E	615 000	735 000
140	300	62	180.0	196.0	26.0	15.0	4.0	NH328	_	615 000	745 000

Note (1) E:High-Capacity Type A,B:Specific Types, respectively

Steel Industry

Bearings for Papermaking Machines

Excellent durability under high-temperature conditions including moisture and dust laden environments, resulting in longer life, higher limiting speed and dramatically enhanced productivity.



A	Product	Line	that	Matches	Specific	Applications
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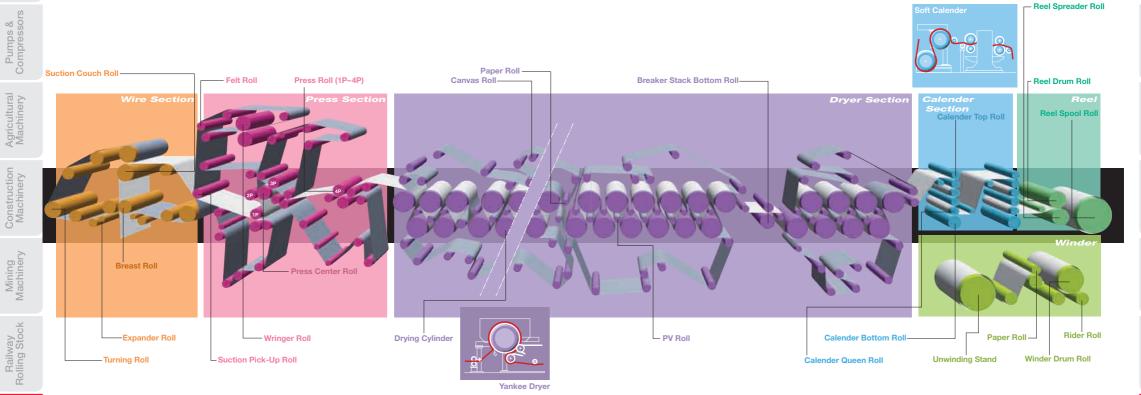
The Papermaking Process and Bearing Specifications D 068

Bearings Table

Spherical Roller Bearings TL Series	D 076
Molded-Oil™ Bearings	D 082
Triple Ring Bearings	D 084



The Papermaking Process and Bearing Specifications





Molded-Oil™ Bearings

Excellent performance in environments exposed to moisture or paper dust, without oil leakage.

Molded oil using an optimized molding method with optimal composition provides higher speed operation, is easy to handle, and safe for the environment.

Major applications: raw material conveyors, carrier rope sheaves, suction rolls



Triple Ring Bearings

Uniquely structured bearing for ease of use and no creep while offering high precision and long

Major applications: press rolls, breaker



Smear-Resistant Spherical Roller Bearings

The anti-smearing performance of the new product compared to conventional products by applying a DLC coating to

Major application: Inner side bearings for suction rolls



Spherical Roller Bearings CA Series

Superior radial load capacity and alignment, featuring high load capacity and excellent strength; equipped with a machined cage. This product lineup includes high running accuracy to ISO tolerance class 5.

Major applications: large diameter rolls

such as suction rolls, press rolls. drum rolls.



Spherical Roller Bearings TL Series

Ideal for high temperature equipment, with resistance to inner ring fracture. Tough, long-life TL bearings boost productivity and lower costs.

Major applications: Press Roll, Drying PV Roll, Calernder Roll



Deep Groove Ball Bearings for **High-Speed Expander Rolls**

Special bearings that suppress friction torque and surface damage such as

Steel

Mining Machinery

Railway Rolling Stock

Steel Industry

■ A Product Line that Matches Specific Applications

High Performance Standard Bearings for Industrial Machinery

NSKHPS™, redefining the standard.

Continually developing products with greater strength and higher accuracy, NSK's new NSKHPS™ fully incorporate the advantages of NSK's world-class design, materials, and manufacturing technologies, setting a new standard for bearings.

NSKHPS™ Spherical Roller Bearings

Features







1. Improved reliability

Bearing life has increased by a maximum of 2 times compared with that of conventional bearings by optimization of the bearing's internal design and improved processing technology. As a result, the NSKHPSTM bearings contribute to reducing maintenance costs and facilitate the downscaling of related equipment.

2. High temperature dimensional stabilizing treatment comes standard

High-temperature dimensional stabilization of up to 200°C has been achieved through the application of NSK's proprietary material heat treatment technology.

As a result, this series of bearing can be used in a wide range of applications.

3. Wide range line-up

Even the giant large size depends on line-up, one for paper making machines It became applicable to the wide roll size.

Bearing No. Pages C266 to C287

NSKHPS™ Cylindrical Roller Bearings

Features





1. Improved reliability

Bearing life has increased by a maximum of 60% compared with that of conventional bearings by the optimization of the bearing's internal design and improvement of processing technology.

2. Wide-range product line-up

NSK has offerd the wide-range line-up of NSKHPS bearings with four types of cages focusing on a wide range of sizes offering a high degree of versatility for various generalpurpose applications.

- · Pressed steel cage with high cost perfomance
- · Highly reliable machined brass cage
- · Polyamide resin cage that excels in heat resistance and chemical resistance

Bearing No. Pages C132 to C147

Spherical Roller Bearings TL Series

Dryer rolls are generally used under high-temperature conditions, which can lead to fracturing of the bearing inner ring, and in the worst case, result in work stoppage. NSK's solution is the TL (Tough and Long-life) bearing, which features sufficient strength to resist inner ring fractures, superior dimensional stability under high temperature conditions, and long life due to superior hardness. All these characteristics mean improved productivity.



<Applications>

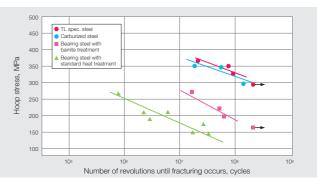
It's used for all except for Drying/Calernder Roll and large size bearing for press rolls.

Bearing No. Pages D076 to D081

Features

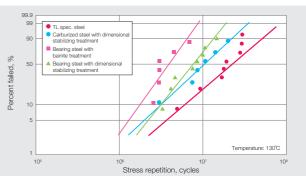
Enhanced inner ring strength

Adoption of a special steel and surface hardening heat treatment, developed by NSK, dramatically enhance inner ring strength against increasing hoop stress caused by rising shaft temperature.



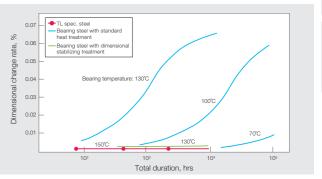
Longer life

Increased hardness of raceway surface provides longer life when foreign debris is present than that of other bearings.



Dimensional stability under high temperatures

Dimensional stability under high temperatures is adopted as a standard specification. (Max. 200°C)



D 070

Steel Industry

■ A Product Line that Matches Specific Applications

Molded-Oil™ Bearings

Molded-Oil™ bearings are lubricated with NSK's own oil-impregnated material, Molded-Oil™ consists of lubricating oil and polyolefin resin that has an affinity for oil. Oil slowly seeping from this material provides ample lubrication to the bearing for extended periods.

Bearing No.	Pages D082 and D083
CAT. No.	E1216



Features

Excellent performance in . water- and dustenvironments

The bearings are designed to prevent liquids such as water, which can wash out the lubricating oil, and dust from getting inside the bearings. Sealed types can be used in environments exposed to water and dust.

*Water and dust dramatically accelerate bearing water and dust transactionly accelerate beam damage. In order to realize stable operation, water and dust from getting in the bearing.

composition and molding methods enable high-speed operation

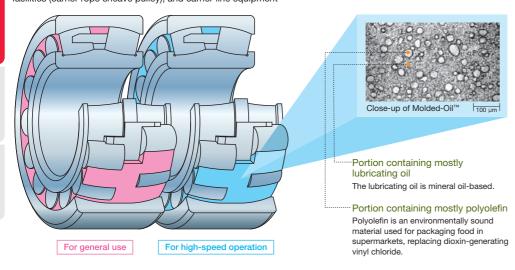
Optimization of composition and molding method of Molded-Oil™ improves strength and enables high-speed operation.

Packing with Molded-Oil™ after providing the bearing surface with Low torque special treatment realizes smooth rotation of rolling elements.



The bearings are lubricated by minute quantities of oil exuded by Molded-Oil™, which consequently minimizes oil leakage.

Material processing equipment (conveyers, agitators), paper mill line equipment (support for wire part rolls), maintenance facilities (carrier rope sheave pulley), and carrier line equipment



Be aware that this bearing has certain restrictions in regards to ambient operating temperatures and limiting speeds (d_mn). Refer to the NSK Molded-Oil™ Bearings catalog (Cat. No. E1216) for details. Furthermore, handling precautions for maintaining the excellent, long-term lubricating capacity of the Molded-Oil™ bearings are listed on page 3 of the same catalog.

Smear-Resistant Spherical Roller Bearings

The newly developed smear-resistant spherical roller bearing is treated with NSK's originally developed DLC* coating (NSK DLC coating) on the rolling contact surface of the rollers which could excel the durability.

*DLC: Hard coating mainly consisting of carbon (diamond-like carbon)

The phenomenon of smearing—or micro-seizing—caused by slippage between the raceway surface of the inner and outer rings and the roller surface may occur in bearings used in lightload areas inside papermaking machinery and areas with poor lubrication conditions.

NSK drastically improved the anti-smearing performance of the new product compared to conventional products by applying a DLC coating to the rolling elements.

Inner bore dimensions ranging from 80mm to 240mm

<Applications>

- · Inner side bearings for suction rolls in press process parts
- · Bearings for soft calendar rolls in calendar process parts

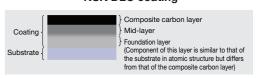
Features

NSK independently developed a DLC coating for bearings. The coating follows the base metal's elastic deformation even better than before, since its elastic modulus is close to that of the substrate base metal. Further, the adhesion between the coating and base metal was improved, making it less likely to come off, even under high surface pressure.(Fig 1)

Conventional DLC coating



NSK DLC coating

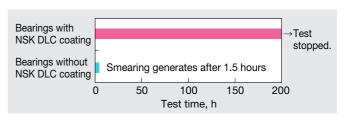


Fia. 1

Twin-disk test

Two disk test pieces Driven side Drive side Loading Fig. 2

A rolling-contact test was conducted under boundary lubrication conditions in addition to sliding contact conditions in which the speeds of two disk test pieces are set differently.(Flg2)



Railv Rolling way Stock

Wind Pow Industry

INDUSTRY SOLUTIONS

Pumps & Compressors

Agricultural Machinery

Railway Rolling Stock

Wind Power Industry

Railway Rolling Stock

■ A Product Line that Matches Specific Applications

Triple Ring Bearings

Combination tapered roller bearings have typically been used for the outside of controlled crown rolls (CCR) and spherical roller bearings for the inside. Switching to high-precision, high load capacity triple ring bearings prevents creep, facilitates easier mounting, and extends operating life.

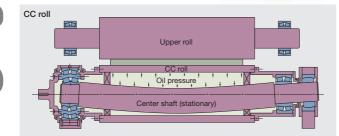
Bearing No.

Page D084

Features

High-load capacity design

Long life es vacuum melted, carburized stee



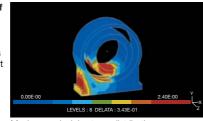
High precision

Optimal inner ring design for lubrication

Lubrication hole and groove provided on inner and outer rings

Finite element analysis of housing design for triple ring bearings.

Bearing load distribution is minimized by finite element method (FEM) analysis, thereby contributing to optimal structural design of the housing for paper machine manufacturers.



Maximum principle stress distribution

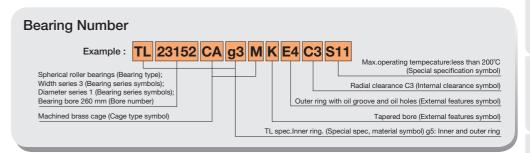
Deep Groove Ball Bearings

Deep Groove Ball Bearings are characterized by high performance and quality, displaying NSK's technological excellence. This top of the line design includes special bearings for highspeed expander rolls with low friction torque that minimize surface damage such as smearing, maintenance-free sealed ball bearings with high-performance seals, and silent ball bearings suitable for motors and pumps.

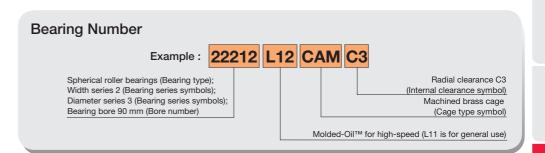


Bearing Numbers

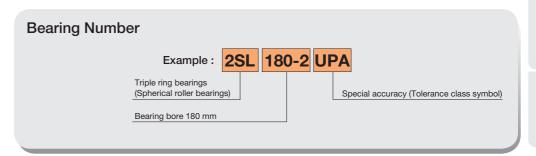
Spherical Roller Bearings TL Series



Molded-Oil™ Bearings

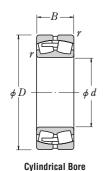


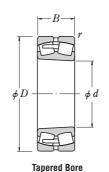
Triple Ring Bearings

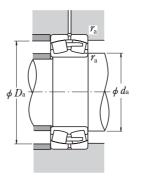


■Spherical Roller Bearings TL Series

Bore Diameter 40 - 160 mm







Dynamic Equivalent Load

 $P = XF_r + YF_a$

$F_{\rm a}/F$	r _r ≤e	$F_{\rm a}/F_{\rm r}{>}e$				
X	Y	X	Y			
1	Y_3	0.67	<i>Y</i> ₂			

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

	Boundary D					d Ratings	_	Bearing	Numbers		Abutment	and Fillet D	imensions		Constant		Axial Load		Mass
d	D (m	m) B	r	C_r (kN	C_{0r}	$C_{ m r}$ {kg	f} C_{0r}	Cylindrical Bore	Tapered Bore(1)		$l_{\rm a}$	(mm)) _a	$r_{\rm a}$	e	Y_2	Factors Y_3	Y_0	(kg)
			min.		01		01			min.	max.	max.	min.	max.					approx.
40	90	33	1.5	122	129	12 400	13 200	TL22308CAME4	TL22308CAMKE4	49	_	81	77	1.5	0.38	2.6	1.8	1.7	1.0
55	120	43	2	209	241	21 300	24 600	TL22311CAME4	TL22311CAMKE4	65		110	103	2	0.36	2.8	1.9	1.8	2.3
60	130	46	2.1	246	288	25 100	29 400	TL22312CAME4	TL22312CAMKE4	72	—	118	111	2 2	0.36	2.8	1.9	1.9	2.9
65	140	48	2.1	375	380	38 000	38 500	TL22313EAE4	TL22313EAKE4	77	84	128	119		0.33	3.0	2.0	2.0	3.5
70	150	51	2.1	425	435	43 500	44 000	TL22314EAE4	TL22314EAKE4	82	91	138	129	2 2	0.33	3.0	2.0	2.0	4.3
75	130	31	2.1	340	415	34 500	42 000	TL22315CAME4	TL22215CAMKE4	87	—	148	134		0.35	2.9	2.0	1.9	3.6
80	170	58	2.1	390	480	39 500	48 500	TL22316CAME4	TL22316CAMKE4	92	_	158	145	2	0.35	2.9	2.0	1.9	6.2
90	190	64	3	665	705	68 000	72 000	TL22318EAE4	TL22318EAKE4	104	115	176	163	2.5	0.33	3.1	2.1	2.0	8.6
95	200	67		525	675	53 500	68 500	TL22319CAME4	TL22319CAMKE4	109	—	186	172	2.5	0.35	2.9	1.9	1.9	9.9
100	215	73	3	860	930	88 000	94 500	TL22320EAE4	TL22320EAKE4	114	130	201	184	2.5	0.33	3.0	2.0	2.0	12.7
110	170	45	2	293	465	29 900	47 500	TL23022CDE4	TL23022CDKE4	120	124	160	153	2	0.24	4.2	2.8	2.8	3.76
	200	69.8	2.1	515	760	52 500	77 500	TL23222CE4	TL23222CKE4	122	130	188	170	2	0.34	3.0	2.0	1.9	9.54
	240	80	3	1 030	1 120	105 000	115 000	TL22322EAE4	TL22322EAKE4	124	145	226	206	2.5	0.30	3.1	2.1	2.0	17.6
120	260	86	3	1 190	1 320	122 000	134 000	TL22324EAE4	TL22324EAKE4	134	157	246	222	2.5	0.32	3.1	2.1	2.0	22.2
130	280	93	4	995	1 350	101 000	137 000	TL22326CAME4	TL22326CAMKE4	148	_	262	236	3	0.34	2.9	2.0	1.9	27.8
140	210	53	2	420	715	43 000	73 000	TL23028CDE4	TL23028CDKE4	150	157	200	190	2	0.22	4.5	3.0	2.9	6.49
	250	68	3	645	930	65 500	95 000	TL22228CDE4	TL22228CDKE4	154	167	236	219	2.5	0.25	4.0	2.7	2.6	14.5
	250	88	3	835	1 300	85 000	133 000	TL23228CE4	TL23228CKE4	154	163	236	213	2.5	0.25	2.9	1.9	1.9	18.8
150	225	56	2.1	470	815	48 000	83 000	TL23030CDE4	TL2303CDKE4	162	168	213	203	2	0.22	4.6	3.1	3.0	7.9
	225	56	2.1	470	815	48 000	83 000	TL23030CAME4	TL23030CAMKE4	162	—	213	203	2	0.22	4.6	3.1	3.0	7.9
	250	80	2.1	725	1 180	74 000	121 000	TL23130CAME4	TL23130CAMKE4	162	—	238	218	2	0.3	3.4	2.3	2.2	15.8
	270	73	3	765	1 120	78 000	114 000	TL22230CDE4	TL22230CDKE4	164	179	256	236	2.5	0.26	3.9	2.6	2.5	18.4
	320	108	4	1 220	1 690	125 000	172 000	TL22330CAME4	TL22330CAMKE4	168	—	302	270	3	0.35	2.9	1.9	1.9	41.5
160	240	60	2.1	540	955	55 000	97 500	TL23032CDE4	TL23032CDKE4	172	179	228	216	2	0.22	4.5	3.0	2.9	9.66
	290	80	3	910	1 320	93 000	135 000	TL22232CDE4	TL22232CDKE4	174	190	276	255	2.5	0.26	3.8	2.6	2.5	23.1
	290	104	3	1 100	1 770	112 000	180 000	TL23232CE4	TL23232CKE4	174	189	276	245	2.5	0.34	2.9	2.0	1.9	30.5

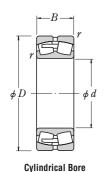
Note (1) The suffix K represents bearings with tapered bores. (taper 1:12)

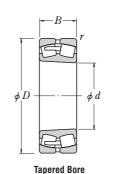
Remark The suffix E4 indicates that the bearing has an oil groove and holes.

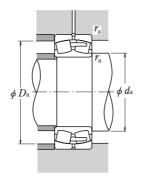
INDUSTRY SOLUTIONS

■Spherical Roller Bearings TL Series

Bore Diameter 170 - 260 mm







Dynamic Equivalent Load

)	$=XF_{r}$	$+YF_a$	

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

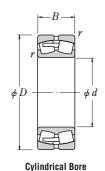
	Boundary D	imensions				d Ratings		Bearing	Numbers		Abutment		Dimensions		Constant		Axial Load		Mass
d	(mn D	n) B	γ min.	$C_{ m r}$ (kN	C_{0r}	$C_{ m r}$ {kg	$C_{0\mathrm{r}}$	Cylindrical Bore	Tapered Bore(1)		d _a		O _a min.	$r_{\rm a}$	e	Y_2	Factors Y_3	Y_0	(kg)
170	230 260 280 360	45 67 88 120	2 2.1 2.1 4	350 640 940 1 580	660 1 090 1 570 2 110	35 500 65 000 96 000 161 000	67 500 112 000 160 000 215 000	TL23934BCAME4 TL23034CDE4 TL23134CAME4 TL22334CAME4	TL23934BCAMKE4 TL23034CDKE4 TL23134CAMKE4 TL22334CAMKE4	min. 180 182 182 188	max. — 191 — —	220 248 268 342	213 233 245 304	2 2 2 2 3	0.17 0.23 0.29 0.35	5.8 4.3 3.5 2.9	3.9 2.9 2.3 1.9	3.8 2.9 2.3 1.9	5.38 13 21 57.9
180	280 320	74 112	2.1 4	750 1 300	1 270 2 110	76 000 133 000	129 000 215 000	TL23036CDE4 TL23236CAME4	TL23036CDKE4 TL23236CAMKE4	192 198	202 —	268 302	249 274	2	0.24 0.35	4.2 2.9	2.8 1.9	2.8 1.9	17.1 38.5
190	290 320 340	75 104 92	2.1 3 4	775 1 190 1 140	1 350 2 020 1 730	79 000 121 000 116 000	138 000 206 000 176 000	TL23038CAME4 TL23138CAME4 TL22238CAME4	TL23038CAMKE4 TL23138CAMKE4 TL22238CAMKE4	202 204 208	_ _ _	278 306 322	261 276 296	2 3.5 3	0.24 0.31 0.26	4.2 3.2 3.8	2.8 2.2 2.6	2.8 2.1 2.5	17.6 34 35.5
	340 400	120 132	4 5	1 440 1 890	2 350 2 590	147 000 193 000	240 000 264 000	TL23238CAME4 TL22338CAME4	TL23238CAMKE4 TL22338CAMKE4	208 212	_	322 378	288 338	3 4	0.35 0.34	2.9 2.9	1.9 2.0	1.9 1.9	46.5 77.6
200	310 340 360 360	82 112 98 128	2.1 3 4 4	940 1 360 1 300 1 660	1 700 2 330 2 010 2 750	96 000 139 000 133 000 169 000	174 000 238 000 204 000 281 000	TL23040CAME4 TL23140CAME4 TL22240CAME4 TL23240CAME4	TL23040CAMKE4 TL23140CAMKE4 TL22240CAMKE4 TL23240CAMKE4	212 214 218 218	_ _ _	298 326 342 342	279 293 315 307	2 2.5 3 3	0.25 0.32 0.26 0.35	4.0 3.2 3.8 2.9	2.7 2.1 2.6 1.9	2.6 2.1 2.5 1.9	22.6 41.5 42.6 57
220	340 370 400	90 120 108	3 4 4	1 090 1 570 1 570	1 980 2 710 2 430	111 000 160 000 160 000	202 000 276 000 247 000	TL23044CAME4 TL23144CAME4 TL22244CAME4	TL23044CAMKE4 TL23144CAMKE4 TL22244CAMKE4	234 238 238		326 352 382	302 320 348	2.5 3 3	0.24 0.31 0.27	4.1 3.2 3.7	2.8 2.2 2.5	2.7 2.1 2.4	29.7 52 59
	400 460	144 145	4 5	2 520 2 350	3 400 3 400	257 000 240 000	350 000 345 000	TL23244CAME4 TL22344CAME4	TL23244CAMKE4 TL22344CAMKE4	238 242	_	382 438	337 391	3 4	0.36 0.33	2.8 3.0	1.9 2.0	1.8 2.0	79.5 116
240	320 350 400 500	60 92 128 155	2.1 3 4 5	635 1 160 1 790 2 600	1 300 2 140 3 100 3 800	65 000 118 000 182 000 265 000	133 000 218 000 320 000 385 000	TL23948CAME4 TL23048CAME4 TL23148CAME4 TL22348CAME4	TL23948CAMKE4 TL23048CAMKE4 TL23148CAMKE4 TL22348CAMKE4	252 254 258 262		308 346 382 478	298 324 347 423	2 2.5 3 4	0.17 0.24 0.31 0.32	6.0 4.2 3.3 3.2	4.0 2.8 2.2 2.1	3.9 2.7 2.2 2.1	13.3 32.6 64.5 147
250	350 400	75 104	2.1 4	930 1 430	1 870 2 580	95 000 145 000	191 000 263 000	TL23952CAME4 TL23052CAME4	TL23952CAMKE4 TL23052CAMKE4	272 278	_	348 382	333 356	2	0.19 0.25	5.4 4.1	3.6 2.7	3.5 2.7	23 46.6
260	440	144	4	2 160	3 750	221 000	385 000	TL23152CAME4	TL23152CAMKE4	278	_	422	380	3	0.32	3.2	2.1	2.1	88.2

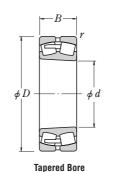
Note (1) The suffix K represents bearings with tapered bores. (taper 1:12)

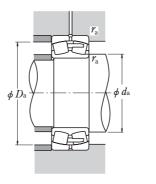
Remark The suffix E4 indicates that the bearing has an oil groove and holes.

■Spherical Roller Bearings TL Series

Bore Diameter 280 - 500 mm







Dynamic Equivalent Load

$P = XF_r + YF_a$	
$F_{\rm a}/F_{\rm r} \leq e$	

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

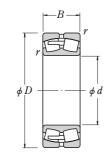
	Boundary D			Basic Load Ratings (kN) {kgf}			. f)	Bearing Numbers			Abutment and Fillet Dimensions						Axial Load		Mass
d	D (m)	11) B	r	$C_{\rm r}$	C_{0r}	$C_{ m r}$	C_{0r}	Cylindrical Bore	Tapered Bore(1)	C	$l_{ m a}$	(mm) <i>1</i>	D _a	γ_{a}	e	Y_2	Factors Y_3	Y_0	(kg)
			min.							min.	max.	max.	min.	max.					approx.
280	380 420 460 500	75 106 146 176	2.1 4 5 5	925 1 540 2 230 2 880	1 950 2 950 4 000 4 900	94 500 157 000 228 000 294 000	199 000 300 000 410 000 500 000	TL23956CAME4 TL23056CAME4 TL23156CAME4 TL23256CAME4	TL23956CAMKE4 TL23056CAMKE4 TL23156CAMKE4 TL23256CAMKE4	292 298 302 302		368 402 438 478	351 377 400 425	2 3 4 4	0.18 0.24 0.3 0.35	5.7 4.2 3.3 2.9	3.9 2.8 2.2 1.9	3.8 2.7 2.2 1.9	24.5 50.5 94.3 147
300	420 460 500 540	90 118 160 192	3 4 5 5	1 230 1 920 2 670 3 400	2 490 3 700 4 800 5 900	125 000 196 000 273 000 350 000	254 000 375 000 490 000 600 000	TL23960CAME4 TL23060CAME4 TL23160CAME4 TL23260CAME4	TL23960CAMKE4 TL23060CAMKE4 TL23160CAMKE4 TL23260CAMKE4	314 318 322 322		406 442 478 518	386 413 433 458	2.5 3 4 4	0.19 0.24 0.31 0.35	5.2 4.2 3.3 2.9	3.5 2.8 2.2 1.9	3.4 2.7 2.2 1.9	38.2 70.5 125 189
320	540	176	5	3 050	5 500	315 000	560 000	TL23164CAME4	TL23164CAMKE4	342	_	518	466	4	0.31	3.2	2.1	2.1	162
340	520 580	133 190	5 5	2 280 3 600	4 400 6 600	232 000 370 000	445 000 670 000	TL23068CAME4 TL23168CAME4	TL23068CAMKE4 TL23168CAMKE4	362 362	_	458 558	465 499	4 4	0.24 0.31	4.2 3.2	2.8 2.1	2.8 2.1	101 206
360 380	540 520	134 106	4 4	2 390 1 870	4 700 4 100	244 000 190 000	480 000 420 000	TL23072CAME4 TL23976CAME4	TL23072CAMKE4 TL23976CAMKE4	382 398	_	518 502	485 482	4 3	0.24 0.18	4.2 5.5	2.8 3.7	2.8 3.6	106 65.4
400 420	600 560	148 106	5 4	2 970 1 870	5 900 4 250	305 000 191 000	605 000 430 000	TL23080CAME4 TL23984CAME4	TL23080CAMKE4 TL23984CAMKE4	422 438	_	578 542	540 521	4 3	0.23 0.17	4.4 6.0	3.0 4.0	2.9 3.9	146 71.6
440 460	650 620	157 118	6 4	3 150 2 220	6 350 4 950	320 000 227 000	645 000 505 000	TL23088CAME4 TL23992CAME4	TL23088CAMKE4 TL23992CAMKE4	468 478	_	622 602	587 573	5 3	0.23 0.17	4.3 5.9	2.9 4.0	2.8 3.9	173 100
500	670	128	5	2 460	5 550	250 000	565 000	TL239/500CAME4	TL239/500CAMKE4	522	_	648	622	4	0.17	6.0	4.0	3.9	124

Note (1) The suffix K represents bearings with tapered bores. (taper 1:12)

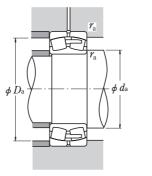
Remark The suffix E4 indicates that the bearing has an oil groove and holes.

INDUSTRY SOLUTIONS

■Molded-Oil™ Bearings Bore Diameter 35 - 160 mm



Cylindrical Bore



Dynamic Equivalent Load

$P = XF_r + YF_a$	
$F_{\cdot}/F_{\cdot} \leq e$	

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

_	Boundary		1S	,	Basic Lo	ad Ratings	af)	Bearing Numbers	Ab	utment and		Dimens	sions		Constant		Axial Load Factors		Mass
d	$D^{(1)}$	nm) B	γ min.	$C_{\rm r}$	C_{0r}	$C_{\rm r}$	gf} $C_{0\mathrm{r}}$	Cylindrical Bore	min.	$d_{ m a}$ max.	(m	$D_{\rm a}$	min.	$oldsymbol{\gamma}_{\mathrm{a}}$ max.	e	Y_2	Y_3	Y_0	(kg) approx.
35	80	21	1.5	71	76	7 250	7 750	21307L12CAM	44		7		67	1.5	0.29	3.5	2.3	2.3	0.52
40	90 90	23 33	1.5 1.5	82 122	93 129	8 350 12 400	9 500 13 200	21308L11ACAM 22308L11CAM	49 49	_	8	1 1	80 77	1.5 1.5	0.25 0.38	4.0 2.6	2.7 1.8	2.6 1.7	0.72 1.00
45	85 100	23 36	1.1 1.5	778 148	88 167	7 950 15 100	9 000 17 100	22209L11CAM 22309L12CAM	52 54	_	7 9	8	75 85	1 1.5	0.28 0.36	3.6 2.8	2.4 1.9	2.4 1.8	0.57 1.24
50	90	23	1.1	82	93	8 350	9 500	22210L11CAM	57	_	8	3	80	1	0.25	4.0	2.7	2.6	0.67
55	120	43	2	209	241	21 300	24 600	22311L12CAM	65	_	11	0	103	2	0.36	2.8	1.9	1.8	2.30
60	110	28	1.5	127	154	12 900	15 700	22212L12CAM	69	_	10	1	97	1.5	0.25	4.0	2.7	2.6	1.13
65	120 140 140	31 48 48	1.5 2.1 2.1	152 265 265	190 315 315	15 500 27 000 27 000	19 300 32 500 32 500	22213L11CAM 22313L11CAM 22313L12CAM	74 77 77	=	11 12 12	8	106 117 117	1.5 2 2	0.26 0.35 0.35	3.9 2.9 2.9	2.6 1.9 1.9	2.6 1.9 1.9	1.46 3.56 3.56
70	125	31	1.5	163	205	16 600	20 900	22214L11CAM	79	_	11	6	111	1.5	0.25	4.0	2.7	2.7	1.46
75	160	55	2.1	340	415	34 500	42 000	22315L12CAM	87	_	14	.8	135	2	0.35	2.9	2.0	1.9	5.26
80	140	33	2	181	232	18 500	23 700	22216L11CAM	90	_	13	0	124	2	0.24	4.3	2.9	2.8	2.14
85	150	36	2	215	276	21 900	28 200	22217L12CAM	95	_	14	.0	134	2	0.24	4.3	2.9	2.8	2.60
90	160	40	2	256	340	26 200	34 500	22218L12CAM	100	_	15	0	142	2	0.25	4.1	2.7	2.7	3.44
95	170	43	2.1	296	395	30 000	40 000	22219L12CAM	107	_	15	8	150	2	0.25	4.1	2.7	2.7	3.87
100	165 215	52 73	2 3	345 600	530 785	35 500 61 500	54 000 80 000	23120L11CAM 22320L11CAM	110 114	=	15 20		144 183	2 2.5	0.30 0.35	3.4 2.9	2.3 1.9	2.2 1.9	4.14 12.7
110	200	53	2.1	425	585	43 500	59 500	22222L12CAM	122	_	18	8	176	2	0.24	4.2	2.8	2.7	7.23
120	180 200	46 62	2 2	315 465	525 720	32 000 47 500	53 500 73 500	23024L11CAM 23124L12CAM	130 130	=	17 19		163 175	2 2	0.22 0.29	4.5 3.5	3.0 2.4	2.9 2.3	4.15 7.94
130	230	64	3	565	815	57 500	83 000	22226L11CAM	144	_	21	6	203	2.5	0.26	3.9	2.6	2.6	11.0
160	220	45	2	360	675	37 000	69 000	23932L11CAM	170	_	21	0	203	2	0.18	5.6	3.8	3.7	4.97

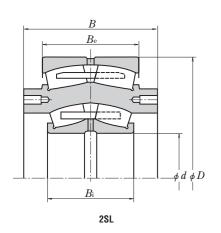
Remark The above table lists examples of available bearing numbers for the Molded -Oil™ bearing.

Agricultural Machinery

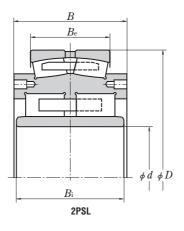
Railway Rolling Stock

Papermaking Machines

Wind Power Industry



■Triple Ring Bearings



Dessins Numbers		Bour	ndary dimensions (mm)	,	Mass
Bearing Numbers	d	D	$B_{ m i}$	$B_{ m e}$	В	(kg)
2SL180-2 UPA	180	480	140	160	215.9	175
2SL200-2 UPA	200	520	160	180	241.3	230
2SL220-2 UPA	220	600	180	200	279.4	330
2SL240-2 UPA	240	620	200	200	279.4	410
2SL260-2 UPA	260	680	218	218	317.5	490
2SL280-2 UPA	280	720	218	218	317.5	525
2SL300-2 UPA	300	780	243	250	342.9	735
2SL320-2 UPA	320	820	258	258	368.3	840
2SL340-2 UPA	340	870	280	272	393.7	1 050
2SL380-3 UPA	380	980	240	308	431.8	1 370
2PSL180-1 UPA	180	460	153	118	160	127
2PSL240-1 UPA	240	600	205	160	225	285

Bearings for Wind Power Industry

NSK high performance and high quality bearings enable stable operation in the growing wind power industry.



A Product Line that Matches Specific Applications



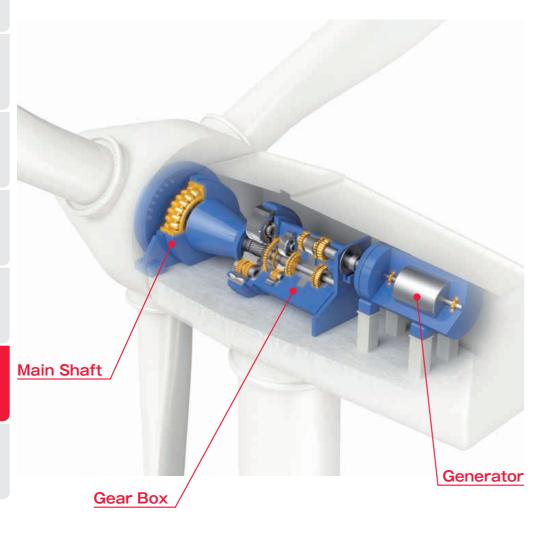
Mining Machinery Railway Rolling Stock

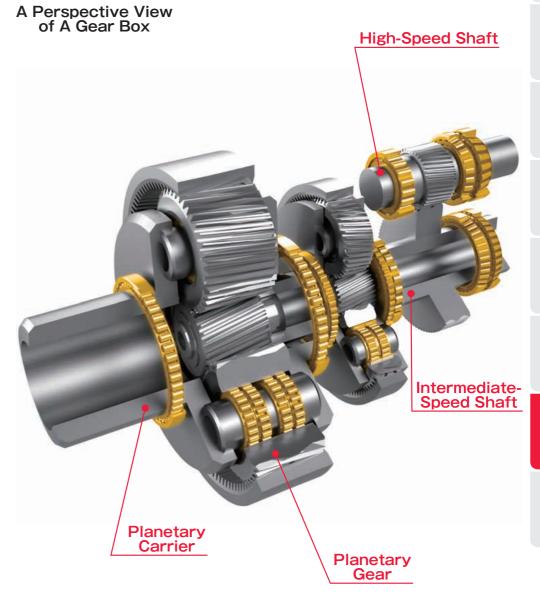
Wind Power Industry

Railway Rolling Stock

A Perspective View of A Nacell

■ A Product Line that Matches Specific Applications





NSK

Pumps & Compressor

Railway Rolling Stock

Mining Machinery

A Product Line that Matches Specific Applications Features of Bearings for the Wind Power Industry



Spherical Roller Bearings-CA Series

CA series bearings are double-row self-aligning spherical roller bearings with a machined-brass cage that have high load capacity, superior durability, and are resistance to

The CA series is especially suitable for applications with heavy load or shock conditions.

Application: Main shaft



Full-Complement Cylindrical Roller Bearings NCF Series(Single-Row), NNCF(Double-Row)

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.

■ Application: Planetary carrier(NCF).Planetary gear(NNCF)



High Load Capacity Cylindrical Roller Bearings-XM Series

By increasing the number of rollers, NSK has reduced the surface pressure exerted on the contact area between the rollers and rings, thereby increasing load capacity and extending the life of the bearing.

Application: Gear Box



High-Load Capacity Tapered Roller Bearings-HR Series

HR Series bearings are tapered roller bearings capable of taking combined heavy radial loads and axial loads in one direction.

The HR series features tapered rollers guided by larger rollers for superior high-load ratings.

■ Application : Gear Box



Four-Point Contact Ball **Bearings-QJ Series**

The inner ring is split radially into two pieces. Their design allows one bearing to sustain significant axial loads in either direction-with high axial load capacity. This type is suitable for carrying pure axial loads or combined loads where the axial load is high.

■ Application : Gear Box intermediate-speed shaft, high-speed shaft



Ceramic-Coated Insulated Bearings

An insulation layer is formed on the outer ring surface. The boundary dimensions are identical to a standard bearing, therefore enabing easy replacement without any changes.

Application : Generator



Super-TF™ Bearings

Super-TF bearings were developed with innovative materials and heat treatment technology for increased durability under harsh conditions.

They combine long service life with good resistance to wear and seizure, even under contaminated lubrication, to achieve outstanding cost performance.



AWS-TF™ Bearings

AWS-TF bearings were developed with a combination of special heat treatment technology and materials. They provide excellent resistance to flaking, including white structure flaking.

Wind Power Industry

Steel Industry

Mining Machinery

Examples Product Symbol

NSK INDUSTRY SOLUTIONS

STF 240 /600 CA g M E4 U303 Material Symbol Special Control Symbol Bearing Series Symbol External Features Symbol (Type Symbol + Width Symbol + Cage Symbol Diameter Symbol) Bearing Bore (Bore Number) Internal Design Symbol

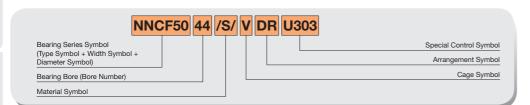
: Spherical Roller Bearing Width Series 4 Diameter Series 0

/600 : Bearing Bore 600mm : High-Capacity Design STF~q : Long-Life Steel

: Machined Brass Cage

: Lubricating Groove in Outside Surface and Holes in Outer Ring

: Special Process Control for Wind Turbine Bearings

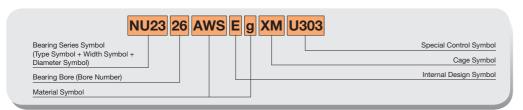


NNCF50: NNCF Type Full-Complement Cylindrical Roller Bearing Width Series 5 Diameter Series 0

: Bearing Bore 220mm /S/ : Black Oxide Coating : Without Cage

: Controlled Size Variation Arrangement

: Special Process Control for Wind Turbine Bearings



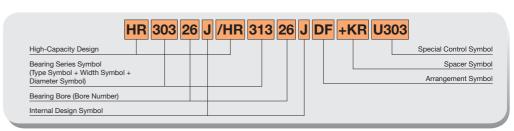
: NU Type Cylindrical Roller Bearing Width Series 2 Diameter Series 3

26 : Bearing Bore 130mm Ε : High Capacity Design

AWS~g : Long Life Steel, Specialized to Prevent White Structure Flaking

: High-Capacity Machined Brass Cage

: Special Process Control for Wind Turbine Bearings



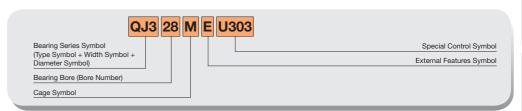
HR/HR: High-Capacity Design

303/313: Tapered Roller Bearing Width Series 0/1 Diameter Series 3

: Bearing Bore 130mm J/J : Conform to ISO

DF : Face-to-Face Arrangement : Bearings with Outer Ring Spacer

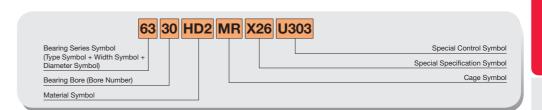
: Special Process Control for Wind Turbine Bearings



: Four-Point Contact Ball Bearing Diameter Series 3 QJ3

28 : Bearing Bore 140mm M : Machined Brass Cage : Notch in Outer Ring

U303 : Special Process Control for Wind Turbine Bearings



: Single-Row Deep Groove Ball Bearing Diameter Series 3

30 : Bearing Bore 150mm

HD2 : Ceramic-Insulated Coating on Outer Ring

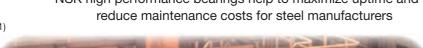
: Ball Guide Machined Brass Cage X26 : Dimensional Stabilizing Treatment

: Special Process Control for Wind Turbine Bearings

Wind Power Industry

Bearings for Steel Industry

NSK high performance bearings help to maximize uptime and to reduce maintenance costs for steel manufacturers













Bearings for Sintering Equipment
Sealed-Clean Bearings for Pallet Wheels-AR Series for Inboard Rollers-2J,2M Series
Bearings for BOFs and Converters
Ultra-Large Split Bearings for BOFs and Converter Trunnions
Bearings for Continuous Casting Machines
SWR™ Bearings (Spherical Roller Bearings) -SWR Series Cylindrical Roller Bearings with Aligning Rings (for Free End) -RUB Series
Split Cylindrical Roller Bearings (for Segmented Rolls) –RNPH/PCR Series
Bearings for Rolling Mills (for Roll Necks) D 12
Extra-Capacity Sealed-Clean™
Four-Row Tapered Roller Bearings–KVS Series
Super-TF™ Bearings-STF Series Water-TF™ Bearings-WTF Series
Four-Row Cylindrical Roller Bearings-STF-RV Series

Notes (*1): Photo courtesy of NIPPON STEEL & SUMITOMO METAL CORPORATION KASHIMA WORKS pamphlet.

Backing Bearings for Multi-Roll Rolling Cluster Mills D 166

(*2): Photo courtesy of Nippon Steel & Sumikin Stainless Steel Corporation.

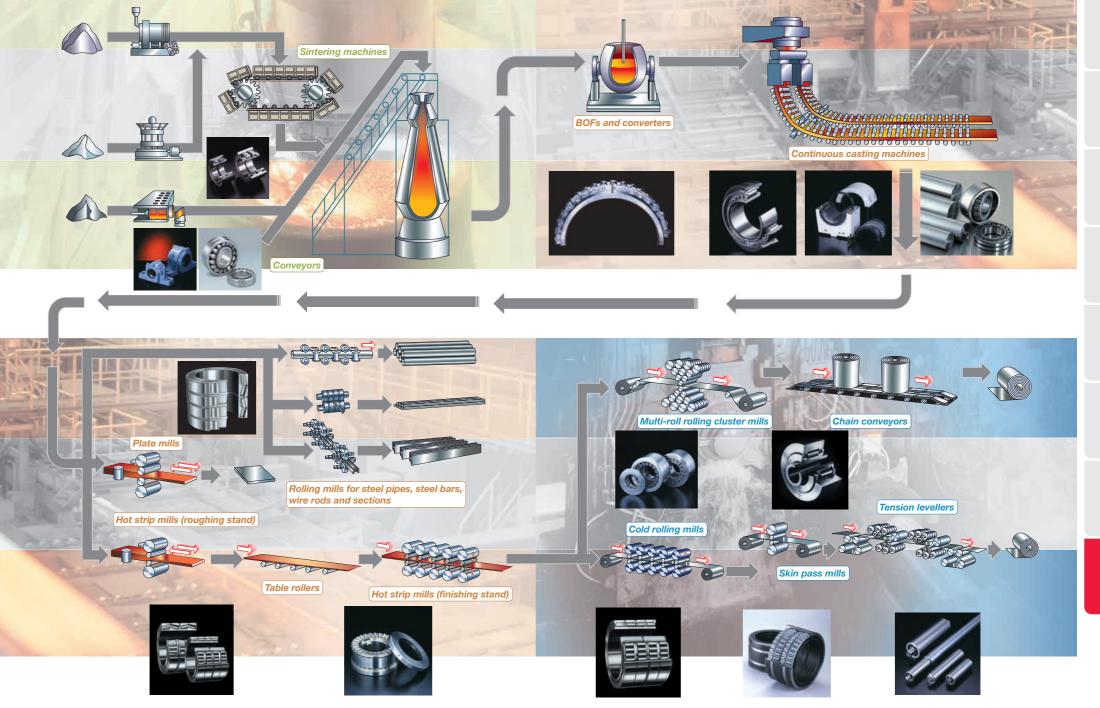
Super-TF™ Backing Bearings-STF Series

Papermaking Machines

Wind Power Industry

INDUSTRY SOLUTIONS

A complete product line for all steel mill processes delivers improved productivity and lowered maintenance costs, with long life and highly reliable bearings.



Bearings for Sintering Equipment

Sealed-Clean Bearings for Pallet Wheels / Sealed-Clean Bearings for Inboard Rollers

Scale

(sintered

particles)

1. Operating conditions

Wheel

• Stable machinery operation through higher reliability and longer operating life

2. Problems

Problem 1

Typical problems of bearings

for sintering equipment

Premature failure of bearings for

pallet wheels and bearings for

inboard rollers (plain bearings)

Poor lubrication

Benefits @ Cleaner areas adjacent to equipment

Inboard roller

Conventional structure

Reduced maintenance costs



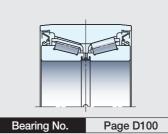




3. Countermeasures

Sealed-Clean Bearings for Pallet Wheels-AR Series

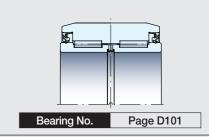
- · Optimum crowning of the roller raceway surface enabling resistance to unbalanced load of wheels
- · High sealing performance (featuring a special contact
- · Packing of grease with excellent heat and pressure
- Easier handling (one-piece design with fastening ring adopted for the inner ring)



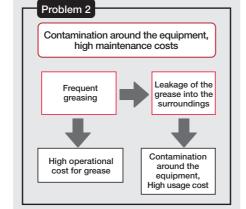
Newly developed structure

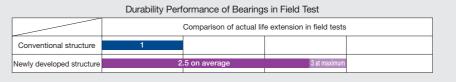
Sealed-Clean Bearings for Inboard Rollers-2J. 2M Series

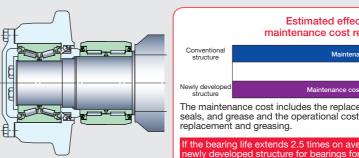
- Higher load capacity (by outer ring thickness design with high strength and full-complement roller type)
- Improvement of axial load capacity
- · High sealing performance (featuring a special contact
- · Packing of grease with excellent heat and pressure resistance
- Easier handling (one-piece design with fastening ring adopted for the inner ring)

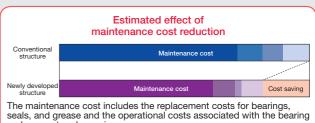


Unbalanced Load (Inboard bearings) · Premature wear and flaking Seizure damage · Fracture of ouder rings Sintering equipment (Inboard bearings)





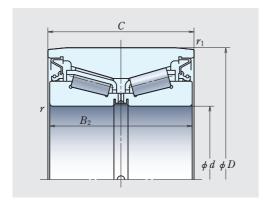




If the bearing life extends 2.5 times on average as a result of using the newly developed structure for bearings for pallet wheels/inboard rollers for pallet dollies, the total maintenance cost reduction effect is estimated to be 25% to 35%

■Bearings for Sintering Equipment

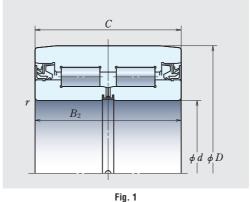
Sealed-Clean Bearings for Pallet Wheels-AR Series



Bearing Numbers			Boundary D)imensions(m	ım)		Basic Load	Ratings(kN)
	d	D	B_2	C	γ (min)	$ m \emph{r}_1(min)$	Cr	C_{0r}
AR80-24	80	150	67	67	2.5	1	269	390
AR90-25	90	160	74	74	2.5	0.5	240	435
AR90-26	90	160	80	80	2.5	0.5	240	435
AR90-27	90	160	78	78	2.5	0.5	240	435
AR90-32A	90	160	100	100	2.5	_	440	850
AR100-29	100	180	98	100	2.5	1	350	675
AR100-30	100	180	100	100	2.5	1	350	675
AR100-38	100	180	100	100	3	0.5	525	835
AR100-39	100	180	98	100	3	0.5	525	835
AR100-40	100	180	98	100	3	0.5	525	835
AR100-44	100	180	91	91	3	0.5	435	665
AR110-28	110	180	86	86	3	0.5	330	660
AR110-29	110	200	92	100	2.5	1	415	805
AR110-39	110	200	100	100	3	1	570	950
AR110-50A	110	200	90	90	3	0.5	500	780

Remark Other bearings are available. Please contact NSK for additional information.

Sealed-Clean Bearings for Inboard Rollers-2J, 2M Series



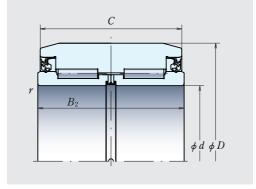


Fig. 2

Bearing Numbers		Bound	dary Dimensio	ons(mm)		Basic Load	Ratings(kN)	Fig.
bearing Numbers	d	D	B_2	C	∤ (min)	$C_{\rm r}$	C_{0r}	rig.
2J100-2	100	200	120	119	2.1	315	910	1
2J120-9A	120	210	120	120	2.5	610	1 080	1
2J120-14	120	210	132	132	2.1	530	1 320	1
2M120-17	120	210	132	132	2.1	425	1 390	2
2M140-(5)	140	250	116	110	2	395	1 030	2
2M140-()	140	250	130	130	4	485	1 460	2
2J140-2	140	250	130	130	4	770	1 420	1
2M150-()	150	320	120	120	5	615	1 350	2
2M158-3	158	250	140	140	5	570	1 850	2
2J160Z-1	160.11	250	130	130	2.5	670	1 540	1
2M160Z-13	160.11	250	150	150	2.5	595	1 980	2
2J160Z-5	160.11 250 155 150		2.1	610	1			

Remark Other bearings are available. Please contact NSK for additional information.

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Bearings for BOFs and Converters

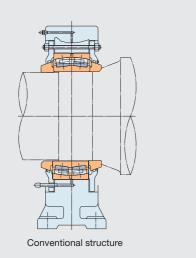
Ultra-Large Split Bearings for BOFs and Converter Trunnions

- Bearings can be replaced without removing the bull gear, thus reducing maintenance costs
- Benefits @ Reduction of maintenance costs by shortening length of time for bearing replacement work
 - 3 Reduction of production loss, which would affect subsequent processes

1. Operating conditions



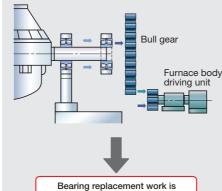




2. Problems

Typical problems of bearings for BOFs and converters

Inboard bearings cannot be replaced without removing the bull gear



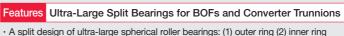
time-consuming, requiring high maintenance costs



In addition, sudden bearing replacement due to an unexpected failure causes large production loss in the subsequent processes

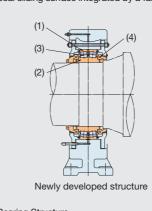


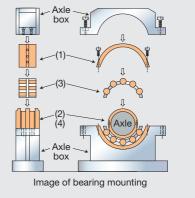
3. Countermeasures



(3) roller and cage assembly and (4) fastening ring

· Seal sliding surface integrated by a fastening ring





· Bearing Structure





Bearing No.

Pages D104 and D105

Maintenance cost reduction effect

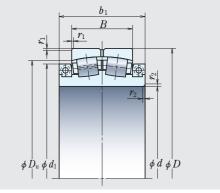
Result of the comparison of time required for bearing replacement work

Bearing type	Comparison of time required for bearing replacement work in field test										
Conventional structure (one-piece type)											
Newly developed structure (split type)	0.65		0.35 ←	 Period shortening 							

- The bearing replacement period represents the actual result for bearings with bore diameter of 1 200 mm to
- In the case above, the bearing with the newly developed structure reduced the time needed for bearing replacement work by approximately 35%, and thereby significantly reduced maintenance cost.

(*1): Photo courtesy of NIPPON STEEL & SUMITOMO METAL CORPORATION KASHIMA WORKS pamphlet.

Ultra-Large Split Bearings for BOFs and Converter Trunnions



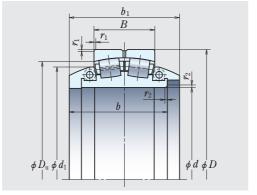


Fig. 1

Fig. 2 Clamp Ring with Tangential Seal Surface

Bearing Numbers				Boundar	y Dimension	ns (mm)				Basic Load	Ratings (kN)	Fig.
Doaring Numbers	d	D	B	b	b_1	d_1	D_{u}	γ_1 (min)	$\gamma_2(min)$	$C_{ m r}$	C_{0r}	l rig.
750SLPT1051	750	1 000	250	355	_	905	914.4	6	7.5	6 800	18 300	1
SL850-7	850	1 120	272	385	_	1 015	1 025	6	6	8 000	21 600	1
900SLPT1251	900	1 250	285	410	_	1 100	1 142	7.5	19	9 850	24 200	1
950SLPT1451	950	1 400	300	520	600	1 182	1 265	7.5	28	12 300	27 900	2
SL1120-3	1 120	1 580	320	632.5	697.5	1 400	1 445	9.5	30	13 200	32 000	2
1200SLPT1751	1 200	1 700	410	780	780	1 470	1 536	9.5	31	17 300	43 500	2
1200SLPT1752	1 200	1 700	410	660	730	1 470	1 536	9.5	19	17 300	43 500	2
1320SLPT1851	1 320	1 850	530	815	814	1 600	1 670	12	31	22 500	63 500	2
1400SLPT1951	1 400	1 900	530	880	880	1 680	1 710	12	31	22 800	65 000	2
1400SLPT1953	1 400	1 900	530	810	860	1 680	1 710	12	31	22 800	65 000	2

Remarks 1. The shapes of bearings marked * are not exactly the same as shown in Fig. 2.

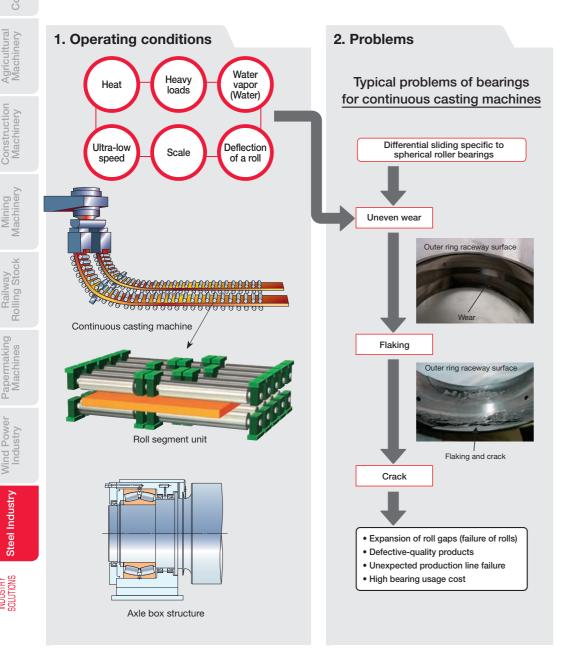
^{2.} Other bearings are available. Please contact NSK for additional information.

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Bearings for Continuous Casting Machines

Bearings for Guide Rolls

- Improved bearing durability prevents unexpected accidents
 - **9** Roll segment is replaced less frequently, thus reducing maintenance costs







3. Countermeasures

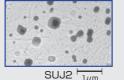
Features SWR™ Bearings (Spherical Roller Bearings) –SWR Series

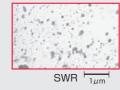
- · Improved wear resistance → Three times compared to AISI 52100 bearing steel
- · Improved flaking life property → Five times compared to AISI 52100 bearing stee
- · Improved toughness of material core

(prevention of crack damage) → Five times compared to AISI 52100 bearing steel



Microstructure (TEM)







SWR

Cylindrical Roller Bearings with Aligning Rings (for free end) –RUB Series

- · Adoption of cylindrical roller bearing type to prevent wear problems caused by sliding and addition of selfaligning function
- · Smooth relief of roll expansion
- · Type: Easy handling cage type, Full-complement type with higher load capacity



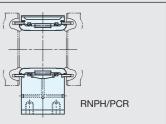


Bearing No. Pages D116 to D123

Split Cylindrical Roller Bearings (for segmented rolls) -RNPH/PCR Series

- Adoption of cylindrical roller bearing type to prevent wear problems caused by sliding and addition of self-aligning function
- · Full-complement, higher load capacity design
- · Multi-functional seal and high rigidity plummer block unit

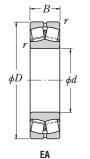
Bearing No. Pages D124 to D127

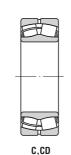


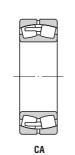
Note (*1): Photo courtesy of NIPPON STEEL & SUMITOMO METAL CORPORATION KASHIMA WORKS pamphlet.

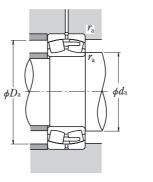
SWR $^{\text{TM}}$ Bearings (Spherical Roller Bearings) –SWR Series Bore Diameter 40 – 100 mm

■Bearings for Continuous Casting Machines









Dynamic Equivalent Load

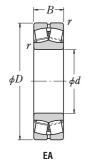
P = X	$F_{\rm r} + YF_{\rm a}$								
$F_{\rm a}/I$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$							
X	Y	X	Y						
1	Y_3	0.67	Y_2						

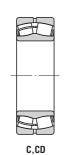
Static Equivalent Load $P_0 = F_r + Y_0 F_a$ The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

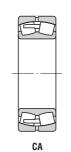
В	oundary l	Dimensio	ns		Basic Loa	ad Ratings				Abutment	:	and Fillet I	Dimension	IS	Constant Axial Load Factor			actors	Mass
	(m	ım)		(kľ	N)	{k	gf}	D : N !					(mm)						(kg)
d	D	B	r	C_{r}	C_{0r}	$C_{\rm r}$	C_{0r}	Bearing Numbers		$d_{\scriptscriptstyle a}$		L),	$r_{\rm a}$					
			min.		01	•	01		min.	max.		max.	min.	max.	e	Y_2	Y_3	Y_0	approx.
40	80	23	1.1	90.5	99.5	9 200	10 100	22208SWREAE4	47	49		73	70	1	0.28	3.6	2.4	2.4	0.5
40	90	33	1.5	136	153	13 900	15 600	22308SWRCAME4	49	_		81	77	1.5	0.38	2.6	1.8	1.7	1.0
50	90	23	1.1	99	119	10 100	12 100	22210SWREAE4	57	60		83	81	1	0.24	4.3	2.9	2.8	0.61
00	00	20		00	110	10 100	12 100	ELE TOOTTILEALT	0,	00		00	01		0.21	1.0	2.0	2.0	
55	100	25	1.5	119	144	12 100	14 600	22211SWREAE4	64	65		91	89	1.5	0.23	4.3	2.9	2.8	0.81
	120	29	2	142	174	14 500	17 800	21311SWREAE4	65	72		110	98	2	0.23	4.4	3.0	2.9	1.58
60	95	26	1.1	98.5	141	10 000	14 400	23012SWRCE4	67	68		88	85	1	0.26	3.9	2.6	2.5	0.68
	110	28	1.5	142	174	14 500	17 800	22212SWREAE4	69	72		101	98	1.5	0.23	4.4	3.0	2.9	1.1
	110	28	1.5	178	154	18 100	15 700	22212SWRCAME4	69	_		101	97	1.5	0.25	4.0	2.7	2.6	1.17
	130	31	2.1	190	244	19 400	24 900	21312SWREAE4	72	87		118	117	2	0.22	4.5	3.0	3.0	1.98
	130	46	2.1	246	288	25 100	29 400	22312SWRCAME4	72	_		118	111	2	0.36	2.8	1.9	1.9	2.9
65	120	31	1.5	152	190	15 500	19 300	22213SWRCAME4	74	_		111	106	1.5	0.26	3.9	2.6	2.6	1.57
00	140	48	2.1	265	315	27 000	32 500	22313SWRCAME4	77	_		128	117	2	0.35	2.9	1.9	1.9	3.56
70	125	31	1.5	225	232	22 900	23 600	22214SWREAE4	79	84		116	111	1.5	0.23	4.3	2.9	2.8	1.58
70	125	31	1.5	163	205	16 600	20 900	22214SWRCAME4	79 79	- -		116	111	1.5	0.25	4.0	2.9	2.7	1.64
75	130	31	1.5	238	244	24 200	24 900	22215SWREAE4	84	87		121	117	1.5	0.22	4.5	3.0	3.0	1.64
80	140	33	2	264	275	27 000	28 000	22216SWREAE4	90	94		130	126	2	0.22	4.6	3.1	3.0	2.01
	170	39	2.1	355	375	36 000	38 000	21316SWREAE4	92	109		158	146	2	0.23	4.4	3.0	2.9	4.32
	170	58	2.1	390	480	39 500	48 500	22316SWRCAME4	92	_		158	145	2	0.35	2.9	2.0	1.9	6.2
85	150	36	2	310	325	320	33 500	22217SWREAE4	95	101		140	135	2	0.22	4.6	3.1	3.0	2.54
90	160	40	2	360	395	37 000	40 000	22218SWREAE4	100	108		150	142	2	0.24	4.3	2.9	2.8	3.3
50	160	52.4	2	340	490	34 500	50 000	23218SWRCE4	100	105		150	138	2	0.24	3.2	2.1	2.1	4.51
	190	64	3	665	705	68 000	72 000	22318SWREAE4	104	115		176	163	2.5	0.33	3.1	2.1	2.0	8.56
95	170	43	2.1	296	395	30 000	40 000	22219SWRCAME4	107	_		158	150	2	0.25	4.1	2.7	2.7	4.19
100	150	37	1.5	212	335	21 600	34 500	23020SWRCDE4	109	112		141	136	1.5	0.22	4.6	3.1	3.0	2.31
.00	150	50	1.5	276	470	28 100	48 000	24020SWRCE4	109	110		141	132	1.5	0.22	3.4	2.3	2.2	3.08
	165	65	2	345	535	35 500	54 000	24120SWRCAME4	110	113		155	144	2	0.30	3.4	2.3	2.2	4.38
	180	46	2.1	455	490	46 500	50 000	22220SWREAE4	112	119		168	160	2	0.24	4.3	2.9	2.8	4.84

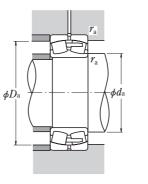
■Bearings for Continuous Casting Machines

SWR™ Bearings (Spherical Roller Bearings) –SWR Series Bore Diameter 110 – 140 mm









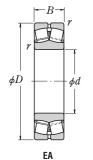
Dynamic Equivalent Load

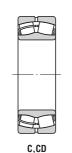
P = X	$F_{\rm r} + YF_{\rm a}$								
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F_{\rm r}{>}e$							
X	Y	X	Y						
1	Y_3	0.67	Y_2						

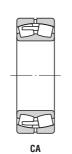
Static Equivalent Load $P_0 = F_r + Y_0 F_a$ The values of e, Y_2 , Y_3 , and Y_0 are given in the table below.

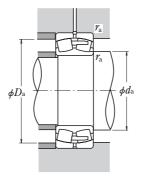
В	oundary I	Dimensio	ns		Basic Lo	ad Ratings				Abutment	and	d Fillet D	Dimension	S	Constant	nt Axial Load Factors			Mass
	(m	m)		(kN)	{k	(gf}	Bearing Numbers					(mm)						(kg)
d	D	B	r	$C_{\rm r}$	C_{0r}	$C_{ m r}$	C_{0r}	bearing Numbers		$d_{\scriptscriptstyle m a}$		D	a	$r_{\rm a}$					
			min.						min.	max.		max.	min.	max.	e	Y_2	Y_3	Y_0	approx.
110	170	45	2	293	465	29 900	47 500	23022SWRCDE4	120	124		160	153	2	0.24	4.2	2.8	2.8	3.76
	170	45	2	293	465	30 900	47 500	23022SWRCAME4	120	_		160	153	2	0.24	4.2	2.8	2.8	3.74
	170	60	2	380	645	38 500	66 000	24022SWRCE4	120	121		160	148	2	0.32	3.1	2.1	2.1	4.96
	180	56	2	480	630	49 000	64 000	23122SWRCAME4	120	_		170	158	2	0.28	3.5	2.4	2.3	5.67
	180	69	2	460	750	47 000	76 500	24122SWRCE4	120	123		170	154	2	0.36	2.8	1.9	1.8	6.84
	200	53	2.1	605	645	61 500	66 000	22222SWREAE4	122	129		188	178	2	0.25	4.0	2.7	2.6	6.99
	200	53	2.1	425	585	43 500	59 500	22222SWRCAME4	122	_		188	176	2	0.24	4.2	2.8	2.7	7.26
	200	69.8	2.1	645	760	65 000	77 500	23222SWRCAME4	122			188	170	2	0.34	3.0	2.0	1.9	9.58
	240	80	3	1030	1120	10 500	115 000	22322SWREAE4	124	145		226	206	2.5	0.33	3.1	2.1	2.0	17.6
120	180	46	2	315	525	32 000	53 500	23024SWRCDE4	130	134		170	163	2	0.22	4.5	3.0	2.9	4.11
	180	46	2	395	525	40 000	53 500	23024SWRCAME4	130	_		170	163	2	0.22	4.5	3.0	2.9	4.11
	180	60	2	395	705	40 500	72 000	24024SWRCE4	130	131		170	158	2	0.32	3.2	2.1	2.1	5.33
	180	60	2	480	680	49 000	69 000	24024SWRCAME4	130	131		170	158	2	0.32	3.2	2.1	2.1	5.33
	200	80	2	575	950	58 500	96 500	24124SWRCE4	130	136		190	171	2	0.37	2.7	1.8	1.8	10
	200	80	2	695	905	70 500	92 000	24124SWRCAME4	130	_		190	171	2	0.37	2.7	1.8	1.8	9.86
	215	58	2.1	490	690	50 000	70 000	22224SWRCAME4	132	_		203	189	2	0.25	4.1	2.7	2.7	9.05
	215	76	2.1	790	970	80 500	99 000	23224SWRCAME4	132	_		203	182	2	0.34	2.9	2.0	1.9	12
	260	86	3	845	1 120	80 600	115 000	22324SWRCAME4	134	_		246	219	2.5	0.35	2.9	2.0	1.9	22.3
130	200	52	2	400	655	40 500	67 000	23026SWRCDE4	140	147		190	180	2	0.23	4.3	2.9	2.9	5.98
	200	69	2	495	865	50 500	88 000	24026SWRCE4	140	143		190	175	2	0.31	3.2	2.2	2.1	7.84
	200	69	2	620	865	60 300	88 000	24026SWRCAME4	140	_		190	175	2	0.31	3.2	2.2	2.1	7.83
	210	80	2	590	1 010	60 000	103 000	24126SWRCE4	140	146		200	180	2	0.35	2.9	1.9	1.9	10.7
	210	80	2	590	1 010	60 000	103 000	24126SWRCAME4	140	_		200	180	2	0.37	2.7	1.8	1.8	10.6
	230	64	3	820	940	83 500	96 000	22226SWREAE4	144	152		216	204	2.5	0.26	3.8	2.6	2.5	11
	230	64	3	565	815	57 500	83 000	22226SWRCAME4	144	_		216	203	2.5	0.26	3.9	2.6	2.6	11.3
	230	80	3	875	1 080	89 500	110 000	23226SWRCAME4	144	_		216	196	2.5	0.34	2.9	2.0	1.9	14.3
140	210	53	2	420	715	43 000	73 000	23028SWRCDE4	150	157		200	190	2	0.22	4.5	3.0	2.9	6.49
	210	69	2	525	945	53 500	96 500	24028SWRCE4	150	154		200	186	2	0.29	3.4	2.3	2.2	8.37
	210	69	2	635	905	64 500	92 500	24028SWRCAME4	150	_		200	186	2	0.31	3.2	2.2	2.1	8.32

SWR™ Bearings (Spherical Roller Bearings) –SWR Series Bore Diameter 140 – 180 mm









Dynamic Equivalent Load

$P = XF_r + YF_a$							
$F_{\rm a}/I$	$r \leq e$	i					
17	٠,						

 $F_{\rm a}/F_{\rm r} > e$ X Y_3 0.67 Y_2

Static Equivalent Load $P_0 = F_r + Y_0 F_a$

The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

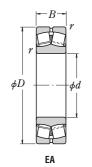
	Boundary I	Dimensio	ns		Basic Lo	oad Ratings				Abutment	an	d Fillet [Dimension	ıs	Constant	Axial	Load F	actors	Mass
	,	nm)		(kN)	Ü	(gf}	D : N .					(mm)	-					(kg)
d	D	B	r	$C_{\rm r}$	C_{0r}	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers		$d_{\scriptscriptstyle m a}$		L) _a	$r_{\rm a}$					
			min.						min.	max.		max.	min.	max.	e	Y_2	Y_3	Y_0	approx.
140	225 225 225	68 85 85	2.1 2.1 2.1	725 670 835	945 1 160 1 160	73 500 68 500 85 500	96 500 118 000 118 000	23128SWRCAME4 24128SWRCE4 24128SWRCAME4	152 152 152	— 156 —		213 213 213	198 193 192	2 2 2	0.28 0.35 0.37	3.6 2.9 2.7	2.4 1.9 1.8	2.3 1.9 1.8	10.5 13 12.9
	250 250 250	68 68 88	3 3 3	645 835 835	930 945 1 300	65 500 85 500 85 000	95 000 96 500 133 000	22228SWRCDE4 22228SWRCAME4 23228SWRCAME4	154 154 154	167 — —		236 236 236	219 221 213	2.5 2.5 2.5	0.25 0.26 0.35	4.0 3.9 2.9	2.7 2.6 2.0	2.6 2.5 1.9	14.5 14.2 18.8
150	225 225 225	56 75 75	2.1 2.1 2.1	470 590 740	815 1 090 1 090	48 000 60 500 75 500	83 000 111 000 111 000	23030SWRCDE4 24030SWRCE4 24030SWRCAME4	162 162 162	168 165 —		213 213 213	203 198 198	2 2 2	0.22 0.30 0.30	4.6 3.4 3.4	3.1 2.3 2.3	3.0 2.2 2.2	7.9 10.5 10.4
	250 250 270 270	80 100 73 96	2.1 2.1 3 3	725 890 765 975	1 180 1 530 1 120 1 560	74 000 91 000 78 000 99 500	121 000 156 000 114 000 159 000	23130SWRCE4 24130SWRCE4 22230SWRCDE4 23230SWRCE4	162 162 164 164	174 169 179 176		238 238 256 256	218 212 236 230	2 2 2.5 2.5	0.30 0.38 0.26 0.35	3.4 2.6 3.9 2.9	2.3 1.8 2.6 1.9	2.2 1.7 2.5 1.9	15.8 19.8 18.4 24.2
160	240 240 240	60 80 80	2.1 2.1 2.1	540 680 845	955 1 260 1 260	55 000 69 000 86 500	97 500 128 000 128 000	23032SWRCDE4 24032SWRCE4 24032SWRCAE3	172 172 172	179 177 —		228 228 228	216 212 212	2 2 2	0.22 0.30 0.30	4.5 3.4 3.4	3.0 2.3 2.3	2.9 2.2 2.2	9.66 12.7 12.3
	270 290 290	109 80 80	2.1 3 3	1 040 910 1 140	1 760 1 320 1 320	106 000 93 000 116 000	179 000 135 000 135 000	24132SWRCE4 22232SWRCDE4 22232SWRCAME4	172 174 174	179 190 —		258 276 276	229 255 255	2 2.5 2.5	0.39 0.26 0.26	2.6 3.8 3.8	1.7 2.6 2.6	1.7 2.5 2.5	25.4 23.1 23.1
170	260 260 280	67 90 88	2.1 2.1 2.1	640 825 940	1 090 1 520 1 570	65 000 84 000 96 000	112 000 155 000 160 000	23034SWRCDE4 24034SWRCE4 23134SWRCAME4	182 182 182	191 188 —		248 248 268	233 228 245	2 2 2	0.23 0.31 0.29	4.3 3.2 3.5	2.9 2.2 2.3	2.8 2.1 2.3	13 17.3 21.6
	280 310 310	109 86 110	2.1 4 4	1 080 990 1 200	1 860 1 500 1 910	110 000 101 000 122 000	190 000 153 000 195 000	24134SWRCE4 22234SWRCDE4 23234SWRCE4	182 188 188	190 206 201		268 292 292	239 270 261	2 3 3	0.37 0.26 0.34	2.7 3.8 2.9	1.8 2.6 2.0	1.8 2.5 1.9	26.6 28.8 36.4
180	280 280 280	74 100 100	2.1 2.1 2.1	750 965 1 210	1 270 1 750 1 750	76 000 98 500 123 000	129 000 178 000 178 000	23036SWRCDE4 24036SWRCE4 24036SWRCAME4	192 192 192	202 200 —		26 268 268	249 245 245	2 2 2	0.24 0.32 0.32	4.2 3.1 3.1	2.8 2.1 2.1	2.8 2.0 2.0	17.1 22.7 22.5
	300 300 300 320	96 118 118 86	3 3 3 4	1 320 1 190 1 490 1 020	1 760 2 040 2 040 1 540	134 000 121 000 152 000 104 000	180 000 208 000 208 000 157 000	23136SWRCAME4 24136SWRCE4 24136SWRCAME4 22236SWRCDE4	194 194 194 198	202 — 212		286 286 286 302	260 255 255 278	2.5 2.5 2.5 3	0.31 0.37 0.37 0.26	3.3 2.7 2.7 3.9	2.2 1.8 1.8 2.6	2.2 1.8 1.8 2.6	27.4 33.1 33 30.2

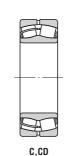
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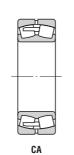
D 113

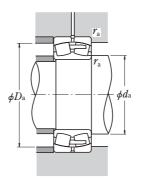
Railway Rolling Stock

SWR™ Bearings (Spherical Roller Bearings) –SWR Series Bore Diameter 190 – 240 mm









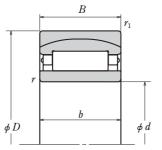
Ilallic Equivalent Luau	
$P = XF_r + YF_a$	

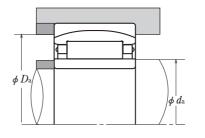
$F_{\rm a}/F$	r _r ≦e	$F_{\rm a}/I$	r > e
X	Y	X	Y
1	<i>Y</i> ₃	0.67	<i>Y</i> ₂

Static Equivalent Load $P_0 = F_r + Y_0 F_a$ The values of \emph{e} , $\emph{Y}_{\emph{2}}$, $\emph{Y}_{\emph{3}}$, and $\emph{Y}_{\emph{0}}$ are given in the table below.

В	Boundary I	Dimensioi m)	ns	,	Basic Lo kN)	ad Ratings	:gf}			Abutment	and Fillet	Dimensioı (mm)	ns	Constant	Axial	Load Fa	actors	Mass (kg)
d	$D^{(iii)}$	B	r	$C_{\rm r}$	C_{0r}	$C_{\rm r}$	C_{0r}	Bearing Numbers		d_{a}	I) _a	γ_{a}					(kg)
			min.						min.	max.	max.	min.	max.	e	Y_2	Y_3	Y_0	approx
190	290	75	2.1	970	1 350	99 000	138 000	23038SWRCAME4	202	_	278	261	2	0.24	4.2	2.8	2.8	17.6
	290 290	100 100	2.1 2.1	975 1 220	1 840 1 840	99 500 124 000	188 000 188 000	24038SWRCE4 24038SWRCAME4	202 202	210	278 278	253 253	2	0.31 0.32	3.2	3.2 2.1	2.1	24 23.8
	290	100	2.1	1 220	1 040	124 000	100 000	240303 W N CAIVIE4	202	_	270	203	2	0.32	3.1	2.1	2.0	23.0
	320	128	3	1 370	2 330	140 000	238 000	24138SWRCE4	204	211	306	269	2.5	0.4	2.5	1.7	1.6	41.5
	320 340	128 92	3 4	1 710 1 140	2 330 1 730	175 000 116 000	238 000 176 000	24138SWRCAME4 22238SWRCAME4	204 208	_	306 322	269 296	2.5 3	0.38 0.26	2.6 3.8	1.8 2.6	1.7 2.5	40.9 35.5
	340	120	4	1 440	2 350	147 000	240 000	23238SWRCE4	208	 222	322	288	3	0.26	2.9	1.9	1.9	47.6
	0.1.0	0.0	0.4	4.400	4 700	400.000	474.000		040		200	070	•	0.05				
200	310 310	82 109	2.1 2.1	1 180 1 140	1 700 2 120	120 000 116 000	174 000 216 000	23040SWRCAME4 24040SWRCE4	212 212	 223	298 298	279 271	2 2	0.25	4.0 3.1	2.7 2.1	2.6 2.0	22.6 30.4
	310	109	2.1	1 420	2 120	145 000	216 000	24040SWRCAME4	212	_	298	271	2	0.33	3.0	2.0	2.0	30.2
	240	1.10	3	1 570	0.070	100 000	070 000	24140SWRCE4	214	000	220	200	0.5	0.00	0.0	1.0	1 7	51.3
	340 340	140 140	3	1 570 1 960	2 670 2 660	160 000 199 000	272 000 271 000	24140SWRCE4 24140SWRCAME4	214	226	326 326	290 290	2.5 2.5	0.39	2.6 2.5	1.8 1.7	1.7 1.7	50.8
	360	98	4	1 300	2 010	133 000	204 000	22240SWRCAME4	218	_	342	315	3	0.26	3.8	2.6	2.5	42.6
220	340	90	3	1 360	1 980	139 000	202 000	23044SWRCAME4	234	_	326	302	2.5	0.24	4.1	2.8	2.7	29.7
220	340	118	3	1 640	2 490	168 000	265 000	24044SWRCE4	234	244	326	296	2.5	0.24	3.2	2.1	2.1	40.5
	340	118	3	1 310	2 490	134 000	254 000	24044SWRCAME4	234	_	326	296	2.5	0.32	3.2	2.1	2.1	39
	370	150	4	1 800	3 200	183 000	325 000	24144SWRCE4	238	248	352	313	3	0.39	2.6	1.7	1.7	66.7
	370	150	4	1 800	3 200	183 000	325 000	24144SWRCAME4	238	_	352	313	3	0.39	2.6	1.7	1.7	64.3
	400	108	4	1 570	2 430	160 000	247 000	22244SWRCAME4	238	_	382	348	3	0.27	3.7	2.5	2.4	59
	400	144	4	2 010	3 400	206 000	350 000	23244SWRCE4	238	260	382	337	3	0.35	2.9	1.9	1.9	80.4
240	360	118	3	1 730	2 730	176 000	278 000	24048SWRCAME4	254	_	346	317	2.5	0.30	3.3	2.2	2.2	42.2
	400	160	4	2 660	3 800	272 000	385 000	24148SWRCAME4	258	_	382	341	3	0.38	2.7	1.8	1.8	79.6

Cylindrical Roller Bearings with Aligning Rings(for Free End)–RUB Series Bore Diameter 90 – 240 mm With Cage

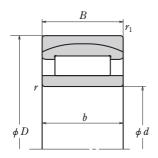


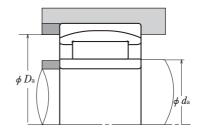


		,	Dimensions				d Ratings		Abutment		imensions
d	D	B (m	nm) b	γ min.	$oldsymbol{\gamma}_1$ min.	$C_{\rm r}$	N) $C_{0\mathrm{r}}$	Bearing Numbers	$d_{ m a}$ min.	(mm) $d_{ m a}$ max.	$D_{ m a}$ min.
90	160	56	50	1.1	2	220	335	90RUB1601P	99	105	143
	170	68	52.4	2	2	270	375	90RUB1702P	99	106	153
	190	64	64	3	3	340	490	90RUB1908P	103	109	166
100	165	52	52	2	1.1	221	385	100RUB31AP	106.5	113	147
	165	58	52	2	1.1	221	385	100RUB1602P	106.5	113	147
	180	46	46	2.1	2.1	251	375	100RUB22P	111	117	163
	215	73	73	3	1.5	435	595	100RUB23P	108	125	190
110	170	75	45	1.1	1.1	191	325	110RUB1701P	116.5	121	155
120	180	46	46	2.5	2.5	215	415	120RUB30P	132	133	165
	180	76	46	2	2	215	415	120RUB1801P	129	133	166
	200	80	80	2	2	370	680	120RUB41P	129	136	174
124.96	255	133	66	2.1	5	430	590	125RUB2502P	144.96	154	229
130	200 230	79 90	52 90	2	2 3	261 540	440 930	130RUB2001P 130RUB2301P	139 143	144 149	184 200
140	250	68	68	3	3	480	740	140RUB22P	153	161	227
150	250	100	100	2.1	2.1	540	1 040	150RUB41P	161	169	219
	270	130	96	3	3	690	1 210	150RUB2702P	163	172	236
180	280	100	100	2.1	2.1	635	1 300	180RUB40P	191	200	250
	300	136	96	3	3	630	1 250	180RUB3002P	193	203	260
	300	158	118	3	3	755	1 460	180RUB3001P	193	203	260
	320	140	112	4	4	950	1 690	180RUB3201P	196	207	279
200	310	82	82	2.5	2.5	635	1 210	200RUB30P	213	222	286
	310	109	109	2.1	2.1	770	1 540	200RUB40P	211	222	280
	340	140	140	3	3	1 080	2 200	200RUB41P	213	229	295
220	380	120	120	4	4	1 090	1 950	220RUB3801P	236	251	341
	400	108	108	4	4	1 040	1 770	220RUB22E1P	236	255	358
240	400	150	128	4	4	1 260	2 500	240RUB4001P	256	269	362

■Bearings for Continuous Casting Machines

Cylindrical Roller Bearings with Aligning Rings(for Free End)–RUB Series Bore Diameter 50 – 110 mm Full-Complement

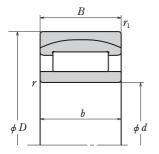


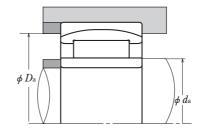


		Boundary D				Basic Load	o .		Abutment	and Fillet D	imensions
d	D	B (mi	m) <i>b</i>	γ min.	$oldsymbol{\mathcal{T}}_1$ min.	$C_{\rm r}$ (kN	$C_{0\mathrm{r}}$	Bearing Numbers	$d_{ m a}$ min.	(mm) $d_{ m a}$ max.	$D_{ m a}$ min.
50	90 110	23 40	23 40	1.5	1.5	69.5 140	104 295	50RUB22PV 50RUB23PV	57 59	58 70	80 94
55	90	32	32	1.1	1.1	82	195	55RUB9001PV	61.5	62.5	80
	100	25	25	1.5	1.5	88	121	55RUB22APV	62	63	90
65	120	31	31	1.5	1.5	131	200	65RUB22PV	73	75	107
	140	48	48	2.1	2.1	221	440	65RUB23PV	76	85	121
70	125	31	31	1.5	1.5	127	213	70RUB22APV	78	85	113
75	130	31	31	1.5	1.5	151	248	75RUB22APV	83	85	118
85	150	65	65	2.5	2.5	286	595	85RUB1501P	97	98	130
90	150	72	60	1.5	1	262	575	90RUB1501PV	95	101	131
	190	64	64	3	1.5	415	780	90RUB23APV	98	116	168
100	150	50	50	2	2	230	530	100RUB40PV	108	109	134
	150	66	50	2	2	230	530	100RUB1501PV	108	109	134
	165	52	52	2	2	272	550	100RUB31PV	109	113	147
	180	46	46	2.1	2.1	277	545	100RUB22APV	111	123	164
	180	60.3	60.3	2.1	2.1	360	650	100RUB32PV	111	116	160
103	180	60	60	2	2	330	790	103RUB1801PV	112	132	163
110	170	45	45	2	2	246	565	110RUB30A1PV	119	123	155
	170	60	60	2	2	300	735	110RUB40PV	119	123	151
	180	56	56	2.5	2.5	335	670	110RUB31A1PV	123	124	161
	180	69	69	2	2	385	835	110RUB41A2PV	119	123	157
	200	53	53	2.5	2.1	380	625	110RUB22APV	121	130	180

■Bearings for Continuous Casting Machines

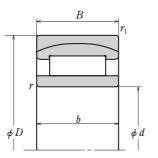
Cylindrical Roller Bearings with Aligning Rings(for Free End)–RUB Series Bore Diameter 120 – 160 mm Full-Complement

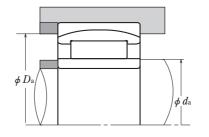




		Boundary D					ad Ratings kN)		Abutment	and Fillet D	imensions
<i>d</i>	D	В (<i>b</i>	γ min.	${m \gamma}_1$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	$d_{ m a}$ min.	$d_{ m a}$ max.	$D_{ m a}$ min.
120	180	46	46	2	2	275	625	120RUB30B2PV	129	132	165
	180	60	60	2	2	330	790	120RUB40A2PV	129	132	163
	180	80	60	2	2	330	790	120RUB1803PV	129	132	163
	200	80	80	2.5	2.5	470	1 040	20RUB41A1PV	133	137	174
	225	58	58	2.5	2.5	460	690	120RUB2201APV	133	138	204
130	200	69	69	2	2	410	955	130RUB40A1PV	139	143	180
	210	64	64	2	2	415	865	130RUB31APV	139	144	189
	210	80	80	2	2	510	1 130	130RUB41A2PV	139	144	184
	230 230	64 80	64 80	3	3	495 585	840 1 090	130RUB22APV 130RUB32APV	143 143	151 146	208 204
140	210	53	53	2	2	365	885	140RUB30A2PV	149	155	194
	210	69	69	2	2	420	990	140RUB40APV	149	152	190
	225	68	68	2.1	2.1	485	1 000	140RUB31APV	151	156	203
	225	85	85	2.1	2.1	575	1 310	140RUB41A1PV	151	156	200
	250	68	68	3	3	510	1 110	140RUB22APV	153	172	227
	250	88	88	3	3	670	1 500	140RUB32PV	153	170	221
150	225	56	56	2.5	2.5	390	840	150RUB30APV	163	166	208
	225	75	75	2.1	2.1	485	1 210	150RUB40A1PV	161	165	203
	225	92	75	2.1	2.1	465	1 160	150RUB2201PV	161	164	203
	250	80	80	2.1	2.1	595	1 290	150RUB31APV	161	170	221
	250	100	100	2.1	2.1	710	1 620	150RUB41APV	161	170	219
	270	96	96	3	3	815	1 640	150RUB32APV	163	174	236
160	240	80	80	2.1	2.1	530	1 330	160RUB40A1PV	171	176	217
	240	85	80	2.1	2.1	530	1 330	160RUB2402PV	171	176	217
	270	109	109	2.1	2.1	855	1 830	160RUB41AE2PV	171	181	237

Cylindrical Roller Bearings with Aligning Rings(for Free End)–RUB Series Bore Diameter 170 – 240 mm Full-Complement



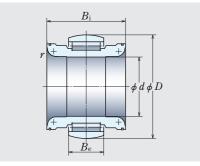


		,	Dimensions				ad Ratings		Abutment	t and Fillet D	imensions
		•	m)			,	(N)	Bearing Numbers		(mm)	
d	D	B	b	r	r_1	$C_{\rm r}$	$C_{0\mathrm{r}}$	Boaring Namboro	$d_{\scriptscriptstyle m a}$	$d_{\scriptscriptstyle m a}$	D_{a}
				min.	min.				min.	max.	min.
170	260	67	67	2.1	2.1	555	1 130	170RUB30APV	181	188	239
	260	90	90	2.1	2.1	655	1 580	170RUB40A1PV	181	188	233
	310	110	110	4	4	1 060	2 090	170RUB32APV	186	195	273
180	280	100	100	2.5	2.5	785	1 870	180RUB40APV	193	198	250
	300	118	118	3	3	940	2 120	180RUB41APV	193	202	260
	320	112	112	4	4	1 090	2 190	180RUB32APV	196	204	279
190	290	100	100	2.1	2.1	850	2 100	190RUB40A1PV	201	210	260
	320	104	104	3	3	1 050	2 240	190RUB31APV	203	214	286
	340	120	120	4	4	1 210	2 430	190RUB32APV	206	218	297
200	310	109	109	2.1	2.1	1 030	2 550	200RUB40A1PV	211	219	280
	340	112	112	3	3	1 160	2 470	200RUB31APV	213	230	305
	340	140	140	3	3	1 340	3 100	200RUB41APV	213	230	295
220	340	90	90	3	3	905	2 020	220RUB30PV	233	243	313
	340	118	118	3	3	1 110	2 630	220RUB40APV	233	243	308
	340	135	118	3	3	1 010	2 670	220RUB3401PV	233	247	308
	370	150	150	4	4	1 510	3 500	220RUB41APV	236	248	322
240	400	128	128	4	4	1 540	3 400	240RUB31APV	256	271	362

Railway Rolling Stock

Wind Power Industry

Split Cylindrical Roller Bearings (for Segmented Rolls)-RNPH Series



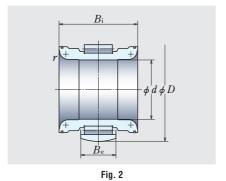






Fig.	1
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Bearing Numbers		Boundary Dim	ensions (mm)			Basic Load	Ratings (kN)	Roll Diameter (mm)	Fig.
	d	D	$B_{ m i}$	$B_{ m e}$	r	$C_{\rm r}$	$C_{0\mathrm{r}}$	Hon Blameter (IIIII)	rig.
100RNPH1801	100	185	169	74	15	475	950	225	2
110RNPH1801	110	180	137	49	15	272	570	230	2
110RNPH1803	110	185	154	76	20	450	1 070	230	2
110RNPH2001	110	200	179	80	20	535	1 090	250	2
115RNPH2001	115	205	202	98	15	625	1 460	240	2
120RNPH1901	120	195	157	66	20	410	950	250	2
120RNPH2001	120	205	179	80	20	560	1 220	255	2
130RNP2001	130	205	139	60	20	455	1 030	270	1
130RNP2101	130	215	174	75	20	540	1 190	280	1
130RNPH2105	130	215	143	60	20	460	975	250	2
130RNPH2107	130	215	174	75	20	550	1 230	250	2
130RNPH2201	130	225	189	90	20	670	1 460	280	2
130RNPH2202	130	220	186	79	20	555	1 370	280	2
135RNPH2101	135	215	183	84	20	570	1 350	250	2
135RNPH2102	135	210	183	84	20	515	1 350	250	2
140RNPH2102	140	215	162	60	20	415	950	270	2
140RNPH2103	140	215	189	74	2.5	490	1 170	265	2
140RNPH2302	140	235	194	84	20	665	1 530	285	2
140RNP2401	140	245	184	85	20	710	1 510	310	1
145RNPH2201	145	225	179	76	20	560	1 340	280	2
145RNPH2303	145	232	196	84	20	630	1 440	280	2
145RNPH2401	145	240	208	89	20	765	1 780	295	2
150RNPH2303	150	230	199	78	2.5	555	1 340	280	2
150RNPH2401	150	245	159	80	20	680	1 550	280	2
150RNPH2403	150	240	195	84	18	690	1 630	290	2
150RNPH2503	150	250	169	70	20	640	1 500	300	2
150RNPH2505	150	250	208	89	20	780	1 840	295	2
150RNPH2601	150	265	187	98	20	900	1 950	320	2
150RNPH2702	150	275	199	100	20	945	1 970	330	2
155RNPH2401	155	245	199	88	20	740	1 720	300	2
160RNPH2502	160	255	199	90	20	735	1 730	310	2
160RNPH2504	160	255	189	86	20	745	1 780	305	2
160RNPH2601	160	265	200	82	20	745	1 700	320	2
160RNPH2703	160	275	214	100	25	945	2 190	325	2
170RNPH2601	170	265	214	100	20	880	2 050	330	2
180RNPH2901	180	290	214	85	20	880	2 050	335	2

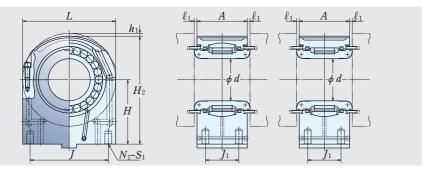
Remark Other bearings are available. Please contact NSK for additional information.

D 124

D 125

Railway Rolling Stock

Plummer Units for Split Cylindrical Roller Bearings-PCR Series





	Obet Diseases (D-: 1 /	Dii ()					
Bearing Numbers	Shaft Diameter(mm)				_	Dimensions (mm)		_	_		
	d	L	A	H	h_1	H_2	ℓ ₁	J	J_1	N_1	S_1
100PCR2201	100	235	152	132	10	234.5	9	165	100	4	M20
110PCR2301	110	230	120	160	10	265	9.5	140	_	2	M30
110PCR2303	110	230	135	180	10	285	10	170	_	2	M30
110PCR2502	110	250	156	150	11.5	263.5	12		_	1	M36
115PCR2401	115	245	183	190	10	300	10	150	_	2	M24
120PCR2501	120	250	142	165	11.5	278.5	9	190	90	4	M24
120PCR2502	120	255	162	230	10	347.5	9	205	100	4	M24
130PCR2701	130	265	118	190	11.5	313.5	11	195	65	4	M30
130PCR2801	130	280	156	160	10	290	9.5	200	100	4	M24
130PCR2705	130	270	132	197	9	313	6	220	93	4	3/4-10UNC
130PCR2604	130	265	175	145	10	260	7.5	210	120	4	M16
130PCR2802	130	280	172	180	11.5	308.5	9	220	110	4	M30
130PCR2603	130	265	171	175	12.5	295	8	230	90	4	M20
135PCR2701	135	270	160	160	10	275	12	180	130	4	M20
135PCR2502	135	250	160	160	10	275	12	150	130	4	M20
140PCR2701	140	270	145	180	10	305	9.5	170	_	2	M30
140PCR2601	140	265	174	175	7.5	300	8	230	130	4	M20
140PCR2804	140	285	179	175	12.5	305	8	250	97.5	4	M20
140PCR3101	140	310	166	175	10	320	9.5	220	110	4	M24
145PCR2801	145	280	162	250	10	380	9	220	100	4	M30
145PCR2804	145	280	183	260	10	390	7	220	123	4	M30
145PCR2901	145	295	195	270	10	407.5	7	230	130	4	M30
150PCR2801	150	280	184	175	10	305	8	230	140	4	M20
150PCR280	150	330	144	310	10	440	8	350	260	4	φ 33
150PCR3004	150	305	180	205.5	14.5	336	8	230	120	4	M24
150PCR3003	150	300	150	180	10	320	10	195	90	4	M30
150PCR2901	150	295	193	310	10	447.5	8	215	126	4	M30
150PCR3203	150	320	168	220	15	365	10	240	90	4	M36
150PCR3301	150	330	182	220	11.5	373.5	9	260	110	4	M36
155PCR3001	155	300	182	260	10	400	9	240	110	4	M30
160PCR3101	160	310	178	185	16.5	323.5	11	150	_	2	M30
160PCR3002	160	305	174	217	12.5	357	8	255	135	4	3/4-10UNC
160PCR3302	160	330	185	225	20	365	8	250	130	4	M24
160PCR3401	160	340	199	200	15.5	347	8	290	130	4	M20
170PCR3301	170	320	194	290.5	10	445.5	10.5	260	340	4	φ 26
180PCR3301	180	335	150	217.5	10	375	10	240	82	4	M30

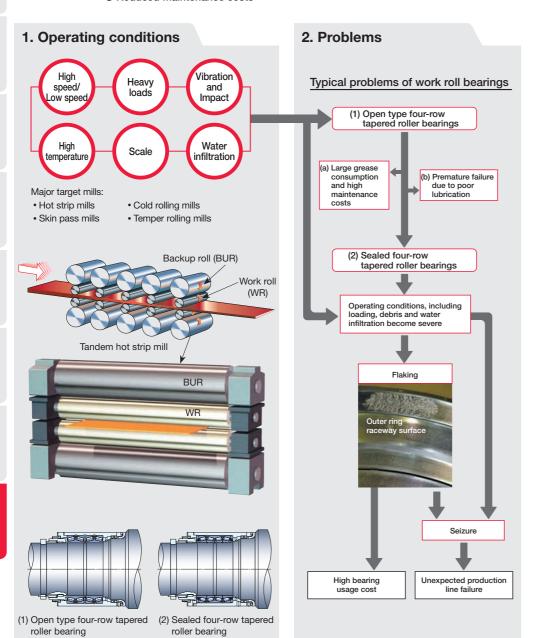
Remark Other bearings are available. Please contact NSK for additional information.

way Stock

Bearings for Rolling Mills

Four-Row Tapered Roller Bearings for Roll Necks

- Higher reliability and longer operating life prevent unexpected accidents
- Benefits @ Bearing seal requires less cleaning of work environment and reduces grease consumption
 - Reduced maintenance costs



INDUSTRY SOLUTIONS

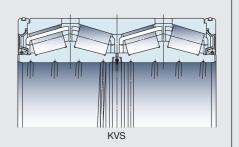
3. Countermeasures

Design measures

Features Extra-Capacity Sealed-Clean™ Four-Row Tapered Roller Bearings-KVS Series

- · Higher load capacity: increased by 15%~35% compared to conventional sealed bearings
- · Adoption of Super-TF™ steel as standard
- · Controlled negative pressure during rolling to prevent water infiltration
- · Improved sealing through usage of heat- and wear-resistant sealing materials
- · Easier handling of seals





■ Material measures 1

Features Super-TF™ Bearings-STF Series

- Adoption of Super-TF™ material
- · Control of the retained austenite reduces concentration of stress resulting from dents caused by infiltration of debris

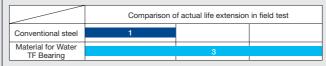
	Comparison of	Comparison of actual life extension in field test					
Conventional sealed bearing	1			for			
KVS Bearing	2	2					

uper-TF™ steel is used as standard r KVS type and KVE.

Material measures 2

Features Water-TF™ Bearings-WTF Series

- · Adoption of super-clean steel with optimum alloy balance controls development and progress of cracks at early flaking stage caused by water infiltration
- Control of the retained austenite reduces concentration of stress resulting from dents caused by infiltration of debris



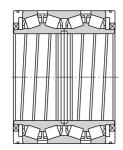
Water-TF™ steel is used as a special purpose bearing series for KVS type and KVE.

(*1): Photo courtesy of NIPPON STEEL & SUMITOMO METAL CORPORATION KASHIMA WORKS pamphlet.

D 131

D 130

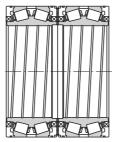
Sealed Four-Row Tapered Roller Bearings(STF/WTF Series) Figures of Typical Four-Row Tapered Roller Bearings



■Bearings for Rolling Mills

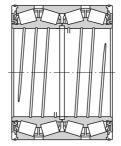
Basic Design of Two Seal Type (KVE) Figure 1

	Variations of Bearing in Figure 1
1-1	Oil holes in cup spacers
1-2	Without intermediate bore seal (for dry rolling)
1-3	Without intermediate bore seal, with holes in cup spacers
1-4	With cone spacer, with intermediate bore seal
1-5	For vertical roll (special cup spacers)



Basic Design of Four Seal Type (KVE) Figure 2

	Variations of Bearing in Figure 2
2-1	Oil holes in cup spacers
2-2	Clearance between cone faces

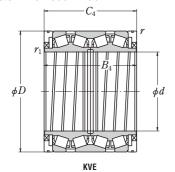


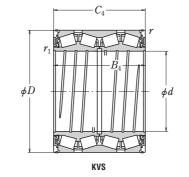
Basic Design of Two Seal Type (KVS) Figure 3

	Variations of Bearing in Figure 3
3-1	Oil holes in cup spacers

■Bearings for Rolling Mills

Sealed Four-Row Tapered Roller Bearings (STF/WTF Series) Bore Diameter 101.600 – 250 mm





Dynamic Equivalent Load

$P = XF_r + YF_a$	
$F_{\rm a}/F_{\rm r} \leq e$	

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	r > e		
X	Y	X	Y		
1	Y_3	0.67	<i>Y</i> ₂		

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

Where $Y_0 = Y_3$

The values of e, Y_2 , and Y_3 are

given in the table below.

	Boundary Dimensions							ad Ratings		Descine No.	Descriptor Number			Axial		Mass
		(mm/inch)				(ki	,	{k	•	Bearing Numbers	Bearing Numbers	Figure(1)	Constant	Fac	tors	(kg)
d	D	B_4	C_4	r_1	r	$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{\rm r}$	C_{0r}	STF Series	WTF Series	• ()		17	17	
				min.	min.								e	Y_2	Y_3	approx.
101.600 4.000	200.025 7.8750	320.000 12.5984	320.000 12.5984	1.0	3.0	1 450	2 420	148 000	247 000	*STF101KVE2051Eg		1-2	0.36	2.8	1.9	47.8
150 170 187.325 7.3750	210 240 269.875 10.6250	240 175 230.000 9.0551	240 175 230.000 9.0551	1 2.5 2.0	2.5 2.5 3.3	990 1 020 1 460	2 270 2 000 3 200	101 000 103 000 149 000	231 000 204 000 325 000	STF150KVE2101Eg STF170KVS2401Eg *STF187KVE2651Eg		1-1 3 1-1	0.32 0.32 0.29	3.2 3.2 3.4	2.1 2.1 2.3	26.1 23 43.6
215.900 8.5000	288.925 11.3750	177.800 7.0000	177.800 7.0000	0.8	3.3	1 070	2 350	109 000	239 000	*STF215KVS2851Eg	*WTF215KVS2851Eg	3	0.49	2.1	1.4	38
216.103 8.5080	330.2 13.0000	263.525 10.3750	269.875 10.6250	1.5	3.3	2 290	4 550	233 000	465 000	*STF216KVS3351Eg	*WTF216KVS3351Eg	3	0.46	2.2	1.5	77
225 228.600 9.0000	295 295 300 320 330 320 400.050 15.7500	315 335 270 290 260 230 296.875 11.6880	315 335 270 290 260 230 296.875 11.6880	1 1 2.5 1.5 4 1 3.3	2.5 2.5 2.5 2.5 3 2 3.3	1 410 1 410 1 650 1 970 2 330 1 510 2 410	3 450 3 450 4 000 4 500 4 800 3 300 4 250	144 000 144 000 168 000 201 000 237 000 154 000 246 000	350 000 350 000 410 000 460 000 490 000 335 000 435 000	STF220KVE2902Eg STF220KVE2901Eg STF220KVE3001Eg STF220KVS3201Eg STF220KVS3301Eg STF225KVE3201Eg *STF225KVE4052Eg	WTF220KVE2902Eg WTF220KVE2901Eg WTF220KVE3001Eg WTF220KVS3201Eg WTF220KVS3301Eg WTF225KVE3201Eg *WTF228KVE4052Eg	2-1 2-1 1-2 1 3 1	0.40 0.40 0.41 0.33 0.40 0.41 0.46	2.5 2.5 2.5 3.0 2.5 2.4 2.2	1.7 1.7 1.7 2.0 1.7 1.6 1.5	61.2 65 56.5 78.7 76 59.9 161
234.950 9.2500	327.025 12.8750	196.850 7.7500	196.850 7.7500	1.5	3.3	1 550	3 200	158 000	325 000	*STF234KVS3251Eg	*WTF234KVS3251Eg	3	0.46	2.2	1.5	49
244.475 9.6250	320 338 338 327.025 12.8750	250 248 290 193.680 7.6250	250 248 290 193.680 7.6250	3 2 2 1.5	3 3 3 3	1 510 1 820 2 120 1 370	3 700 4 000 5 000 3 300	154 000 185 000 216 000 148 000	375 000 405 000 510 000 325 000	STF240KVE3202Eg STF240KVE3301Eg STF240KVE3302Eg *STF244KVS3251Eg	WTF240KVE3202Eg WTF240KVE3301Eg WTF240KVE3302Eg *WTF244KVS3251Eg	1 1 1 3	0.33 0.43 0.42 0.40	3.0 2.3 2.4 2.5	2.0 1.6 1.6 1.7	56.3 70.6 82.6 43
245 250	345 365 365	310 270 270	310 270 270	2 2.5 2.5	3 3 3	2 700 2 210 2 210	6 650 4 650 4 650	275 000 225 000 225 000	680 000 475 000 475 000	STF245KVS3402Eg STF250KVE3601AEg STF250KVE3601Eg	WTF245KVS3402Eg WTF250KVE3601AEg WTF250KVE3601Eg	3 1 1-1	0.40 0.33 0.33	2.5 3.0 3.0	1.7 2.0 2.0	85 96 96

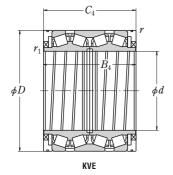
Remark The bearings denoted by an asterisk (*) are inch design

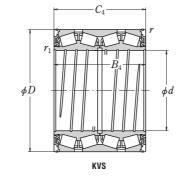
Note (1) Refer to pages D130 and D131.

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2	SOLU

■Bearings for Rolling Mills

Sealed Four-Row Tapered Roller Bearings (STF/WTF Series) Bore Diameter 254.000 – 304.902 mm





Dynamic Equivalent Load

$P = XF_r + YF_a$									
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$							
X	Y	X	Y						
1	Y_3	0.67	Y_2						

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

Where $Y_0 = Y_3$

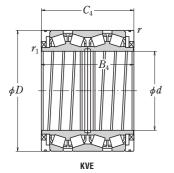
The values of e, Y_2 , and Y_3 are

given in the table below.

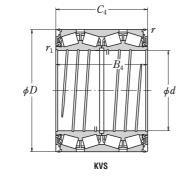
Boundary Dimensions					Basic Load Ratings								Axial Load		Mass	
		(mm/inch)				,	kN)		gf}	Bearing Numbers	Bearing Numbers	Figure(1)	Constant	Fac	tors	(kg)
d	D	B_4	C_4	$m{r}_1$ min.		$C_{\rm r}$	$C_{0\mathrm{r}}$	$C_{\rm r}$	$C_{0\mathrm{r}}$	STF Series	WTF Series	19217()	e	Y_2	Y_3	approx.
254.000 10.0000	358.775 14.1250	269.875 10.6250	269.875 10.6250	1.5	3.3	2 420	5 500	247 000	560 000	*STF254KVS3552Eg	*WTF254KVS3552Eg	3	0.40	2.5	1.7	86
260	365 365	340 340	340 340	2.7 2.5	4 4	2 960 2 960	7 350 7 350	300 000 300 000	750 000 750 000	STF260KVS3601Eg STF260KVS3651Eg	WTF260KVS3601Eg WTF260KVS3651Eg	3	0.40 0.40	2.5 2.5	1.7 1.7	110 110
260.350 10.2500	422.275 16.6250	314.325 12.3750	317.500 12.5000	6.4	3.3	3 600	7 050	370 000	720 000	*STF260KVS4251Eg	*WTF260KVS4251Eg	3	0.33	3.0	2.0	170
266.700 10.5000	355.600 14.0000	230.188 9.0625	228.600 9.0000	1.5	3.3	1 960	4 600	200 000	470 000	*STF266KVS3551Eg	*WTF266KVS3551Eg	3	0.35	2.9	1.9	62
276.225 10.8750	393.700 15.5000	269.875 10.6251	269.875 10.6251	1.5	3.3	2 720	6 100	277 000	620 000	*STF276KVS3952Eg	*WTF276KVS3952Eg	3	0.45	2.2	1.5	105
279.400 11.0000	393.700 15.5000	269.875 10.6250	269.875 10.6250	1.5	6.4	2 720	6 100	277 000	620 000	*STF279KVS3952Eg	*WTF279KVS3952Eg	3	0.45	2.2	1.5	102
	393.700 15.5000	270.630 10.6547	269.875 10.6250	1.5	6.4	2 290	5 150	233 000	525 000	*STF279KVE3951Eg	*WTF279KVE3951Eg	1	0.41	2.5	1.7	105
279.4 280 290 304.648 11.9940	393.7 410 380 395 395 410 412 400 438.048 17.2460	320 420 290 340 340 268 340 346 280.990 11.6260	320 420 290 340 340 268 340 346 279.400 11.0000	1.5 1 1.5 1.5 1.5 1.5 3 3 3.3	6.4 6.4 3 2.5 2.5 6.4 3 4 3.3	3 100 3 300 2 230 2 950 2 950 2 330 3 300 3 250 3 100	7 350 7 400 5 350 7 050 7 050 4 600 7 400 8 400 6 750	315 000 335 000 227 000 300 000 300 000 237 000 335 000 330 000 315 000	745 000 755 000 545 000 720 000 720 000 470 000 755 000 855 000 690 000	STF279KVS3954Eg STF279KVE4101Eg STF280KVE3801Eg STF280KVE3901Eg STF280KVE3902Eg STF280KVE4101Eg STF280KVE4102Eg STF290KVS4001Eg *STF304KVS4351Eg	WTF279KVS3954Eg WTF279KVE4101Eg WTF280KVE3801Eg WTF280KVE3901Eg WTF280KVE3902Eg WTF280KVE4101Eg WTF280KVE4102Eg WTF290KVS4001Eg *WTF304KVS4351Eg	2 1-4 1 1 1-4 1-1 3	0.40 0.42 0.37 0.40 0.40 0.33 0.42 0.40 0.45	2.5 2.4 2.7 2.5 2.5 3.0 2.4 2.5 2.2	1.7 1.6 1.8 1.7 1.7 2.0 1.6 1.7	120 190 96.2 133 133 121 156 112 132
	438.048 17.2460	281.740 11.0921	279.400 11.0000	3.3	3.3	2 630	5 600	268 000	570 000	*STF304KVE4351Eg	*WTF304KVE4351Eg	1-2	0.47	2.1	1.4	140
304.8 12.0000	419.100 16.5000	269.875 10.6250	269.875 10.6250	1.5	6.4	2 850	6 550	291 000	665 000	*STF304KVS4151Eg	*WTF304KVS4151Eg	3	0.33	3.0	2.0	111
304.902 12.0040	412.648 16.2460	266.700 10.5000	266.700 10.5000	1.5	3.3	2 760	6 500	281 000	665 000	*STF304KVS4152Eg	*WTF304KVS4152Eg	3	0.33	3.0	2.0	100

Remark The bearings denoted by an asterisk (*) are inch design. Note (1) Refer to pages D130 and D131.

Sealed Four-Row Tapered Roller Bearings (STF/WTF Series) Bore Diameter 310 – 482.600 mm



■Bearings for Rolling Mills



Dynamic Equivalent Load

$P = XF_r + YF_a$									
$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F_{\rm r} > e$							
X	Y	X	Y						
1	Y_3	0.67	<i>Y</i> ₂						

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

Where $Y_0 = Y_3$

The values of e, Y_2 , and Y_3 are given in the table below.

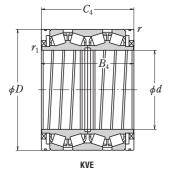
Boundary Dimensions					Basic Lo	ad Ratings	-					Axial Load		Mass		
		(mm/inch)				,	(N)		kgf}	Bearing Numbers	Bearing Numbers	Figure(1)	Constant	Fact	tors	(kg)
d	D	B_4	C_4	r_1 min.	γ min.	$C_{\rm r}$	C_{0r}	$C_{\rm r}$	C_{0r}	STF Series	WTF Series	3(,)	e	Y_2	Y_3	approx.
310	430 430	310 350	310 350	3 2.7	3 3	3 350 3 700	8 200 9 550	345 000 375 000	835 000 970 000	STF310KVS4301Eg STF310KVS4302Eg	WTF310KVS4301Eg WTF310KVS4302Eg	3	0.46 0.46	2.2 2.2	1.5 1.5	140 155
317.500 12.5000	422.275 16.6250	269.875 10.6250	269.875 10.6250	1.5	3.3	2 740	6 750	279 000	690 000	*STF317KVS4251Eg	*WTF317KVS4251Eg	3	0.34	3.0	2.0	100
	447.675 17.6250	367.000 14.4488	367.000 14.4488	2.5	3.0	3 450	8 100	350 000	825 000	*STF317KVE4451Eg	*WTF317KVE4451Eg	1	0.46	2.2	1.5	184
343.052 13.5060	457.098 17.9960	254.000 10.0000	254.000 10.0000	1.5	3.3	2 430	6 700	289 000	685 000	*STF343KVS4551Eg	*WTF343KVS4551Eg	3	0.45	2.2	1.5	110
	457.098 17.9960	299.000 11.7717	299.000 11.7717	1.5	3.3	2 830	6 950	289 000	705 000	*STF343KVE4561Eg	*WTF343KVE4561Eg	1	0.46	2.2	1.5	137
355.600 14.0000	457.200 18.0000	252.412 9.9375	252.412 9.9375	1.5	3.3	2 650	6 750	270 000	685 000	*STF355KVS4551Eg	*WTF355KVS4551Eg	3	0.32	3.2	2.1	98
395 406.400 16.0000	545 546.100 21.5000	360 288.925 11.3750	360 288.925 11.3750	2.5 1.5	5 6.4	3 600 3 950	9 050 9 450	365 000 400 000	920 000 965 000	STF395KVE5401Eg *STF406KVS5451Eg	WTF395KVE5401Eg *WTF406KVS5451Eg	1-1 3	0.47 0.48	2.1 2.1	1.4 1.4	255 184
	546.100 21.5000	346.000 13.6221	346.000 13.6221	0.5	6.4	2 560	5 800	261 000	590 000	*STF406KVE5454Eg	*WTF406KVE5454Eg	2-1	0.47	2.1	1.4	231
420	590	395	375	2.5	5	3 550	8 200	365 000	835 000	STF420KVE5901Eg	WTF420KVE5901Eg	1-1	0.80	1.3	8.0	332
440	590 620	510 454	510 454	4	4 6	5 450 6 500	14 300 15 700	555 000 665 000	1 460 000 1 600 000	STF440KVE5901Eg STF440KVE6201Eg	WTF440KVE5901Eg WTF440KVE6201Eg	2-1 1-1	0.38 0.33	2.7 3.0	1.8 2.0	396 435
450	595	368	368	4	5	5 550	15 000	565 000	1 520 000	STF450KVS5901Eg	WTF450KVS5901Eg	3	0.33	3.0	2.0	272
457.200 18.0000	596.900 23.5000	276.225 10.8750	279.400 11.0000	1.5	3.3	4 000	9 850	405 000	1 010 000	*STF457KVS5951Eg	*WTF457KVS5951Eg	3	0.47	2.2	1.4	206
460	590	470	470	2.5	5	4 900	14 100	500 000	1 440 000	STF460KVE5901Eg	WTF460KVE5901Eg	1-1	0.28	3.6	2.4	322
480	615 678	435 574	435 574	3	5 5	4 650 8 400	12 800 21 500	470 000 860 000	1 310 000 2 190 000	STF480KVE6101AEg STF480KVE6702Eg	WTF480KVE6101AEg WTF480KVE6702Eg	2-2 2-1	0.32 0.34	3.2 3.0	2.1 2.0	323 662
482.600 19.0000	615.950 24.2500	330.200 13.0000	330.200 13.0000	4.3	6.4	4 900	13 500	500 000	1 370 000	*STF482KVS6151Eg	*WTF482KVS6151Eg	3	0.33	3.1	2.1	235

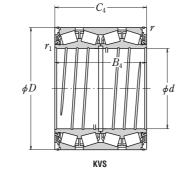
Remark The bearings denoted by an asterisk (*) are inch design.

Note (1) Refer to pages D130 and D131.

■Bearings for Rolling Mills

Sealed Four-Row Tapered Roller Bearings (STF/WTF Series) Bore Diameter 482.600 – 825.5 mm





Dynamic Equivalent Load

P =	$XF_{\rm r}$	$+YF_a$
-----	--------------	---------

$F_{\rm a}/F$	$r \leq e$	$F_{\rm a}/F$	r > e
X	Y	X	Y
1	Y_3	0.67	Y_2

Static Equivalent Load

 $P_0 = F_{\rm r} + Y_0 F_{\rm a}$

Where $Y_0 = Y_3$

The values of e, Y_2 , and Y_3 are

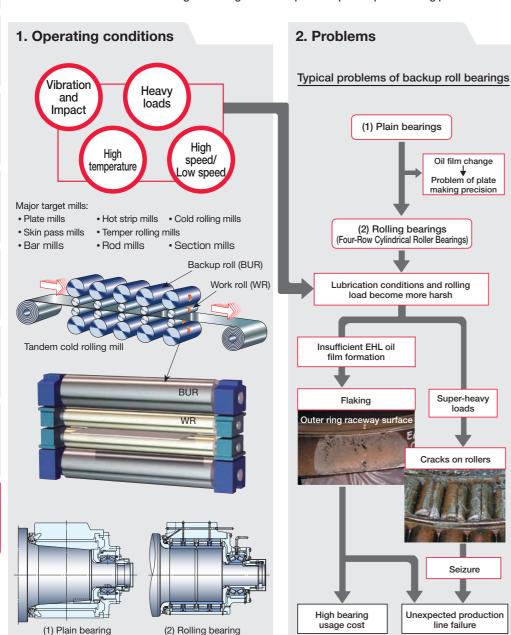
given in the table below.

	Во	undary Dimens	ions				Basic Lo	oad Ratings	=					Axial	Load	Mass
		(mm/inch)				,	kN)		gf}	Bearing Numbers	Bearing Numbers	Figure(1)	Constant	Fac	tors	(kg)
d	D	B_4	C_4	${m \gamma}_1$ min.		$C_{\rm r}$	C_{0r}	$C_{\rm r}$	C_{0r}	STF Series	WTF Series	riguro()	e	Y_2	Y_3	approx.
	615.950 24.2500	330.200 13.0000	330.200 13.0000	4.3	6.4	3 650	9 650	370 000	985 000	*STF482KVE6152Eg	*WTF482KVE6152Eg	1	0.37	2.7	1.8	243
	615.950 24.2500	419.100 16.5000	402.050 15.8287	2.3	6.4	4 700	13 600	480 000	1 380 000	*STF482KVE6155Eg	*WTF482KVE6155Eg	1	0.38	2.7	1.8	302
	647.700 25.5000	417.512 16.4375	417.512 16.4375	3.3	6.4	5 500	13 800	560 000	1 410 000	*STF482KVE6453Eg	*WTF482KVE6453Eg	1-5	0.37	2.7	1.8	392
488.950 19.2500	622.300 24.5000	365.125 14.3750	365.125 14.3750	3.8	6.4	3 450	8 950	350 000	915 000	*STF488KVE6251Eg	*WTF488KVE6251Eg	2	0.29	3.5	2.3	272
490	625	435	435	3	5	4 550	12 500	465 000	1 280 000	STF490KVE6201AEg	WTF490KVE6201AEg	2-2	0.32	3.2	2.1	329
509.948 20.0767	654.924 25.7844	377.000 14.8425	379.000 14.9213	1.5	6.4	4 800	13 000	490 000	1 330 000	*STF509KVE6554Eg	*WTF509KVE6554Eg	1	0.41	2.4	1.6	321
520	735	535	535	5	6	8 800	22 700	900 000	2 310 000	STF520KVE7301Eg	WTF520KVE7301Eg	1-1	0.33	3.0	2.0	726
558.800 22.0000	736.600 29.0000	540.000 21.2598	540.000 21.2598	3.3	6.4	8 950	25 300	910 000	2 580 000	*STF558KVE7351Eg	*WTF558KVE7351Eg	1-3	0.35	2.9	1.9	625
595.312 23.4375	844.550 33.2500	615.950 24.2500	615.950 24.2500	1.5	6.4	12 600	33 000	1 290 000	3 350 000	*STF595KVE8451Eg	*WTF595KVE8451Eg	1	0.33	3.0	2.0	1 110
	844.550 33.2500	615.950 24.2500	615.950 24.2500	3.3	6.4	10 900	27 200	1 110 000	2 780 000	*STF595KVE8452Eg	*WTF595KVE8452Eg	4	0.35	2.9	1.9	1 110
609.600 24.0000	787.400 31.0000	361.950 14.2500	361.950 14.2500	1.5	6.4	5 450	14 400	555 000	1 470 000	*STF609KVE7851Eg	*WTF609KVE7851Eg	1	0.42	2.4	1.6	452
711.200 28.0000	914.400 36.0000	387.350 15.2500	317.500 12.5000	3.3	6.4	6 400	19 300	655 000	1 970 000	*STF711KVE9152AEg	*WTF711KVE9152AEg	1	0.38	2.6	1.8	585
	914.400 36.0000	410.000 16.1417	410.000 16.1417	3.3	6.4	7 000	20 100	715 000	2 050 000	*STF711KVE9153Eg	*WTF711KVE9153Eg	1-1	0.44	2.3	1.5	681
	914.400 36.0000	425.450 16.7500	387.350 15.2500	8.0	6.4	6 400	19 300	655 000	1 970 000	*STF711KVE9155Eg	*WTF711KVE9155Eg	1	0.38	2.6	1.8	675
785	1 015	700	700	4	6	13 500	41 000	1 380 000	4 150 000	STF785KVE1001Eg	WTF785KVE1001Eg	2-1	0.40	2.5	1.7	1 460
825.5	1 160	565	565	5	6	13 900	33 500	1 420 000	3 400 000	STF825KVE1101Eg	WTF825KVE1101Eg	1	0.40	2.5	1.7	1 890

Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings for Roll Necks

- Higher reliability and longer operating life prevent unexpected accidents
- Benefits @ Reduced maintenance costs
 - 3 Smoother rolling of bearings for backup rolls improves plate making precision



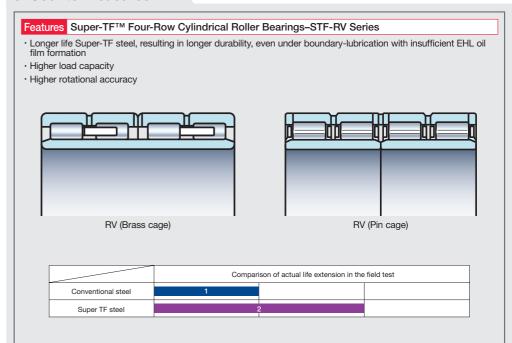


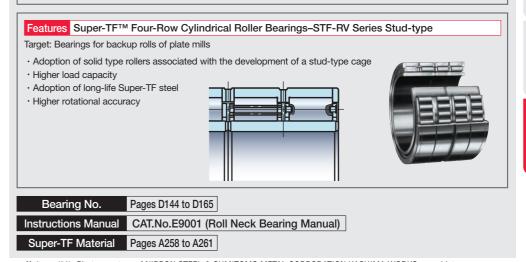




INDUSTRY SOLUTIONS

3. Countermeasures





Pumps & Compressors

Agricultural Machinery

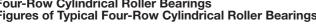
Railway Rolling Stock

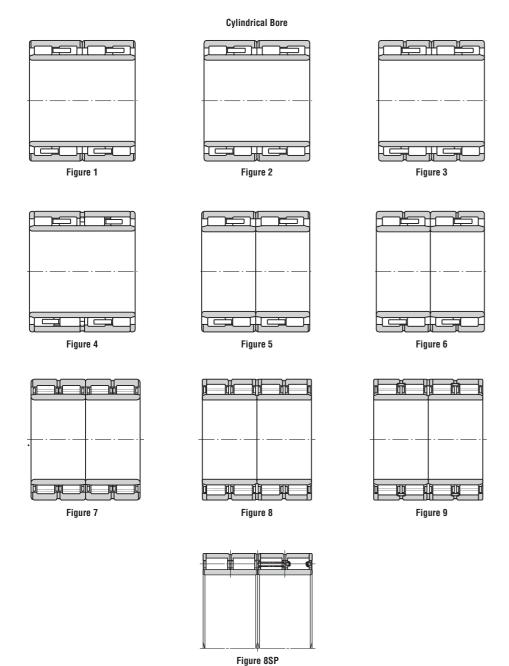
Wind Power Industry

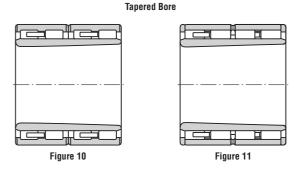
Mining Machinery

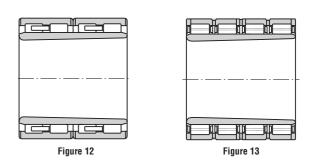
■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Figures of Typical Four-Row Cylindrical Roller Bearings



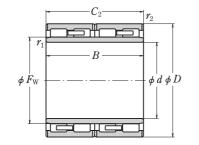


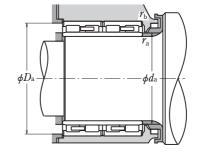




Four-Row Cylindrical Roller Bearings Bore Diameter 100 – 160 mm

■Bearings for Rolling Mills



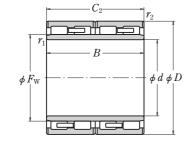


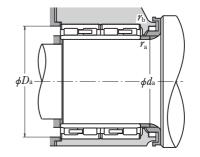
		Bou	ındary Dimensi (mm)	ons				ad Ratings :N)	Decring Numbers	Fig-	Abuti	ment and Fill (mm		ons	Mass (kg)
<i>d</i>	D	В	C_2	$F_{ m w}$	$ extcolor{r}_1$ min.	$\emph{\textbf{r}}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{ m a}$	D_{a}	$m{\gamma}_{\mathrm{a}}$ max.	$m{\gamma}_{ m b}$ max.	approx.
100	140	104	104	111	1.5	1.1	400	820	HTF100RV1401g	3	110	130	1.5	1	4.8
110	160 170	120 120	120 120	124 127	1.1 2	1.1 2	560 615	1 080 1 100	HTF110RV1601g HTF110RV1701g	3 1	119 122	150 157	1 2	1 2	7.9 9.9
120	165 180 215	87 105 174	87 105 174	134.5 136 147	1.1 2 2.1	1.1 2 2.1	365 530 1 060	725 880 1 600	HTF120RV1601g HTF120RV1801g HTF120RV2101g	1 1 1	130 132 134	155 167 199	1 2 2	1 2 2	5.4 8.9 26.6
127	174.625 203.2	150.812 127	150.812 127	139.5 147.5	1.5 2	2 1.5	735 705	1 580 1 110	HTF127RV1722g HTF127RV2001g	1	138 139	163 190	1.5 2	1.5 2	10.5 15.4
130	200 200	125 104	125 104	149 149	2 2	2 2	700 570	1 190 950	STF130RV2001g STF130RV2003g	1	142 142	187 187	2 2	2	14 11.7
140	210	116	116	160	2	2	640	1 130	STF140RV2101g	1	152	196	2	2	13.9
145	210 225	155 156	155 156	166 169	1.5 2	1.5 2	925 975	1 920 1 820	STF145RV2101g STF145RV2201g	1 1	157 158	197 211	1.5 2	1.5 2	17.8 23
150	220 225 225	150 150 136	150 150 136	168 168.5 168.776	2 1.5 2.1	2 2.1 2.1	900 970 820	1 700 1 810 1 460	STF150RV2201g STF150RV2203g STF150RV2204g	1 1 1	163 162 165	206 209 209	2 1.5 2	2 2 2	20 20.8 18.6
	230 230	130 156	130 156	174 174	2.1 2	2.1 2	845 965	1 520 1 810	STF150RV2301g STF150RV2302g	1 1	165 163	214 216	2 2	2 2	19.6 23.6
159.99	220	180	180	176	2	2	1 050	2 410	STF159RV2201g	2	173	206	2	2	20.6
160	230 230 230	130 168 168	130 168 168	178 179 180	2 2 2	2 2 2	780 900 1 040	1 340 2 050 2 200	STF160RV2301g STF160RV2307g STF160RV2302g	1 1 1	173 173 173	216 216 216	2 2 2	2 2 2	16.4 23.0 22.7
	230 240 240 240	180 120 170 145	180 120 170 145	178 183 183 180.016	2 2.1 2 2.1	2 2.1 2 2.1	1 080 745 1 080 920	2 280 1 320 2 050 1 600	STF160RV2303g STF160RV2401g STF160RV2402g STF160RV2403g	2 1 1 1	173 175 173 175	216 224 226 224	2 2 2 2	2 2 2 2	24.2 18.8 26.6 22.3

Note (1) Refer to pages D142 and D143.

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 165.1 – 200 mm





		В	oundary Dimen (mm)	sions				nd Ratings N)	D : N .	Fig-	Abutr	ment and Fill (mm		ons	Mass (kg)
d	D	В	C_2	$F_{ m w}$	$ au_1$ min.	$ extbf{ extit{r}}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	d_{a}	D_{a}	$oldsymbol{\gamma}_{\mathrm{a}}$ max.	$ m \emph{r}_b$ max.	approx.
165.1	225.45	168.3	168.3	180.975	1.5	2.5	1 010	2 220	STF165RV2221g	5	177	209	1.5	2	19.4
170	230 240	120 160	120 160	187 190	2 2	2 2	755 1 000	1 610 2 130	STF170RV2301g STF170RV2402g	1 1	183 183	216 226	2 2	2 2	14 22.8
	250 250 255 260	168 170 180 150	168 170 180 150	192 192 193 195	2.1 2.1 2.1 2.1	2.1 2.1 2.1 2.1	1 210 1 210 1 310 1 030	2 320 2 320 2 500 1 840	STF170RV2501g STF170RV2502g STF170RV2503g STF170RV2602g	1 1 1 1	185 185 185 185	234 234 239 244	2 2 2 2	2 2 2 2	27.4 27.7 31.5 28.2
180	250 260 265	156 168 180	156 168 180	200 202 204	2 2.1 2.1	2 2.1 2.1	1 020 1 150 1 340	2 230 2 300 2 690	STF180RV2501g STF180RV2601g STF180RV2602g	1 1 1	193 195 195	236 244 248	2 2 2	2 2 2	23.4 29.2 33.7
	265 280	180 180	180 180	203 205.085	2.1 2.1	2.1 2.1	1 230 1 410	2 420 2 490	STF180RV2603g STF180RV2802g	1 3	195 195	248 263	2 2	2 2	33.4 40.9
190	260 270 270	168 200 170	168 200 170	212 212 213	2 2.1 2.1	2 2.1 2.1	1 140 1 470 1 290	2 600 3 100 2 610	STF190RV2601g STF190RV2701g STF190RV2702g	1 1 1	203 206 206	245 253 253	2 2 2	2 2 2	26.6 36 30.4
	270 280	170 200	170 200	212 214	2 2.1	2 2.1	1 290 1 480	2 610 2 920	STF190RV2703g STF190RV2801g	1 1	203 206	255 263	2 2	2 2	30.6 41.3
200	250 270 270	200 170 200	200 170 200	215 222 222.25	1 2.1 2.1	1 2.1 2.1	900 1 120 1 330	2 500 2 590 3 250	STF200RV2521g STF200RV2702g STF200RV2703g	SP 1 SP	210 216 216	240 253 253	1 2 2	1 2 2	22.3 27.9 34.4
	280 280 280	200 200 190	200 200 190	224 222 223	2.1 2.1 2.1	2.1 2.1 2.1	1 410 1 410 1 350	3 200 3 200 3 050	STF200RV2801g STF200RV2802g STF200RV2803g	1 1 1	216 216 216	263 263 263	2 2 2	2 2 2	38.3 38.6 36.4
	280 280 290	170 200 192	170 200 192	223 222 226	2.1 2.1 2.1	2.1 2.1 2.1	1 150 1 500 1 420	2 460 3 200 3 000	STF200RV2804g STF200RV2808g STF200RV2901g	1 1 1	216 216 216	263 263 273	2 2 2	2 2 2	32.3 37.8 42.3
	310 320	230 216	230 216	229 231	2.1 3	2.1 3	1 840 2 120	3 500 3 900	STF200RV3102g STF200RV3231g	1 4	216 218	293 300	2 4	2 4	63.7 69.9

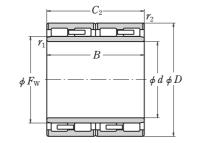
Notes (1) Refer to pages D142 and D143.

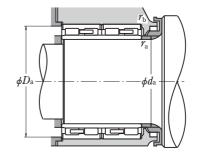
The letter "SP" indicates special design.

Please consult with NSK for detailed specification.

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 210 – 260 mm





	,	Воц	ındary Dimensi (mm)	ons				d Ratings N)		Fig-	Abuti	ment and Fill (mm		ons	Mass (kg)
d	D	В	C_2	$F_{ m w}$	$oldsymbol{\gamma}_1$ min.	${m r}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{\scriptscriptstyle m a}$	$D_{\rm a}$	$oldsymbol{\gamma}_{ m a}$ max.	$\emph{r}_{ m b}$ max.	approx.
210	290 300	192 210	192 210	236 234	2.1 2	2.1 2	1 400 1 750	3 350 3 600	STF210RV2901g STF210RV3001g	1 1	226 224	273 285	2 2	2 2	39 47.4
219.954	310	183	183	244.5	1.5	1	1 480	3 150	STF219RV3131g	4	233	298	1.5	1	45.3
220	310	192	192	247	2.1	2.1	1 540	3 450	STF220RV3101g	1	236	293	2	2	46.1
	310	225	225	245	2.1	2.1	1 740	3 900	STF220RV3102g	1	236	293	2	2	52.9
	310	192	192	246	2.1	2.1	1 540	3 450	STF220RV3103g	1	236	293	2	2	46.2
	310	192	192	246	2.1	2.1	1 660	3 550	STF220RV3106g	1	236	293	2	2	46.0
	310	225	225	244	2.1	2.1	1 900	4 100	STF220RV3107g	1	236	293	2	2	53.0
	320	210	210	248	2.1	2.1	1 790	3 650	STF220RV3201g	1	236	302	2	2	56
	320 320	210 210	210 210	249 246	2.1 2.1	2.1 2.1	1 850 1 900	3 600 3 750	STF220RV3202g STF220RV3203g	1 SP	236 236	302 302	2 2	2 2	54.9 57
222.25	320.675	241.3	241.3	251	2.1	2.1	1 990	4 350	STF222RV3201g	2	238	303	2	2	65
230	330	206	206	260	2.1	2.1	1 760	3 900	STF230RV3301g	1	246	312	2	2	58.2
	330	206	206	258	2.1	2.1	1 870	3 950	STF230RV3302g	1	246	312	2	2	57.3
	340	260	260	261	3	3	2 390	5 100	STF230RV3401g	1	248	320	2.5	2.5	81
	365	250	250	266	3	3	2 310	4 300	STF230RV3601g	5	248	344	2.5	2.5	98.3
240	330	220	220	270	3	3	1 770	4 400	STF240RV3301g	1	259	310	2.5	2.5	57.7
	330	220	220	264	3	3	1 840	4 100	STF240RV3304g	3	259	310	2.5	2.5	55.1
	340	220	220	268	3	3	1 890	3 900	STF240RV3403g	1	259	320	2.5	2.5	61.7
	360	220	220	272	3	3	2 250	4 350	STF240RV3601g	2	259	340	2.5	2.5	77.8
250	340	230	230	276	4	4	2 030	4 750	STF250RV3401g	1	272	317	3	3	60.3
	350	220	220	278	3	3	1 930	4 200	STF250RV3501g	1	269	330	2.5	2.5	64.8
259.948	368	218	218	290	2.1	1.1	2 010	4 350	STF259RV3631g	4	277	354	2	1	76.7
260	355	260	260	286	2.1	2.1	2 090	5 000	STF260RV3521g	5	277	337	2	2	74.5
	370	220	220	292	3	3	2 050	4 450	STF260RV3701g	1	279	349	2.5	2.5	76
	370	220	220	290	3	3	2 220	4 450	STF260RV3704g	1	279	349	2.5	2.5	73.5
	370	260	260	290	3	3	2 720	5 950	STF260RV3721g	1	279	349	2.5	2.5	89.3
	380	280	280	294	3	3	2 820	6 250	STF260RV3801g	1	279	359	2.5	2.5	107
	400	290	290	296	4	4	3 250	6 350	STF260RV4001g	1	282	376	3	3	133

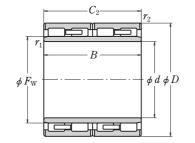
Notes (1) Refer to pages D142 and D143.

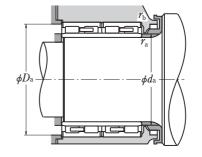
The letter "SP" indicates special design.

Please consult with NSK for detailed specification.

Four-Row Cylindrical Roller Bearings Bore Diameter 270 – 330 mm

■Bearings for Rolling Mills





		Boo	undary Dimens (mm)	ions				ad Ratings		Fig-	Abut	ment and Fill (mm		ons	Mass (kg)
d	D	B	C_2	$F_{ m w}$	${m \gamma}_1$ min.	${m \gamma}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{ m a}$	D_{a}	$m{\gamma}_{ m a}$ max.	$ m \emph{r}_b$ max.	approx.
270	380	230	230	298	2.1	2.1	2 330	5 050	STF270RV3801g	1	287	361	2	2	83
280	390 390 390	220 240 275	220 240 275	312 312 308	3 3 3	3 3 1.1	2 120 2 360 2 860	4 800 5 500 6 450	STF280RV3901g STF280RV3902g STF280RV3903g	1 1 1	299 299 299	369 369 375	2.5 2.5 2.5	2.5 2.5 1	80.9 88.5 100
	390 390 390 400	220 275 275 285	220 275 275 285	312 308 308 316	3 Spec. Spec. 3	3 1.1 3 3	2 280 2 860 2 860 3 000	5 100 6 450 6 450 6 950	STF280RV3907Ag STF280RV3911Ag STF280RV3921Ag STF280RV4021g	SP	299 298 298 299	369 375 369 379	2.5 2 2 2.5	2.5 1 2.5 2.5	81.6 99.5 99.2 117
290	390 410 410 420	234 240 240 300	234 240 240 300	320 320 321 327	3 3 3 3	3 3 3	2 270 2 570 2 600 3 300	5 600 5 450 5 250 7 500	STF290RV3901g STF290RV4101g STF290RV4102g STF290RV4201g	1 1 1 1	310 310 310 310	369 389 389 398	2.5 2.5 2.5 2.5	2.5 2.5 2.5 2.5	79.7 99 97.1 138
300	400 420 420	300 240 300	300 240 300	328 332 332	2 3 3	2 3 3	2 720 2 670 3 200	6 900 5 750 7 200	STF300RV4021g STF300RV4201g STF300RV4204Ag	5 1 3	316 320 320	383 398 398	2 2.5 2.5	2 2.5 2.5	103 101 127
	420 420	300 300	300 300	332 332	Spec. 2	1.5 2	3 550 3 200	8 350 7 200	STF300RV4216g STF300RV4221g	SP 5	319 316	403 402	2 2	1.5 2	132 128
310	420 430	300 240	300 240	338 344.5	3	3 3	3 300 2 610	8 050 5 950	STF310RV4201g STF310RV4301g	1 1	330 330	398 408	2.5 2.5	2.5 2.5	119 107
320	440 450 450	240 240 240	240 240 240	351 358 355	4 3 3	4 3 3	2 490 2 760 2 710	5 350 6 150 5 750	STF320RV4401g STF320RV4501g STF320RV4502g	1 1 1	343 340 340	415 428 428	3 2.5 2.5	3 2.5 2.5	104 120 117
	460 460 480	340 240 350	340 240 350	360 364 364	3 3 4	3 3 1.5	3 850 2 820 4 850	8 700 6 100 10 500	STF320RV4601g STF320RV4621g STF320RV4811g	3 5 8	340 340 343	438 438 462	2.5 2.5 3	2.5 2.5 1.5	184 131 232
330	430 440 460 460	230 200 340 340	230 200 340 340	358 360 365 365	3 3 4 4	3 3 4 2.5	2 340 2 160 3 550 4 150	5 850 4 750 8 650 9 750	STF330RV4301g STF330RV4401g STF330RV4601g STF330RV4611g	1 3 1 SP	350 350 353 353	408 418 435 439	2.5 2.5 3	2.5 2.5 3 2	86.3 83.8 174 172

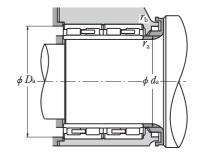
Notes (1) Refer to pages D142 and D143.

The letter "SP" indicates special design.

Please consult with NSK for detailed specification.

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 340 – 400 mm



		Во	undary Dimens (mm)	ions				ad Ratings (N)	Decring Numbers	Fig-	Abutı	ment and Fill (mm		ons	Mass (kg)
d	D	В	C_2	$F_{ m w}$	$m{r}_1$ min.	${m r}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{\scriptscriptstyle \mathrm{a}}$	D_{a}	$m{\gamma}_{\mathrm{a}}$ max.	$ m \emph{r}_b$ max.	approx.
340	450	250	250	371	3	3	2 720	6 750	STF340RV4501g	1	361	428	2.5	2.5	108
	450	250	250	368	3	3	2 720	6 750	STF340RV4502g	3	361	428	2.5	2.5	108
	480	350	350	378	4	4	4 050	9 400	STF340RV4801g	1	364	454	3	3	198
	480 490	350 300	350 300	378 379	Spec. 5	1.5 5	4 600 3 750	11 100 8 200	STF340RV4812Eg STF340RV4901g	1 1	355 368	462 460	2.9 4	1.5 4	208 186
345	480	350	350	376	3	3	4 400	10 300	STF345RV4821g	6	366	457	2.5	2.5	190
350	500	380	380	389	5	5	4 850	11 100	STF350RV5021g	6	378	470	4	4	237
360	480	290	290	394	3	3	3 250	8 300	STF360RV4801g	1	381	457	2.5	2.5	146
	500	250	250	394	3	3	3 450	7 250	STF360RV5022g	5	381	477	2.5	2.5	146
	510	370	370	400	4	4	4 500	10 100	STF360RV5101g	1	384	484	3	3	234
370	480	250	250	401	3	3	2 830	7 350	STF370RV4801g	1	391	457	2.5	2.5	116
	520	380	380	409	4	2	6 000	14 400	STF370RV5211g	SP	394	500	3	2	263
	520	380	380	409	Spec.	1.5	5 600	13 300	STF370RV5212g	SP	393	501	3	1.5	252
	540	400	400	415	4	4	5 250	12 000	STF370RV5401g	1	394	513	3	3	311
380	500	290	290	414	3	3	3 350	8 800	STF380RV5001g	1	401	477	2.5	2.5	153
	520	290	290	418	4	4	3 750	8 850	STF380RV5201g	1	404	493	3	3	181
	520	280	280	417	4	4	3 650	8 450	STF380RV5202g	1	404	493	3	3	174
	540	340	340	424	5	5	4 700	10 900	STF380RV5431g	4	408	509	4	4	259
	540	400	400	424	5	5	5 050	12 000	STF380RV5401g	3	408	509	4	4	280
	540	400	400	422	5	2	6 000	14 400	STF380RV5411g	8	408	520	4	2	305
	540	400	400	424	5	2	5 750	13 800	STF380RV5412g	SP	408	520	4	2	294
390	510	290	290	424	3	3	3 400	9 000	STF390RV5101g	1	412	487	2.5	2.5	156
	550	400	400	434	5	5	5 150	12 400	STF390RV5521g	6	419	519	4	4	303
400	520	250	250	432	4	4	3 000	7 700	STF400RV5202g	3	425	493	3	3	136
	550	300	300	441	4	4	4 150	9 750	STF400RV5501g	1	425	523	3	3	212
	560	400	400	446	5	5	5 650	13 600	STF400RV5612g	8	429	529	4	4	308
	560	410	410	445	5	2	6 550	16 500	STF400RV5613g	8M	429	539	4	2	315
	560	400	400	446	5	5	4 750	11 300	STF400RV5621g	6	429	529	4	4	304
	560	410	410	445	5	2	6 550	16 500	STF400RV5611g	8	429	539	4	2	315

Notes (1) Refer to pages D142 and D143.

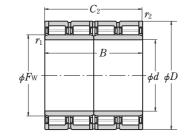
The letter "M" indicates bearing for oil mist lubrication.

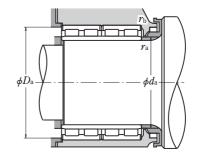
The letter "SP" indicates special design.

Please consult with NSK for detailed specification.

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 406.4 – 500 mm





		Воц	indary Dimensi (mm)	ions				ad Ratings (N)		Fig-	Abuti	ment and Fill (mm		ons	Mass (kg)
d	D	В	C_2	$F_{ m w}$	$m{ au}_1$ min.	$ extcolor{r}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	d_{a}	D_{a}	$oldsymbol{\gamma}_{\mathrm{a}}$ max.	$oldsymbol{\gamma}_{ m b}$ max.	approx.
406.4	609.6	304.8	304.8	460	5	5	4 650	9 150	STF406RV6001g	1	435	577	4	4	307
410	600	440	440	460	5	5	7 350	16 600	STF410RV6011g	8	439	568	4	4	438
420	560 560 600 600	280 400 440 440	280 400 440 440	457 458 470 465	4 4 5 5	4 4 2 5	3 800 4 950 7 100 7 300	9 250 13 000 17 200 17 200	STF420RV5601g STF420RV5602g STF420RV6011g STF420RV6012g	1 6 8 8	445 445 449 449	533 533 579 568	3 3 4 4	3 3 4 4	190 270 419 402
430	591 591	420 420	420 420	476 476	4 4	4 4	6 350 5 200	16 100 13 400	STF430RV5911g STF430RV5921g	8 5	455 455	563 563	3	3 3	347 347
440	620 620 620	450 450 450	450 450 450	487 487 490	5 Spec. 4	5 3 4	7 350 8 100 7 450	17 800 19 700 19 000	STF440RV6213g STF440RV6215g STF440RV6221g	8 8 5	470 466 466	588 594 591	4 3 3	4 2.5 3	430 433 430
450	630	450	450	500	4	4	6 950	17 500	STF450RV6321g	5	476	601	3	3	440
460	620 620 620	400 400 460	400 400 460	506 502 502	4 4 4	4 4 4	5 500 6 400 7 100	14 700 16 600 19 100	STF460RV6201g STF460RV6211g STF460RV6212g	1 8 8M	486 486 486	591 591 591	3 3 3	3 3 3	347 358 412
	650 650 670	470 470 500	470 470 500	509 509 522	6 4 6	3 3 6	8 400 8 600 8 900	20 900 21 200 22 700	STF460RV6511g STF460RV6513g STF460RV6721g	8 8 7	496 486 496	624 624 631	5 3 5	2.5 2.5 5	514 501 596
470	660	470	470	519	4	4	8 450	20 800	STF470RV6611g	8	496	631	3	3	505
480	680 680 680	420 500 500	420 500 500	528 532 534	Spec. 4 5	3 3 5	8 350 9 400 9 000	19 000 23 500 23 100	STF480RV6814g STF480RV6815g STF480RV6801g	8 8 7	508 506 510	653 653 646	3.5 3 4	2.5 2.5 4	490 586 610
	680 700	500 400	500 400	534 538	5 6	5 6	9 000 7 650	23 100 17 400	STF480RV6811g STF480RV7031g	8 9	510 517	646 660	4 5	4 5	610 538
500	670 670 680	450 450 420	450 450 405	540 540 550	Spec. 5 5	4 5 5	7 750 8 300 6 700	20 000 22 300 17 600	STF500RV6713g STF500RV6712Eg STF500RV6812g	8 SP 8	529 531 531	640 637 646	3.5 4 4	3 4 4	446 464 451

Notes (1) Refer to pages D142 and D143.

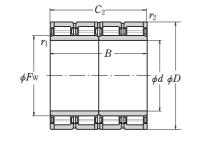
The letter "M" indicates bearing for oil mist lubrication.

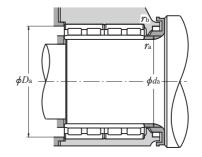
The letter "SP" indicates special design.

Please consult with NSK for detailed specification.

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 500 – 610 mm





		Воц	ındary Dimensi	ons			Basic Loa	nd Ratings			Abutr	ment and Fill	et Dimensio	ons	Mass
			(mm)				,	N)	Bearing Numbers	Fig-		(mm	1)		(kg)
d	D	В	C_2	$F_{ m w}$	$ m \emph{\emph{r}}_1$ min.	${m r}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Boaring Namboro	ure(1)	$d_{ m a}$	D_{a}	$m{r}_{\mathrm{a}}$ max.	$ m \emph{r}_b$ max.	approx.
500	690 690 700	510 510 515	510 510 515	550 552 554	5 5 5	5 5 5	8 850 9 000 9 100	23 900 24 600 23 800	STF500RV6913g STF500RV6921g STF500RV7021g	8M 7 7	531 531 531	656 656 666	4 4 4	4 4 4	480 580 622
	710 720 720	480 530 530	480 530 530	558 560 568	5 6 6	5 6 6	8 500 9 950 10 100	21 200 25 300 25 900	STF500RV7111g STF500RV7211g STF500RV7214g	8 8 8M	531 537 537	676 680 680	4 5 5	4 5 5	632 782 722
510	670 680	320 500	320 500	554 560	5 5	5 5	4 950 8 950	12 700 25 700	STF510RV6701g STF510RV6811g	1 8	541 541	637 646	4 4	4 4	298 514
520	735 735	535 535	535 535	574.5 574.5	5 5	5 5	10 400 10 800	26 300 27 500	STF520RV7331g STF520RV7311g	9 8M	551 551	700 700	4 4	4 4	750 733
530	780 780	570 570	570 570	601 595	6 6	6 6	11 800 11 800	29 200 29 200	STF530RV7811g STF530RV7813g	8M 8	568 568	738 738	5 5	5 5	960 960
536.176	762.03 762.03	558.8 558.8	558.8 558.8	600 598	5 Spec.	5 4	10 800 11 600	28 800 30 000	STF536RV7631g STF536RV7612Eg	9 SP	568 568	727 731	4 5.8	4 3	849 849
550	740 740	510 510	510 510	602 600	5 Spec.	5 2	9 150 10 100	25 700 27 600	STF550RV7411Ag STF550RV7413g	8M 8	582 580	705 716	4 3.5	4 2	648 632
560	800 820	600 600	600 600	620 625	6 Spec.	6 6	12 400 14 100	31 500 34 000	STF560RV8011g STF560RV8211g	8 8	598 595	758 778	5 4.5	5 5	1 020 1 100
570	815 815	594 594	594 594	628 628	6 6	6 6	13 200 13 700	32 000 33 500	STF570RV8113g STF570RV8111g	8 8	608 608	773 773	5 5	5 5	1 010 960
571.1	812.97	594	594	636	6	5	13 200	34 500	STF571RV8111g	8	610	777	5	4	947
600	820 850 870 870 870	575 600 640 640 640	575 600 640 640 640	660 664 682 672 669	Spec. 5 7.5 7.5 5	3 5 4 4 5	12 900 14 600 15 700 15 700 15 700	35 500 37 500 40 000 40 000 40 000	STF600RV8212Eg STF600RV8511g STF600RV8711g STF600RV8713g STF600RV8714g	SP 8M 8M 8	629 633 645 645 633	790 813 836 836 833	5.5 4 6 6 4	2.5 4 3 3 4	931 1 110 1 320 1 320 1 310
610	850 870	570 660	570 660	670 680	6 6	5 6	12 600 15 400	33 000 41 500	STF610RV8511g STF610RV8711g	8 8	649 649	813 827	5 5	4 5	1 040 1 330

Notes (1) Refer to pages D142 and D143.

The letter "M" indicates bearing for oil mist lubrication.

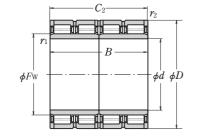
The letter "SP" indicates special design.

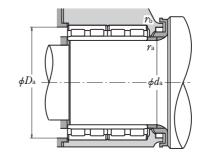
Please consult with NSK for detailed specification.

D 156

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 628 – 750 mm





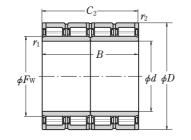
		Во	undary Dimens (mm)	sions				nd Ratings N)		Fig-	Abuti	ment and Fill (mm		ons	Mass (kg)
d	D	В	C_2	$F_{ m w}$	$ eals_1$ min.	$ extbf{\emph{r}}_2$ min.	$C_{ m r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{\scriptscriptstyle m a}$	D_{a}	${m \gamma}_{ m a}$ max.	$ m \emph{r}_b$ max.	approx.
628	922	600	600	702	6	5	15 600	37 000	STF628RV92119	, 8	668	883	5	4	1 390
634.5	901.87 901.87	674 674	674 674	705 705	7.5 5	4 4	16 200 17 000	43 500 44 500	STF634RV9031g STF634RV9011g		680 668	868 868	6 4	3 3	1 440 1 410
640	870 880	610 600	610 600	697 700	6 6	3 6	14 200 14 200	40 000 38 000	STF640RV8711g STF640RV8812g		680 680	839 836	5 5	2.5 5	1 100 1 110
650	900 920 920	650 670 690	650 670 690	710 723 723	Spec. 7.5 7.5	5 7.5 7.5	16 000 16 200 16 600	42 000 44 000 45 000	STF650RV9011g STF650RV9212g STF650RV9211g	8	688 696 696	862 870 870	4.5 6 6	4 6 6	1 280 1 470 1 520
660	930	660	660	728	6	6	17 000	44 000	STF660RV93119	8	700	885	5	5	1 440
680	980	640	640	760	Spec.	4	17 500	43 500	STF680RV98119	8	727	944	6	3	1 630
690	960 980 980	670 715 750	670 715 750	760 767.5 766	7.5 7.5 7.5	7.5 7.5 7.5	17 400 17 900 19 200	47 000 48 000 53 000	STF690RV96110 STF690RV98310 STF690RV98320	9	737 737 737	909 929 929	6 6 6	6 6 6	1 520 1 790 1 880
	980 980	750 750	750 750	766 766	7.5 7.5	7.5 7.5	19 200 19 200	53 000 53 000	STF690RV9812 STF690RV9813		737 737	929 929	6 6	6 6	1 880 1 860
700	930 930 980 980	620 620 700 700	620 620 700 700	763 763 774 774	6 6 6	6 6 6	12 900 14 800 18 000 17 800	38 000 43 000 48 500 49 000	STF700RV93110 STF700RV93130 STF700RV98130 STF700RV98210	8	741 741 741 741	885 885 934 934	5 5 5	5 5 5 5	1 200 1 180 1 680 1 720
710	1000	715	715	787.5	7.5	7.5	18 700	50 500	STF710RV10119	8	757	948	6	6	1 840
725	1000 1000 1000	700 700 700	700 700 700	796 790 796	6 Spec. 6	6 4 6	18 200 19 000 17 700	51 000 51 500 49 500	STF725RV10110 STF725RV10120 STF725RV10210	8	767 763 767	954 964 954	5 4.5 5	5 3 5	1 670 1 700 1 670
730	960 1030	620 750	620 750	790 809	6 6	3 6	15 000 20 700	44 500 56 500	STF730RV9611g STF730RV1011g		772 772	928 983	5 5	2.5 5	1 250 2 050
750	1000 1000	670 670	670 670	813 813	6 Spec.	6 3	16 800 17 500	49 500 50 000	STF750RV1011g STF750RV1013g		792 798	954 967	5 6	5 2.5	1 520 1 490

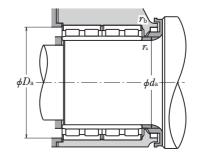
Notes (1) Refer to pages D142 and D143.

The letter "M" indicates bearing for oil mist lubrication.

D 158

Four-Row Cylindrical Roller Bearings Bore Diameter 755 – 850 mm





	-	Вог	undary Dimension (mm)	ons				nd Ratings N)		Fig-	Abu	ment and Fill (mm		ons	Mass (kg)
d	D	В	C_2	$F_{ m w}$	\emph{r}_1 min.	$ extbf{\emph{r}}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{\scriptscriptstyle m a}$	D_{a}	$oldsymbol{r}_{ m a}$ max.	$ m \emph{r}_b$ max.	approx.
755	1 070	750	750	837	7.5	7.5	21 700	58 500	STF755RV1011g	8	803	1 017	6	6	2 230
760	1 030 1 030 1 080	750 750 805	750 750 790	834 828 845	7.5 7.5 6	7.5 7.5 6	18 200 20 800 22 200	53 500 60 000 61 000	STF760RV1031g STF760RV1012g STF760RV1032Ag	9 8M 9M	808 808 802	978 978 1 032	6 6 5	6 6 5	1 880 1 850 2 430
761.425	1 079.602 1 079.602	787.4 787.4	787.4 787.4	846 845	Spec. 7.5	7.5 7.5	23 900 22 200	65 500 61 000	STF761RV1012g STF761RV1032g	8 9	807 810	1 026 1 026	5.5 6	6 6	2 390 2 390
770	1 075	770	770	847	7.5	7.5	23 100	63 500	STF770RV1011g	8M	819	1 022	6	6	2 220
780	1 070	780	780	853	6	6	22 800	64 500	STF780RV1013g	8	823	1 023	5	5	2 140
800	1 080 1 080 1 080 1 080	700 700 750 750	700 700 750 750	878 878 880 880	6 6 6	3 3 6 6	19 100 19 600 19 200 18 700	56 000 58 000 56 500 56 500	STF800RV1013g STF800RV1011g STF800RV1012g STF800RV1032g	8 8 8 9	843 843 843 843	1 045 1 045 1 032 1 032	5 5 5 5	2.5 2.5 5 5	1 920 1 910 2 050 2 050
820	1 100 1 100 1 130	745 745 650	720 720 650	892 892 891	6 6 Spec.	3 6 6	19 700 20 100 20 300	58 500 59 000 53 000	STF820RV1132g STF820RV1119g STF820RV11112g	SP 8M 8	863 863 867	1 065 1 052 1 081	5 5 5.5	2.5 5 5	2 000 1 990 2 000
	1 130 1 130 1 160	800 825 840	800 800 840	903 903 911	7.5 7.5 7.5	7.5 7.5 7.5	22 900 22 900 25 600	66 500 66 500 72 000	STF820RV1117g STF820RV1134g STF820RV1111Ag	8M SP 8	870 870 870	1 076 1 076 1 105	6 6 6	6 6 6	2 510 2 530 2 900
840	1 160	840	840	920	2	7.5	24 900	71 000	STF840RV1111g	8M	866	1 105	2	6	2 790
850	1 150 1 150 1 180	840 840 650	840 840 650	928 928 945	7.5 7.5 7.5	4 8 7.5	23 300 25 600 19 600	68 500 77 500 53 000	STF850RV1114g STF850RV1115g STF850RV1133g	8 8 9	900 900 900	1 111 1 093 1 125	6 6 6	3 6.5 6	2 610 2 600 2 260
	1 180 1 180	850 875	850 850	940 940	7.5 7.5	7.5 7.5	24 600 24 600	72 000 72 000	STF850RV1111g STF850RV1112Ag	8M 8M	900 900	1 125 1 125	6 6	6 6	2 850 2 880

Notes (1) Refer to pages D142 and D143.

The letter "M" indicates bearing for oil mist lubrication.

The letter "SP" indicates special design.

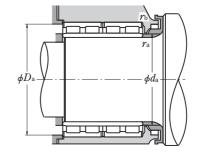
Please consult with NSK for detailed specification.

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 860 – 1348.95 mm

Railway Rolling Stock

Wind Power Industry



-		Во	undary Dimens (mm)	ions				nd Ratings N)		Fig-	Abuti	ment and Fille		ons	Mass (kg)
d	D	В	C_2	$F_{ m w}$	$ extcolor{r}_1$ min.	${m \gamma}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{ m a}$	D_{a}	$oldsymbol{\gamma}_{ m a}$ max.	$ m \emph{r}_b$ max.	approx.
860	1 130 1 160	670 735	670 710	934 940	6 7.5	6 4	18 400 20 400	56 500 60 000	STF860RV1132g STF860RV1133g	9	904 910	1 081 1 121	5 6	5 3	1 780 2 200
865 870 880	1 180 1 145 1 230	750 705 850	750 685 850	945.3 940 970	Spec. 9.5 7.5	7.5 6 7.5	23 800 20 500 29 100	67 000 61 000 81 000	STF865RV1111g STF870RV1111g STF880RV1211g	8 8 8	915 929 931	1 125 1 096 1 174	6 8 6	6 5 6	2 480 1 970 3 240
900	1 220 1 220 1 230	810 840 895	800 840 870	981 989 985	7.5 7.5 7.7	6 4 7.5	25 900 26 800 25 800	74 500 80 000 76 000	STF900RV1216g STF900RV1212g STF900RV1211g	8 8 8M	951 951 951	1 170 1 179 1 174	6 6 6	5 3 6	2 790 2 950 3 200
	1 280 1 280	930 930	930 930	1 000 1 000	7.5 7.5	7.5 7.5	32 000 33 000	89 500 93 000	STF900RV1213g STF900RV1217g	8	951 951	1 223 1 223	6 6	6 6	3 990 4 010
920	1 280	865	865	1 015	7.5	7.5	28 000	80 000	STF920RV1211Ag	8M	972	1 223	6	6	3 510
950	1 330 1 360	950 1 000	950 1 000	1 053 1 075	Spec. 9.5	9 5	33 500 37 500	97 000 108 000	STF950RV1314g STF950RV1311g	8	1 008 1 010	1 266 1 313	7.5 8	7.5 4	4 240 4 910
1 120	1 580	1 150	1 150	1 255	9.5	9.5	43 500	134 500	STF1120RV1511g	8	1 184	1 509	8	8	7 400
1 270	1 602	850	850	1 350	7.5	7.5	32 000	103 000	STF1270RV1612g	SP	1 329	1 538	6	6	4 130
1 300	1 655	890	880	1 391	7.5	7.5	34 000	110 500	STF1300RV1612g	SP	1 359	1 590	6	6	4 710
1 348.95	1 745	1 010	1 000	1 466	11.4	7.5	42 500	134 000	STF1348RV1711g	SP	1 423	1 678	9.5	6	6 240

Notes (1) Refer to pages D142 and D143.

The letter "M" indicates bearing for oil mist lubrication.

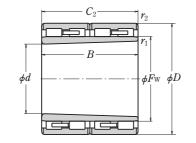
The letter "SP" indicates special design.

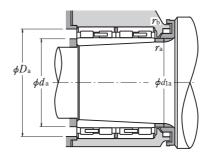
Please consult with NSK for detailed specification.

D 162

■Bearings for Rolling Mills

Four-Row Cylindrical Roller Bearings Bore Diameter 110.417 – 633.333 mm





	Boundary Dimensions (mm)						Basic Load Ratings (kN)			Fig-		Abutment a	nd Fillet Dir (mm)	nensions		Mass (kg)
d	D	B	C_2	$F_{ m w}$	${m \gamma}_1$ min.	${m \gamma}_2$ min.	$C_{\rm r}$	$C_{0\mathrm{r}}$	Bearing Numbers	ure(1)	$d_{ m a}$	$d_{1\mathrm{a}}$	D_{a}	$ m \emph{r}_a$ max.	$r_{ m b}$ max.	approx.
110.417	180	115	115	136	1	1	490	840	STF120RVK1801g	10	118	128	171	1	1	10
151.5	230	168	168	180	1	1	1 040	2 170	STF165RVK2331g	11	160	174	220	1	1	23.5
179.75	260	175	168	212	1.1	2	1 140	2 600	STF193RVK2602g	10	190	205	245	1	2	25.1
180	260	175	168	212	1.1	2	1 140	2 600	STF194RVK2602g	10	191	206	245	1	2	25
181.5	260	168	168	209	1	2	1 140	2 600	STF195RVK2602g	10	191	205	245	1	2	24.2
235.367	360	268	268	278	1.5	1.5	2 770	6 000	STF257RVK3631g	11	249	272	344	1.5	1.5	92.9
266.25	400	285	285	312	2	2	3 200	7 500	STF290RVK4031g	11	281	305	383	2	2	118
356.667	550 550	400 400	400 400	434 431.9	5 3	5 2.5	5 450 5 450	13 300 13 300	STF390RVK5531g STF390RVK5532g	12 12	385 378	419 412	519 527	4 2.5	4 2	328 328
412.335	650	488	488	494.5	3	4	8 900	21 100	STF453RVK6521g	SP	434	476	621	2.5	3	603
485	740	540	540	580	5	5	10 100	26 800	STF530RVK7431g	13	516	561	705	4	4	823
633.333	960	680	680	745.8	7.5	7.5	18 100	47 000	STF690RVK9632g	13	679	737	909	6	6	1 720

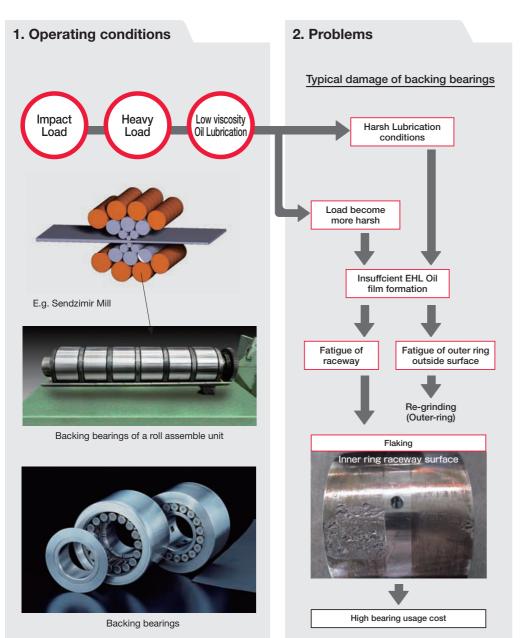
Notes (1) Refer to pages D142 and D143.

The letter "SP" indicates special design.

Please consult with NSK for detailed specification.

Backing Bearings for Multi-Roll Rolling **Cluster Mills**

- Higher reliability and longer operating life prevent unexpected accident
- Benefits @ Reduce maintenance cost
 - **3** Somoother rolling of backing bearing's roll Improves plate making precision.



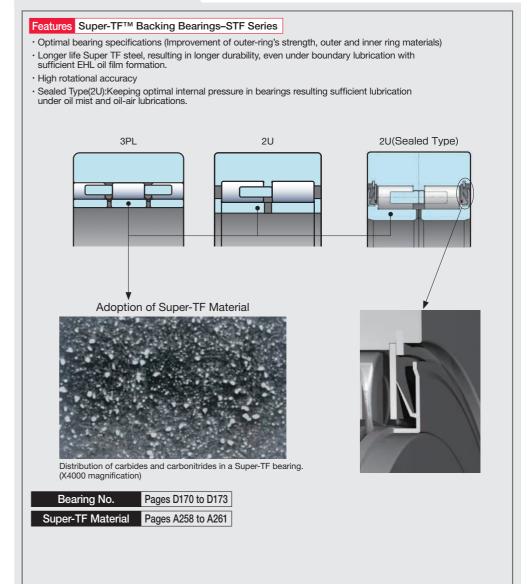






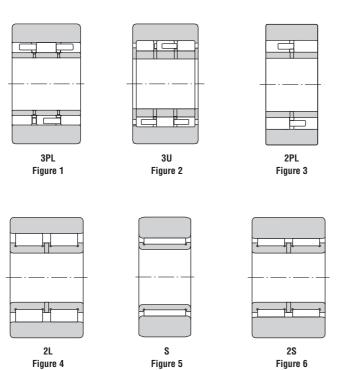
INDUSTRY SOLUTIONS

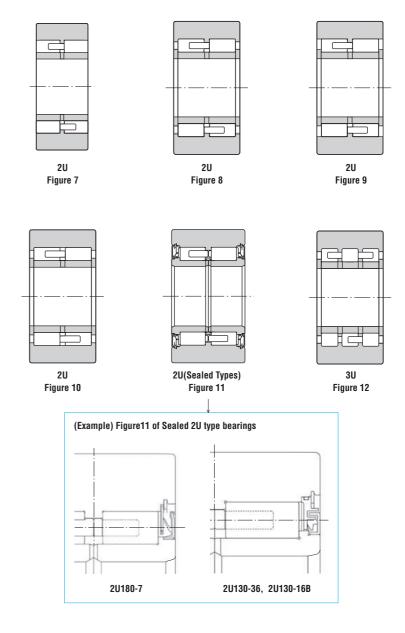
3. Countermeasures



D 166

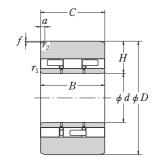
Figures of Typical Backing Bearings for Multi-Roll Rolling Mills





■Backing Bearings for Multi-Roll Rolling Cluster Mills

Bore Diameter 31.75 - 120 mm



		Boundary I	Dimensions			Basic Load	١	1 011111001010			Outer Ring E	dae Bevel		dial Thickness	Mass
d	D	B (m	nm) C	r_1	r_2	$C_{ m r}$ (kl)	$C_{0r}(^1)$	Radial Load Pu (kN)	Bearing Numbers	Figure(²)		Ü	VV	hen Delivered (mm)	(kg)
				min.				approx.			a	f		Н	approx.
31.75 50	76.2 120	46.23 80	45.85 80	1 1.5	0.8 1.5	94.5 257	174 385	91.8 147	2S31Z-5 2U50-4 *2U50-4g3	6 9	6.5	 0.042	22.2 34.976	0 to +0.010 ±0.010	1.3 5.2
	120	85	85	1	1.5	305	435	113	*2050-493 2U50-6 *2U50-693	9	6.5	0.042	34.984	±0.010	5.3
55	120	26	26	1.6	1.6	74.5	142	90.2	S55-2	5	_	_	32.5	-0.025 to -0.010	1.7
	120	52.2	52	1.6	1.6	159	375	185	*S55-2g5 S55-1 S55-1g5	5	7	0.041	32.485	-0.010 to +0.005	3.4
	120	52.2	52	1	1	186	298	115	2L55-1	4	5	0.036	32.5	0 to +0.010	3.2
60	160	95	95	1.1	1.5	400	590	290	2U60-4	9	6.5	0.042	49.984	±0.010	11.5
62 70 90	155 155 160 220	90 110 90 95	90 110 90 95	1.5 1.5 1.1 1.1	1 1 1 2	355 405 410 590	530 620 745 880	247 297 303 347	2U62-1 3U62-1 3PL70-1 2U90-18 *STF2U90-18q4	10 2 1 8	6 6 6	0.036 0.036 0.035 0.105	46.484 46.484 45 64.982	±0.010 -0.048 to -0.018	9.9 12.1 10.7 20.8
	220.02 220 220	96 120 122	94 119 119	1.5 1 1	1.5 3 3	520 685 685	730 1 020 1 020	333 411 410	*5172090-18g4 2U90-13 2U90-11 2U90-17	8 8 8SP	8 21 21	0.047 0.086 0.086	65 65 65	-0.010 to 0 -0.015 to 0 -0.015 to 0	20.5 26.0 27.0
	220 220 230	120 130 100	120 130 100	1 1 2.5	2 2 2	675 680 645	1 260 1 090 990	494 499 322	3U90-1 3U90-4 2U90-9	2 2SP 10SP	6 6 12	0.105 0.105 0.07	64.98 64.982 69.98	0 to +0.010 ±0.010 ±0.010	27.2 28.7 24.4
100	225 225	80 120	80 119	2 2	1.5 3	535 550	925 1 000	366 586	2PL100-3 2U100-14 *2U100-14q3	3 8	7.6 12	0.045 0.07	62.47 62.5	0 to +0.010 ±0.010	18.4 27.2
	225	120	120	2	2	715	1 350	542	3PL100-1A	1	8	0.093	62.47	0 to +0.010	27.5
100 110 115	260 280 260	130 165 140	130 165 140	2 2.5 1.1	2 2 2	950 1 120 940	1 580 1 880 1 660	617 818 613	2U100-15 3U110-4 3U115-3	10SP 2 2	12 12 12	0.07 0.072 0.209	79.97 84.965 72.47		41.5 60.2 42.1
120	280 300 350	165 160 165	165 160 165	2.5 2 2.5	2 2 2	1 190 1 180 1 370	2 060 1 960 2 220	802 847 1 140	2U120-15 3U120-4 2U120-14	9 2SP 9	12 12 12	0.072 0.07 0.072	79.965 89.966 114.965	±0.010	58.0 66.7 98.5

Notes (1)Cr and Cor of basic load ratings is not the limiting load. Cor is for reference.

(2)Refer to pages D168 and D169.

The letter "SP" indicate a special design.

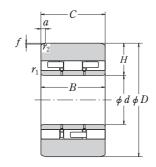
Remarks Outer rings are used for back-up roll, it must be use less than permissible radial Load(Pu)

Bearings marked * are special material design.

Bearing number of "STF" is adopted Super-TF™ material.

Please consult with NSK for selection and usage of bearings.

Bore Diameter 130 - 180 mm



		Boundary [1	d Ratings N)	Permissible Radial Load Pu		Fig-	Outer R	ing Edge Bevel		al Thickness en Delivered	Mass (kg)
d	D	B (m	m) C	$oldsymbol{r}_1$ min.	r_2	$C_{\rm r}$	$C_{0r}(^1)$	(kN) approx.	Bearing Numbers	ure(²	a	(mm)		(mm) H	approx.
130	300	132	129	2	4	1 040	1 580	590	2U130-32 *2U130-32g2	8SF	28.2	0.082	85	-0.015 to 0	52.3
	300.02 300	150 160	149 159.5	2 2	4 1.1	1 100 1 470	1 850 2 670	732 799	*STF2U130-32g3 2U130-34 3PL130-2C	9SF 1	25 9	0.145 0.209	85.01 84.95	-0.015 to 0 0 to +0.010	60.9 66.6
	300 300	172.64 172.64	172.64 172.64	2 2	4 4	1 580 1 580	2 930 2 930	862 862	*3PL130-2Cg2 3PL130-1C 3PL130-1F	1 1SF	10 10	0.131 0.131	84.95 84.95	0 to +0.010 0 to +0.010	71.8 72
	300.02 300 300	172.64	172.64 172.64 172.644	2 2 2	3 4 4	1 580 1 580 1 370	2 930 2 930 2 440	862 862 854	*3PL130-1Fg2 *STF3PL130-1Fg3 3PL130-1Y 3PL130-7B 2U130-26	1 1 9	25.4 25 12.7	0.148 0.087 0.2	84.95	-0.010 to 0 0 to +0.010 ±0.010	72.1 72 69.1
	300		172.644 172.644	3	4 4 2	1 240	2 150	854 808 800	2U130-26 2U130-36 *2U130-36g2 2U130-16B	11	25	0.2 0.15 0.05		±0.010 ±0.010	68.8
179.984	300 350	172.64 175 224 224.25	171.6 175 220.66 220	2 2.5 3 3	4 2 3.3 4	1 320 1 450 1 950 2 250	2 300 2 410 3 550 4 250	866 1 230 1 460 1 570	3U130-2 2U130-29B 2U179Z-3 2U179Z-14	12 9 11 11	10 12 15.9 60	0.131 0.10 0.093 0.175	84.95 109.965	0 to +0.010 ±0.010 -0.015 to 0	69.4 102 168 161
180	406.42	171.04 171.04 171.04	171.04 171.04 171.04	2.1 2.1 0.6	4 4 1	2 060 2 060 1 900	3 800 3 800 3 300	1 220 1 220 1 150	*STF2U179Z-14gA5 3PL180-3B 3PL180-3E 2U180-3 *STF2U180-3q3	1 1 9	25 25 25	0.145 0.145 0.145	113.155 113.155 113.16	-0.010 to 0 ±0.005 -0.010 to 0	129 129 125
	406.42	171.04 171.04 171.04	170 170 171.04	2 2 3	3 3 4	1 650 1 650 1 560	2 850 2 850 2 660	1 220 1 220 1 150	2U180-5 2U180-5A 2U180-7 *STF2U180-7g3	8 8 8	25 36.5 25	0.145 0.212 0.25	113.2 113.2 113.155	-0.015 to 0 -0.015 to 0 ±0.010	124 124 123
	406.42 406.4	176 217	170 217	2 2.1	3 1.5	1 650 2 550	2 850 5 000	1 220 1 560	2U180-8 3PL180-1B *3PL180-1Bg2	8	25 10	0.145 0.058	113.2 113.16	-0.015 to 0 -0.012 to 0	128 164
	406.4 406.4	224 224	220 220	2.1	1.5 1.5	2 050	3 750 3 750	1 580 1 580	3U180-2 *3U180-2g2 3U180-3	12 12	10	0.058 0.058	113.16 113.205	-0.012 to 0 -0.015 to 0	162 162
	406.42	224	224	2.1	1.5	2 610	5 150	1 610 1 510	3PL180-2A *3PL180-2Ag2 2U180-4	1	10	0.058		-0.012 to 0	169
	-1								*STF2U180-4g3						

Notes (1) Cr and Cor of basic load ratings is not the limiting load. Cor is for reference.

(2) Refer to pages D168 and D169.

The letter "SP" indicate a special design.

Remarks Outer rings are used for back-up roll, it must be use less than permissible radial Load(Pu)

Bearings marked * are special material design.

Bearing number of "STF" is adopted Super-TF™ material.

Please consult with NSK for selection and usage of bearings.

APPENDICES

Appendix Table 1	1	Conversion Table from
		SI (International Units) System E 002
Appendix Table 2	2	$N\!-\!kgf$ Force Conversion Table $\!$
Appendix Table 3	3	$kg\!-\!lb$ Mass Conversion Table $\!$
Appendix Table 4	4	$^{\circ}C^{\circ}F$ Temperature Conversion Table $\cdots\!$
Appendix Table 5	5	$\textbf{Viscosity Conversion Table} \\ \\ \texttt{E} \ \texttt{007}$
Appendix Table 6	6	$inch-mm \ \textbf{Conversion Table} \\ \texttt{E} \ \texttt{008}$
Appendix Table 7	7	$\textbf{Hardness Conversion Table} \\ \cdots \\ \textbf{E 010}$
Appendix Table 8	8	Physical and Mechanical Properties of
		Materials E 011
Appendix Table 9	9	Tolerances for Shaft Diameters $\cdots\cdots\cdots$ E 012
Appendix Table 10	0	Tolerances for Housing Bore Diameters \cdots E $\rm 014$
Appendix Table 11	1	Values of Standard Tolerance Grades $IT\cdot\cdot$ E 016
Appendix Table 12	2	Speed Factor f_n E 018
Appendix Table 13	3	Fatigue Life Factor $f_{ m h}$ and
		Fatigue Life $L\!-\!L_h$ E 019
Appendix Table 14	4	Index of Inch Design Tapered Roller
		Bearings E 020

Appendix Table 1 Conversion Table from SI (International Units) System

Comparison of SI, CGS, and Engineering Units

Units Unit System	Length	ı 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/m²	kgf/m²	$kgf\cdot m$	kgf·m/s

Conversion Factors from SI Units

Parameter	SI Units		Units other than S	I	Conversion Factors
raidilielei	Names of Units	Symbols	Name of Units	Symbols	from SI Units
Angle	Radian	rad	Degree Minute Second	o , ″	180/π 10 800/π 648 000/π
Length	Meter	m	Micron Angstrom	μ Å	10 ⁶ 10 ¹⁰
Area	Square meter	m ²	Are Hectare	a ha	10 ⁻² 10 ⁻⁴
Volume	Cubic meter	m ³	Liter Deciliter	l, L dl, dL	10 ³ 10 ⁴
Time	Second	s	Minute Hour Day	min h d	1/60 1/3 600 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 Knot	km/h kn	3 600/1 000 3 600/1 852
Acceleration	Meter per second per second	m/s ²	Gal g	Gal G	10 ² 1/9.806 65
Mass	Kilogram	kg	Ton	t	10-3
Force	Newton	N	Kilogram-force Ton-force Dyne	kgf tf dyn	1/9.806 65 1/ (9.806 65×10 ³) 10 ⁵
Torque or Moment	Newton · meter	N⋅m	Kilogram-force meter	$kgf \cdot m$	1/9.806 65
Stress	Pascal	Pa (N/m²)	Kilogram-force per square centimeter Kilogram-force per square millimeter		1/ (9.806 65×10 ⁴) 1/ (9.806 65×10 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)

			s irom 31 omis (continueu)		
Parameter	SI Units		Units other than S	I	Conversion Factors
T didinotoi	Names of Units	Symbols	Names of Units	Units	from SI Units
Pressure	Pascal (Newton per square meter)	Pa (N/m²)	Kilogram-force per square meter Water Column Mercury Column Torr Bar Atmosphere	kgf/m² mH ₂ O mmHg Torr bar atm	1/9.806 65 1/(9.806 65×10³) 760/(1.013 25×10⁵) 760/(1.013 25×10⁵) 10⁻⁵ 1/(1.013 25×10⁵)
Energy	Joule (Newton · meter)	J (N·m)	Erg Calorie (International) Kilogram-force meter Kilowatt hour French horse power hour	$\begin{array}{c} erg \\ cal_{IT} \\ kgf \cdot m \\ kW \cdot h \\ PS \cdot h \end{array}$	10 ⁷ 1/4.186 8 1/9.806 65 1/(3.6×10 ⁶) ≈ 3.776 72×10 ⁻⁷
Work	Watt (Joule per second)	W (J/s)	Kilogram-force meter per second Kilocalorie per hour French horse power	kgf·m/s kcal/h PS	1/9.806 65 1/1.163 ≈ 1/735.498 8
Viscosity, Viscosity Index	Pascal second	Pa·s	Poise	P	10
Kinematic Viscosity, Kinematic Viscosity Index	Square meter per second	m²/s	Stokes Centistokes	St cSt	10 ⁴ 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 Density	Tesla	Т	Gauss Gamma	Gs γ	10 ⁴ 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 ΔT = $\Delta \theta$. However, ΔT 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

E 002

Appendix Table 2 N-kgf Force Conversion Table

Appendix Table 3 kg-lb Mass Conversion Table

[Method of using this table] For example, to convert 10N 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 10N is 1.0197kgf. To convert 10kgf into N, read the figure in the left N column of the same row, which indicates that the answer is 98.066N.

1 N=0.1019716 kgf 1 kgf=9.80665 N

[Method of using this table] For example, to convert 10kg 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 10kg is 22.046lb. To convert 10lb into kg, read the figure in the left kg column of the same row, which indicates that the answer is 4.536kg.

1 kg=2.2046226 lb 1 lb=0.45359237 kg

N		kgf	N		kgf	N		kgf	•	kg		lb		kg		lb	•	kg		lb
		1181						1181		118			_	**8		15	_	**8		
9.8066 19.613	1 2 3	0.1020 0.2039	333.43 343.23 353.04	34 35 36	3.4670 3.5690	657.05 666.85	67 68 69	6.8321 6.9341		0.454 0.907	1 2 3	2.205 4.409		15.422 15.876	34 35 36	74.957 77.162		30.391 30.844	67 68 69	147.71 149.91
29.420 39.227 49.033	3 4 5	0.3059 0.4079 0.5099	353.04 362.85 372.65	36 37 38	3.6710 3.7729 3.8749	676.66 686.47 696.27	69 70 71	7.0360 7.1380 7.2400		1.361 1.814 2.268	3 4 5	6.614 8.818 11.023		16.329 16.783 17.237	36 37 38	79.366 81.571 83.776		31.298 31.751 32.205	69 70 71	152.12 154.32 156.53
	5	0.5099	372.00	36	3.0749	090.27	/ 1	7.2400		2.200	5	11.025			30	83.770		32.205	<i>,</i> ,	150.55
58.840 68.647 78.453	6 7	0.6118 0.7138	382.46 392.27	39 40	3.9769 4.0789	706.08 715.89	72 73	7.3420 7.4439		2.722 3.175	6	13.228 15.432		17.690 18.144 18.597	39 40	85.980 88.185		32.659 33.112 33.566	72 73	158.73 160.94
78.453 88.260 98.066	8 9 10	0.8158 0.9177 1.0197	402.07 411.88 421.69	41 42 43	4.1808 4.2828 4.3848	725.69 735.50 745.31	74 75 76	7.5459 7.6479 7.7498		3.629 4.082 4.536	8 9 10	17.637 19.842 22.046		18.597 19.051 19.504	41 42 43	90.390 92.594 94.799		33.566 34.019 34.473	74 75 76	163.14 165.35 167.55
	10			43			70				10				43				70	
107.87 117.68	11 12	1.1217 1.2237	431.49 441.30	44 45	4.4868 4.5887	755.11 764.92	77 78	7.8518 7.9538		4.990 5.443	11 12	24.251 26.455		19.958 20.412	44 45	97.003 99.208		34.927 35.380	77 78	169.76 171.96
127.49 137.29 147.10	13 14 15	1.3256 1.4276 1.5296	451.11 460.91 470.72	46 47 48	4.6907 4.7927 4.8946	774.73 784.53 794.34	79 80 81	8.0558 8.1577 8.2597		5.897 6.350 6.804	13 14 15	28.660 30.865 33.069		20.865 21.319 21.772	46 47 48	101.41 103.62 105.82		35.834 36.287 36.741	79 80 81	174.17 176.37 178.57
	13	1.5250	470.72	40	4.0540		01				13				40			30.741	01	
156.91 166.71	16 17	1.6315 1.7335	480.53 490.33	49 50	4.9966 5.0986	804.15 813.95	82 83	8.3617 8.4636		7.257 7.711	16 17	35.274 37.479		22.226 22.680	49 50	108.03 110.23		37.195 37.648	82 83	180.78 182.98
166.71 176.52 186.33 196.13	18 19 20	1.8355 1.9375 2.0394	500.14 509.95 519.75	51 52 53	5.2006 5.3025 5.4045	823.76 833.57 843.37	84 85 86	8.5656 8.6676 8.7696		8.165 8.618 9.072	18 19 20	39.683 41.888 44.092		23.133 23.587 24.040	51 52 53	112.44 114.64 116.84		38.102 38.555 39.009	84 85 86	185.19 187.39 189.60
							00				20				30					
205.94 215.75	21	2.1414 2.2434	529.56 539.37	54 55	5.5065 5.6084	853.18 862.99	87 88	8.8715 8.9735		9.525 9.979	21	46.297 48.502		24.494 24.948	54 55	119.05 121.25		39.463 39.916	87 88	191.80 194.01
225.55 235.36 245.17	23 24 25	2.3453 2.4473 2.5493	549.17 558.98 568.79	56 57 58	5.7104 5.8124 5.9144	872.79 882.60 892.41	89 90 91	9.0755 9.1774 9.2794		10.433 10.886 11.340	23 24 25	50.706 52.911 55.116		25.401 25.855 26.308	56 57 58	123.46 125.66 127.87		40.370 40.823 41.277	89 90 91	196.21 198.42 200.62
254.97 264.78	26 27	2.6513 2.7532	578.59 588.40	59 60	6.0163 6.1183	902.21 912.02	92 93	9.3814 9.4834		11.793 12.247	26 27	57.320 59.525		26.762 27.216	59 60	130.07 132.28		41.730 42.184	92 93	202.83 205.03
274.59 284.39 294.20	28 29 30	2.8552 2.9572 3.0591	598.21 608.01 617.82	61 62 63	6.2203 6.3222 6.4242	921.83 931.63 941.44	94 95 96	9.5853 9.6873 9.7893		12.701 13.154 13.608	28 29 30	61.729 63.934 66.139		27.669 28.123 28.576	61 62 63	134.48 136.69 138.89		42.638 43.091 43.545	94 95 96	207.23 209.44 211.64
304.01 313.81	31 32	3.1611 3.2631	627.63 637.43	64 65	6.5262 6.6282	951.25 961.05	97 98	9.8912 9.9932		14.061 14.515	31 32	68.343 70.548		29.030 29.484	64 65	141.10 143.30		43.998 44.452	97 98	213.85 216.05
323.62	33	3.3651	647.24	66	6.7301	970.86	99	10.095		14.969	33	72.753	-	29.937	66	145.51		44.906	99	218.26

Appendix Table 5 Viscosity Conversion Table

Appendix Table 4 $\,^{\circ}\text{C-}^{\circ}\text{F}$ Temperature Conversion Table

[Method of using this table] For example, to convert 38°C into ${}^\circ F$, read the figure in the right ${}^\circ F$ 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.

$$C = \frac{5}{9}(F - 32)$$

 $F = 32 + \frac{9}{2}C$

						_						
°C		°F	°C		°F		°C		°F	°C		°F
-73.3 -62.2 -51.1 -40.0 -34.4	-100 - 80 - 60 - 40 - 30	-148.0 -112.0 - 76.0 - 40.0 - 22.0	0.0 0.6 1.1 1.7 2.2	32 33 34 35 36	89.6 91.4 93.2 95.0 96.8	•	21.7 22.2 22.8 23.3 23.9	71 72 73 74 75	159.8 161.6 163.4 165.2 167.0	43.3 46.1 48.9 51.7 54.4	110 115 120 125 130	230 239 248 257 266
-28.9 -23.3 -17.8 -17.2 -16.7	- 20 - 10 0 1 2	- 4.0 14.0 32.0 33.8 35.6	2.8 3.3 3.9 4.4 5.0	37 38 39 40 41	98.6 100.4 102.2 104.0 105.8		24.4 25.0 25.6 26.1 26.7	76 77 78 79 80	168.8 170.6 172.4 174.2 176.0	57.2 60.0 65.6 71.1 76.7	135 140 150 160 170	275 284 302 320 338
-16.1 -15.6 -15.0 -14.4 -13.9	3 4 5 6 7	37.4 39.2 41.0 42.8 44.6	5.6 6.1 6.7 7.2 7.8	42 43 44 45 46	107.6 109.4 111.2 113.0 114.8		27.2 27.8 28.3 28.9 29.4	81 82 83 84 85	177.8 179.6 181.4 183.2 185.0	82.2 87.8 93.3 98.9 104.4	180 190 200 210 220	356 374 392 410 428
-13.3 -12.8 -12.2 -11.7 -11.1	8 9 10 11 12	46.4 48.2 50.0 51.8 53.6	8.3 8.9 9.4 10.0 10.6	47 48 49 50 51	116.6 118.4 120.2 122.0 123.8		30.0 30.6 31.1 31.7 32.2	86 87 88 89 90	186.8 188.6 190.4 192.2 194.0	110.0 115.6 121.1 148.9 176.7	230 240 250 300 350	446 464 482 572 662
-10.6 -10.0 - 9.4 - 8.9 - 8.3	13 14 15 16 17	55.4 57.2 59.0 60.8 62.6	11.1 11.7 12.2 12.8 13.3	52 53 54 55 56	125.6 127.4 129.2 131.0 132.8		32.8 33.3 33.9 34.4 35.0	91 92 93 94 95	195.8 197.6 199.4 201.2 203.0	204 232 260 288 316	400 450 500 550 600	752 842 932 1022 1112
- 7.8 - 7.2 - 6.7 - 6.1 - 5.6	18 19 20 21 22	64.4 66.2 68.0 69.8 71.6	13.9 14.4 15.0 15.6 16.1	57 58 59 60 61	134.6 136.4 138.2 140.0 141.8		35.6 36.1 36.7 37.2 37.8	96 97 98 99 100	204.8 206.6 208.4 210.2 212.0	343 371 399 427 454	650 700 750 800 850	1202 1292 1382 1472 1562
- 5.0 - 4.4 - 3.9 - 3.3 - 2.8	23 24 25 26 27	73.4 75.2 77.0 78.8 80.6	16.7 17.2 17.8 18.3 18.9	62 63 64 65 66	143.6 145.4 147.2 149.0 150.8		38.3 38.9 39.4 40.0 40.6	101 102 103 104 105	213.8 215.6 217.4 219.2 221.0	482 510 538 593 649	900 950 1000 1100 1200	1652 1742 1832 2012 2192
- 2.2 - 1.7 - 1.1 - 0.6	28 29 30 31	82.4 84.2 86.0 87.8	19.4 20.0 20.6 21.1	67 68 69 70	152.6 154.4 156.2 158.0		41.1 41.7 42.2 42.8	106 107 108 109	222.8 224.6 226.4 228.2	704 760 816 871	1300 1400 1500 1600	2372 2552 2732 2912

Kinematic Viscosity		bolt ersal (sec)	Redv	Type wood sec)	Engler E (degree)	Kinematic Viscosity	Say Univ SUS		No.1 Redw R (s	ood	Engler E (degree)
mm ² /s	100°F	210°F	50°C	100°C		mm ² /s	100°F	210°F	50°C	100°C	
2	32.6	32.8	30.8	31.2	1.14	35	163	164	144	147	4.70
3	36.0	36.3	33.3	33.7	1.22	36	168	170	148	151	4.83
4	39.1	39.4	35.9	36.5	1.31	37	172	173	153	155	4.96
5	42.3	42.6	38.5	39.1	1.40	38	177	178	156	159	5.08
6	45.5	45.8	41.1	41.7	1.48	39	181	183	160	164	5.21
7	48.7	49.0	43.7	44.3	1.56	40	186	187	164	168	5.34
8	52.0	52.4	46.3	47.0	1.65	41	190	192	168	172	5.47
9	55.4	55.8	49.1	50.0	1.75	42	195	196	172	176	5.59
10	58.8	59.2	52.1	52.9	1.84	43	199	201	176	180	5.72
11	62.3	62.7	55.1	56.0	1.93	44	204	205	180	185	5.85
12	65.9	66.4	58.2	59.1	2.02	45	208	210	184	189	5.98
13	69.6	70.1	61.4	62.3	2.12	46	213	215	188	193	6.11
14	73.4	73.9	64.7	65.6	2.22	47	218	219	193	197	6.24
15	77.2	77.7	68.0	69.1	2.32	48	222	224	197	202	6.37
16	81.1	81.7	71.5	72.6	2.43	49	227	228	201	206	6.50
17	85.1	85.7	75.0	76.1	2.54	50	231	233	205	210	6.63
18	89.2	89.8	78.6	79.7	2.64	55	254	256	225	231	7.24
19	93.3	94.0	82.1	83.6	2.76	60	277	279	245	252	7.90
20	97.5	98.2	85.8	87.4	2.87	65	300	302	266	273	8.55
21	102	102	89.5	91.3	2.98	70	323	326	286	294	9.21
22	106	107	93.3	95.1	3.10	75	346	349	306	315	9.89
23	110	111	97.1	98.9	3.22	80	371	373	326	336	10.5
24	115	115	101	103	3.34	85	394	397	347	357	11.2
25	119	120	105	107	3.46	90	417	420	367	378	11.8
26	123	124	109	111	3.58	95	440	443	387	399	12.5
27	128	129	112	115	3.70	100	464	467	408	420	13.2
28	132	133	116	119	3.82	120	556	560	490	504	15.8
29	137	138	120	123	3.95	140	649	653	571	588	18.4
30	141	142	124	127	4.07	160	742	747	653	672	21.1
31	145	146	128	131	4.20	180	834	840	734	757	23.7
32	150	150	132	135	4.32	200	927	933	816	841	26.3
33	154	155	136	139	4.45	250	1 159	1 167	1 020	1 051	32.9
34	159	160	140	143	4.57	300	1 391	1 400	1 224	1 241	39.5

Remark 1mm²/s=1cSt

Appendix Table 6 inch - mm Conversion Tab

1"=25.4 mm

										. 20	. 111111
inch	0	1	2	3	4	5	6	7	8	9	10
Fraction Decimal						mm					
0 0.000000	0.000	25.400	50.800 51.197 51.594 51.991	76.200	101.600	127.000	152.400	177.800	203.200	228.600	254.000
1/64 0.015625	0.397	25.797		76.597	101.997	127.397	152.797	178.197	203.597	228.997	254.397
1/32 0.031250	0.794	26.194		76.994	102.394	127.794	153.194	178.594	203.994	229.394	254.794
3/64 0.046875	1.191	26.591		77.391	102.791	128.191	153.591	178.991	204.391	229.791	255.191
1/16 0.062500 5/64 0.078125 3/32 0.093750 7/64 0.109375	1.588 1.984 2.381 2.778	26.988 27.384 27.781 28.178	52.388 52.784 53.181 53.578	77.788 78.184 78.581 78.978	103.188 103.584 103.981 104.378	128.588 128.984 129.381 129.778	153.988 154.384 154.781 155.178	179.388 179.784 180.181 180.578	204.788 205.184 205.581 205.978	230.188 230.584 230.981 231.378	255.588 255.984 256.381 256.778
1/8 0.125000 9/64 0.140625 5/32 0.156250 11/64 0.171875	3.175	28.575	53.975	79.375	104.775	130.175	155.575	180.975	206.375	231.775	257.175
	3.572	28.972	54.372	79.772	105.172	130.572	155.972	181.372	206.772	232.172	257.572
	3.969	29.369	54.769	80.169	105.569	130.969	156.369	181.769	207.169	232.569	257.969
	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 13/64 0.203125 7/32 0.218750 15/64 0.234375	4.762 5.159 5.556 5.953	30.162 30.559 30.956 31.353	55.562 55.959 56.356 56.753	80.962 81.359 81.756 82.153	106.362 106.759 107.156 107.553	131.762 132.159 132.556 132.953	157.162 157.559 157.956 158.353	182.562 182.959 183.356 183.753	207.962 208.359 208.756 209.153	233.362 233.759 234.156 234.553	258.762 259.159 259.556 259.953
1/4 0.250000	6.350	31.750	57.150 57.547 57.944 58.341	82.550	107.950	133.350	158.750	184.150	209.550	234.950	260.350
17/64 0.265625	6.747	32.147		82.947	108.347	133.747	159.147	184.547	209.947	235.347	260.747
9/32 0.281250	7.144	32.544		83.344	108.744	134.144	159.544	184.944	210.344	235.744	261.144
19/64 0.296875	7.541	32.941		83.741	109.141	134.541	159.941	185.341	210.741	236.141	261.541
5/16 0.312500 21/64 0.328125 11/32 0.343750 23/64 0.359375	7.938 8.334 8.731 9.128	33.338 33.734 34.131 34.528	58.738 59.134 59.531 59.928	84.138 84.534 84.931 85.328	109.538 109.934 110.331 110.728	134.938 135.334 135.731 136.128	160.338 160.734 161.131 161.528	185.738 186.134 186.531 186.928	211.138 211.534 211.931 212.328	236.538 236.934 237.331 237.728	261.938 262.334 262.731 263.128
3/8 0.375000 25/64 0.390625 13/32 0.406250 27/64 0.421875	9.525 9.922 10.319 10.716	34.925 35.322 35.719 36.116	60.325 60.722 61.119 61.516	85.725 86.122 86.519 86.916	111.125 111.522 111.919 112.316	136.525 136.922 137.319 137.716	161.925 162.322 162.719 163.116	187.325 187.722 188.119 188.516	212.725 213.122 213.519 213.916	238.125 238.522 238.919 239.316	263.525 263.922 264.319 264.716
7/16 0.437500 29/64 0.453125 15/32 0.468750 31/64 0.484375	11.112 11.509 11.906 12.303	36.512 36.909 37.306 37.703	61.912 62.309 62.706 63.103	87.312 87.709 88.106 88.503	112.712 113.109 113.506 113.903	138.112 138.509 138.906 139.303	163.512 163.909 164.306 164.703	188.912 189.309 189.706 190.103	214.312 214.709 215.106 215.503	239.712 240.109 240.506 240.903	265.112 265.509 265.906 266.303
1/2 0.500000 33/64 0.515625 17/32 0.531250 35/64 0.546875	12.700	38.100	63.500	88.900	114.300	139.700	165.100	190.500	215.900	241.300	266.700
	13.097	38.497	63.897	89.297	114.697	140.097	165.497	190.897	216.297	241.697	267.097
	13.494	38.894	64.294	89.694	115.094	140.494	165.894	191.294	216.694	242.094	267.494
	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 37/64 0.578125 19/32 0.593750 39/64 0.609375	14.288	39.688	65.088	90.488	115.888	141.288	166.688	192.088	217.488	242.888	268.288
	14.684	40.084	65.484	90.884	116.284	141.684	167.084	192.484	217.884	243.284	268.684
	15.081	40.481	65.881	91.281	116.681	142.081	167.481	192.881	218.281	243.681	269.081
	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 41/64 0.640625 21/32 0.656250 43/64 0.671875	15.875	41.275	66.675	92.075	117.475	142.875	168.275	193.675	219.075	244.475	269.875
	16.272	41.672	67.072	92.472	117.872	143.272	168.672	194.072	219.472	244.872	270.272
	16.669	42.069	67.469	92.869	118.269	143.669	169.069	194.469	219.869	245.269	270.669
	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 45/64 0.703125 23/32 0.718750 47/64 0.734375	17.462	42.862	68.262	93.662	119.062	144.462	169.862	195.262	220.662	246.062	271.462
	17.859	43.259	68.659	94.059	119.459	144.859	170.259	195.659	221.059	246.459	271.859
	18.256	43.656	69.056	94.456	119.856	145.256	170.656	196.056	221.456	246.856	272.256
	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 49/64 0.765625 25/32 0.781250 51/64 0.796875	19.050	44.450	69.850	95.250	120.650	146.050	171.450	196.850	222.250	247.650	273.050
	19.447	44.847	70.247	95.647	121.047	146.447	171.847	197.247	222.647	248.047	273.447
	19.844	45.244	70.644	96.044	121.444	146.844	172.244	197.644	223.044	248.444	273.844
	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 53/64 0.828125 27/32 0.843750 55/64 0.859375	20.638	46.038	71.438	96.838	122.238	147.638	173.038	198.438	223.838	249.238	274.638
	21.034	46.434	71.834	97.234	122.634	148.034	173.434	198.834	224.234	249.634	275.034
	21.431	46.831	72.231	97.631	123.031	148.431	173.831	199.231	224.631	250.031	275.431
	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 57/64 0.890625 29/32 0.906250 59/64 0.921875	22.225	47.625	73.025	98.425	123.825	149.225	174.625	200.025	225.425	250.825	276.225
	22.622	48.022	73.422	98.822	124.222	149.622	175.022	200.422	225.822	251.222	276.622
	23.019	48.419	73.819	99.219	124.619	150.019	175.419	200.819	226.219	251.619	277.019
	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 61/64 0.953125 31/32 0.968750 63/64 0.984375	23.812 24.209 24.606 25.003	49.212 49.609 50.006 50.403	74.612 75.009 75.406 75.803	100.012 100.409 100.806 101.203	125.412 125.809 126.206 126.603	150.812 151.209 151.606 152.003	176.212 176.609 177.006 177.403	201.612 202.009 202.406 202.803	227.012 227.409 227.806 228.203	252.412 252.809 253.206 253.603	277.812 278.209 278.606 279.003

1 =Z3.4 IIIII	.4 mm	=25.	۱″	1
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in	ch	11	12	13	14	15	16	17	18	19	20
Fraction	n Decimal					m	m				_
0 1/16 1/8 3/16	0.0000 0.0625 0.1250 0.1875	279.400 280.988 282.575 284.162	304.800 306.388 307.975 309.562	330.200 331.788 333.375 334.962	355.600 357.188 358.775 360.362	381.000 382.588 384.175 385.762	406.400 407.988 409.575 411.162	431.800 433.388 434.975 436.562	457.200 458.788 460.375 461.962	482.600 484.188 485.775 487.362	508.000 509.588 511.175 512.762
1/4 5/16 3/8 7/16	0.2500 0.3125 0.3750 0.4375	285.750 287.338 288.925 290.512	311.150 312.738 314.325 315.912	336.550 338.138 339.725 341.312	361.950 363.538 365.125 366.712	387.350 388.938 390.525 392.112	412.750 414.338 415.925 417.512	438.150 439.738 441.325 442.912	463.550 465.138 466.725 468.312	488.950 490.538 492.125 493.712	514.350 515.938 517.525 519.112
1/2 9/16 5/8 11/16	0.5000 0.5625 0.6250 0.6875	292.100 293.688 295.275 296.862	317.500 319.088 320.675 322.262	342.900 344.488 346.075 347.662	368.300 369.888 371.475 373.062	393.700 395.288 396.875 398.462	419.100 420.688 422.275 423.862	444.500 446.088 447.675 449.262	469.900 471.488 473.075 474.662	495.300 496.888 498.475 500.062	520.700 522.288 523.875 525.462
3/4 13/16 7/8 15/16	0.7500 0.8125 0.8750 0.9375	298.450 300.038 301.625 303.212	323.850 325.438 327.025 328.612	349.250 350.838 352.425 354.012	374.650 376.238 377.825 379.412	400.050 401.638 403.225 404.812	425.450 427.038 428.625 430.212	450.850 452.438 454.025 455.612	476.250 477.838 479.425 481.012	501.650 503.238 504.825 506.412	527.050 528.638 530.225 531.812

1"=25.4 mm

in	ch	21	22	23	24	25	26	27	28	29	30
Fraction	Decimal					m	m				
0 1/16 1/8 3/16	0.0000 0.0625 0.1250 0.1875	533.400 534.988 536.575 538.162	558.800 560.388 561.975 563.562	584.200 585.788 587.375 588.962	609.600 611.188 612.775 614.362	635.000 636.588 638.175 639.762	660.400 661.988 663.575 665.162	685.800 687.388 688.975 690.562	711.200 712.788 714.375 715.962	736.600 738.188 739.775 741.362	762.000 763.588 765.175 766.762
1/4 5/16 3/8 7/16	0.2500 0.3125 0.3750 0.4375	539.750 541.338 542.925 544.512	565.150 566.738 568.325 569.912	590.550 592.138 593.725 595.312	615.950 617.538 619.125 620.712	641.350 642.938 644.525 646.112	666.750 668.338 669.925 671.512	692.150 693.738 695.325 696.912	717.550 719.138 720.725 722.312	742.950 744.538 746.125 747.712	768.350 769.938 771.525 773.112
1/2 9/16 5/8 11/16	0.5000 0.5625 0.6250 0.6875	546.100 547.688 549.275 550.862	571.500 573.088 574.675 576.262	596.900 598.488 600.075 601.662	622.300 623.888 625.475 627.062	647.700 649.288 650.875 652.462	673.100 674.688 676.275 677.862	698.500 700.088 701.675 703.262	723.900 725.488 727.075 728.662	749.300 750.888 752.475 754.062	774.700 776.288 777.875 779.462
3/4 13/16 7/8 15/16	0.7500 0.8125 0.8750 0.9375	552.450 554.038 555.625 557.212	577.850 579.438 581.025 582.612	603.250 604.838 606.425 608.012	628.650 630.238 631.825 633.412	654.050 655.638 657.225 658.812	679.450 681.038 682.625 684.212	704.850 706.438 708.025 709.612	730.250 731.838 733.425 735.012	755.650 757.238 758.825 760.412	781.050 782.638 784.225 785.812

1"=25.4 mm

in	ch	31	32	33	34	35	36	37	38	39	40
Fraction	Decimal					m	m				
0 1/16 1/8 3/16	0.0000 0.0625 0.1250 0.1875	787.400 788.988 790.575 792.162	812.800 814.388 815.975 817.562	838.200 839.788 841.375 842.962	863.600 865.188 866.775 868.362	889.000 890.588 892.175 893.762	914.400 915.988 917.575 919.162	939.800 941.388 942.975 944.562	965.200 966.788 968.375 969.962	990.600 992.188 993.775 995.362	1016.000 1017.588 1019.175 1020.762
1/4 5/16 3/8 7/16	0.2500 0.3125 0.3750 0.4375	793.750 795.338 796.925 798.512	819.150 820.738 822.325 823.912	844.550 846.138 847.725 849.312	869.950 871.538 873.125 874.712	895.350 896.938 898.525 900.112	920.750 922.338 923.925 925.512	946.150 947.738 949.325 950.912	971.550 973.138 974.725 976.312	996.950 998.538 1000.125 1001.712	1022.350 1023.938 1025.525 1027.112
1/2 9/16 5/8 11/16	0.5000 0.5625 0.6250 0.6875	800.100 801.688 803.275 804.862	825.500 827.088 828.675 830.262	850.900 852.488 854.075 855.662	876.300 877.888 879.475 881.062	901.700 903.288 904.875 906.462	927.100 928.688 930.275 931.862	952.500 954.088 955.675 957.262	977.900 979.488 981.075 982.662	1003.300 1004.888 1006.475 1008.062	1028.700 1030.288 1031.875 1033.462
3/4 13/16 7/8 15/16	0.7500 0.8125 0.8750 0.9375	806.450 808.038 809.625 811.212	831.850 833.438 835.025 836.612	857.250 858.838 860.425 862.012	882.650 884.238 885.825 887.412	908.050 909.638 911.225 912.812	933.450 935.038 936.625 938.212	958.850 960.438 962.025 963.621	984.250 985.838 987.425 989.012	1009.650 1011.238 1012.825 1014.412	1035.050 1036.638 1038.225 1039.812

E 008

Appendix Table 7 Hardness Conversion Table (Reference)

Rockwell C Scale Hardness (1 471N) {150kgf}	Vickers Hardness	Brinell H Standard Ball	lardness Tungsten Carbide Ball	Rockwell A Scale Load ^{588.4} N {60kgf} Brale Indenter	Hardness B Scale Load ^{980.7N} {100kgf} 1.588 mmBall (1/16in)	Shore Hardness
68 67 66 65 64	940 900 865 832 800		— — 739 722	85.6 85.0 84.5 83.9 83.4		97 95 92 91 88
63 62 61 60 59	772 746 720 697 674		705 688 670 654 634	82.8 82.3 81.8 81.2 80.7		87 85 83 81 80
58 57 56 55 54	653 633 613 595 577		615 595 577 560 543	80.1 79.6 79.0 78.5 78.0		78 76 75 74 72
53 52 51 50 49	560 544 528 513 498	500 487 475 464	525 512 496 481 469	77.4 76.8 76.3 75.9 75.2		71 69 68 67 66
48 47 46 45 44	484 471 458 446 434	451 442 432 421 409	455 443 432 421 409	74.7 74.1 73.6 73.1 72.5		64 63 62 60 58
43 42 41 40 39	423 412 402 392 382	400 390 381 371 362	400 390 381 371 362	72.0 71.5 70.9 70.4 69.9		57 56 55 54 52
38 37 36 35 34	372 363 354 345 336	353 344 336 327 319	353 344 336 327 319	69.4 68.9 68.4 67.9 67.4	(109.0) (108.5) (108.0)	51 50 49 48 47
33 32 31 30 29	327 318 310 302 294	311 301 294 286 279	311 301 294 286 279	66.8 66.3 65.8 65.3 64.7	(107.5) (107.0) (106.0) (105.5) (104.5)	46 44 43 42 41
28 27 26 25 24	286 279 272 266 260	271 264 258 253 247	271 264 258 253 247	64.3 63.8 63.3 62.8 62.4	(104.0) (103.0) (102.5) (101.5) (101.0)	41 40 38 38 37
23 22 21 20	254 248 243 238	243 237 231 226	243 237 231 226	62.0 61.5 61.0 60.5	100.0 99.0 98.5 97.8	36 35 35 34
(18) (16) (14) (12)	230 222 213 204	219 212 203 194	219 212 203 194	_ _ _	96.7 95.5 93.9 92.3	33 32 31 29
(10) (8) (6) (4) (2) (0)	196 188 180 173 166 160	187 179 171 165 158 152	187 179 171 165 158 152	_ _ _ _	90.7 89.5 87.1 85.5 83.5 81.7	28 27 26 25 24 24

Appendix Table 8 Physical and Mechanical Properties of Materials

I	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	12.5×10⁻ ⁶	650 to 740	208 000 {21 200}	1 570 to 1 960 {160 to 200}	_	_
	tic Stainless Steel SUS 440C	7.68	10.1×10 ⁻⁶	580	200 000 {20 400}	1 960 {200}	1 860 {190}	_
Mild Steel	(C=0.12 to 0.20%)	7.86	11.6×10 ⁻⁶	100 to 130	206 000 {21 000}	373 to 471 {38 to 48}	216 to 294 {22 to 30}	24 to 36
Hard Stee	el (C=0.3 to 0.5%)	7.84	11.3×10 ⁻⁶	160 to 200	206 000 {21 000}	539 to 686 {55 to 70}	333 to 451 {34 to 46}	14 to 26
	ic Stainless Steel SUS 304	8.03	16.3×10 ⁻⁶	150	193 000 {19 700}	588 {60}	245 {25}	60
Cast Iron	Gray Iron FC200	7.3	10.4×10 ⁻⁶	223	98 100 {10 000}	More than 200 {20}	_	_
ouot iron	Spheroidal graphite Iron FCD400	7.0	11.7×10 ⁻⁶	Less than 201	169 000 {17 200}	More than 400 {41}	_	More than 12
Aluminu	ım	2.69	23.7×10 ⁻⁶	15 to 26	70 600 {7 200}	78 {8}	34 {3.5}	35
Zinc		7.14	31×10 ⁻⁶	30 to 60	92 200 {9 400}	147 {15}	_	30 to 40
Copper		8.93	16.2×10 ⁻⁶	50	123 000 {12 500}	196 {20}	69 {7}	15 to 20
Brass	(Annealed) (Machined)	8.5	19.1×10 ⁻⁶	45 85 to 130	103 000 {10 500}	294 to 343 {30 to 35} 363 to 539 {37 to 55}	_	65 to 75 15 to 50

Remark The hardness of hardened bearing steel and martensitic stainless steel is usually expressed using the Rockwell C Scale, but for comparison, it is converted into Brinell hardness.

Appendix Table 9 Tolerances

Dian Classifica over	neter tion (mm) incl.	(Normal)	d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6
3	6	0 - 8	- 30 - 38	- 20 - 28	- 10 - 18	- 4 - 9	- 4 - 12	0 - 5	0 - 8	0 - 12	0 - 18	0 30	0 - 48	± 2.5	± 4
6	10	_ 0 _ 8	- 40 - 49	- 25 - 34	- 13 - 22	- 5 - 11	- 12 - 5 - 14	- 5 - 6	0 9	0 - 15	0 - 22	- 30 - 36	- 48 0 - 58	± 3	± 4.5
10	18	_ 0 _ 8	- 50 - 61	- 32 - 43	- 16 - 27	- 6 - 14	- 6 - 17	0 - 8	0 -11	0 - 18	0 - 27	0 - 43	0 - 70	± 4	± 5.5
18	30	0 - 10	- 65 - 78	- 40 - 53	- 20 - 33	- 7 - 16	- 7 - 20	_ 0 _ 9	0 -13	0 - 21	0 - 33	0 - 52	0 - 84	± 4.5	± 6.5
30	50	0 - 12	- 80 - 96	- 50 - 66	- 25 - 41	- 9 - 20		0 -11	0 -16	0 - 25	0 - 39	0 - 62	0 100	± 5.5	± 8
50	80	0 - 15	-100 -119	- 60 - 79	- 30 - 49	- 10 - 23	- 10 - 29	0 -13	0 - 19	- 30	- 46	0 - 74	0 120	± 6.5	± 9.5
80	120	0 20	-120 -142	- 72 - 94	- 36 - 58	- 12 - 27	- 12 - 34	0 15	0 -22	0 - 35	0 - 54	0 - 87	0 -140	± 7.5	± 11
120	180	0 - 25	-145 -170	- 85 -110	- 43 - 68	- 14 - 32	- 14 - 39	0 18	0 -25	- ⁰ 40	- 63		0 -160	± 9	± 12.5
180	250	- 30	-170 -199	-100 -129	- 50 - 79	- 15 - 35	- 15 - 44	0 -20	0 -29	0 - 46	- ⁰	0 115	0 185	± 10	± 14.5
250	315	0 - 35	-190 -222	-110 -142	- 56 - 88	- 17 - 40	- 17 - 49	0 -23	0 -32	0 - 52	- 81	0 -130	0 210	± 11.5	± 16
315	400	- 40	-210 -246	- 125 - 161	- 62 - 98	- 18 - 43	- 18 - 54	0 -25	0 -36	0 - 57	- 89	0 140	0 -230	± 12.5	± 18
400	500	0 - 45	-230 -270	135 175	- 68 -108	- 20 - 47	- 20 - 60	0 -27	0 40	- 63	- 97	0 -155	0 -250	± 13.5	± 20
500	630	- 50	-260 -304	-145 -189	- 76 -120	_	- 22 - 66	_	0 44	- ⁰	0 110	0 -175	0 -280	_	± 22
630	800	0 - 75	-290 -340	-160 -210	- 80 -130	_	- 24 - 74	_	0 -50	- 80	0 125	0 200	0 320	_	± 25
800	1 000	0 100	-320 -376	-170 -226	- 86 -142	_	- 26 - 82	_	0 -56	- 90	0 -140	0 -230	_360	_	± 28
1 000	1 250	0 -125	-350 -416	- 195 - 261	- 98 -164	_	- 28 - 94	_	0 -66	0 -105	0 -165	0 -260	0 -420	_	± 33
1 250	1 600	0 -160	-390 -468	-220 -298	-110 -188	_	- 30 -108	_	0 - 78	0 -125	0 195	0 -310	0 -500		± 39
1 600	2 000	0 -200	-430 -522	-240 -332	-120 -212	_	- 32 -124	_	0 -92	0 -150	0 -230	0 -370	0 600	_	± 46

for Shaft Diameters

Units : µm

j5	j6	j7	k5	k6	k7	m5	m6	n6	р6	r6	r7	Diameter C (m	lassification nm)
												over	incl.
+ 3 - 2	+ 6 - 2	+ 8 - 4	+ 6 + 1	+ 9 + 1	+ 13 + 1	+ 9 + 4	+ 12 + 4	+ 16 + 8	+ 20 + 12	+ 23 + 15	+ 27 + 15	3	6
+ 4	+ 7 — 2	+ 10 — 5	+ 7 + 1	+ 10 + 1	+ 16 + 1	+ 12 + 6	+ 15 + 6	+ 19 + 10	+ 24 + 15	+ 28 + 19	+ 34 + 19	6	10
+ 5 - 3	+ 8 - 3	+ 12 6	+ 9 + 1	+ 12 + 1	+ 19 + 1	+ 15 + 7	+ 18 + 7	+ 23 + 12	+ 29 + 18	+ 34 + 23	+ 41 + 23	10	18
+ 5 - 4	+ 9 - 4	+ 13 — 8	+ 11 + 2	+ 15 + 2	+ 23 + 2	+ 17 + 8	+ 21 + 8	+ 28 + 15	+ 35 + 22	+ 41 + 28	+ 49 + 28	18	30
+ 6 - 5	+ 11 - 5	+ 15 10	+ 13 + 2	+ 18 + 2	+ 27 + 2	+ 20 + 9	+ 25 + 9	+ 33 + 17	+ 42 + 26	+ 50 + 34	+ 59 + 34	30	50
+ 6	+ 12 - 7	+ 18	+ 15	+ 21	+ 32	+ 24	+ 30	+ 39	+ 51	+ 60 + 41	+ 71 + 41	50	65
- 7	– 7	-12	+ 2	+ 2	+ 2	+ 11	+ 11	+ 20	+ 32	+ 62 + 43	+ 73 + 43	65	80
+ 6	+ 13	+ 20	+ 18	+ 25	+ 38	+ 28	+ 35	+ 45	+ 59	+ 73 + 51	+ 86 + 51	80	100
- 9	- 9	— 15	+ 3	+ 3	+ 3	+ 13	+ 13	+ 23	+ 37	+ 76 + 54	+ 89 + 54	100	120
					40					+ 88 + 63	+ 103 + 63	120	140
+ 7 -11	+ 14 11	+ 22 18	+ 21 + 3	+ 28 + 3	+ 43 + 3	+ 33 + 15	+ 40 + 15	+ 52 + 27	+ 68 + 43	+ 90 + 65 + 93	+ 105 + 65 + 108	140	160
										+ 68	+ 68	160	180
+ 7	+ 16	+ 25	+ 24	+ 33	+ 50	+ 37	+ 46	+ 60	+ 79	+ 106 + 77 + 109	+ 123 + 77 + 126	180	200
-13	- 13	-21	+ 4	+ 4	+ 4	+ 17	+ 17	+ 31	+ 50	+ 80	+ 80	200	225
										+ 84 + 126	+ 84	225	250
+ 7 -16	± 16	± 26	+ 27	+ 36 + 4	+ 56 + 4	+ 43 + 20	+ 52 + 20	+ 66 + 34	+ 88 + 56	+ 94	+ 94	250	280
										+ 98 + 144	+ 98 + 165	280	315
+ 7 -18	± 18	+ 29 28	+ 29 + 4	+ 40 + 4	+ 61 + 4	+ 46 + 21	+ 57 + 21	+ 73 + 37	+ 98 + 62	+ 108 + 150	+ 108 + 171	315	355 400
										+ 114 + 166	+ 114	400	450
+ 7 -20	± 20	+ 31 - 32	+ 32 + 5	+ 45 + 5	+ 68 + 5	+ 50 + 23	+ 63 + 23	+ 80 + 40	+ 108 + 68	+ 126	+ 126	450	500
				4.4	70		70	00	400	+ 132	+ 132	500	560
-	_	_	-	+ 44	+ 70 0	_	+ 70 + 26	+ 88 + 44	+ 122 + 78	+ 150 + 199 + 155	+ 150 + 225 + 155	560	630
				+ 50	+ 80		+ 80	+ 100	+ 138	+ 225 + 175	+ 255 + 175	630	710
-	_	_	-	0	0	_	+ 30	+ 50	+ 88	+ 235 + 185	+ 265 + 185	710	800
				+ 56	+ 90		+ 90	+ 112	+ 156	+ 266 + 210	+ 300 + 210	800	900
_	_	_	_	0	0	_	+ 34	+ 56	+ 100	+ 276 + 220	+ 310 + 220	900	1 000
				+ 66	+ 105		+ 106	+ 132	+ 186	+ 316 + 250	+ 355 + 250	1 000	1 120
				0	0		+ 40	+ 66	+ 120	+ 326 + 260	+ 365 + 260	1 120	1 250
	_	_		+ 78	+ 125		+ 126	+ 156	+ 218	+ 378 + 300	+ 425 + 300	1 250	1 400
				0	0		+ 48	+ 78	+ 140	+ 408 + 330	+ 455 + 330	1 400	1 600
_	_	_	_	+ 92	+ 150	_	+ 150	+ 184	+ 262	+ 462 + 370	+ 520 + 370	1 600	1 800
				0	0		+ 58	+ 92	+ 170	+ 492 + 400	+ 550 + 400	1 800	2 000

Appendix Table 10

	meter ation (mm) incl.	Single Plane Mean O.D. Deviation (Normal) ΔD_{mp}	E6	F6	F7	G6	G7	Н6	Н7	Н8	J6 J7		JS6	JS7
10	18	- 8	+ 43 + 32	+ 27 + 16	+ 34 + 16	+ 17 + 6	+ 24 + 6	+ 11	+ 18	+ 27	+ 6 +		: 5.5	± 9
18	30	_ 0 _ 9	+ 53 + 40	+ 33 + 20	+ 41 + 20	+ 20 + 7	+ 28 + 7	+ 13	+ 21	+ 33	+ 8 +		: 6.5	± 10.5
30	50	0 - 11	+ 66 + 50	+ 41 + 25	+ 50 + 25	+ 25 + 9	+ 34 + 9	+ 16 0	+ 25	+ 39	+10 + 6 -		: 8	± 12.5
50	80	0 - 13	+ 79 + 60	+ 49 + 30	+ 60 + 30	+ 29 + 10	+ 40 + 10	+ 19	+ 30	+ 46	+ 13 + 1		9.5	± 15
80	120	0 - 15	+ 94 + 72	+ 58 + 36	+ 71 + 36	+ 34 + 12	+ 47 + 12	+ 22	+ 35	+ 54	+16 +2		: 11	± 17.5
120 150	150 180	0 - 18 0 - 25	+ 110 + 85	+ 68 + 43	+ 83 + 43	+ 39 + 14	+ 54 + 14	+ 25	+ 40	+ 63	+ 18 + 2		12.5	± 20
180	250	- 30	+ 129 + 100	+ 79 + 50	+ 96 + 50	+ 44 + 15	+ 61 + 15	+ 29	+ 46	+ 72	+ 22 + 3	80 6 ±	: 14.5	± 23
250	315	0 - 35	+ 142 + 110	+ 88 + 56	+ 108 + 56	+ 49 + 17	+ 69 + 17	+ 32	+ 52	+ 81	+ 25 + 3		: 16	± 26
315	400	0 - 40	+ 161 + 125	+ 98 + 62	+ 119 + 62	+ 54 + 18	+ 75 + 18	+ 36	+ 57 0	+ 89	+29 +3	19 8 ±	: 18	± 28.5
400	500	0 - 45	+ 175 + 135	+ 108 + 68	+ 131 + 68	+ 60 + 20	+ 83 + 20	+ 40	+ 63	+ 97	+33 +4		: 20	± 31.5
500	630	0 - 50	+ 189 + 145	+ 120 + 76	+ 146 + 76	+ 66 + 22	+ 92 + 22	+ 44	+ 70	+ 110		- ±	: 22	± 35
630	800	0 - 75	+ 210 + 160	+ 130 + 80	+ 160 + 80	+ 74 + 24	+ 104 + 24	+ 50 0	+ 80	+ 125 0		- ±	: 25	± 40
800	1 000	0 -100	+ 226 + 170	+ 142 + 86	+ 176 + 86	+ 82 + 26	+ 116 + 26	+ 56 0	+ 90	+ 140		- ±	: 28	± 45
1 000	1 250	0 125	+ 261 + 195	+ 164 + 98	+ 203 + 98	+ 94 + 28	+ 133 + 28	+ 66	+ 105 0	+ 165 0		- ±	: 33	± 52.5
1 250	1 600	0 -160	+ 298 + 220	+ 188 + 110	+ 235 + 110	+ 108 + 30	+ 155 + 30	+ 78 0	+ 125 0	+ 195 0		- ±	: 39	± 62.5
1 600	2 000	0 -200	+ 332 + 240	+ 212 + 120	+ 270 + 120	+ 124 + 32	+ 182 + 32	+ 92	+ 150 0	+ 230		- ±	: 46	± 75
2 000	2 500	0 -250	+ 370 + 260	+ 240 + 130	+ 305 + 130	+ 144 + 34	+ 209 + 34	+ 110	+ 175 0	+ 280		- ±	: 55	± 87.5

Tolerances for Housing Bore Diameters

Units : µm

K5	K6	K7	M5	MC	MZ	NE	N6	N7	P6	P7		lassification m)
KS	Ko	Κ/	M3	M6	M7	N5	INO	IN /	го	Гί	over	incl.
+ 2 - 6	+ 2 - 9	+ 6 - 12	- 4 -12	- 4 - 15	- 18	- 9 -17	- 9 - 20	- 5 - 23	- 15 - 26	- 11 - 29	10	18
+ 1 - 8	+ 2 - 11	+ 6 - 15	- 5 -14	- 4 - 17	0 - 21	-12 -21	- 11 - 24	- 7 - 28	- 18 - 31	- 14 - 35	18	30
+ 2 - 9	+ 3 - 13	+ 7 - 18	- 5 -16	- 4 - 20	0 - 25	-13 -24	- 12 - 28	- 8 - 33	- 21 - 37	- 17 - 42	30	50
+ 3 -10	+ 4 - 15	+ 9 - 21	- 6 -19	- 5 - 24	- 30	-15 -28	- 14 - 33	- 9 - 39	- 26 - 45	- 21 - 51	50	80
+ 2 -13	+ 4 - 18	+ 10 - 25	- 8 -23	- 6 - 28	0 - 35	-18 -33	- 16 - 38	- 10 - 45	- 30 - 52	- 24 - 59	80	120
+ 3 -15	+ 4 - 21	+ 12 - 28	- 9 -27	- 8 - 33	0 - 40	-21 -39	- 20 - 45	- 12 - 52	- 36 - 61	- 28 - 68	120	180
+ 2 -18	+ 5 - 24	+ 13 - 33	-11 -31	- 8 - 37	0 - 46	-25 -45	- 22 - 51	- 14 - 60	- 41 - 70	- 33 - 79	180	250
+ 3 -20	+ 5 - 27	+ 16 - 36	-13 -36	- 9 - 41	0 - 52	-27 -50	- 25 - 57	- 14 - 66	- 47 - 79	- 36 - 88	250	315
+ 3 -22	+ 7 - 29	+ 17 — 40	-14 -39	- 10 - 46	- ⁰	-30 -55	- 26 - 62	- 16 - 73	- 51 - 87	- 41 - 98	315	400
+ 2 -25	+ 8 - 32	+ 18 - 45	-16 -43	- 10 - 50	0 - 63	-33 -60	- 27 - 67	- 17 - 80	- 55 - 95	- 45 -108	400	500
_	0 - 44	- ⁰	_	- 26 - 70	- 26 - 96	_	- 44 - 88	- 44 -114	- 78 -122	- 78 -148	500	630
_	0 - 50	0 - 80	_	- 30 - 80	- 30 -110	_	- 50 -100	- 50 -130	- 88 -138	- 88 -168	630	800
_	0 - 56	0 - 90	_	- 34 - 90	- 34 -124	_	- 56 -112	- 56 -146	-100 -156	-100 -190	800	1 000
_	0 - 66	0 105	_	- 40 -106	- 40 -145	_	- 66 -132	- 66 -171	-120 -186	-120 -225	1 000	1 250
_	0 - 78	0 125	_	- 48 -126	- 48 -173	_	- 78 -156	- 78 -203	-140 -218	-140 -265	1 250	1 600
_	0 - 92	0 -150	_	- 58 -150	- 58 -208	_	- 92 -184	- 92 -242	-170 -262	-170 -320	1 600	2 000
_	0 110	0 175	_	- 68 - 178	- 68 -243	_	-110 -220	-110 -285	-195 -305	195 370	2 000	2 500

E 014

Appendix Table 11 Values of

Basic	: Size											Standard
(m	nm)	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11
over	incl.					Tol	erances (μ	m)				
_	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

$\textbf{Remarks} \quad \textbf{1.} \quad \textbf{Standard tolerance grades IT} \textbf{14 to IT} \textbf{18 shall not be used for basic sizes less than or equal to 1 } \textbf{mm}.$

Standard Tolerance Grades IT

Grades												
IT12	IT13	IT18	(n	nm)								
	Tolerances (mm)											
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				

^{2.} Values for standard tolerance grades IT1 to IT5 for basic sizes over 500 mm are included for experimental use.

Appedix Table 12 Speed Factor $f_{ m n}$

Appendix Table 13 Fatigue Life Factor $f_{
m h}$ and Fatigue Life $L\!-\!L_{
m h}$

Ball Bearings $f_{
m n}$ = (0.03 $\it n$) $^{-1/3}$ Roller Bearings $f_{
m n}$ = (0.03 n) $^{-3/10}$ Ball Bearings L=(C / P) 3 $L_{
m h}$ =500 $f_{
m h}{}^3$

Speed	1		Speed	Speed F	actor $f_{\rm n}$	•	Speed	Speed F	actor f_n
<i>n</i> (min ⁻¹)	Ball Bearings	Roller Bearings	<i>n</i> (min ⁻¹)	Ball Bearings	Roller Bearings	_	<i>n</i> (min ⁻¹)	Ball Bearings	Roller Bearings
10	1.49	1.44	180	0.570	0.603		3 000	0.223	0.259
11	1.45	1.39	190	0.560	0.593		3 200	0.218	0.254
12	1.41	1.36	200	0.550	0.584		3 400	0.214	0.250
13	1.37	1.33	220	0.533	0.568		3 600	0.210	0.245
14	1.34	1.30	240	0.518	0.553		3 800	0.206	0.242
15	1.30	1.27	260	0.504	0.540		4 000	0.203	0.238
16	1.28	1.25	280	0.492	0.528		4 200	0.199	0.234
17	1.25	1.22	300	0.481	0.517		4 400	0.196	0.231
18	1.23	1.20	320	0.471	0.507		4 600	0.194	0.228
19	1.21	1.18	340	0.461	0.498		4 800	0.191	0.225
20	1.19	1.17	360	0.452	0.490		5 000	0.188	0.222
21	1.17	1.15	380	0.444	0.482		5 200	0.186	0.220
22	1.15	1.13	400	0.437	0.475		5 400	0.183	0.217
23	1.13	1.12	420	0.430	0.468		5 600	0.181	0.215
24	1.12	1.10	440	0.423	0.461		5 800	0.179	0.213
25	1.10	1.09	460	0.417	0.455		6 000	0.177	0.211
26	1.09	1.08	480	0.411	0.449		6 200	0.175	0.209
27	1.07	1.07	500	0.405	0.444		6 400	0.173	0.207
28	1.06	1.05	550	0.393	0.431		6 600	0.172	0.205
29	1.05	1.04	600	0.382	0.420		6 800	0.170	0.203
30	1.04	1.03	650	0.372	0.410		7 000	0.168	0.201
31	1.02	1.02	700	0.362	0.401		7 200	0.167	0.199
32	1.01	1.01	750	0.354	0.393		7 400	0.165	0.198
33.3	1.00	1.00	800	0.347	0.385		7 600	0.164	0.196
34	0.993	0.994	850	0.340	0.378		7 800	0.162	0.195
36	0.975	0.977	900	0.333	0.372		8 000	0.161	0.193
38	0.957	0.961	950	0.327	0.366		8 500	0.158	0.190
40	0.941	0.947	1 000	0.322	0.360		9 000	0.155	0.186
42	0.926	0.933	1 050	0.317	0.355		9 500	0.152	0.183
44	0.912	0.920	1 100	0.312	0.350		10 000	0.149	0.181
46	0.898	0.908	1 150	0.307	0.346		11 000	0.145	0.176
48	0.886	0.896	1 200	0.303	0.341		12 000	0.141	0.171
50	0.874	0.885	1 250	0.299	0.337		13 000	0.137	0.167
55	0.846	0.861	1 300	0.295	0.333		14 000	0.134	0.163
60	0.822	0.838	1 400	0.288	0.326		15 000	0.130	0.160
65	0.800	0.818	1 500	0.281	0.319		16 000	0.128	0.157
70	0.781	0.800	1 600	0.275	0.313		17 000	0.125	0.154
75	0.763	0.784	1 700	0.270	0.307		18 000	0.123	0.151
80	0.747	0.769	1 800	0.265	0.302		19 000	0.121	0.149
85	0.732	0.755	1 900	0.260	0.297		20 000	0.119	0.147
90	0.718	0.742	2 000	0.255	0.293		22 000	0.115	0.143
95	0.705	0.730	2 100	0.251	0.289		24 000	0.112	0.139
100	0.693	0.719	2 200	0.247	0.285		26 000	0.109	0.136
110	0.672	0.699	2 300	0.244	0.281		28 000	0.106	0.133
120	0.652	0.681	2 400	0.240	0.277		30 000	0.104	0.130
130	0.635	0.665	2 500	0.237	0.274	_	32 000	0.101	0.127
140	0.620	0.650	2 600	0.234	0.271		34 000	0.099	0.125
150	0.606	0.637	2 700	0.231	0.268		36 000	0.097	0.123
160	0.593	0.625	2 800	0.228	0.265		38 000	0.096	0.121
170	0.581	0.613	2 900	0.226	0.262		40 000	0.094	0.119

						Roller B	earings $L=(C$		$=500 f_{\rm h}^{10}$
	Ball Bear	ing Life	Roller Bea	aring Life		Ball Bea			aring Life
C/P or $f_{\rm h}$	L	$L_{ m h}$	L	$L_{ m h}$	C/P or $f_{\rm h}$	L	$L_{ m h}$	L	$L_{\rm h}$
	(10 ⁶ rev)	(h)	(10 ⁶ rev)	(h)		(10 ⁶ rev)	(h)	(10 ⁶ rev)	(h)
0.70	0.34	172	0.30	152	3.45	41.1	20 500	62.0	31 000
0.75	0.42	211	0.38	192	3.50	42.9	21 400	65.1	32 500
0.80	0.51	256	0.48	238	3.55	44.7	22 400	68.2	34 100
0.85	0.61	307	0.58	291	3.60	46.7	23 300	71.5	35 800
0.90	0.73	365	0.70	352	3.65	48.6	24 300	74.9	37 400
0.95	0.86	429	0.84	421	3.70	50.7	25 300	78.3	39 200
1.00	1.00	500	1.00	500	3.75	52.7	26 400	81.9	41 000
1.05	1.16	579	1.18	588	3.80	54.9	27 400	85.6	42 800
1.10	1.33	665	1.37	687	3.85	57.1	28 500	89.4	44 700
1.15	1.52	760	1.59	797	3.90	59.3	29 700	93.4	46 700
1.20	1.73	864	1.84	918	3.95	61.6	30 800	97.4	48 700
1.25	1.95	977	2.10	1 050	4.00	64.0	32 000	102	50 800
1.30	2.20	1 100	2.40	1 200	4.05	66.4	33 200	106	52 900
1.35	2.46	1 230	2.72	1 360	4.10	68.9	34 500	110	55 200
1.40	2.74	1 370	3.07	1 530	4.15	71.5	35 700	115	57 400
1.45	3.05	1 520	3.45	1 730	4.20	74.1	37 000	120	59 800
1.50	3.38	1 690	3.86	1 930	4.25	76.8	38 400	124	62 200
1.55	3.72	1 860	4.31	2 150	4.30	79.5	39 800	129	64 600
1.60	4.10	2 050	4.79	2 400	4.35	82.3	41 200	134	67 200
1.65	4.49	2 250	5.31	2 650	4.40	85.2	42 600	140	69 800
1.70	4.91	2 460	5.86	2 930	4.45	88.1	44 100	145	72 500
1.75	5.36	2 680	6.46	3 230	4.50	91.1	45 600	150	75 200
1.80	5.83	2 920	7.09	3 550	4.55	94.2	47 100	156	78 000
1.85	6.33	3 170	7.77	3 890	4.60	97.3	48 700	162	80 900
1.90	6.86	3 430	8.50	4 250	4.65	101	50 300	168	83 900
1.95	7.41	3 710	9.26	4 630	4.70	104	51 900	174	87 000
2.00	8.00	4 000	10.1	5 040	4.75	107	53 600	180	90 100
2.05	8.62	4 310	10.9	5 470	4.80	111	55 300	187	93 300
2.10	9.26	4 630	11.9	5 930	4.85	114	57 000	193	96 600
2.15	9.94	4 970	12.8	6 410	4.90	118	58 800	200	99 900
2.20	10.6	5 320	13.8	6 920	4.95	121	60 600	207	103 000
2.25	11.4	5 700	14.9	7 460	5.00	125	62 500	214	107 000
2.30	12.2	6 080	16.1	8 030	5.10	133	66 300	228	114 000
2.35	13.0	6 490	17.3	8 630	5.20	141	70 300	244	122 000
2.40	13.8	6 910	18.5	9 250	5.30	149	74 400	260	130 000
2.45	14.7	7 350	19.8	9 910	5.40	157	78 700	276	138 000
2.50	15.6	7 810	21.2	10 600	5.50	166	83 200	294	147 000
2.55	16.6	8 290	22.7	11 300	5.60	176	87 800	312	156 000
2.60	17.6	8 790	24.2	12 100	5.70	185	92 600	331	165 000
2.65	18.6	9 300	25.8	12 900	5.80	195	97 600	351	175 000
2.70	19.7	9 840	27.4	13 700	5.90	205	103 000	371	186 000
2.75	20.8	10 400	29.1	14 600	6.00	216	108 000	392	196 000
2.80	22.0	11 000	30.9	15 500	6.50	275	137 000	513	256 000
2.85	23.1	11 600	32.8	16 400	7.00	343	172 000	656	328 000
2.90	24.4	12 200	34.8	17 400	7.50	422	211 000	826	413 000
2.95 3.00 3.05 3.10 3.15	25.7 27.0 28.4 29.8 31.3	12 800 13 500 14 200 14 900 15 600	36.8 38.9 41.1 43.4 45.8	18 400 19 500 20 600 21 700 22 900	8.00 8.50 9.00 9.50 10.0	512 614 729 857 1 000	256 000 307 000 365 000 429 000	1 020 1 250 1 520 1 820 2 150	512 000 627 000 758 000 908 000
3.20 3.25 3.30 3.35 3.40	32.8 34.3 35.9 37.6 39.3	16 400 17 200 18 000 18 800 19 700	48.3 50.8 53.5 56.3 59.1	24 100 25 400 26 800 28 100 29 600	11.0 12.0 13.0 14.0 15.0	1 330 1 730 2 200 2 740 3 380	_ _ _	2 960 3 960 5 170 6 610 8 320	_ _ _ _

Appendix Table14 Index of Inch Design Tapered Roller Bearings

Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages
332	D 80.000	C214,C218,C220	497	d 85.725	C236
336	d 41.275	C220	498	d 84.138	C236
342	d 41.275	C220	522	D 101.600	C222,C224
342 S	d 42.875	C220	528	d 47.625	C222
344	d 40.000	C218	529	d 50.800	C224
344 A	d 40.000	C218	529 X	d 50.800	C224
346	d 31.750	C214	532 X	D 107.950	C226
354 A	D 85.000	C222	539	d 53.975	C226
359 S	d 46.038	C222	552 A	D 123.825	C226,C228,C230
362 A	D 88.900	C222,C224	553 X	D 122.238	C228,C230
366	d 50.000	C224	555 S	d 57.150	C226
368	d 50.800	C224	557 S	d 53.975	C226
368 A	d 50.800	C224	558	d 60.325	C228
369 A	d 47.625	C222	559	d 63.500	C228
372	D 100.000	C224	560	d 66.675	C230
374	D 93.264	C222	560 S	d 68.262	C230
376	d 45.000	C222	563	D 127.000	C228,C230,C232
377	d 52.388	C224	563 X	D 127.000	C230
382	D 98.425	C226	565	$egin{array}{ccc} d & 63.500 \\ d & 69.850 \\ d & 73.025 \\ \end{array}$	C228
382 A	D 96.838	C226	566		C230
382 S	D 96.838	C226	567		C232
385	d 55.000	C226	567 A	d 71.438	C232
387	d 57.150	C226	567 S	d 71.438	C232
387 A	d 57.150	C226	568	d 73.817	C232
388 A	d 57.531	C226	569	d 64.963	C228
390 A	d 63.500	C228	570	d 68.262	C230
394 A	D 110.000	C228,C230	572	D 139.992	C232,C234
395	d 63.500	C228	572 X	D 139.700	C234
395 A	d 66.675	C230	575	d 76.200	C232
395 S	d 66.675	C230	580	d 82.550	C234
397	d 60.000	C228	581	d 80.962	C234
399 A	d 68.262	C230	582	d 82.550	C234
414	D 88.501	C218	590 A	d 76.200	C232
418	d 38.100	C218	592	D 152.400	C238
432	D 95.250	C220	592 A	D 152.400	C232,C236,C238
432 A	D 95.250	C222	593	d 88.900	C236
436	d 46.038	C222	594	d 95.250	C238
438	d 44.450	C220	596	d 85.725	C236
453 A	D 107.950	C222	597	d 93.662	C238
453 X	D 104.775	C226	598	d 92.075	C238
460	d 44.450	C222	598 A	d 92.075	C238
462	d 57.150	C226	614 X	D 115.000	C226
469	d 57.150	C226	622 X	d 55.000	C226
472	D 120.000	C230,C232	632	D 136.525	C228,C232
472 A	D 120.000	C230	633	D 130.175	C228,C230,C232
478	d 65.000	C230	637	d 60.325	C228
480	d 68.262	C230	639	d 63.500	C228
484	d 70.000	C232	643	d 69.850	C230
492 A	D 133.350	C234,C236	644	d 71.438	C232
493	D 136.525	C232,C234,C236	645	d 71.438	C232
495	d 82.550	C234	652	D 152.400	C232,C234
495 A	d 76.200	C232	653	D 146.050	C230,C232,C234,C236
495 AX	d 76.200	C232	653 X	D 150.000	C232
496	d 80.962	C234	655	d 69.850	C230

Bearing No. CONE, CUP	d:C0	nal Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages	Bearing No. CONE, CUP	d:00	al Dimension (mm) NE (Bore Dia.) P (Outside Dia.)	Pages
657 658 659	$egin{pmatrix} d \\ d \\ d \end{pmatrix}$	73.025 74.612 76.200	C232 C232 C232	1328 1329 1380	D D d	52.388 53.975 22.225	C210 C210 C210
661 663 664	$d \\ d \\ d$	79.375 82.550 84.138	C234 C234 C236	1620 1680 1729	D d D	66.675 33.338 56.896	C216 C216 C210,C212
665 665 A 672	$d \\ d \\ D$	85.725 85.725 168.275	C236 C236 C236,C238,C240	1755 1779 1922	$d \\ d \\ D$	22.225 23.812 57.150	C210 C212 C212
677 681 683	$d \\ d \\ d$	85.725 92.075 95.250	C236 C238 C238	1988 1997 X A2047	$egin{array}{c} d \\ d \\ d \end{array}$	28.575 26.988 12.000	C212 C212 C210
685 687 742	$d \\ d \\ D$	98.425 101.600 150.089	C238 C240 C230,C234,C236	A2126 2523 2558	$D \\ D \\ d$	31.991 69.850 30.162	C210 C214,C216 C214
743 745 A 749	$egin{array}{c} D \\ d \\ d \end{array}$	150.000 69.850 85.026	C234 C230 C236	2559 2580 2582	d d d	30.162 31.750 31.750	C214 C214 C214
749 A 749 S 750	d d d	82.550 85.026 79.375	C234 C236 C234	2585 2631 2690	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	33.338 66.421 29.367	C216 C214 C214
752 753 757	$D \\ D \\ d$	161.925 168.275 82.550	C234,C236 C234,C236 C234	2720 2729 2735 X	$D \\ D \\ D$	76.200 76.200 73.025	C218 C218 C218
758 759 760	$egin{pmatrix} d \\ d \\ d \end{pmatrix}$	85.725 88.900 90.488	C236 C236 C236	2788 2789 2820	$d \\ d \\ D$	38.100 39.688 73.025	C218 C218 C216
766 772 776	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	88.900 180.975 95.250	C236 C238,C240 C238	2877 2924 2984	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	34.925 85.000 46.038	C216 C222 C222
779 780 782	$egin{array}{c} d \\ d \\ d \end{array}$	98.425 101.600 104.775	C238 C240 C240	3120 3188 3197	$egin{array}{c} D \\ d \\ d \end{array}$	72.626 31.750 33.338	C214,C216 C214 C216
787 792 795	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	104.775 206.375 120.650	C240 C242 C242	3320 3386 3420	D d D	80.167 39.688 79.375	C218 C218 C216,C218
797 799 799 A	$egin{array}{c} d \\ d \\ d \end{array}$	130.000 128.588 130.175	C242 C242 C242	3478 3479 3490	$d \\ d \\ d$	34.925 36.512 38.100	C216 C218 C218
832 837 842	$egin{array}{c} D \\ d \\ d \end{array}$	168.275 76.200 82.550	C234,C236 C234 C234	3525 3576 3578	D d d	87.312 41.275 44.450	C220 C220 C220
843 850 854	$d \\ d \\ D$	76.200 88.900 190.500	C234 C236 C236,C238,C240	3720 3730 3775	$D \\ D \\ d$	93.264 93.264 50.800	C220 C224 C224
855 857 861	$d \\ d \\ d$	88.900 92.075 101.600	C236 C238 C240	3780 3782 3820	d d D	50.800 44.450 85.725	C224 C220 C220
864 866 932	d d D	95.250 98.425 212.725	C238 C238 C240	3877 3920 3926	$D \\ D \\ D$	41.275 112.712 112.712	C220 C228,C230 C226,C228
938 1220 1280	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	114.300 57.150 22.225	C240 C210 C210	3981 3982 3984	d d d	58.738 63.500 66.675	C226 C228 C230

Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages
3994	d 66.675	C230	02820	D 73.025	C212,C216
A4050	d 12.700	C210	02872	d 28.575	C212
A4059	d 15.000	C210	02878	d 34.925	C216
A4138	D 34.988	C210	03062	d 15.875	C210
4335	D 90.488	C220	03162	D 41.275	C210
4388	d 41.275	C220	05062	d 15.875	C210
4535	D 104.775	C226	05068	d 17.462	C210
4595	d 53.975	C226	05075	d 19.050	C210
A5069	d 17.455	C210	05079	d 19.990	C210
A5144	D 36.525	C210	05175	D 44.450	C210
5335	D 103.188	C222	05185	D 47.000	C210
5356	d 44.450	C222	07079	d 20.000	C210
5535	D 122.238	C226,C228	07087	d 22.225	C210
5566	d 55.562	C226	07097	d 25.000	C212
5582	d 60.325	C228	07098	d 24.981	C212
5584	$egin{array}{ccc} d & 63.500 \\ D & 135.733 \\ d & 76.200 \\ \end{array}$	C228	07100	d 25.400	C212
5735		C232,C234	07100SA	d 25.400	C212
5760		C232	07196	D 50.005	C210,C212
5795	d 77.788	C234	07204	D 51.994	C210,C212
A6062	d 15.875	C210	07205	D 52.001	C212
A6067	d 16.993	C210	08118	d 30.162	C214
A6075	d 19.050	C210	08125	$egin{array}{ccc} d & 31.750 \\ D & 58.738 \\ d & 15.875 \end{array}$	C214
A6157	D 39.992	C210	08231		C214
6220	D 127.000	C224,C226	09062		C210
6279	d 50.800	C224	09067	$egin{array}{ccc} d & 19.050 \\ d & 19.050 \\ d & 19.050 \\ \end{array}$	C210
6280	d 53.975	C226	09074		C210
6320	D 135.755	C228,C230	09078		C210
6376	d 60.325	C228	09081	d 20.625	C210
6379	d 65.088	C230	09194	D 49.225	C210
6420	D 149.225	C226,C230,C232	09195	D 49.225	C210
6454	d 69.850	C230	09196	$ \begin{array}{ccc} D & 49.225 \\ d & 41.275 \\ D & 76.200 \end{array} $	C210
6455	d 57.150	C226	11162		C220
6460	d 73.025	C232	11300		C220
6461	d 76.200	C232	11520	D 42.862	C210
6535	D 161.925	C232,C234,C236	11590	d 15.875	C210
6536	D 161.925	C232	LM11710	D 39.878	C210
6559	d 82.550	C234	LM11749	$egin{array}{cccc} d & 17.462 \\ D & 45.237 \\ d & 19.050 \\ \end{array}$	C210
6575	d 76.200	C232	LM11910		C210
6576	d 76.200	C232	LM11949		C210
6580	d 88.900	C236	12168	d 42.862	C220
9121	D 152.400	C228,C230	12303	D 76.992	C220
9180	d 61.912	C228	12520	D 49.225	C210
9185	d 68.262	C230	12580	d 20.638	C210
9220	D 161.925	C232	M12610	D 50.005	C210
9285	d 76.200	C232	M12648	d 22.225	C210
9320	D 177.800	C234	M12649	d 21.430	C210
9321	D 171.450	C234,C236	LM12710	D 45.237	C210
9378	d 76.200	C234	LM12711	D 45.975	C210
9380	d 76.200	C234	LM12749	d 22.000	C210
9385	d 84.138	C236	13175	d 44.450	C220
02420	D 68.262	C212,C214	13181	d 46.038	C222
02473	d 25.400	C212	13318	D 80.962	C220,C222
02474	d 28.575	C212	13620	D 69.012	C218
02475	d 31.750	C214	13621	D 69.012	C218

Bearing No. CONE, CUP	d:C0	al Dimension (mm) NE (Bore Dia.) P (Outside Dia.)	Pages	Bearing No. CONE, CUP	d:C0	al Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages
13685 13687 13830	$d \\ d \\ D$	38.100 38.100 63.500	C218 C218 C218	19150 19268 21075	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	38.100 68.262 19.050	C218 C216,C218 C210
13889 14123 A 14125 A	$egin{array}{c} d \\ d \\ d \end{array}$	38.100 31.750 31.750	C218 C214 C214	21212 L21511 L21549	$D \\ D \\ d$	53.975 34.988 15.875	C210 C210 C210
14130 14131 14137 A	$egin{pmatrix} d \\ d \\ d \end{pmatrix}$	33.338 33.338 34.925	C216 C216 C216	22168 22325 23100	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	42.862 82.550 25.400	C220 C220 C212
14138 A 14139 14274	$d \\ d \\ D$	34.925 34.976 69.012	C216 C216 C214,C216	23256 23621 23691	$D \\ D \\ d$	65.088 73.025 35.000	C212 C216 C216
14276 14283 15100	$D \\ D \\ d$	69.012 72.085 25.400	C214,C216 C216 C212	24720 24721 24780	$D \\ D \\ d$	76.200 76.200 41.275	C220 C220 C220
15101 15106 15112	$egin{array}{c} d \\ d \\ d \end{array}$	25.400 26.988 28.575	C212 C212 C212	25520 25521 25523	$D \\ D \\ D$	82.931 83.058 82.931	C220,C222 C220 C220,C222
15113 15116 15117	$egin{array}{c} d \\ d \\ d \end{array}$	28.575 30.112 30.000	C212 C214 C214	25577 25578 25580	$egin{pmatrix} d \\ d \\ d \end{pmatrix}$	42.875 42.862 44.450	C220 C220 C220
15118 15119 15120	$egin{array}{c} d \\ d \\ d \end{array}$	30.213 30.213 30.213	C214 C214 C214	25584 25590 25820	d d D	44.983 45.618 73.025	C222 C222 C216
15123 15125 15126	$egin{array}{c} d \\ d \\ d \end{array}$	31.750 31.750 31.750	C214 C214 C214	25821 25877 25878	D d d	73.025 34.925 34.925	C216,C218 C216 C216
15245 15250 15250 X	$D \\ D \\ D$	62.000 63.500 63.500	C212,C214 C214 C212	25880 26118 26131	$egin{pmatrix} d \\ d \\ d \end{pmatrix}$	36.487 30.000 33.338	C218 C214 C216
15520 15523 15578	$D \\ D \\ d$	57.150 60.325 25.400	C212 C212 C212	26283 26820 26822	$D \\ D \\ D$	72.000 80.167 79.375	C214,C216 C220 C220
15580 16150 16284	$d \\ d \\ D$	26.988 38.100 72.238	C212 C218 C218	26823 26882 26884	D d d	76.200 41.275 42.875	C220 C220 C220
16929 16986 17098	$egin{array}{c} D \\ d \\ d \end{array}$	74.988 43.000 24.981	C220 C220 C212	27620 27687 27689	$egin{array}{c} D \\ d \\ d \end{array}$	125.412 82.550 83.345	C234 C234 C234
17118 17244 17520	$D \\ D \\ D$	30.000 62.000 42.862	C214 C212,C214 C210	27690 27820 27880	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	83.345 80.035 38.100	C234 C218 C218
17580 17831 17887	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	15.875 79.985 45.230	C210 C222 C222	28138 28315 28521	$D \\ D \\ D$	34.976 80.000 92.075	C216 C216 C224
18200 18337 18520	$D \\ D \\ D$	50.800 85.725 73.025	C224 C224 C218	28580 28584 28622	$d \\ d \\ D$	50.800 52.388 97.630	C224 C224 C226
18590 18620 18690	$egin{pmatrix} d \\ D \\ d \end{pmatrix}$	41.275 79.375 46.038	C218 C222 C222	28680 28920 28921	$D \\ D \\ D$	55.562 101.600 100.000	C226 C228 C228
18720 18790 19138	$egin{array}{c} D \\ d \\ d \end{array}$	85.000 50.800 34.976	C224 C224 C216	28985 29520 29586	$d \\ D \\ d$	60.325 107.950 63.500	C228 C228 C228

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E 022

Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages	Bearing No. CONE, CUP	Nominal Dimension (mm) d:CONE (Bore Dia.) D:CUP (Outside Dia.)	Pages
29620	D 112.712	C230,C232	42690	d 77.788	C234
29630	D 120.650	C230	43118	d 30.162	C214
29675	d 69.850	C230	43131	d 33.338	C216
29685	d 73.025	C232	43300	D 76.200	C214
LM29710	D 65.088	C218	43312	D 79.375	C216
LM29711	D 65.088	C218	44143	d 36.512	C218
LM29748	d 38.100	C218	44150	d 38.100	C218
LM29749	d 38.100	C218	44157	d 40.000	C218
31520	D 76.200	C216	44162	d 41.275	C220
31594	d 34.925	C216	44348	D 88.501	C218,C220
33262	d 66.675	C230	L44610	D 50.292	C212
33275	d 69.850	C230	L44640	d 23.812	C212
33281	d 71.438	C232	L44643	d 25.400	C212
33287	d 73.025	C232	L44649	d 26.988	C212
JHM33410	D 55.000	C212	45220	D 104.775	C226
JHM33449	d 24.000	C212	45221	D 104.775	C226
33462	D 117.475	C230,C232	45289	d 57.150	C226
33821	D 95.250	C224	L45410	D 50.292	C214
33889	d 50.800	C224	L45449	d 29.000	C214
34300	d 76.200	C232	46143	d 36.512	C218
34306	d 77.788	C234	46162	d 41.275	C220
34478	D 121.442	C232,C234	46176	d 44.450	C220
36620	D 193.675	C242	46368	D 93.662	C218,C220
36690	d 146.050	C242	46720	D 225.425	C242
36920	D 227.012	C244	46780	$\begin{array}{ccc} d & 158.750 \\ D & 120.000 \\ d & 69.850 \end{array}$	C242
36990	d 177.800	C244	47420		C230,C232
37425	d 107.950	C240	47487		C230
37625	D 158.750	C240	47490	$egin{array}{cccc} d & 71.438 \\ D & 133.350 \\ d & 76.200 \\ \end{array}$	C232
M38510	D 66.675	C216	47620		C232,C234
M38511	D 65.987	C216	47680		C232
M38547	$egin{array}{ccc} d & 35.000 \\ d & 34.925 \\ d & 60.000 \\ \end{array}$	C216	47685	d 82.550	C234
M38549		C216	47686	d 82.550	C234
39236		C228	47687	d 82.550	C234
39250	d 63.500	C228	47820	D 146.050	C238
39412	D 104.775	C228	47890	d 92.075	C238
39520	D 112.712	C228,C230	47896	d 95.250	C238
39521	D 112.712	C230	48120	D 161.925	C240
39585	d 63.500	C228	48190	d 107.950	C240
39590	d 66.675	C230	48220	D 182.562	C242
41100	d 25.400	C212	48282	d 120.650	C242
41125	d 28.575	C212	48286	d 123.825	C242
41126	d 28.575	C212	48290	d 127.000	C242
41286	D 72.626	C212	48320	D 190.500	C242
42350	d 88.900	C236	48385	d 133.350	C242
42362	d 92.075	C238	48393	d 136.525	C242
42368	d 93.662	C238	LM48510	D 65.088	C216
42375	d 95.250	C238	LM48511	D 65.088	C216
42376	d 95.250	C238	LM48548	d 34.925	C216
42381	d 96.838	C238	48620	D 200.025	C242
42584	D 148.430	C238	48685	d 142.875	C242
42587	D 149.225	C236,C238	49175	d 44.450	C220
42620	D 127.000	C232,C234	49176	d 44.450	C220
42687	d 76.200	C232	49368	D 93.662	C220
42688	d 76.200	C232	49520	D 101.600	C224

Bearing No. CONE, CUP	d:00	nal Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages	Bearing No. CONE, CUP	d:C0	nal Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages
49585 52387 52393	$egin{array}{c} d \\ d \\ d \end{array}$	50.800 98.425 100.012	C224 C238 C238	67920 67983 67985	D d d	282.575 203.200 206.375	C244 C244 C244
52400 52618 52637	$D \\ D \\ D$	101.600 157.162 161.925	C240 C238,C240 C238,C240	L68110 L68111 L68149	$D \\ D \\ d$	59.131 59.975 35.000	C216 C216 C216
53150 53162 53176	$egin{array}{c} d \\ d \\ d \end{array}$	38.100 41.275 44.450	C218 C220 C222	68450 68462 68709	$d \\ d \\ D$	114.300 117.475 180.000	C240 C240 C240
53177 53178 53375	$d \\ d \\ D$	44.450 44.450 95.250	C222 C222 C218,C222	68712 JL69310 JL69349	$D \\ D \\ d$	180.975 63.000 38.000	C240 C218 C218
53387 55175 55187	$egin{array}{c} D \\ d \\ d \end{array}$	98.425 44.450 47.625	C220,C222 C222 C222	71412 71425 71437	$egin{array}{c} d \\ d \\ d \end{array}$	104.775 107.950 111.125	C240 C240 C240
55200 55200 C 55206	$egin{array}{c} d \\ d \\ d \end{array}$	50.800 50.800 52.388	C224 C224 C224	71450 71453 71750	$d \\ d \\ D$	114.300 115.087 190.500	C240 C240 C240
55437 55443 56418	$D \\ D \\ d$	111.125 112.712 106.362	C222,C224 C222 C240	72187 72200 72200 C	$egin{array}{c} d \\ d \\ d \end{array}$	47.625 50.800 50.800	C222 C224 C224
56425 56650 59200	$egin{array}{c} d \\ D \\ d \end{array}$	107.950 165.100 50.800	C240 C240 C224	72212 72212C 72218	$egin{array}{c} d \\ d \\ d \end{array}$	53.975 53.975 55.562	C226 C226 C226
59429 64433 64450	$egin{array}{c} D \\ d \\ d \end{array}$	108.966 109.992 114.300	C224 C240 C240	72218C 72225C 72487	$d \\ d \\ D$	55.562 57.150 123.825	C226 C226 C222,C224,C226
64700 65200 65212	$egin{array}{c} D \\ d \\ d \end{array}$	177.800 50.800 53.975	C240 C224 C226	LM72810 LM72849 74500	$egin{array}{c} D \\ d \\ d \end{array}$	47.000 22.606 127.000	C212 C212 C242
65237 65320 65385	$egin{array}{c} d \\ D \\ d \end{array}$	60.325 114.300 44.450	C228 C222 C222	74525 74537 74550	$egin{array}{c} d \\ d \\ d \end{array}$	133.350 136.525 139.700	C242 C242 C242
65500 66187 66462	D d D	127.000 47.625 117.475	C224,C226,C228 C222 C222	74850 74856 77375	$D \\ D \\ d$	215.900 217.488 95.250	C242 C242 C238
66520 66584 66585	$egin{array}{c} D \\ d \\ d \end{array}$	122.238 53.975 60.000	C226,C228 C226 C228	77675 78225 78250	$egin{array}{c} D \\ d \\ d \end{array}$	171.450 57.150 63.500	C238 C226 C228
66587 LM67010 LM67043	$egin{matrix} d \\ D \\ d \end{bmatrix}$	57.150 59.131 28.575	C226 C212,C214 C212	LM78310 LM78310 A LM78349	$D \\ D \\ d$	62.000 62.000 35.000	C216 C216 C216
LM67048 67320 67322	$D \atop D$	31.750 203.200 196.850	C214 C242 C242	78537 78551 78571	$D \\ D \\ D$	136.525 140.030 144.983	C228 C226,C228 C226
67388 67389 67390	$egin{array}{c} d \\ d \\ d \end{array}$	127.000 130.175 133.350	C242 C242 C242	HM81610 HM81649 M84210	D d D	47.000 16.000 59.530	C210 C210 C212
67720 67780 67787	$egin{array}{c} D \\ d \\ d \end{array}$	247.650 165.100 174.625	C242,C244 C242 C244	M84249 M84510 M84548	$d \\ D \\ d$	25.400 57.150 25.400	C212 C212 C212
67790 67820 67885	$egin{matrix} d \\ D \\ d \end{bmatrix}$	177.800 266.700 190.500	C244 C244 C244	M86610 M86643 M86647	$egin{array}{c} D \\ d \\ d \end{array}$	64.292 25.400 28.575	C212,C214 C212 C212

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Bearing No. CONE, CUP	d:C0	nal Dimension (mm) ONE (Bore Dia.) JP (Outside Dia.)	Pages	Bearing No. CONE, CUP	d:CON	Dimension (mm) NE (Bore Dia.) O (Outside Dia.)	Pages
M86648 A M86649 M88010	d d D	30.955 30.162 68.262	C214 C214 C214,C216	HH221432 HH221434 HH221440	d d d	87.312 88.900 95.250	C236 C236 C238
M88043 M88046 M88048	$d \\ d \\ d$	30.162 31.750 33.338	C214 C214 C216	HH221442 HH221447 HH221449	$egin{array}{c} d \\ d \\ d \end{array}$	98.425 99.982 101.600	C238 C238 C240
HM88510 HM88542 HM88547	$egin{array}{c} D \\ d \\ d \end{array}$	73.025 31.750 33.338	C214,C216 C214 C216	HH224310 HH224335 HH224340	d	212.725 101.600 107.950	C240 C240 C240
HM88610 HM88630 HM88638	$egin{array}{c} D \\ d \\ d \end{array}$	72.233 25.400 32.000	C212,C214,C216,C218 C212 C214	HH224346 M224710 M224748	$egin{matrix} d \\ D \\ d \end{bmatrix}$	114.300 174.625 120.000	C240 C242 C242
HM88648 HM88649 HM89410	$d \\ d \\ D$	35.717 34.925 76.200	C218 C216 C216,C218	LL225710 LL225749 HM231110	d	165.895 127.000 236.538	C242 C242 C242
HM89411 HM89443 HM89444	$egin{array}{c} D \\ d \\ d \end{array}$	76.200 33.338 33.338	C216 C216 C216	HM231140 M236810 M236849	$egin{array}{c} d \\ D \\ d \end{array}$	146.050 260.350 177.800	C242 C244 C244
HM89446 HM89446 A HM89449	$egin{array}{c} d \\ d \\ d \end{array}$	34.925 34.925 36.512	C216 C216 C218	LM300811 LM300849 L305610	D d D	68.000 41.000 80.962	C218 C218 C224
99100 99550 99575	$egin{array}{c} D \\ d \\ d \end{array}$	254.000 139.700 146.050	C242 C242 C242	L305649 JH307710 JH307749	$egin{matrix} d \\ D \\ d \end{bmatrix}$	50.800 110.000 55.000	C224 C226 C226
99587 99600 LM102910	$d \\ d \\ D$	149.225 152.400 73.431	C242 C242 C222	JHM318410 JHM318448 L327210	$egin{matrix} D \\ d \\ D \end{matrix}$	155.000 90.000 177.008	C236 C236 C242
LM102949 JLM104910 LM104911	$D \\ D \\ D$	45.242 82.000 82.550	C222 C224 C224	L327249 LM328410 LM328448	$egin{matrix} d \\ D \\ d \end{bmatrix}$	133.350 187.325 139.700	C242 C242 C242
LM104911 A LM104912 LM104947 A	$D \\ D \\ d$	82.550 82.931 50.000	C224 C224 C224	H414210 H414245 H414249	$egin{array}{c} D \\ d \\ d \end{array}$	136.525 68.262 71.438	C230,C232 C230 C232
JLM104948 LM104949 M201011	$d \\ d \\ D$	50.000 50.800 73.025	C224 C224 C218	JH415610 JH415647 LM501310	$egin{matrix} D \\ d \\ D \end{matrix}$	145.000 75.000 73.431	C232 C232 C218
M201047 JM205110 JM205149	$d \\ D \\ d$	39.688 90.000 50.000	C218 C224 C224	LM501314 LM501349 LM503310	D d D	73.431 41.275 75.000	C218 C218 C222
JM207010 JM207049 JH211710	D d D	95.000 55.000 120.000	C226 C226 C230	LM503349 HH506310 HH506348	$egin{array}{c} d \\ D \\ d \end{array}$	46.000 114.300 49.212	C222 C224 C224
JH211749 HM212010 HM212011	$D \\ D \\ D$	65.000 122.238 122.238	C230 C228,C230 C228,C230	JLM506810 JLM506849 JLM508710	D d D	90.000 55.000 95.000	C226 C226 C228
HM212044 HM212046 HM212047	$d \\ d \\ d$	60.325 63.500 63.500	C228 C228 C228	JLM508748 JM511910 JM511946	$egin{array}{c} d \\ D \\ d \end{array}$	60.000 110.000 65.000	C228 C230 C230
HM212049 JH217210 JH217249	$d \\ D \\ d$	66.675 150.000 85.000	C230 C236 C236	JM515610 JM515649 HM516410	d	130.000 80.000 133.350	C234 C234 C234
HM218210 HM218248 HH221410	$D \atop d \atop D$	147.000 90.000 190.500	C236 C236 C236,C238,C240	HM516448 JHM516810 JHM516849	$egin{array}{c} d \\ D \\ d \end{array}$	82.550 140.000 85.000	C234 C236 C236

Bearing No. CONE, CUP	d:C0	nal Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages
HM518410	$D \atop d \atop D$	152.400	C236
HM518445		88.900	C236
LM522510		159.987	C240
LM522546	$egin{matrix} d \\ d \\ d \end{bmatrix}$	107.950	C240
LM522548		109.987	C240
LM522549		109.987	C240
JHM522610	$D \atop d \atop D$	180.000	C240
JHM522649		110.000	C240
JHM534110		230.000	C244
JHM534149	$_{D}^{d}$	170.000	C244
LM603011		77.788	C222
LM603012		77.788	C222
LM603049	$d \\ D \\ d$	45.242	C222
L610510		94.458	C228
L610549		63.500	C228
JM612910	$egin{matrix} D \\ d \\ D \end{matrix}$	115.000	C232
JM612949		70.000	C232
LM613410		112.712	C230
LM613449	$egin{matrix} d \\ D \\ d \end{bmatrix}$	69.850	C230
HM617010		142.138	C236
HM617049		85.725	C236
L623110	$D \atop d \atop D$	152.400	C240
L623149		114.300	C240
JLM710910		105.000	C230
JLM710949	${\scriptsize \begin{array}{c} d \\ D \\ d \end{array}}$	65.000	C230
JLM714110		115.000	C232
JLM714149		75.000	C232
JM714210	$egin{matrix} D \\ d \\ D \end{matrix}$	120.000	C232
JM714249		75.000	C232
H715311		136.525	C228,C230,C232
H715334	$egin{matrix} d \\ d \\ d \end{bmatrix}$	61.912	C228
H715340		65.088	C230
H715341		66.675	C230
H715343	$d \\ d \\ D$	68.262	C230
H715345		71.438	C232
JM716610		130.000	C236
JM716648	$d \\ d \\ D$	85.000	C236
JM716649		85.000	C236
JM718110		145.000	C236
JM718149	${\scriptsize \begin{array}{c} d \\ D \\ d \end{array}}$	90.000	C236
JM719113		150.000	C238
JM719149		95.000	C238
JM720210	$D \\ D \\ d$	155.000	C238
JHM720210		160.000	C238
JM720249		100.000	C238
JHM720249	${\scriptsize \begin{array}{c} d \\ D \\ d \end{array}}$	100.000	C238
JL724314		170.000	C242
JL724348		120.000	C242
JL725316	$D \atop d \atop D$	175.000	C242
JL725346		125.000	C242
JM734410		240.000	C244
JM734449	$d \\ D \\ d$	170.000	C244
JM738210		260.000	C244
JM738249		190.000	C244

Bearing No. CONE, CUP	d:00	al Dimension (mm) DNE (Bore Dia.) JP (Outside Dia.)	Pages
HM801310	$D \atop d \atop D$	82.550	C218
HM801346		38.100	C218
M802011		82.550	C220
M802048	$d \\ D \\ d$	41.275	C220
HM803110		88.900	C220
HM803145		41.275	C220
HM803146	$d \\ d \\ D$	41.275	C220
HM803149		44.450	C220
M804010		88.900	C222
M804049	$d \\ D \\ d$	47.625	C222
HM804810		95.250	C220,C222,C224
HM804840		41.275	C220
HM804843	$egin{array}{c} d \\ d \\ d \end{array}$	44.450	C222
HM804846		47.625	C222
HM804848		48.412	C224
HM804849	$_{D}^{d}$	48.412	C224
HM807010		104.775	C222,C224
HM807011		104.775	C224
JHM807012	$egin{matrix} D \\ d \\ d \end{smallmatrix}$	105.000	C224
HM807040		44.450	C222
HM807044		49.212	C224
JHM807045	$\stackrel{d}{\stackrel{d}{\stackrel{D}}}$	50.000	C224
HM807046		50.800	C224
JLM813010		110.000	C232
JLM813049	$\stackrel{d}{\stackrel{D}{D}}_{d}$	70.000	C232
JLM820012		150.000	C238
JLM820048		100.000	C238
JM822010	$D \atop d \atop D$	165.000	C240
JM822049		110.000	C240
JHM840410		300.000	C244
JHM840449	$\stackrel{d}{\stackrel{D}{D}}_{d}$	200.000	C244
HM903210		95.250	C222
HM903247		44.450	C222
HM903249	$\stackrel{d}{\stackrel{D}{\atop D}}$	44.450	C222
HM911210		130.175	C226
HM911242		53.975	C226
H913810	$egin{array}{c} D \\ d \\ d \end{array}$	146.050	C228,C230
H913842		61.912	C228
H913849		69.850	C230

App.

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In addition to the quality and compactness customers already enjoy, NSK now offers sealed and shielded types for greater convenience and protection.





High-carbon chromium bearing steel Low-carbon steel and others

Features of the Sealed & Shielded Type Double Row Angular Contact Ball Bearings:

- Availability of sealed or shielded types in addition to our conventional open-type products
- No need to replace or refill grease since the lubricant is sealed into
 - the bearings

 Compact and narrower than back-to-back duplex
 - (DB) products

 Capable of accommodating heavy radial loads, axial loads in either direction
- High capacity for momentary loads

- Bearing Nomenclature

5202□DDU

NS7S

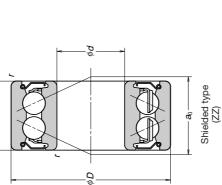
Internal configuration

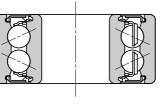
Grease type

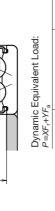
5202□ZZ

NS7S









Contact sealed type (DDU)

	$F_{\rm a}/F_{\rm r}$ >e	>	1.41		
	Fa/	×	0.67		
nt Load:	F _a ∕ F _{r≦} e	7	0.92	-oad:	
Jynamic Equivalent Load: P=XF _r +YF _a	$F_{\rm a}/$	×	-	uivalent l	$6F_{\rm a}$
Dynamic E P=XF _r +YF _a		Ð	0.68	Static Equivalent Load:	$P_0 = F_r + 0.76F_a$

Boundary Dimensions (mm)
Sealed d D B (Minimum) $C_{\rm r}$
10 30 14.3 0.6 7 150 3 900
12 32 15.9 0.6 8 500 5 300
19.0 1 14.700 9.100
<u></u>
OZ
67
20
င္ပ
40 90 36.5 1.5 49 500 38 000
45 85 30.2 1.1 41500 33500
45 100 39.7 1.5 61 500 48 500
50 90 30.2 1.1 40.500 36.000 4.100
50 110 44.4
55 100 33.3 1.5 49 500 43 500
55 120 49.2

Note: (1) These bearing numbers are for the double-shielded and double-sealed types. Single-shielded and single-sealed types are also available



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New 40° Angular Contact Ball Bearings

In addition to the quality and performance customers already enjoy, NSK now offers a new, higher capacity universal mounting series for greater convenience and longer bearing life.



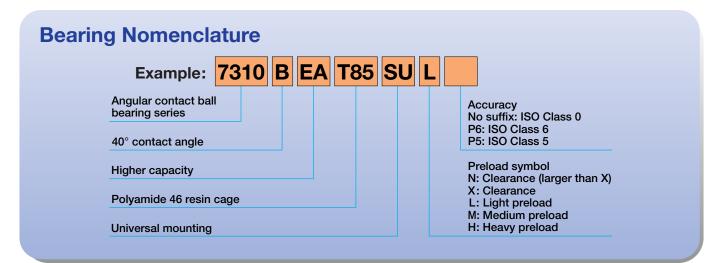
New 40° Angular Contact Ball Bearings



Features

- Higher capacity and longer life compared to our conventional types
- Universal mounting, single row, angular contact ball bearings with various clearances and preload classes available
- Cage molded from a redesigned glass fiber reinforced polyamide 46 resin

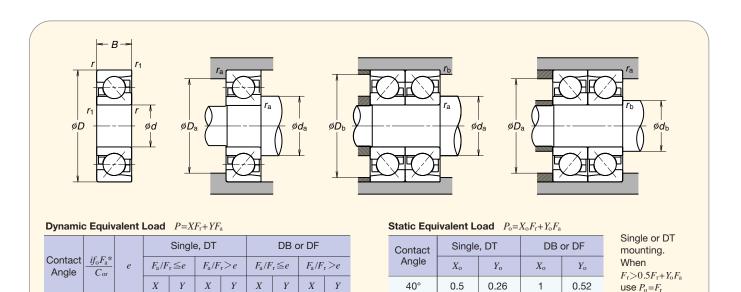




Face control for 40° angular contact bearings

	Diameter mm)		Axial Clearance (+) / Axial Interference (-) (Total for two bearings face to face or back to back) (µm)												
over	d include	Suffix min.	Suffix SUN min. max.		Suffix SUX min. max.		Suffix SUL min. max.		Suffix SUM min. max.		Suffix SUH min. max.				
10	30	16	36	-2	18	-12	8	-16	4	-20	0				
30	50	16	40	-2	18	-12	8	-18	2	-22	-2				
50	80	22	46	-2	22	-14	6	-22	-2	-28	-8				

Remark: These values are under measuring load.



 1.14
 1
 0
 0.35
 0.57
 1
 0.55
 0.57
 0.93

*For i, use 2 for DB or DF, and 1 for DT.

		Bounda	ary Dime	ensions		Basic Loa	nd Ratings		Abutme	nt and F	illet Dim	ensions	
Bearing	-1	_	(mm)				V)	-d			m)		
Numbers	d	D	В	<i>r</i> min.	r_1 min.	C _r dynamic	C₀r static	d _a min.	$D_{\rm a}$ max.	r _a max.	$d_{ extsf{b}}$ min.	<i>D</i> _b max.	r_{b} max.
7201BEA	12	32	10	0.6	0.3	7 750	3 750	17	27	0.6	14.5	29.5	0.3
7301BEA	12	37	12	1	0.6	10 500	4 950	18	31	1	17	32	0.6
7202BEA	15	35	11	0.6	0.3	9 300	4 800	20	30	0.6	17.5	32.5	0.3
7302BEA	15	42	13	1	0.6	13 600	6 900	21	36	1	20	37	0.6
7203BEA	17	40	12	0.6	0.3	11 000	6 100	22	35	0.6	19.5	37.5	0.3
7303BEA	17	47	14	1	0.6	16 000	8 300	23	41	1	22	42	0.6
7204BEA	20	47	14	1	0.6	14 800	8 150	26	41	1	25	42	0.6
7304BEA	20	52	15	1.1	0.6	18 900	10 500	27	45	1	25	47	0.6
7205BEA	25	52	15	1	0.6	16 700	10 200	31	46	1	30	47	0.6
7305BEA	25	62	17	1.1	0.6	25 900	14 900	32	55	1	30	57	0.6
7206BEA	30	62	16	1	0.6	22 600	14 300	36	56	1	35	57	0.6
7306BEA	30	72	19	1.1	0.6	34 500	20 600	37	65	1	35	67	0.6
7207BEA	35	72	17	1.1	0.6	31 000	19 600	42	65	1	40	67	0.6
7307BEA	35	80	21	1.5	1	38 500	24 400	44	71	1.5	41	74	1
7208BEA	40	80	18	1.1	0.6	36 500	24 500	47	73	1	45	75	0.6
7308BEA	40	90	23	1.5	1	50 500	33 000	49	81	1.5	46	84	1
7209BEA	45	85	19	1.1	0.6	38 500	27 100	52	78	1	50	80	0.6
7309BEA	45	100	25	1.5	1	59 500	39 500	54	91	1.5	51	94	1
7210BEA	50	90	20	1.1	0.6	40 000	29 700	57	83	1	55	85	0.6
7310BEA	50	110	27	2	1	74 500	50 500	60	100	2	56	104	1
7211BEA	55	100	21	1.5	1	49 000	37 000	64	91	1.5	61	94	1
7311BEA	55	120	29	2	1	85 000	58 500	65	110	2	61	114	1
7212BEA	60	110	22	1.5	1	59 000	45 000	69	101	1.5	66	104	1
7312BEA	60	130	31	2.1	1.1	97 500	68 500	72	118	2	67	123	1
7213BEA	65	120	23	1.5	1	66 500	53 500	74	111	1.5	71	114	1
7313BEA	65	140	33	2.1	1.1	108 000	77 000	77	128	2	72	133	1
7214BEA	70	125	24	1.5	1	72 000	58 500	79	116	1.5	76	119	1
7314BEA	70	150	35	2.1	1.1	118 000	87 500	82	138	2	77	143	1
7215BEA	75	130	25	1.5	1	75 000	63 500	84	121	1.5	81	124	1
7315BEA	75	160	37	2.1	1.1	127 000	98 500	87	148	2	82	153	1
7216BEA	80	140	26	2	1	83 500	70 000	90	130	2	86	134	1
7316BEA	80	170	39	2.1	1.1	138 000	110 000	92	158	2	87	163	1

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NSK AMERICAN TECHNOLOGY CENTER
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www.nssa.nsk.com
tel: 802-442-5448
 Bennington
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<As of July 2010>

For the latest information, please refer to the NSK website.

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For more information about NSK products, please contact:





Bearings for Papermaking Machines

NSK bearings achieved the longer life and higher limiting speed under high-temperature conditions including moisture and dust environment such as papermaking machines and the productivity was enhanced dramatically.





The NSK brand, recognized around the world

From home electric appliances, automobiles, and large-scale equipment to the aerospace industry—NSK bearings are used in an extensive range of fields. NSK established its global-scale enterprise on technology that has met the exacting requirements of Japanese industry. We have also established R&D systems and support services to meet the diverse needs of our customers throughout the world.

As a brand recognized around the world, NSK continues to lead the industry with its technical prowess.



THE AMERICAS (Locations of bases)

Headquarters 1 U.S.A.

Production site 8 Canada

Sales site 20 Mexico

R&D center 2 Brazil

Representative 1 Peru

office Argentina

EUROPE/AFRICA										
Headquarters	1									
Production site	9									
Sales site	15									
R&D center	3									
Representative office	3									

U.K.
Germany
France
Italy
Spain
Poland
Russia
Norway
Turkey
United Arab Emirates
South Africa

(Locations of bases)

ASIA / OCEANIA

Headquarters 3
Production site 25
Sales site 50
R&D center 3
Representative 3
office

As of March 2013

(Locations of bases)

Singapore

Malaysia

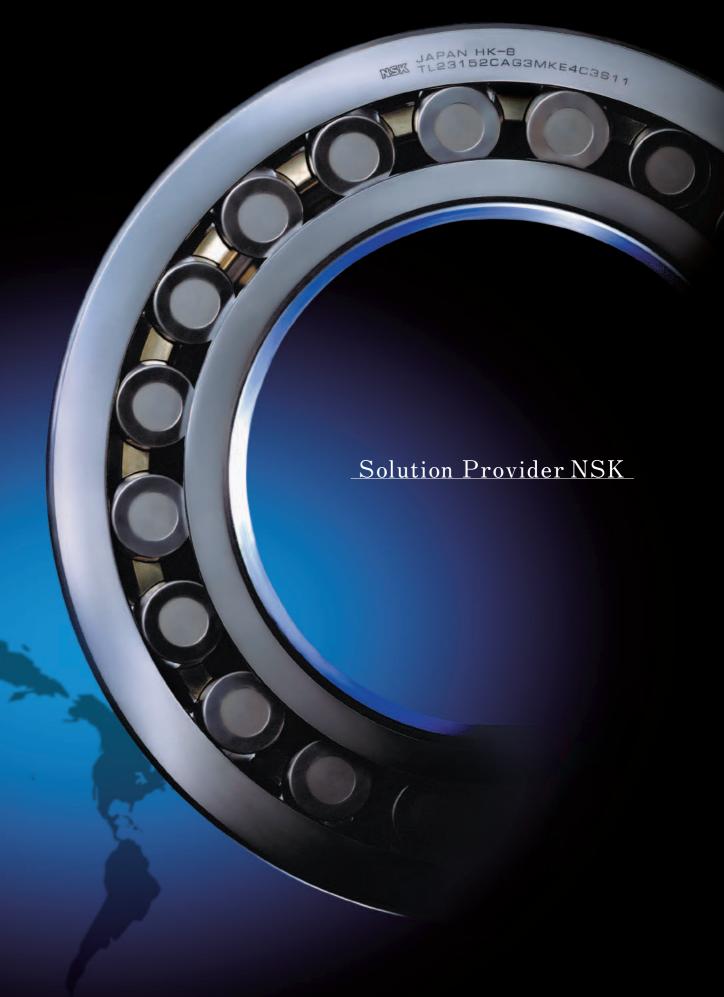
Vietnam India

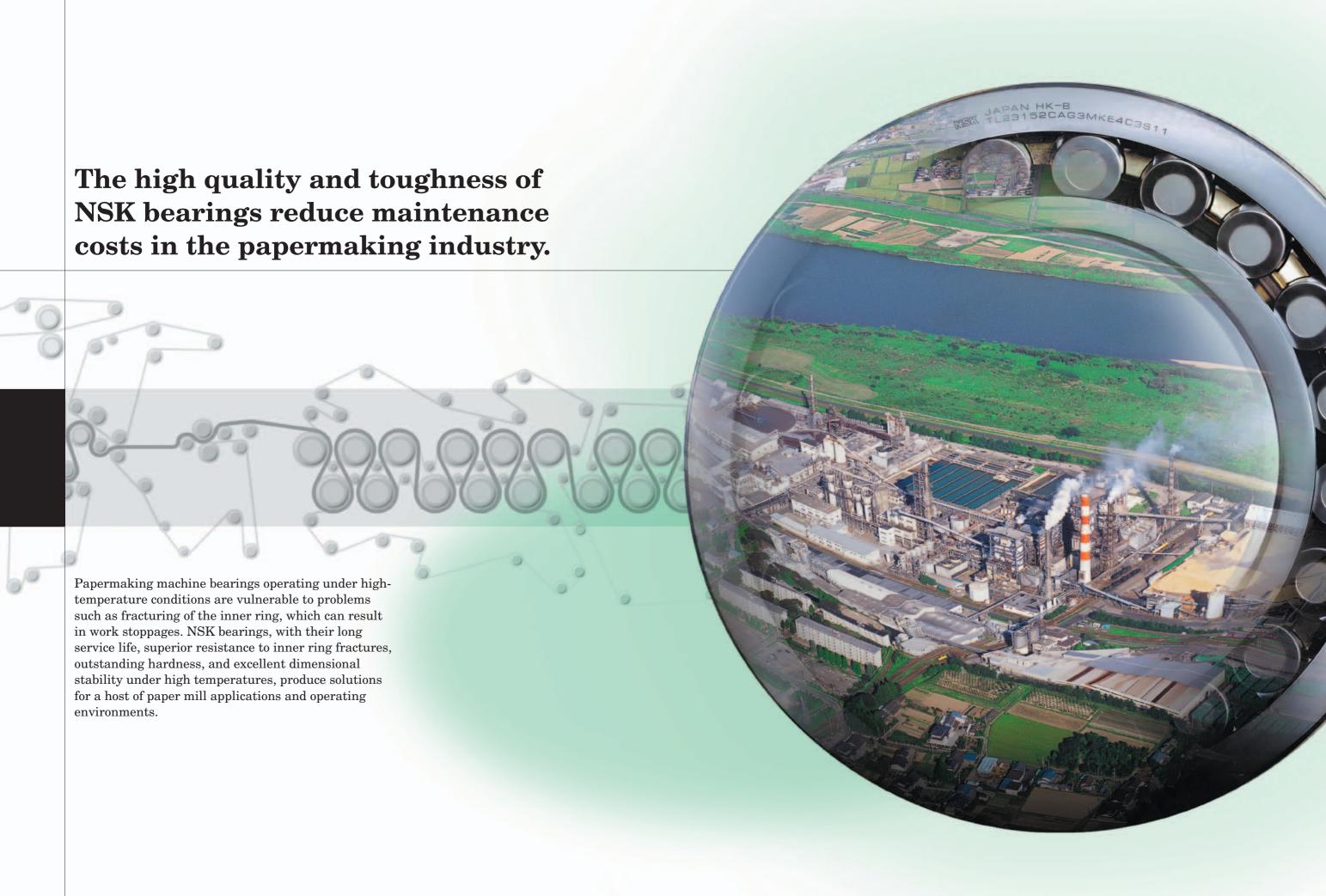
Australia New Zealand

China

South Korea Taiwan

Philippines







③ Inch series (or 223XX)

Mormal or C3 / P0

⑤ Grease

The Papermaking Process and **Spherical Roller Bearing Specifications**



①SR **260-70** 3 223XX Mormal / P0 **Soft Calender** ⑤ Grease 2 400-600 3 232, 241XX @ C3 or C4/ P0 or P55 Reel Drum Roll ⑤ Oil circulation ①SR @ Heat treatment: TL or S11 2 190 or carburized steel + S11 3 222, 223XX

- Reel Spreader Roll

Reel Spool Re

①TR

2 130-180

Mormal / P0

Rider Roll

3 222, 223XX

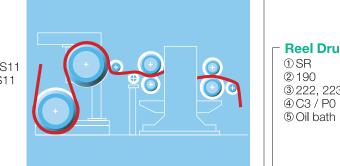
260-80

4 C3 / P6

⑤ Oil bath

③322XX

⑤ Grease



Calender Top Roll

① SR

220-280

4 Normal / P0

⑤ Oil circulation

③ 230XX

TL Series Spherical Roller Bearings

Ideal for high temperature equipment, with resistance to Tough, long-life TL bearings boost productivity and lower costs.

Major applications: dryer rolls, canvas rolls, PV rolls, and calender rolls



NSKHPS Spherical Roller Bearings

Next-generation standard bearings utilizing innovative materials and technologies benefit from NSK's experience and expertise o deliver longer life and higher limiting speed.

ajor applications: small diameter rolls such as canvas rolls, paper rolls, felt rolls, and rider rolls



Molded-Oil[™] Bearings

Excellent performance in environments exposed to moisture or paper dust, without oil leakage. Molded oil using an optimized molding method with optimal omposition provides higher speed operation, is easy to handle, and safe for the environment.

ajor applications: raw material conveyors, carrier rope sheaves, suction rolls



A Product Line

Specific

EM Series Cylindrical Roller Bearings

Bearings with integrated machined cages offer enhanced performance by combining the advantages of the conventional M series bearings and the high-load EMA1 series.



Triple Ring Bearings

Uniquely structured bearing for ease of use and no creep while offering high precision and long life.

Major applications: press rolls, breaker stack rolls



CA Series Spherical Roller Bearings

Superior radial load capacity and alignment, featuring high load capacity and excellent strength; equipped with a machined cage. his product lineup includes high running accuracy to ISO

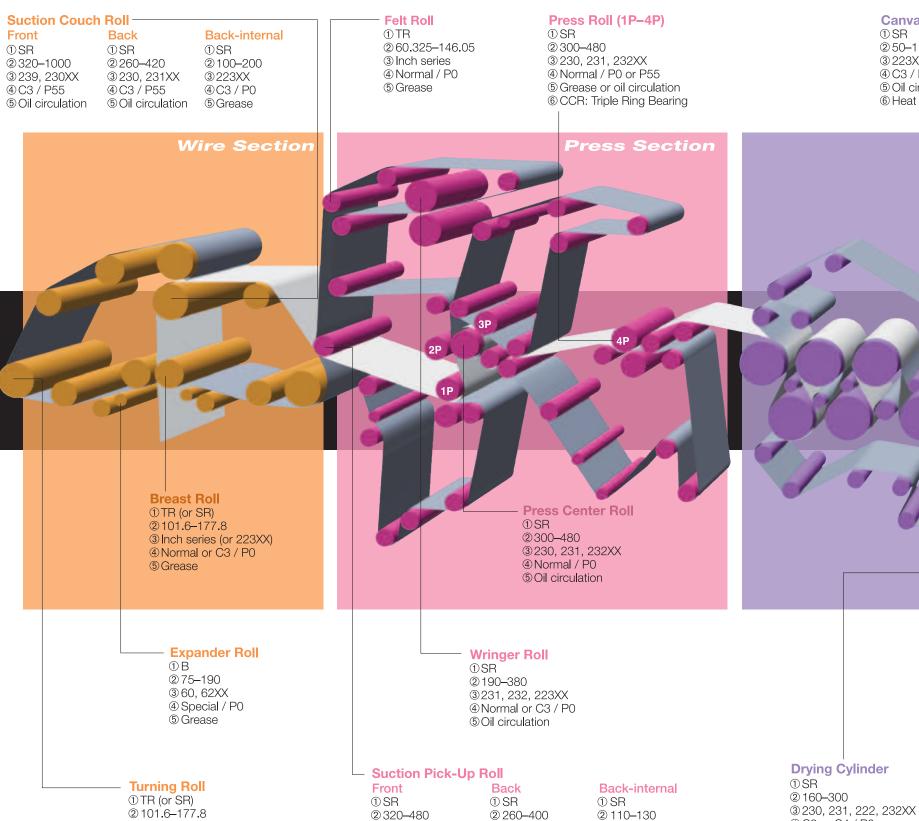
or applications: large diameter rolls such as suction rolls, press rolls,



Deep Groove Ball Bearings for High-Speed Expander Rolls Special bearings that suppress friction torque and surface damage

ch as smearing and others.

NSK offers other advantageous products for various rolls and conveyors, including the HR series of high load capacity tapered roller bearings and easy-to-handle ball bearing units.



3 230, 231XX

⑤ Oil circulation

4 C3 / P55

3 239, 230, 231XX

⑤ Oil circulation

③ 232XX

4 C3 / P0

4 C3 or C4 / P0

6 Heat treatment: TL

⑤ Oil circulation

Yankee Dryer DSR 2 400–600 3 230, 231XX 4 C3 or C4 / P0 5 Oil circulation © Heat treatment: TL or S11 or carburized steel + S11

PV Roll ① SR 2 90-380 3 239, 231, 222, 223XX

⑤ Oil circulation 6 Heat treatment: TL or S11

Calender Queen Roll ①SR **2**160-320 3231XX **4** C3 / P0

⑤ Oil circulation

① SR

2 240-530

4 C3 / P0

⑤ Oil circulation

③ 232XX

Calender Bottom Roll -

CCR: Triple Ring Bearing

① SR

Unwinding Stand 280-130 3 222XX

4 C3 / P6 or P0 ⑤ Oil bath

Winder Drum Roll

Paper Roll -

① SR

260–95

③ 223XX

4 C3 / P6

⑤ Oil bath or grease

①SR 2 130-160 3 223XX @C3/P6 ⑤ Oil bath

NSK 8

TL Series Spherical Roller Bearings

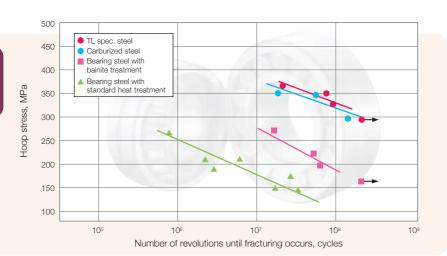
Dryer rolls are generally used under high-temperature conditions, which can lead to fracturing of the bearing inner ring, and in the worst case, result in work stoppage. NSK's solution is the TL (Tough and Long-life) bearing, which features sufficient strength to resist inner ring fractures, superior dimensional stability under high-temperature conditions, and long life due to superior hardness. All these characteristics mean improved productivity.



Features

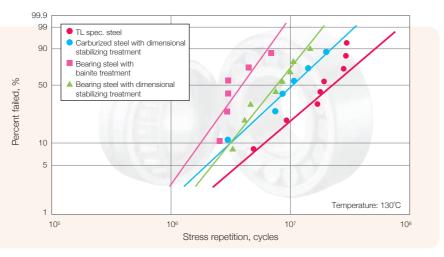
Enhanced inner ring strength

Adoption of a special steel and surface hardening heat treatment, developed by NSK, dramatically enhance inner ring strength against increasing hoop stress caused by rising shaft temperature.



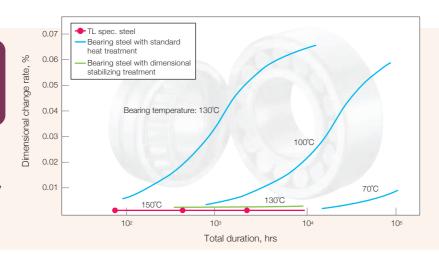
Longer life

Increased hardness of raceway surface provides longer life when foreign debris is present than that of other bearings.



Dimensional stability under high temperatures

High-temperature dimensional stabilization of up to 200°C has been achieved through the application of NSK's proprietary material heat treatment technology.



High Performance Standard Bearings for Industrial Machinery

NSKHPS, redefining the standard.

Continually developing products with greater strength and higher accuracy, NSK's new NSKHPS fully incorporate the advantages of NSK's world-class design, materials, and manufacturing technologies, setting a new standard for bearings.



Features

Compared with conventional bearings · · ·

Bearing life

2
times
longer
(maximum)

Limiting speed
20%
higher
(maximum)

Working temperature up to 200°c



1. Improved reliability

Bearing life has increased by a maximum of 2 times compared with that of conventional bearings by optimization of the bearing's internal design and improved processing technology.

As a result, the NSKHPS bearings contribute to reducing maintenance costs and facilitate the downscaling of related equipment.

2. Improved limiting speed (EA type only).

Limiting speed has been increased by a maximum of 20 % compared with that of conventional bearings by improving cage wear resistance.

3. High temperature dimensional stabilizing treatment comes standard

High-temperature dimensional stabilization of up to 200° C has been achieved through the application of NSK's proprietary material heat treatment technology.

As a result, this series of bearing can be used in a wide range of applications.

CA Series Spherical Roller Bearings

CA series bearings have high load capacity, superior durability, and wear resistance featuring a brass cage for various types of large rolls such as suction rolls, press rolls, calender rolls, and reel drum rolls, etc.

The CA series is available in a wide selection of sizes and other specifications, such as bearings with a lubricant hole and groove provided in the outer ring (E4), high heat-resistant bearings capable of withstanding up to 200°C (S11), and high-precision bearings (class 5).



Deep Groove Ball Bearings for High-speed Expander Rolls

Special bearings offer low frictional torque and minimize surface damage, such as smearing and others, through optimal design of the bearing interior and the adoption of coating treatment on the inner and outer rings.

The bearings are characterized by high performance and quality of the No. 1 brand including low-noise bearings suitable for motors and pumps.



Molded-Oil™ Bearings

Molded-Oil™ bearings are lubricated with NSK's own oil-impregnated material, Molded-Oil™ consists of lubricating oil and polyolefin resin that has an affinity for oil. Oil slowly seeping from this material provides ample lubrication to the bearing for extended periods.



Features

Excellent performance in water- and dustcontaminated environments

The bearings are designed to prevent liquids such as water, which can wash out the lubricating oil, and dust from getting inside the bearings. Sealed types can be used in environments exposed to water and dust.

*Water and dust dramatically accelerate bearing damage. In order to realize stable operation, w recommend using seals to prevent water and dust from getting in the bearing.

Optimal composition and molding methods enable high-speed operation

Optimization of composition and molding method of Molded-Oil™ improves strength and enables high-speed operation.

Low torque

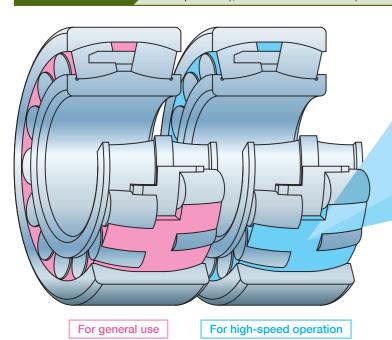
Packing with Molded-Oil™ after providing the bearing surface with special treatment realizes smooth rotation of rolling elements.

Environmentally friendly

The bearings are lubricated by minute quantities of oil exuded by Molded-Oil™, which consequently minimizes oil leakage.

Applications

Material processing equipment (conveyers, agitators), paper mill line equipment (support for wire part rolls), maintenance facilities (carrier rope sheave pulley), and carrier line equipment



Close-up of Molded-Oil™

Portion containing mostly lubricating oil

The lubricating oil is mineral oil-based.

Portion containing mostly polyolefin

Polyolefin is an environmentally sound material used for packaging food in supermarkets, replacing dioxin-generating vinyl chloride.

Be aware that this bearing has certain restrictions in regards to ambient operating temperatures and limiting speeds $(d_m n)$. Refer to the NSK Molded-Oil™ Bearings catalog (Cat. No. E1216) for details. Furthermore, handling precautions for maintainig the excellent, long-term lubricating capacity of the Molded-Oil™ bearings are listed on page 3 of the same catalog.

EM Series Cylindrical Roller Bearings

The high-load capacity standard cylindrical roller bearing delivers outstanding performance across a wide range of applications.

High-load capacity is achieved by using more rollers than conventional bearings based on an innovative NSK concept. We also offer standard cylindrical roller bearings for today's needs that provide longer service life and low-noise and lowvibration performance through an optimally designed one-piece cage with high rigidity and low wear.



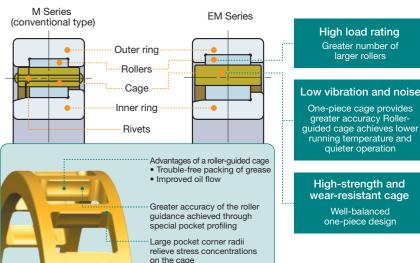
Features Series are available in bearing inner bore dimensions ranging from 25 mm to 200 mm

Compared to the conventional M Series:

Bearing life approximately 2 times

Low vibration and noise 50% to 60% less

Cage strength dramatically enhanced (generated stress cut in half)



Catalog No. E1237

Triple Ring Bearings

Combination tapered roller bearings have typically been used for the outside of controlled crown rolls (CCR) and spherical roller bearings for the inside. Switching to high-precision, high load capacity triple ring bearings prevents creep, facilitates easier mounting, and extends operating life.



Features

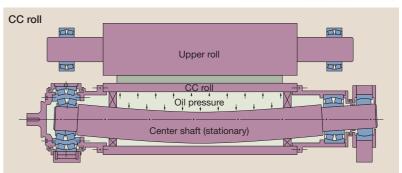
High-load capacity design

Long life (uses vacuum melted, carburized steel)

High precision (dimensional and rotational precision)

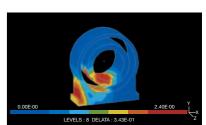
Optimal inner ring design for lubrication

Lubrication hole and groove provided on inner and outer rings



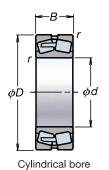
Finite element analysis of housing design for triple ring bearings.

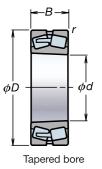
Bearing load distribution is minimized by finite element method (FEM) analysis, thereby contributing to optimal structural design of the housing for paper machine manufacturers.

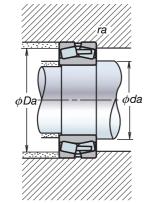


Maximum principle stress distribution

TL Series Spherical Roller Bearings







Dynamic equivalent load $P=XF_r+YF_a$

F _a /	F _r ≤e	F _a / F _r >e					
Χ	Y	Χ	Y				
1	Y ₃	0.67	Y ₂				

Static equivalent load $P_0=F_r+Y_0F_a$

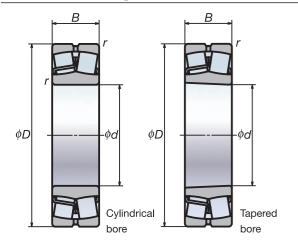
The values for e, Y_2 , Y_3 and Y_0 are given in the table below.

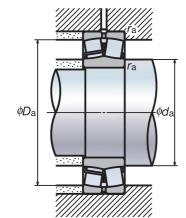
Bearing Nomenclature Example: TL 23152 CA g3 M K E4 C3 S11 Max.operating tempecature:less than 200°C (Special specification symbol) Width series 3 (Bearing series symbols); Diameter series 1 (Bearing series symbols); Bearing bore 260 mm (Bore number) Machined brass cage (Cage type symbol) TL spec.Inner ring. (Special spec, material symbol) g5: Inner and outer ring

	Bound	dary dim	ensions (mr	m)	Basic load	ratings (N)	Limiting spe	eeds (min-1)	Bearing	numbers		Abutment	and fillet dimens	sions (mm)		Constant		Axial load factor	's	Mass
d		D	В	<i>r</i> (min .)	Cr	C _{or}	Grease	Oil	Cylindrical bore	Tapered bore (1)	(min.)	d _a (max.)	(max.)) _a (min.)	r _a (max.)	е	Y ₂	Y ₃	<i>Y</i> ₀	(kg) approx.
65	5	140	48	2.1	375 000	380 000	3 200	4 000	TL22313EAE4	TL22313EAKE4	77	84	128	119	2	0.33	3.0	2.0	2.0	3.52
70)	150	51	2.1	425 000	435 000	3 000	3 800	TL22314EAE4	TL22314EAKE4	82	91	138	129	2	0.33	3.0	2.0	2.0	4.28
90		190	64	3	665 000	705 000	2 400	3 000	TL22318EAE4	TL22318EAKE4	104	115	176	163	2.5	0.33	3.1	2.1	2.0	8.56
100		215	73	3	860 000	930 000	2 000	2 600	TL22320EAE4	TL22320EAKE4	114	130	201	184	2.5	0.33	3.0	2.0	2.0	12.7
110)	170	45	2	293 000	465 000	2 000	2 400	TL23022CDE4	TL23022CDKE4	120	124	160	153	2	0.24	4.2	2.8	2.8	3.76
110)	200	69.8	2.1	515 000	760 000	1 500	1 900	TL23222CE4	TL23222CKE4	122	130	188	170	2	0.34	3.0	2.0	1.9	9.54
110)	240	80	3	825 000	1 120 000	1 700	2 200	TL22322EAE4	TL22322EAKE4	124	145	226	206	2.5	0.30	3.1	2.1	2.0	17.6
120		260	86	3	955 000	1 320 000	1 600	2 000	TL22324EAE4	TL22324EAKE4	134	157	246	222	2.5	0.32	3.1	2.1	2.0	22.2
130		280	93	4	995 000	1 350 000	1 300	1 600	TL22326CAE4	TL22326CAKE4	148	_	262	236	3	0.34	2.9	2.0	1.9	27.8
140		210	53	2	420 000	715 000	1 600	1 900	TL23028CDE4	TL23028CDKE4	150	157	200	190	2	0.22	4.5	3.0	2.9	6.49
140		250	68	3	645 000	930 000	1 400	1 700	TL22228CDE4	TL22228CDKE4	154	167	236	219	2.5	0.25	4.0	2.7	2.6	14.5
140		250	88	3	835 000	1 300 000	1 100	1 500	TL23228CE4	TL23228CKE4	154	163	236	213	2.5	0.35	2.9	1.9	1.9	18.8
150		225	56	2.1	470 000	815 000	1 400	1 800	TL23030CDE4	TL23030CDKE4	162	168	213	203	2	0.22	4.6	3.1	3.0	7.90
150		250	80	2.1	725 000	1 180 000	1 100	1 400	TL23130CAE4	TL23130CAKE4	162	_	238	218	2	0.30	3.4	2.3	2.2	15.8
150		270	73	3	765 000	1 120 000	1 300	1 600	TL22230CDE4	TL22230CDKE4	164	179	256	236	2.5	0.26	3.9	2.6	2.5	18.4
150		320	108	4	1 220 000	1 690 000	1 100	1 400	TL22330CAE4	TL22330CAKE4	168	_	302	270	3	0.35	2.9	1.9	1.9	41.5
160		240	60	2.1	540 000	955 000	1 300	1 700	TL23032CDE4	TL23032CDKE4	172	179	228	216	2	0.22	4.5	3.0	2.9	9.66
160		290	80	3	910 000	1 320 000	1 200	1 500	TL22232CDE4	TL22232CDKE4	174	190	276	255	2.5	0.26	3.8	2.6	2.5	23.1
160		290	104	3	1 100 000	1 770 000	1 000	1 300	TL23232CE4	TL23232CKE4	174	189	276	245	2.5	0.34	2.9	2.0	1.9	30.5
170		230	45	2	350 000	660 000	1 400	1 800	TL23934BCAE4	TL23934BCAKE4	180	_	220	213	2	0.17	5.8	3.9	3.8	5.38
170		260	67	2.1	640 000	1 090 000	1 200	1 600	TL23034CDE4	TL23034CDKE4	182	191	248	233	2	0.23	4.3	2.9	2.8	13.0
170		280	88	2.1	940 000	1 570 000	1 000	1 300	TL23134CAE4	TL23134CAKE4	182	_	268	245	2	0.29	3.5	2.3	2.3	21.0
170		360	120	4	1 580 000	2 110 000	1 000	1 200	TL22334CAE4	TL22334CAKE4	188	_	342	304	3	0.35	2.9	1.9	1.9	57.9
180		280	74	2.1	750 000	1 270 000	1 200	1 400	TL23036CDE4	TL23036CDKE4	192	202	268	249	2	0.24	4.2	2.8	2.8	17.1
180		320	112	4	1 300 000	2 110 000	850	1 100	TL23236CAE4	TL23236CAKE4	198	_	302	274	3	0.35	2.9	1.9	1.9	38.5
190		290	75	2.1	775 000	1 350 000	1 100	1 400	TL23038CAE4	TL23038CAKE4	202	_	278	261	2	0.24	4.2	2.8	2.8	17.6
190		320	104	3	1 190 000	2 020 000	850	1 100	TL23138CAE4	TL23138CAKE4	204	_	306	276	3.5	0.31	3.2	2.2	2.1	34.0
190		340	92	4	1 140 000	1 730 000	1 000	1 200	TL22238CAE4	TL22238CAKE4	208	_	322	296	3	0.26	3.8	2.6	2.5	35.5
190		340	120	4	1 440 000	2 350 000	800	1 100	TL23238CAE4 TL22338CAE4	TL23238CAKE4 TL22338CAKE4	208	-	322	288	3 4	0.35	2.9	1.9	1.9	46.5
190		400	132	5	1 890 000	2 590 000	900	1 100	TL2338CAE4 TL23040CAE4	TL2336CAKE4 TL23040CAKE4	212	_	378	338	2	0.34 0.25	2.9	2.0	1.9	77.6 22.6
200 200		310 340	82	2.1 3	940 000	1 700 000	1 000	1 300 1 000	TL23040CAE4	TL23140CAKE4	212	_	298 326	279	2.5	0.25	4.0	2.7	2.6 2.1	41.5
200		360	112 98	4	1 360 000 1 300 000	2 330 000 2 010 000	800 950	1 200	TL23140CAE4	TL22140CAKE4	214	_	342	293 315	3	0.32	3.2	2.1 2.6	2.5	42.6
200		360	128	4	1 660 000	2 750 000	750	1 000	TL23240CAE4	TL23240CAKE4	218	_	342	307	3	0.35	2.9	1.9	1.9	57.0
220		340	90	3	1 090 000	1 980 000	950	1 200	TL23044CAE4	TL23044CAKE4	234	_	326	302	2.5	0.24	4.1	2.8	2.7	29.7
220		370	120	4	1 570 000	2 710 000	710	950	TL23144CAE4	TL23144CAKE4	238	_	352	320	3	0.31	3.2	2.2	2.1	52.0
220		400	108	4	1 570 000	2 430 000	850	1 000	TL22244CAE4	TL22244CAKE4	238	_	382	348	3	0.27	3.7	2.5	2.4	59.0
220		400	144	4	2 010 000	3 400 000	670	900	TL23244CAE4	TL23244CAKE4	238	_	382	337	3	0.36	2.8	1.9	1.8	79.5
220		460	145	5	2 350 000	3 400 000	750	950	TL22344CAE4	TL22344CAKE4	242	_	438	391	4	0.33	3.0	2.0	2.0	116
240		320	60	2.1	635 000	1 300 000	950	1 200	TL23948CAE4	TL23948CAKE4	252	_	308	298	2	0.17	6.0	4.0	3.9	13.3
240		360	92	3	1 160 000	2 140 000	850	1 100	TL23048CAE4	TL23048CAKE4	254	_	346	324	2.5	0.24	4.2	2.8	2.7	32.6
240		400	128	4	1 790 000	3 100 000	670	850	TL23148CAE4	TL23148CAKE4	258	_	382	347	3	0.31	3.3	2.2	2.2	64.5
240		500	155	5	2 600 000	3 800 000	670	850	TL22348CAE4	TL22348CAKE4	262	_	478	423	4	0.32	3.2	2.1	2.1	147
260		360	75	2.1	930 000	1 870 000	850	1 000	TL23952CAE4	TL23952CAKE4	272	_	348	333	2	0.19	5.4	3.6	3.5	23.0
260		400	104	4	1 430 000	2 580 000	800	950	TL23052CAE4	TL23052CAKE4	278	_	382	356	3	0.25	4.1	2.7	2.7	46.6
260		440	144	4	2 160 000	3 750 000	600	800	TL23152CAE4	TL23152CAKE4	278	_	422	380	3	0.32	3.2	2.1	2.1	88.2
280		380	75	2.1	925 000	1 950 000	800	950	TL23956CAE4	TL23956CAKE4	292	-	368	351	2	0.18	5.7	3.9	3.8	24.5
280		420	106	4	1 540 000	2 950 000	710	900	TL23056CAE4	TL23056CAKE4	298	_	402	377	3	0.24	4.2	2.8	2.7	50.5
280		460	146	5	2 230 000	4 000 000	560	750	TL23156CAE4	TL23156CAKE4	302	_	438	400	4	0.30	3.3	2.2	2.2	94.3
280		500	176	5	2 880 000	4 900 000	530	670	TL23256CAE4	TL23256CAKE4	302	_	478	425	4	0.35	2.9	1.9	1.9	147
300		420	90	3	1 230 000	2 490 000	710	900	TL23960CAE4	TL23960CAKE4	314	_	406	386	2.5	0.19	5.2	3.5	3.4	38.2
300		460	118	4	1 920 000	3 700 000	670	850	TL23060CAE4	TL23060CAKE4	318	_	442	413	3	0.24	4.2	2.8	2.7	70.5
300		500	160	5	2 670 000	4 800 000	500	670	TL23160CAE4	TL23160CAKE4	322	_	478	433	4	0.31	3.3	2.2	2.2	125
300		540	192	5	3 400 000	5 900 000	480	630	TL23260CAE4	TL23260CAKE4	322	_	518	458	4	0.35	2.9	1.9	1.9	189
320		540	176	5	3 050 000	5 500 000	480	600	TL23164CAE4	TL23164CAKE4	342	_	518	466	4	0.31	3.2	2.1	2.1	162
340)	520	133	5	2 280 000	4 400 000	560	710	TL23068CAE4	TL23068CAKE4	362	-	498	465	4	0.24	4.2	2.8	2.8	101
340		580	190	5	3 600 000	6 600 000	430	560	TL23168CAE4	TL23168CAKE4	362	_	558	499	4	0.31	3.2	2.1	2.1	206
360		540	134	5	2 390 000	4 700 000	530	670	TL23072CAE4	TL23072CAKE4	382	_	518	485	4	0.24	4.2	2.8	2.8	106
380)	520	106	4	1 870 000	4 100 000	530	670	TL23976CAE4	TL23976CAKE4	398	_	502	482	3	0.18	5.5	3.7	3.6	65.4

Note (1) The suffix K indicates that the bearing has a tapered bore (taper 1:12). Remarks The suffix E4 indicates that the bering has an oil groove and holes.

NSKHPS Spherical Roller Bearings





Dynamic equivalent load $P=XF_r+YF_a$

Fa/	F _r ≤e	F _a / F _r >e							
X	Y	X	Y						
1	Y ₃	0.67	Y ₂						

Static equivalent load

 $P_0=F_r+Y_0F_a$

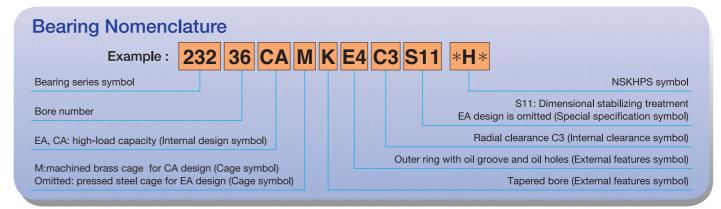
The values for e, Y_2 , Y_3 and Y_0 are given in the table below.

Boun	dary dim	nensions	s (mm)	Basic load	I ratings (N)	Limiting sp	eeds (min-1)	Bearing	ı numbers	Abutm	ent and	fillet din	nension	s (mm)	Constant	Axial load factors			
d	D	В	r (min.)	Cr	C _{0r}	Grease	Oil	Cylindrical bore	Tapered bore (1)	d (min.)	a (max.)	(max.)		ra (max.)	е	Y2	Y3	Yo	
40	80	23	1.1	113 000	99 500	6 700	8 500	22208EAE4	22208EAKE4	47	49	73	70	1	0.28	3.6	2.4	2.4	
40	90	23	1.5	118 000	111 000	6 000	7 500	21308EAE4	21308EAKE4	49	54	81	75	1.5	0.25	3.9	2.7	2.6	
	90	33	1.5	170 000	153 000	5 300	6 700	22308EAE4	22308EAKE4	49	52	81	77	1.5	0.35	2.8	1.9	1.9	
45	85	23	1.1	118 000	111 000	6 000	7 500	22209EAE4	22209EAKE4	52	54	78	75	1	0.25	3.9	2.7	2.6	
40	100	25	1.5	149 000	144 000	5 000	6 300	21309EAE4	21309EAKE4	54	65	91	89	1.5	0.23	4.3	2.9	2.8	
	100	36	1.5	207 000	195 000	4 500	5 600	22309EAE4	22309EAKE4	54	59	91	86	1.5	0.34	2.9	2.0	1.9	
50	90	23	1.1	124 000	119 000	5 600	7 100	22210EAE4	22210EAKE4	57	60	83	81	1	0.24	4.3	2.9	2.8	
- 00	110	27	2	178 000	175 000	4 500	5 600	21310EAE4	21310EAKE4	60	72	100	98	2	0.23	4.4	3.0	2.9	
	110	40	2	246 000	234 000	4 300	5 300	22310EAE4	22310EAKE4	60	64	100	93	2	0.35	2.8	1.9	1.9	
55	100	25	1.5	149 000	144 000	5 300	6 700	22211EAE4	22211EAKE4	64	65	91	89	1.5	0.23	4.3	2.9	2.8	
	120	29	2	178 000	174 000	4 500	5 600	21311EAE4	21311EAKE4	65	72	110	98	2	0.23	4.4	3.0	2.9	
	120	43	2	292 000	292 000	3 800	4 800	22311EAE4	22311EAKE4	65	73	110	103	2	0.34	2.9	2.0	1.9	
60	110	28	1.5	178 000	174 000	4 800	6 000	22212EAE4	22212EAKE4	69	72	101	98	1.5	0.23	4.4	3.0	2.9	
	130	31	2.1	238 000	244 000	3 800	4 800	21312EAE4	21312EAKE4	72	87	118	117	2	0.22	4.5	3.0	3.0	
	130	46	2.1	340 000	340 000	3 600	4 500	22312EAE4	22312EAKE4	72	79	118	111	2	0.34	3.0	2.0	1.9	
65	120	31	1.5	221 000	230 000	4 300	5 300	22213EAE4	22213EAKE4	74	80	111	107	1.5	0.24	4.2	2.8	2.7	
	140	33	2.1	264 000	275 000	3 600	4 500	21313EAE4	21313EAKE4	77	94	128	126	2	0.22	4.6	3.1	3.0	
	140	48	2.1	375 000	380 000	3 200	4 000	22313EAE4	22313EAKE4	77	84	128	119	2	0.33	3.0	2.0	2.0	
70	125	31	1.5	225 000	232 000	4 000	5 300	22214EAE4	22214EAKE4	79	84	116	111	1.5	0.23	4.3	2.9	2.8	
	150	35	2.1	310 000	325 000	3 200	4 000	21314EAE4	21314EAKE4	82	101	138	135	2	0.22	4.6	3.1	3.0	
	150	51	2.1	425 000	435 000	3 000	3 800	22314EAE4	22314EAKE4	82	91	138	129	2	0.33	3.0	2.0	2.0	
75	130	31	1.5	238 000	244 000	4 000	5 000	22215EAE4	22215EAKE4	84	87	121	117	1.5	0.22	4.5	3.0	3.0	
	160	37	2.1	310 000	325 000	3 200	4 000	21315EAE4	21315EAKE4	87	101	148	134	2	0.22	4.6	3.1	3.0	
	160	55	2.1	485 000	505 000	2 800	3 600	22315EAE4	22315EAKE4	87	97	148	137	2	0.33	3.0	2.0	2.0	
80	140	33	2	264 000	275 000	3 600	4 500	22216EAE4	22216EAKE4	90	94	130	126	2	0.22	4.6	3.1	3.0	
	170	39	2.1	355 000	375 000	3 000	3 800	21316EAE4	21316EAKE4	92	109	158	146	2	0.23	4.4	3.0	2.9	
	170	58	2.1	540 000	565 000	2 600	3 400	22316EAE4	22316EAKE4	92	103	158	145	2	0.33	3.0	2.0	2.0	
85	150	36	2	310 000	325 000	3 400	4 300	22217EAE4	22217EAKE4	95	101	140	135	2	0.22	4.6	3.1	3.0	
	180	41	3	360 000	395 000	3 000	4 000	21317EAE4	21317EAKE4	99	108	166	142	2.5	0.24	4.3	2.9	2.8	
	180	60	3	600 000	630 000	2 400	3 200	22317EAE4	22317EAKE4	99	110	166	155	2.5	0.33	3.1	2.1	2.0	
90	160	40	2	360 000	395 000	3 200	4 000	22218EAE4	22218EAKE4	100	108	150	142	2	0.24	4.3	2.9	2.8	
	190	43	3	415 000	450 000	2 800	3 600	21318EAE4	21318EAKE4	104	115	176	152	2.5	0.24	4.3	2.9	2.8	
	190	64	3	665 000	705 000	2 400	3 000	22318EAE4	22318EAKE4	104	115	176	163	2.5	0.33	3.1	2.1	2.0	
95	170	43	2.1	415 000	450 000	3 000	3 800	22219EAE4	22219EAKE4	107	115	158	152	2	0.24	4.3	2.9	2.8	
	200	45	3	430 000	435 000	1 500	2 000	21319CAME4	21319CAMKE4	109	127	186	172	2.5	0.22	4.6	3.1	3.0	
	200	67	3	735 000	780 000	2 200	2 800	22319EAE4	22319EAKE4	109	121	186	172	2.5	0.33	3.1	2.1	2.0	
100	180	46	2.1	455 000	490 000	2 800	3 600	22220EAE4	22220EAKE4	112	119	168	160	2	0.24	4.3	2.9	2.8	
	180	60.3	2.1	525 000	605 000	1 600	2 200	23220CAME4	23220CAMKE4	112	118	168	155	2	0.32	3.2	2.1	2.1	
	215	47	3	495 000	485 000	1 400	1 900	21320CAME4	21320CAMKE4	114	133	201	184	2.5	0.23	4.4	3.0	2.9	
	215	73	3	860 000	930 000	2 000	2 600	22320EAE4	22320EAKE4	114	130	201	184	2.5	0.33	3.0	2.0	2.0	
110	180	56	2	480 000	630 000	1 600	2 000	23122CAME4	23122CAMKE4	120	127	170	158	2	0.28	3.5	2.4	2.3	
	180	69	2	575 000	750 000	1 600	2 000	24122CAME4	24122CAMKE4	120	123	170	154	2	0.36	2.8	1.9	1.8	
	200	53	2.1	605 000	645 000	2 600	3 200	22222EAE4	22222EAKE4	122	129	188	178	2	0.25	4.0	2.7	2.6	
	200	69.8	2.1	645 000	760 000	1 500	1 900	23222CAME4	23222CAMKE4	122	130	188	170	2	0.34	3.0	2.0	1.9	
	240	50	3	565 000	545 000	1 300	1 700	21322CAME4	21322CAMKE4	124	145	226	206	2.5	0.22	4.6	3.1	3.0	
120	240 180	80 46	3	1 030 000	1 120 000 525 000	1 900 1 800	2 400 2 200	22322EAE4 23024CAME4	22322EAKE4 23024CAMKE4	124 130	145 134	226 170	206 163	2.5	0.33	3.1 4.5	2.1	2.0	
120		60	2	480 000	680 000			24024CAME4		130				2		3.2	2.1	2.9	
	180					1 500	2 000		24024CAMKE4		131	170	158		0.32				
	200	62 80	2	580 000 695000	720 000 905000	1 400 1 400	1 800	23124CAME4 24124CAME4	23124CAMKE4 24124CAMKE4	130	138 136	190 190	175 171	2	0.29	3.5 2.7	2.4	2.3	
							1 800										1.8		
	215	58 76	2.1	685 000 790 000	765 000 970 000	2 400 1 300	3 000 1 700	22224EAE4 23224CAME4	22224EAKE4	132 132	142	203	190	2	0.25 0.34	3.9	2.7	2.6	
	215	76 86	2.1	1 190 000			2 200	23224CAME4 22324EAE4	23224CAMKE4 22324EAKE4	134	140	246	182	2 2 5	0.34	2.9 3.1	2.0	1.9	
130	260	86 52	3	500 000	1 320 000	1 700					157	190	222	2.5	0.32		2.1	2.0	
130	200 200	69	2	620 000	655 000 865 000	1 700 1 400	2 000	23026CAME4 24026CAME4	23026CAMKE4 24026CAMKE4	140	147	190	180 175	2	0.23	4.3 3.2	2.9	2.8	
	210		2	630 000	825 000	1 300	1 800 1 700	23126CAME4	23126CAMKE4	140	143 149	200	184	2	0.31	3.2		2.1	
	210	64 80	2	735 000	1 010 000	1 300	1 700	24126CAME4	24126CAMKE4	140	149	200	180	2	0.26	2.7	2.4 1.8	1.8	
	230	64	3	820 000	940 000	2 200	2 600	22226EAE4	22226EAKE4	144	152	216	204	2.5	0.37	3.8	2.6	2.5	
	230	80	3	875 000	1 080 000	1 200	1 600	23226CAME4	23226CAMKE4	144	150	216	196	2.5	0.26	2.9	2.0	1.9	
	280	93	4	1 240 000	1 350 000	1 300	1 600	22326CAME4	22326CAMKE4	148	166	262	236	3	0.34	2.9	2.0	1.9	
	200	55	7	1 240 000	1 000 000	1 000	1 000	LZ0Z00/NVIL4	LLUZUU/NVI/L4	170	100	202	200	U	0.07	2.0	2.0	1.0	

Note (1) The suffix K indicates that the bearing has a tapered bore (taper 1:12).

Remarks 1. The maximum operating temperature of standard NSKHPS spherical roller bearings is 200°C.

2. The suffix E4 indicates that the bearing has an oil groove and holes

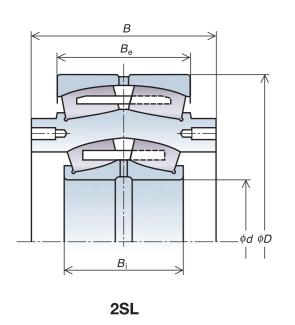


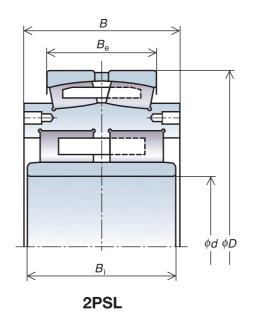
Bound	undary dimensions (mm) Basic load ratings (N)		ratings (N)	Limiting speeds (min-1)		Bearing	Abutment and fillet dimensions (mm)					Constant	Axial load factors					
d	D	В	r (min.)	Cr	C _{0r}	Grease	Oil	Cylindrical bore	Tapered bore (1)	(min.)	la (max.)	(max.)	a (min.)	ra (max.)	е	Y2	Y3	Yo
140	210	53	2	525 000	715 000	1 600	1 900	23028CAME4	23028CAMKE4	150	157	200	190	2	0.22	4.5	3.0	2.9
	210	69	2	655 000	945 000	1 300	1 700	24028CAME4	24028CAMKE4	150	154	200	186	2	0.31	3.2	2.1	2.1
	225 225	68 85	2.1	725 000 835 000	945 000	1 200	1 600 1 600	23128CAME4	23128CAMKE4 24128CAMKE4	152 152	158 156	213 213	198 192	2	0.28 0.37	3.6 2.7	2.4 1.8	2.3
	250	68	3	835 000	1 160 000 945 000	1 200 1 400	1 700	24128CAME4 22228CAME4	22228CAMKE4	154	167	236	221	2.5	0.37	3.9	2.6	1.8
	250	88	3	1 040 000	1 300 000	1 100	1 500	23228CAME4	23228CAMKE4	154	163	236	213	2.5	0.25	2.9	1.9	1.9
	300	102	4	1 450 000	1 590 000	1 200	1 500	22328CAME4	22328CAMKE4	158	177	282	253	3	0.35	2.9	1.9	1.9
150	225	56	2.1	590 000	815 000	1 400	1 800	23030CAME4	23030CAMKE4	162	168	213	203	2	0.22	4.6	3.1	3.0
	225	75	2.1	740 000	1 090 000	1 200	1 500	24030CAME4	24030CAMKE4	162	165	213	198	2	0.30	3.4	2.3	2.2
	250	80	2.1	905 000	1 180 000	1 100	1 400	23130CAME4	23130CAMKE4	162	174	238	218	2	0.30	3.4	2.3	2.2
	250	100	2.1	1 070 000	1 450 000	1 100	1 400	24130CAME4	24130CAMKE4	162	169	238	212	2	0.38	2.6	1.8	1.7
	270	73	3	955 000	1 120 000	1 300	1 600	22230CAME4	22230CAMKE4	164	179	256	236	2.5	0.26	3.9	2.6	2.5
	270	96	3	1 220 000	1 560 000	1 100	1 400	23230CAME4	23230CAMKE4	164	176	256	230	2.5	0.35	2.9	1.9	1.9
160	320 220	108 45	4	1 530 000 450 000	1 690 000 675 000	1 100 1 400	1 400 1 800	22330CAME4 23932CAME4	22330CAMKE4 23932CAMKE4	168 170	-	302 210	270 203	3	0.35 0.18	2.9 5.6	1.9 3.8	1.9
100	240	60	2.1	675 000	955 000	1 300	1 700	23032CAME4	23032CAMKE4	170	179	228	216	2	0.18	4.5	3.0	2.9
	240	80	2.1	845 000	1 260 000	1 100	1 400	24032CAME4	24032CAMKE4	172	177	228	212	2	0.30	3.4	2.3	2.2
	270	86	2.1	1 070 000	1 400 000	1 000	1 300	23132CAME4	23132CAMKE4	172	185	258	234	2	0.30	3.4	2.3	2.2
	270	109	2.1	1 240 000	1 670 000	1 000	1 300	24132CAME4	24132CAMKE4	172	179	258	229	2	0.39	2.6	1.7	1.7
	290	80	3	1 140 000	1 320 000	1 200	1 500	22232CAME4	22232CAMKE4	174	190	276	255	2.5	0.26	3.8	2.6	2.5
	290	104	3	1 370 000	1 770 000	1 000	1 300	23232CAME4	23232CAMKE4	174	189	276	245	2.5	0.34	2.9	2.0	1.9
	340	114	4	1 700 000	1 900 000	1 100	1 300	22332CAME4	22332CAMKE4	178	-	322	287	3	0.35	2.9	1.9	1.9
170	230	45	2	440 000	660 000	1 400	1 800	23934BCAME4	23934BCAMKE4	180	-	220	213	2	0.17	5.8	3.9	3.8
	260	67	2.1	795 000	1 090 000	1 200	1 600	23034CAME4	23034CAMKE4	182	191	248	233	2	0.23	4.3	2.9	2.8
	260	90	2.1	1 030 000	1 520 000	1 000	1 300	24034CAME4	24034CAMKE4	182	188	248	228	2	0.31	3.2	2.2	2.1
	280	88	2.1	1 180 000	1 570 000	1 000	1 300	23134CAME4	23134CAMKE4	182	194	268	245	2	0.29	3.5	2.3	2.3
	280 310	109 86	2.1	1 280 000 1 240 000	1 770 000 1 500 000	1 000 1 100	1 300 1 400	24134CAME4 22234CAME4	24134CAMKE4 22234CAMKE4	182 188	190 206	268 292	239 270	2	0.38 0.26	2.7 3.8	1.8 2.6	1.7 2.5
	310	110	4	1 500 000	1 910 000	900	1 200	23234CAME4	23234CAMKE4	188	201	292	261	3	0.25	2.9	1.9	1.9
	360	120	4	1 970 000	2 110 000	1 000	1 200	22334CAME4	22334CAMKE4	188	-	342	304	3	0.35	2.9	1.9	1.9
180	250	52	2	590 000	890 000	1 200	1 600	23936CAME4	23936CAMKE4	190	-	240	230	2	0.18	5.5	3.7	3.6
	280	74	2.1	935 000	1 270 000	1 200	1 400	23036CAME4	23036CAMKE4	192	202	268	249	2	0.24	4.2	2.8	2.8
	280	100	2.1	1 210 000	1 750 000	950	1 200	24036CAME4	24036CAMKE4	192	200	268	245	2	0.32	3.1	2.1	2.0
	300	96	3	1 320 000	1 760 000	900	1 200	23136CAME4	23136CAMKE4	194	206	286	260	2.5	0.31	3.3	2.2	2.2
	300	118	3	1 490 000	2 040 000	900	1 200	24136CAME4	24136CAMKE4	194	202	286	255	2.5	0.37	2.7	1.8	1.8
	320	86	4	1 280 000	1 540 000	1 100	1 300	22236CAME4	22236CAMKE4	198	212	302	278	3	0.26	3.9	2.6	2.6
	320	112	4	1 620 000	2 110 000	850	1 100	23236CAME4	23236CAMKE4	198	211	302	274	3	0.35	2.9	1.9	1.9
190	380 260	126 52	4	2 170 000 575 000	2 340 000	950 1 200	1 200 1 500	22336CAME4 23938CAME4	22336CAMKE4 23938CAMKE4	198 200	-	362 250	322 240	3	0.34 0.18	2.9 5.7	2.0 3.8	1.9 3.7
190	290	75	2.1	970 000	875 000 1 350 000	1 100	1 400	23038CAME4	23038CAMKE4	202	-	278	261	2	0.18	4.2	2.8	2.8
	290	100	2.1	1 220 000	1 840 000	900	1 200	24038CAME4	24038CAMKE4	202	210	278	253	2	0.32	3.1	2.1	2.0
	320	104	3	1 480 000	2 020 000	850	1 100	23138CAME4	23138CAMKE4	204	219	306	276	2.5	0.31	3.2	2.2	2.1
	320	128	3	1 630 000	2 240 000	850	1 100	24138CAME4	24138CAMKE4	204	211	306	269	2.5	0.38	2.6	1.8	1.7
	340	92	4	1 420 000	1 730 000	1 000	1 200	22238CAME4	22238CAMKE4	208	-	322	296	3	0.26	3.8	2.6	2.5
	340	120	4	1 800 000	2 350 000	800	1 100	23238CAME4	23238CAMKE4	208	222	322	288	3	0.35	2.8	1.9	1.9
	400	132	5	2 370 000	2 590 000	900	1 100	22338CAME4	22338CAMKE4	212	-	378	338	4	0.34	2.9	2.0	1.9
200	280	60	2.1	710 000	1 060 000	1 100	1 400	23940CAME4	23940CAMKE4	212	-	268	258	2	0.20	5.1	3.4	3.3
	310	82	2.1	1 180 000	1 700 000	1 000	1 300	23040CAME4	23040CAMKE4	212	-	298	279	2	0.25	4.0	2.7	2.6
	310	109	2.1	1 420 000	2 120 000	850	1 100	24040CAME4	24040CAMKE4	212	223	298	271	2 2 5	0.33	3.0	2.0	2.0
	340 340	112 140	3	1 700 000	2 330 000 2 660 000	800 800	1 000	23140CAME4 24140CAME4	23140CAMKE4 24140CAMKE4	214 214	232 226	326 326	293 290	2.5 2.5	0.32	3.2 2.5	2.1 1.7	2.1
	360	98	4	1 620 000	2 010 000	950	1 200	22240CAME4	22240CAMKE4	214	-	342	315	3	0.39	3.8	2.6	2.5
	360	128	4	2 070 000	2 750 000	750	1 000	23240CAME4	23240CAMKE4	218	237	342	307	3	0.35	2.9	1.9	1.9
220	300	60	2.1	785 000	1 240 000	1 000	1 300	23944CAME4	23944CAMKE4	232	-	288	278	2	0.18	5.7	3.8	3.7
	340	90	3	1 360 000	1 980 000	950	1 200	23044CAME4	23044CAMKE4	234	-	326	302	2.5	0.24	4.1	2.8	2.7
	340	118	3	1 640 000	2 490 000	750	1 000	24044CAME4	24044CAMKE4	234	244	326	296	2.5	0.32	3.2	2.1	2.1
	370	120	4	1 960 000	2 710 000	710	950	23144CAME4	23144CAMKE4	238	254	352	320	3	0.31	3.2	2.1	2.1
	370	150	4	2 250 000	3 200 000	710	950	24144CAME4	24144CAMKE4	238	248	352	313	3	0.39	2.6	1.7	1.7
	400	108	4	1 960 000	2 430 000	850	1 000	22244CAME4	22244CAMKE4	238	260	382	348	3	0.27	3.7	2.5	2.4
0.40	400	144	4	2 520 000	3 400 000	670	900	23244CAME4	23244CAMKE4	238	-	382	337	3	0.36	2.8	1.9	1.8
240	320	60	2.1	795 000	1 300 000	950 850	1 200	23948CAME4	23948CAMKE4	252	-	308	298	2 2 5	0.17	6.0	4.0	3.9
	360 360	92 118	3	1 450 000 1 730 000	2 140 000 2 730 000	850 710	1 100 950	23048CAME4 24048CAME4	23048CAMKE4 24048CAMKE4	254 254	265	346 346	324 317	2.5 2.5	0.24	4.2 3.3	2.8	2.7
	400	128	4	2 230 000	3 100 000	670	850	23148CAME4	23148CAMKE4	258	275	382	347	3	0.30	3.3	2.2	2.2
	400	160	4	2 660 000	3 800 000	670	850	24148CAME4	24148CAMKE4	258	268	382	341	3	0.38	2.7	1.8	1.8
260	360	75	2.1	1 170 000	1 870 000	850	1 000	23952CAME4	23952CAMKE4	272	-	348	333	2	0.19	5.4	3.6	3.5

Triple Ring Bearings

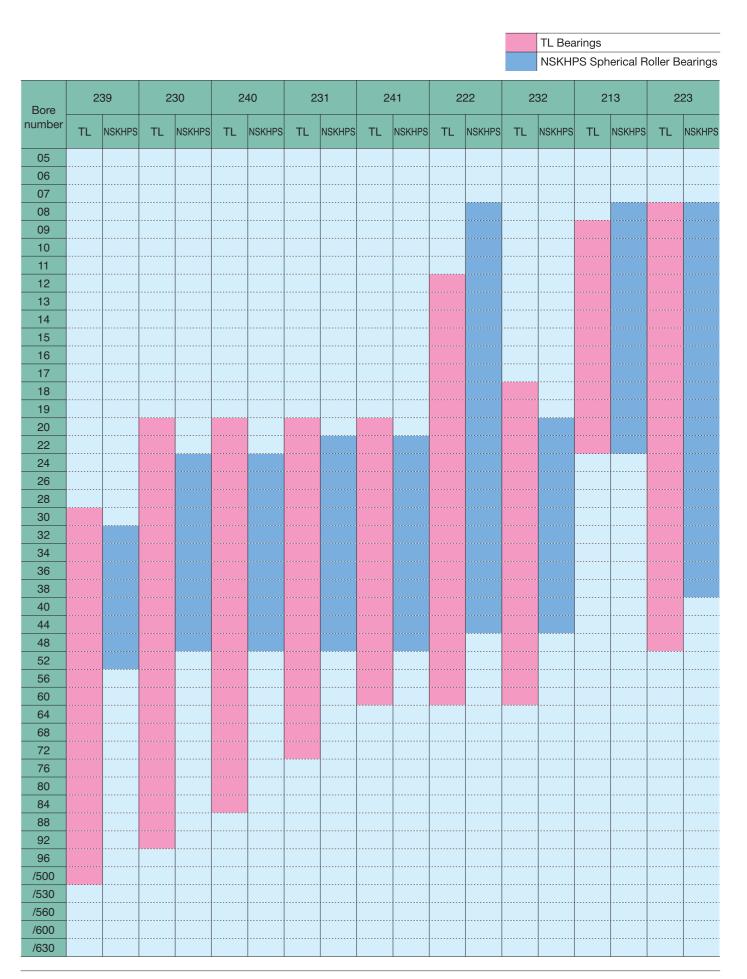
Bearing Nomenclature Example: 2SL 180-2 UPA Triple ring bearings (Spherical roller bearings) Special accuracy (Tolerance class symbol) Bearing bore 180 mm

Pooring numbers			Mass			
Bearing numbers	d	D	Bi	B _e	В	(kg)
2SL180-2 UPA	180	480	140	160	215.9	175
2SL200-2 UPA	200	520	160	180	241.3	230
2SL220-2 UPA	220	600	180	200	279.4	330
2SL240-2 UPA	240	620	200	200	279.4	410
2SL260-2 UPA	260	680	218	218	317.5	490
2SL280-2 UPA	280	720	218	218	317.5	525
2SL300-2 UPA	300	780	243	250	342.9	735
2SL320-2 UPA	320	820	258	258	368.3	840
2SL340-2 UPA	340	870	280	272	393.7	1 050
2SL380-3 UPA	380	980	240	308	431.8	1 370
2PSL180-1 UPA	180	460	153	118	160	127
2PSL240-1 UPA	240	600	205	160	225	285





Spherical Roller Bearings for Papermaking Machines



Radial Clearance in Spherical Roller Bearings with Tapered Bores

Bearings with tapered bores are directly mounted onto tapered shafts or onto cylindrical shafts with adapters or withdrawal sleeves (Fig. 1).

Large bearings are often mounted using hydraulic pressure. Fig. 2 shows a bearing mounting utilizing a sleeve and hydraulic nut. Another mounting method is to drill holes in the sleeve which are used to feed oil under pressure to seat the bearing. As the bearing expands radially, the sleeve is inserted axially with adjusting bolts. The bearing should be mounted with a suitable interference fit by checking residual clearance while measuring their radialclearance reduction and referring to the amount of axial movement listed in Table 1. Radial clearance must be measured using clearance

900

1 000

1 000

1 120

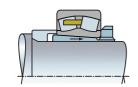


Fig. 1 Mounting with adapter

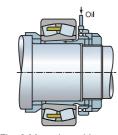


Fig. 2 Mounting with hydraulic nut

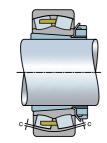
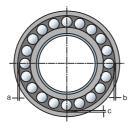


Fig. 3 Clearance measurement of spherical roller bearing

gauges. As shown in Fig 3, radial clearance for both rows of rollers must be measured simultaneously, and those two values should be kept roughly the same.

When a large bearing is mounted on a shaft, the outer ring may be deformed into an oval shape by its own weight. If radial clearance is measured at the lowest part of the deformed bearing, the measured value may be greater than the true value. If an incorrect radial internal clearance is obtained in this manner and the value in Table 1 are used, then the interference fit may become too tight and the true residual clearance may become too small. In this case, as shown in Fig. 4, one half of the total clearance at points a and b (which are on a horizontal line passing through the bearing center) and c (which is the lowest position of the bearing) may be used as the residual clearance.



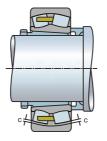


Fig. 4 Measuring clearance in large spherical roller

Unit: mm

Table 1 Radial Clearance in Spherical Roller Bearings with Tapered Bores

0.930 0.930 1.190

1.190

1.520

0.340

0.460

5.5

7.4

8.0

14.0

18.5

15.0 20.0

0.310 0.470 0.730 0.360 0.530 0.800

Bearing bore diameter			Cle	arance ir	n bearing	gs with ta	pered bo	ores	Reduc			Axial mo	ovement			um perm ual clear	
	d			N		3	C				Taper		Taper		CN	C3	C4
	over	incl	min	max	min	max	min	max	min	max	min	max	min —	max —	0.040	0.005	0.005
	30	40	0.035	0.050	0.050	0.065	0.065	0.085	0.025	0.030	0.40	0.45			0.010	0.025	0.035
	40	50	0.045	0.060	0.060	0.080	0.080	0.100	0.030	0.035	0.45	0.55	_	_	0.015	0.030	0.045
	50	65	0.055	0.075	0.075	0.095	0.095	0.120	0.030	0.035	0.45	0.55	_	_	0.025	0.035	0.060
	65	80	0.070	0.095	0.095	0.120	0.120	0.150	0.040	0.045	0.60	0.70	_	_	0.030	0.040	0.075
	80	100	0.080	0.110	0.110	0.140	0.140	0.180	0.045	0.055	0.70	0.85	1.75	2.15	0.035	0.050	0.085
	100	120	0.100	0.135	0.135	0.170	0.170	0.220	0.050	0.060	0.75	0.90	1.9	2.25	0.045	0.065	0.110
	120	140	0.120	0.160	0.160	0.200	0.200	0.260	0.060	0.070	0.90	1.1	2.25	2.75	0.055	0.080	0.130
	140	160	0.130	0.180	0.180	0.230	0.230	0.300	0.065	0.080	1.0	1.3	2.5	3.25	0.060	0.100	0.150
	160	180	0.140	0.200	0.200	0.260	0.260	0.340	0.070	0.090	1.1	1.4	2.75	3.5	0.070	0.110	0.170
	180	200	0.160	0.220	0.220	0.290	0.290	0.370	0.080	0.100	1.3	1.6	3,25	4.0	0.070	0.110	0.190
	200	225	0.180	0.250	0.250	0.320	0.320	0.410	0.090	0.110	1.4	1.7	3.5	4.25	0.080	0.130	0.210
	225	250	0.200	0.270	0.270	0.350	0.350	0.450	0.100	0.120	1.6	1.9	4.0	4.75	0.090	0.140	0.230
	250	280	0.220	0.300	0.300	0.390	0.390	0.490	0.110	0.140	1.7	2.2	4.25	5.5	0.100	0.150	0.250
	280	315	0.240	0.330	0.330	0.430	0.430	0.540	0.120	0.150	1.9	2.4	4.75	6.0	0.110	0.160	0.280
	315	355	0.270	0.360	0.360	0.470	0.470	0.590	0.140	0.170	2.2	2.7	5.5	6.75	0.120	0.180	0.300
	355	400	0.300	0.400	0.400	0.520	0.520	0.650	0.150	0.190	2.4	3.0	6.0	7 . 5	0.130	0.200	0.330
	400	450	0.330	0.440	0.440	0.570	0.570	0.720	0.170	0.210	2.7	3.3	6.75	8.25	0.140	0.220	0.360
	450	500	0.370	0.490	0.490	0.630	0.630	0.790	0.190	0,240	3.0	3,7	7 . 5	9,25	0.160	0.240	0.390
	500	560	0.410	0.540	0.540	0.680	0.680	0.870	0.210	0.270	3.4	4.3	8.5	11.0	0.170	0.270	0.410
	560	630	0.460	0.600	0.600	0.760	0.760	0,980	0.230	0.300	3.7	4.8	9,25	12.0	0,200	0,310	0.460
	630	710	0.510	0.670	0.670	0.850	0.850	1.090	0.260	0.330	4.2	5.3	10.5	13.0	0,220	0.330	0.520
	710	800	0.570	0.750	0.750	0.960	0.960	1,220	0.280	0,370	4.5	5.9	11.5	15.0	0.240	0.390	0.590
	800	900	0.640	0.730	0.730	1.070	1.070	1.370	0.310	0.410	5.0	6.6	12.5	16.5	0.240	0.430	0.660
	000	900	0.040	0.040	0.040	1.070	1.070	1.370	0.510	0.410	5.0	0.0	12.5	10.5	0.200	0.430	0.000

Bearing Maintenance and Inspection

Maintenance

Bearings and operating conditions must be periodically inspected and maintained to maximize bearing life to prevent mechanical failure, ensure reliable operation, raise productivity, and enhance cost performance.

Maintenance should be performed regularly according to work standards that may vary according to machine operating conditions. Operating conditions should be monitored, lubricant replenished or changed, and the machine periodically disassembled and overhauled.

1. Inspection under operating conditions

Review lubricant properties, check operating temperatures, and inspect for any vibrations and bearing noise to determine bearing replacement periods and replenishment intervals of the lubricant.

2. Inspection of the bearing

Be sure to thoroughly examine the bearings during periodic machine inspections and part replacement. Check the raceway for any damage and confirm if the bearing can be reused or should be replaced.

Inspection points

Items to be checked while the machine is running should include bearing noise, vibrations, temperature, and lubricant condition.

1. Bearing noise

Sound detection instruments can be used during operation to ascertain the volume and characteristics of bearing rotation noise through sound patterns that are readily distinguishable, which can reveal the presence of bearing damage such as slight flaking. Three typical noise conditions are described in Table 1.

2. Bearing vibration

Bearing irregularities can be analyzed by performing a quantitative analysis of vibration amplitude and frequency using a frequency spectrum analyzer. Measured data varies depending on the operating conditions of the bearing and the location of the vibration pick-up. Therefore, this method requires the determination of evaluation standards for each measured machine.

Table 1 Bearing irregularity causes and measures

	Irregularities	Possible causes	Measures			
		Abnormal load	Improve the fit, internal clearance, preload, or position of housing shoulder.			
	Loud metallic sound	Incorrect mounting	Improve machining accuracy, alignment accuracy or mounting accuracy of shaft and housing, or use the correct mounting method.			
		Insufficient or improper lubricant	Replenish the lubricant or select another lubricant.			
		Contact of rotating parts	Modify the labyrinth seal.			
Noise	Loud regular sound	Flaws, corrosion, or scratches on raceways caused by foreign particles	Replace or clean the bearing, improve sealing conditions, or usclean lubricant.			
		Brinelling	Replace the bearing and use care when handling.			
		Flaking on raceway	Replace the bearing.			
	Irregular sound	Excessive clearance	Improve the fit, clearance, or preload.			
		Contamination by foreign particles	Replace or clean the bearing, improve the seals, and use clean lubricant.			
		Flaws or flaking on balls	Replace the bearing.			
		Excessively small clearance	Improve the fit, clearance, or preload.			
		Excessive amount of lubricant	Reduce amount of lubricant and select stiffer grease.			
		Insufficient or improper lubricant	Replenish lubricant or select a proper one.			
Abnorn	mal temperature rise	Abnormal load	Improve the fit, internal clearance, preload, or position of housing shoulder.			
		Incorrect mounting	Improve machining accuracy, alignment accuracy or mounting accuracy of shaft and housing, or use the correct mounting method.			
		Creep on fitted surface, or excessive seal friction	Correct the seals, replace the bearing, and correct the fitting or mounting.			
		Brinelling	Replace the bearing, and use care when handling bearings.			
Vibration		Flaking	Replace the bearing.			
((Axial runout)	Incorrect mounting	Correct the squareness between the shaft and housing shoulder or side of spacer.			
		Penetration of foreign particles	Replace or clean the bearing components and improve sealing.			
Leakage or discoloration of lubricant		Too much lubricant, or contamination by foreign particles or wear debris				

Examples of Bearing damage and countermeasures for papermaking machines



Creer

Bearing type	Application	Cause of damage	Measures
Tapered Roller Bearing	Press CC roll	Insufficient interference fit	Tighten interference fit
Spherical Roller Bearing	Dryer canvas roll	Dimensional variation at high temperatures	 Use TL steel Use NSKHPS bearing Apply high-temperature dimensional stabilizing treatment (S11)



Inner ring fracture

Bearing type	Application	Cause of damage	Measures
Spherical Roller Bearing	Dryer cylinder roll	Excessive force applied during mounting Defective bore face contact High hoop stress	Control residual clearanceAdjust with taper gaugeUse TL steel



Rust and corrosion

	Bearing type	Application	Cause of damage	Measures
	Spherical Roller Bearing	Wire suction roll	Insufficient oil film formation due to water entry	Reinforce lubricating oil control Improve bearing housing
		Press suction roll	Rust formed while stationary or being stored	Anti-rust treatment for idle periods



Flaking

Bearing type	Application	Cause of damage	Measures
	Wire suction roll	Insufficient oil film formation due to water entry	Reinforce lubricating oil control Improve bearing housing
Spherical Roller Bearing	Dryer cylinder roll	Insufficient oil film formation at high temperatures	 Use TL steel Increase oil viscosity Increase volume and reinforce control of lubricating oil temperature Use thermal insulation sleeve
	Dryer canvas roll	Excessive axial loading due to expansion of outer ring on the free-end bearing	 Use TL steel Use NSKHPS bearing Apply high temperature dimensional stabilizing treatment (S11)



Smearing

Bearing type Application		Cause of damage	Measures		
Spherical Roller	Calender CC roll	Insufficient oil film formation	 Increase oil viscosity Increase oil volume and reinforce control of		
Bearing	(triple ring)		lubricating oil temperature Add additives to lubricating oil		



Electrical corrosion

Bearing type	Application	Cause of damage	Measures
Deep Groove Ball Bearing Cylindrical Roller Bearing	Motor	Sparks produced by flow of current where rolling elements contact the raceway	Design electric circuit which prevents current flow through the bearings Insulate the bearing



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MELBOURNE ☆	P: +61-3-9765-4400	SINGAPORE	P: +65-6496-8000	DUBAI	P: +971-4-804-8200
SYDNEY	P: +61-2-8843-8100	NSK SINGAPORE (PRIVATE) LTD.			
BRISBANE	P: +61-7-3347-2600	SINGAPORE	P: +65-6496-8000	North and South America	
PERTH	P: +61-8-9256-5000	Taiwan:	1.400 0400 0000	United Sates of America:	
New Zealand:				NSK AMERICAS, INC. (AMERICA	
NSK NEW ZEALAND LTD.		TAIWAN NSK PRECISION CO., LTD.		ANN ARBOR	P: +1-734-913-750
AUCKLAND	P: +64-9-276-4992	TAIPEI ☆	P: +886-2-2509-3305	NSK CORPORATION	
China:	1.104 3 270 4332	TAICHUNG	P: +886-4-2311-7978	ANN ARBOR	P: +1-734-913-7500
NSK HONG KONG LTD.		TAINAN	P: +886-6-505-5861	NSK PRECISION AMERICA, INC.	
	B: 050 0300 0000	TAIWAN NSK TECHNOLOGY CO., LT	ΓD.	FRANKLIN ☆	P: +1-317-738-500
HONG KONG ☆	P: +852-2739-9933	TAIPEI ☆	P: +886-2-2509-3305	SAN JOSE	P: +1-408-944-9400
SHENZHEN	P: +86-755-25904886	TAICHUNG	P: +886-4-2358-2945	NSK LATIN AMERICA, INC.	1.41 400 544 540
NSK (SHANGHAI) TRADING CO., LT		TAINAN	P: +886-6-505-5861	MIAMI	P: +1-305-477-060
JIANGSU	P: +86-512-5796-3000	Thailand:			P. +1-305-477-000
NSK (CHINA) INVESTMENT CO., LTI	D.	NSK BEARINGS (THAILAND) CO., LT	rn	Canada:	
JIANGSU ☆	P: +86-512-5796-3000	BANGKOK	P: +66-2320-2555	NSK CANADA INC.	
BEIJING	P: +86-10-6590-8161	Vietnam:	F. +00-2320-2333	TORONTO ☆	P: +1-905-890-0740
TIAN JIN	P: +86-22-8319-5030			MONTREAL	P: +1-514-633-1220
CHANGCHUN	P: +86-431-8898-8682	NSK VIETNAM CO., LTD.	B 04 4 0055 0450	VANCOUVER	P: +1-877-994-6675
SHENYANG	P: +86-24-2334-2868	HANOI	P: +84-4-3955-0159	Argentina:	
DALIAN	P: +86-411-8800-8168	NSK REPRESENTATIVE OFFICE		NSK ARGENTINA SRL	
NANJING	P: +86-25-8472-6671	HO CHI MINH CITY	P: +84-8-3822-7907	BUENOS AIRES	P: +54-11-4704-510
FUZHOU		Europe		Brazil:	
	P: +86-591-8380-1030	United Kingdom:		NSK BRASIL LTDA.	
WUHAN	P: +86-27-8556-9630	NSK EUROPE LTD. (EUROPEAN HEA	ADOLIADTEDS)	SAO PAULO ☆	P: +55-11-3269-478
QINGDAO	P: +86-532-5568-3877	MAIDENHEAD	P: +44-1628-509-800	BELO HORIZONTE	P: +55-31-3274-259
GUANGZHOU	P: +86-20-3817-7800	NSK UK LTD.	F. +44-1028-309-800	JOINVILLE	
CHANGSHA	P: +86-731-8571-3100		D 44 4000 005 400		P: +55-47-3422-544
LUOYANG	P: +86-379-6069-6188	_NEWARK	P: +44-1636-605-123	PORTO ALEGRE	P: +55-51-3222-132
XI'AN	P: +86-29-8765-1896	France:		RECIFE	P: +55-81-3326-378
CHONGQING	P: +86-23-6806-5310	NSK FRANCE S.A.S.		Peru:	
CHENGDU	P: +86-28-8528-3680	PARIS	P: +33-1-30-57-39-39	NSK PERU S.A.C.	
NSK CHINA SALES CO., LTD.		Germany:		LIMA	P: +51-1-652-3372
JIANGSU	P: +86-512-5796-3000	NSK DEUTSCHLAND GMBH		Mexico:	
India:	1 . +00-012-0700-0000	DUSSELDORF ☆	P: +49-2102-4810	NSK RODAMIENTOS MEXICANA	. S.A. DE C.V.
NSK INDIA SALES CO.PVT.LTD.		STUTTGART	P: +49-711-79082-0	MEXICO CITY ☆	P: +52-55-3682-290
	D 01 11 0017 0000	WOLFSBURG	P: +49-5361-27647-10	MONTERREY	P: +52-81-8000-730
CHENNAI ☆	P: +91-44-2847-9600	Italv:	1.110 0001 27017 10	MONTENNET	1.102 01 0000 700
GURGAON	P: +91-124-4104-530	NSK ITALIA S.P.A.			
MUMBAI	P: +91-22-2838-7787	MILANO	P: +39-299-5191		
Indonesia:			r. +39-299-0191		
PT. NSK INDONESIA		Netherlands:			
JAKARTA	P: +62-21-252-3458	NSK EUROPEAN DISTRIBUTION CE			
Korea:		TILBURG	P: +31-13-4647647		
NSK KOREA CO., LTD.		Poland:			
SEOUL	P: +82-2-3287-0300	NSK REPRESENTATIVE OFFICE			<as 2013<="" june="" of="" td=""></as>
	102 2 0207 0000	WARSAW	P: +48-22-645-1525	For the latest information, please	refer to the NSK websit.
				i or the latest information, please	reier to the NOIX Website
					www.nsk.com

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For more information about NSK products, please contact: -





Industrial Motor Bearings



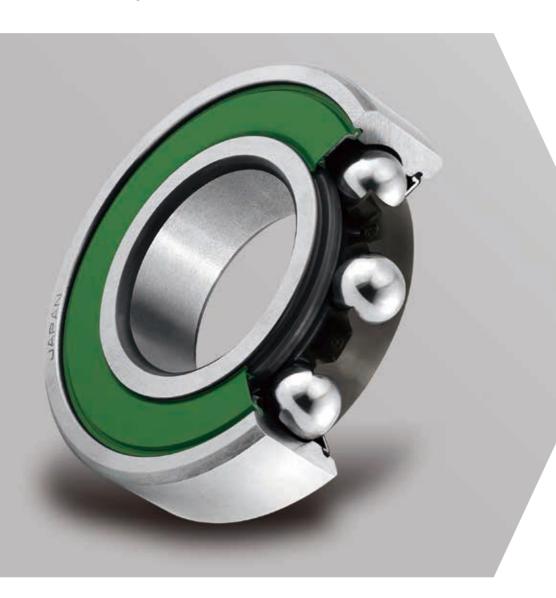


INDUSTRIAL MOTOR BEARINGS

All industries are powered by motors. NSK's proven bearings take loads and support smooth and quiet rotation in rotating motor components.

Our top priority is to deliver solutions that protect the environment. To this end, we focus on Tribology to create technologies that reduce energy loss and improve life. We address trends towards electric power by offering high-performance bearings with low energy loss, high reliability, and long product life.

This catalog details NSK's industrial motor bearings, including products with low torque, long life, and low heat generation.



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NSK Solutions for Industrial Motor Needs

							Bearing Co	omponents				
			Outer Ring	/Inner Ring	В	all	Ca	ige	Seal		Grease	
	Issues/Needs	NSK's Response	Ceramic- Coated Insulated Bearings	Creep-Free Bearings	Ceramic Balls	Seizure- Resistant Heat-Treated Steel Balls	Plastic Cages for EV Motors	Plastic Cages	DW Seal	EA7	LGU	EA9
			P. 12–13	P. 20-21	P. 18–19	P. 14-15	P. 14-15	P. 16–17	P. 8-9	P. 6	P. 7	P. 10-11
	Encoder error and brake slip	Low-particle- emission bearings									•	
Servomotors P. 6-9	Longer maintenance intervals	Longer seizure life			0							
	Improved reliability under harsh operating conditions	Improved fretting resistance			\circ							
High-	Reduced motor loss	Reduced rotating resistance						0				
Efficency Motors	Longer maintenance intervals	Longer seizure life			0			0				
P. 10–11	Vibrating and unbalanced loads	Improved creep resistance										
Inverter Motors P. 12–13	Electical erosion Maintenance-free operation	Bearings as insulator	•		0							
EV Motors P. 14–15	High-speed rotation	Longer seizure life			0	•	•					
	Longer maintenance intervals	Longer seizure life			0	•	•					
	High-speed rotation and unbalanced loads	Improved creep resistance		0								



High-Reliability EA7 Grease for Servomotors

Machine tools, robots, and carrier equipment require servomotors to endure repeated start/stop/reverse operations under harsh conditions with microvibrations caused by slight positioning errors during servo-lock. These conditions may lead to an insufficient oil film on the bearing raceway surface, resulting in fretting damage. In response, NSK developed EA7 grease with excellent fretting resistance, long life, and improved reliability.

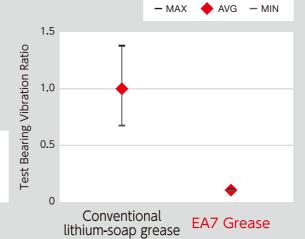
Features

Better Reliability Under Harsh Operating Conditions

EA7 grease improves fretting resistance in environments with micro-vibrations, reducing vibration and achieving longer bearing life.

Fretting: Wear due to repeated sliding between two surfaces. When bearings face vibrations or oscillations while stopped, an insufficient oil film may result, leading to this damage.

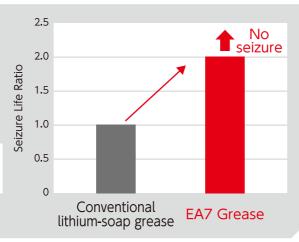
Tested bearings: $\phi 8 \times \phi 22 \times 7$ Preload: 49 N Oscillation angle: 1° (±0.5°) Oscillation frequency: 30 Hz Oscillations: 5 000 000



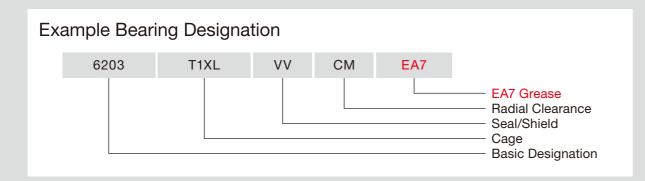
Longer Maintenance Intervals

Bearings filled with EA7 Grease have a much longer life than those with conventional lithium-soap grease.

Tested bearings: φ25×φ62×17 Rotational speed: 10 000 min⁻¹ Temperature: 140 °C



DATA





Low-Particle-Emission LGU Grease for Servomotors

LGU grease features an optimized grease composition free of sulfur and metal elements.

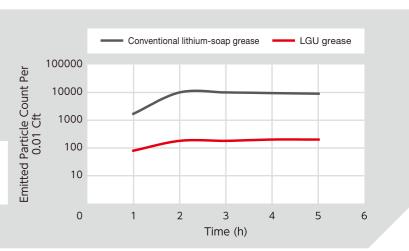
This greatly reduces particle emissions, helping to prevent encoder contamination and brake slip.

Features



LGU grease has nearly 90% less particle emissions than conventional lithium-soap grease.

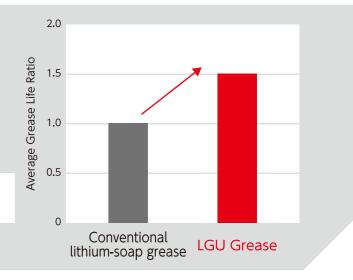
Tested bearings: $\phi 8 \times \phi 22 \times 7$ Grease Fill: Light (L) Rotational Speed: 1 800 min⁻¹ Particle Size: Over 0.1 µm



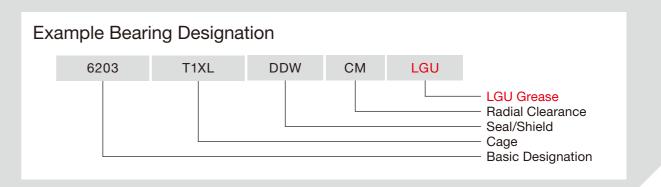
Longer Maintenance Intervals

Bearings with LGU grease realize a grease life 1.5 times longer than that with conventional lithium-soap grease.

> Tested bearings: ϕ 25× ϕ 62×17 Rotational speed: 10 000 min⁻¹ Temperature: 140 °C



DATA



 $6 \,$



Low-Particle-Emission DW Seal for Servomotors

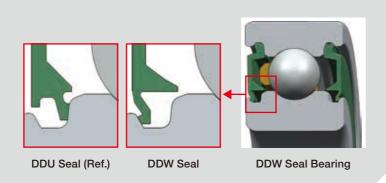
Light-contact DW seals have an optimized seal lip structure that prevents grease from leaking from the bearing and realizes low torque. These features help prevent encoder contamination and brake slip in servomotors.

Features

Light-Contact Seal Lip

A special seal lip structure lowers lip pressure, resulting in low torque.

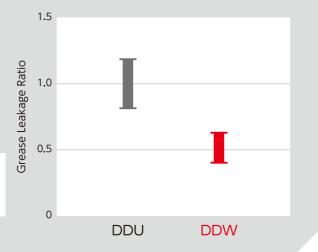
The main lip has outward contact with the beveled portion of the inner ring seal groove. This prevents the seal from opening due to internal pressure and prevents grease leakage.



Less Encoder Contamination and Brake Slip

DW seals minimize grease leakage.

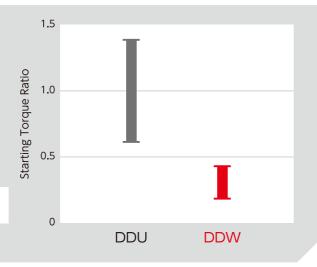
Tested Bearings: $\phi 17 \times \phi 26 \times 5$ Rotational Speed: 10 000 min⁻¹ Temperature: 50 °C Time: 50 h



Lower Energy Consumption

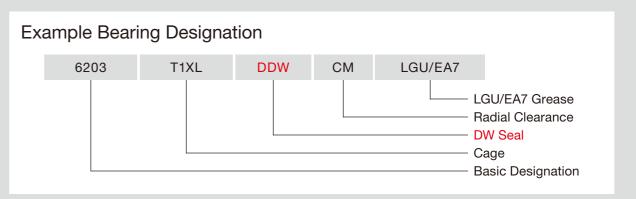
DW seals greatly reduce starting torque compared to DU seals.

> Tested bearings: $\phi 17 \times \phi 40 \times 12$ Temperature: 25 °C





Boundary Dimensions (mm)



Designation	Boundar	y Dimensio	ons (mm)
Designation	Bore Dia.	Outside Dia.	Width
6000		26	8
6200	10	30	9
6300		35	11
6001		28	8
6201	12	32	10
6301		37	12
6002		32	9
6202	15	35	11
6302		42	13
6003		35	10
6203	17	40	12
6303		47	14
6004		42	12
6204	20	47	14
6304	25	52	15
6005		47	12
6205		52	15
6305		62	17

Designation		y Difficiliate	7113 (111111)
Designation	Bore Dia.	Outside Dia.	Width
6006		55	13
6206	30	62	16
6306		72	19
6007		62	14
6207	35	72	17
6307		80	21
6008		68	15
6208	40	80	18
6308		90	23
6209	45	85	19
6309	45	100	25
6010		80	16
6210	50	90	20
6310		110	27
6311	55	120	29



Low Torque & Long-Life Bearings for High-Efficiency Motors

1.2

NSK optimized the type of grease and fill amount, grease shear, and agitation resistance during bearing rotation to not only realize low torque and long life, but also save energy. Using a plastic cage allows for even lower torque and longer life.

Features

Increases Motor Efficiency

Our new specification steel cages achieve 60% less mechanical loss than conventional products. For even less mechanical loss, new plastic cages achieve a huge 80% reduction.

Ratio 0.8 0.6 0.4 0.2 Std. Spec. New Spec. New Spec. (Steel Cage) (Plastic Cage)

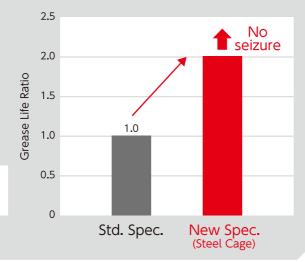
Longer Motor Maintenance Intervals

Using new EA9 grease makes seizure life over 2 times longer, improving durability.

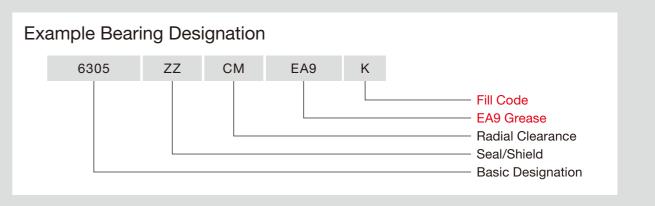
> Tested bearings: ϕ 25× ϕ 62×17 Rotational speed: 10 000 min⁻¹ Temperature: 140 °C

Motor: 7.5 kW 2P 200 V 50 Hz

Temperature: 25 °C



Effective for Various Motor Sizes Std. Spec. New Spec. (Steel Cage) 10 15 20 25 30 35 Motor Output (kW)



Designation	Boundar	Boundary Dimensions (mm)				
Designation	Bore Dia.	Outside Dia.	Width	Fill Code		
6200	10	26	8	K		
6300	10	35	11	K		
6201	12	32	10	K		
6301	12	37	12	K		
6202	15	35	11	K		
6302	15	42	13	K		
6203	17	40	12	K		
6303		47	14	K		
6204		47	14	K		
6304		52	15	K		
6205	25	52	15	K		
6305	23	62	17	K		
6206	30	62	16	K		
6306	30	72	19	K		
6207	35	72	17	K		
6307	33	80	21	K		
6208	40	80	18	K		
6308	40	90	23	K		

Designation	Boundar	Grease Fill		
Designation	Bore Dia.	Outside Dia.	Width	Code
6209	45	85	19	L
6309	45	100	25	L
6210	50	90	20	L
6310	50	110	27	L
6211	55	100	21	L
6311	33	120	29	L
6212	60	110	22	L
6312	00	130	31	L
6213	65	120	23	L
6313	0.5	140	33	L
6214	70	125	24	L
6314	70	150	35	L
6215	75	130	25	L
6315	7.5	160	37	L
6216	80	140	26	L
6316	00	170	39	L

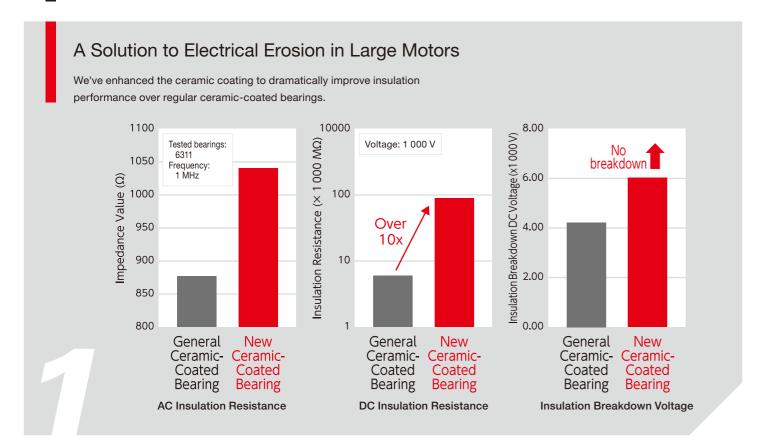




Ceramic-Coated Insulated Bearings for Inverter Motors

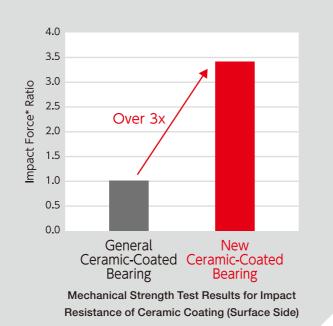
By coating the outer ring with insulating ceramic material, electric current cannot pass through the bearing and cause electrical erosion.

Features



Easy to Handle and Mount

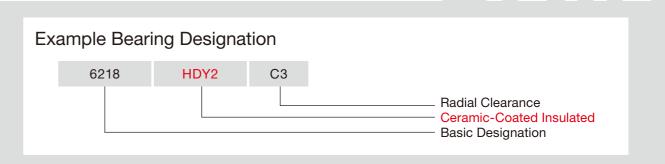
Optimized specifications make the impact resistance of our new ceramic-coated bearings over 3 times higher than conventional products.



*Refers to force on the surface coating

Reduced Premature Motor Failure
From Bearing Heat Generation

Our optimized ceramic coating more effectively dissipates heat.

Description of the properties


Docionation	Boundary Dimensions (mm)					
Designation	Bore Dia. Outside Dia. 60 130 65 140 75 130 160 80 140	Width				
6312	60	130	31			
6313	65	140	33			
6215	75	130	25			
6315	75	160	37			
6216	90	140	26			
6316	00	170	39			
6217	05	150	28			
6317	85	180	41			

 Listed bearings are offer 	ered as standard open bearings	
with C3 clearance.		

Docionation	Boundary Dimensions (mm)				
Designation	Bore Dia.	Outside Dia.	Width		
6218	90	160	30		
6318	90	190	43		
6219	95	170	32		
6319	90	200	45		
6220	100	180	41		
6320	100	215	47		
6322	110	240	50		
6224	120	215	40		
6226	130	230	40		

• Please handle ceramic bearings with the same care as standard bearings.

• Be sure to avoid strong impacts to the outer ring when mounting the bearing using methods involving a hammer or similar. Excessive impacts may cause breaking or cracking of the ceramic coating and/or scratches on the bearing raceway. Bearings cannot be used if damaged.

12





Electric Vehicle (EV) Motor Bearings

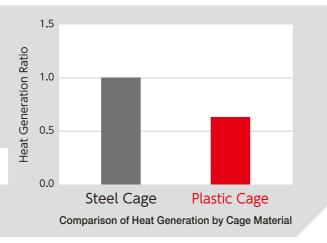
NSK bearings improve the high-speed rotation performance of EV motors by utilizing a plastic cage, specialized grease, and steel balls heat-treated to resist seizure.

Features

Plastic Cage for High-Speed Rotation

Today's applications cause bearings to face high temperature and speeds. In response, our plastic cages feature excellent heat resistance. We also examined cage strength through our proven analysis technologies to optimize the shape of the cage.

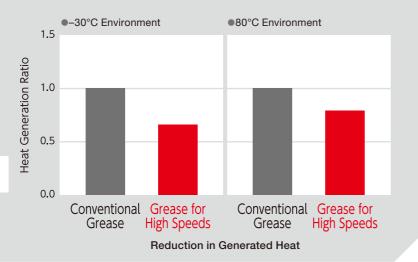
> Tested bearings: $\phi 20 \times \phi 47 \times 14$ Rotational speed: 3 000 min



Grease for **High-Speed Rotation**

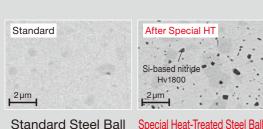
By matching the thickener to the grease, we reduced bearing heat generation across a wide temperature range.

> Tested bearings: $\phi 35 \times \phi 62 \times 14$ Rotational speed: 3 000 min⁻¹

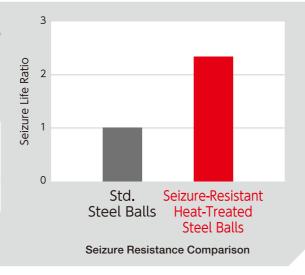


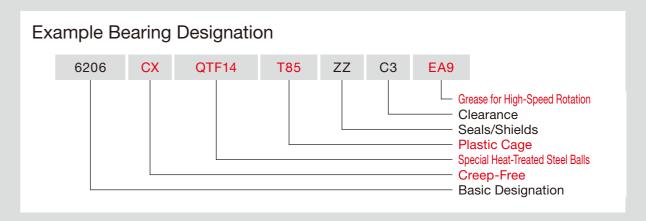
Seizure-Resistant Heat-Treated Steel Balls for High-Speed Rotation

Steel balls with a hard nitride formed on the surface improve seizure resistance.



Difference in Ball Surface Structure





	Boundar	y Dimensio	ons (mm)	Limiting Sp	eeds (min ⁻¹)	
Designation	Bore Dia.	Outside Dia.	Width	n	n' (Seizure-Resistant HT Ball Spec.)	Seizure-Resistant HT Ball Spec
6005	25	47	12	19000	20000	QTF14
6205	25	52	15	16000	18000	QTF14
6006	30	55	13	16000	18000	QTF14
6206	30	62	16	14000	15000	QTF14
6007	35	62	14	14000	15000	QTF14
6207	33	72	17	12000	13000	QTF14
6008	40	68	15	13000	14000	QTF14
6208	40	80	18	11000	_	_
6009	45	75	16	12000	13000	QTF14
6209	45	85	19	10000	11000	QTF14
6010	50	80	16	11000	12000	QTF14
6210	50	90	20	9000	10000	QTF14
6011	55	90	18	9500	10000	QTF14

[•] Plastic cages for EV motors use T85 (Nylon 4,6).

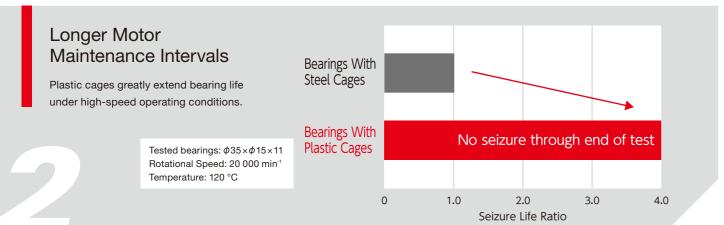


Bearings With Plastic Cages

Plastic cages are lighter than steel cages, have excellent self-lubricating properties, and have a low coefficient of friction. For this reason, they generate little heat and are excellent under high speed rotation. In addition, since they don't need as much grease, they effectively reduce bearing torque and contamination.

Features

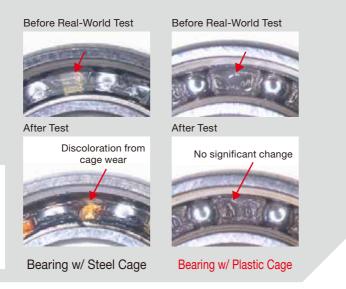
1.2 Motor Energy Savings 1.0 1.0 Plastic cages reduce mechanical loss in motors by up to 50% compared to steel cages. 0.8 0.6 0.2 Motor: 5 kW 2P 200 V 50 Hz Temperature: 25 °C Steel Cage Plastic Cage

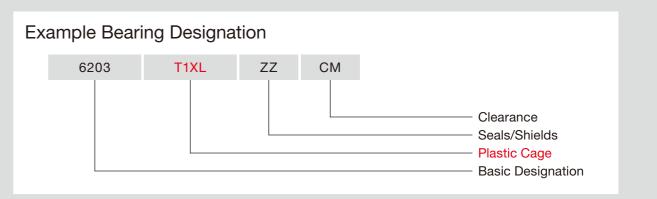


Usable in Magnetic Environments

Steel cages are affected by magnetic forces, resulting in abnormal friction that shortens the seizure life. Plastic cages don't face this issue and can be used easily and with longer life in magnetic environments, such as with servomotors.

> Tested bearings: $\phi 12 \times \phi 21 \times 5$ Inclination: 0.3 deg Rotational speed: 1 800 min Preload: 20 N Environment temperature: 40 °C Test period: 2 weeks Magnetic strength: 3 500 Gs





Designation	Plastic	Boundary Dimensions (mm)			
Designation	Cage	Bore Dia.	Outside Dia.	Width	
6000	T1X		26	8	
6200	T1XL	10	30	9	
6300*	T1X		35	11	
6001	T1XL		28	8	
6201	T1XL	12	32	10	
6301	T1X		37	12	
6002	T1XL		32	9	
6202	T1XL	15	35	11	
6302	T1X	15	42	13	
6003	T1XL		35	10	
6203	T1XL	17	40	12	
6303	T1X		47	14	
6004	T1X		42	12	
6204	T1XL	20	47	14	
6304	T1XL		52	15	

Designation	Plastic	Boundar	y Dimensio	ons (mm)
Designation	Cage	Bore Dia.	Outside Dia.	Width
6005	T1XL		47	12
6205	T1XL	25	52	15
6305	T1X		62	17
6006	T1X		55	13
6206	T1X	30	62	16
6306	T1X		72	19
6007	T1X		62	14
6207	T1X	35	72	17
6307	T1X		80	21
6008	T1X		68	15
6208	T1XA	40	80	18
6308	T1XA		90	23

*Indicates a plastic cage that is not mass produced. Please contact NSK for details.

- Plastic cages for industrial motors use T1X, T1XL, and T1XA (Nylon 6,6).
- The maximum operating temperature of polyamide cages is normally 120 °C or less.





Ceramic Ball Bearings

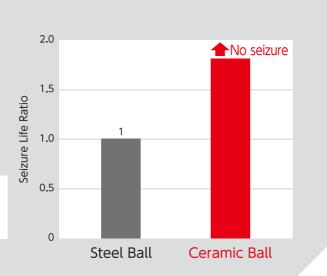
Lightweight ceramic materials have excellent insulation, heat resistance, durability, and low thermal expansion. Using ceramic balls extends seizure life dramatically and prevents electric current from passes through the bearing, stopping electric erosion.

Features

"Maintenance-Free" Motors

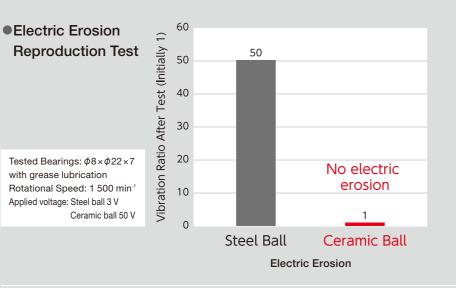
Compared to steel ball bearings, ceramic ball bearings have a significantly longer seizure life.

> Tested bearings: $\phi 8 \times \phi 22 \times 7$ Lubrication: Light oil 10 mg Rotational speed: 1 800 min Temperature: 100 °C

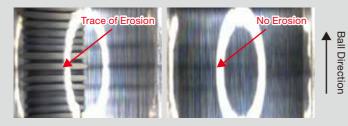


No Electric Erosion

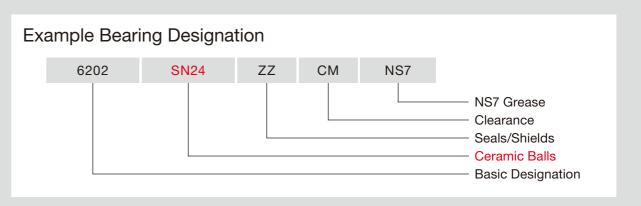
By insulating the rolling elements, electric currents can not pass through the bearing, preventing electric erosion.



Race Surface After Test



Steel Ball Ceramic Ball



Designation	Boundary Dimensions (mm)				
Designation	Bore Dia.	Outside Dia.	Width		
608	8	22	7		
6000	10	26	8		
6200	10	30	9		
6001	12	28	8		
6201	12	32	10		
6002		32	9		
6202	15	35	11		
6302		42	13		
6003	17	35	10		
6203	17	40	12		
6004	20	42	12		
6204	20	47	14		
6205	25	52	15		
6305	20	62	17		

Bore Dia. Outside Dia. Width 6206 30 62 16 6306 72 19 6207 35 72 17 6307 80 21 6208 40 80 18 6308 40 90 23 6209 45 19 100 25 6010 50 80 16 10 27 6211 50 100 21 27 100 21 29 6012 60 95 18 18 18 18 12 24 24	Designation	Boundary Dimensions (mm)			
6306 30 6207 35 6307 80 6208 80 6308 80 6309 85 6309 85 6310 80 6311 100 25 6311 100 21 6312 100 21 6311 100 21 6312 60 95 18	Designation	Bore Dia.	Outside Dia.	Width	
6306 72 19 6207 35 72 17 6307 80 21 6208 40 80 18 6308 90 23 6209 45 19 6309 85 19 6309 80 16 6310 50 80 16 6310 100 21 6311 55 120 29 6012 60 95 18	6206	30	62	16	
6307 80 21 6208 40 80 18 6308 90 23 6209 45 85 19 6309 100 25 6010 80 16 6310 110 27 6211 55 120 29 6012 60 95 18	6306	30	72	19	
6307 80 21 6208 40 80 18 6308 90 23 6209 85 19 6309 100 25 6010 80 16 6310 110 27 6211 55 120 29 6012 60 95 18	6207	25	72	17	
6308 40 6308 90 6209 85 6309 100 6010 80 6310 16 6310 10 27 6211 55 6311 100 21 6312 60 95 18	6307	30	80	21	
6308 90 23 6209 45 85 19 6309 100 25 6010 80 16 6310 110 27 6211 55 100 21 6311 120 29 6012 60 95 18	6208	40	80	18	
6309 45 6010 80 6310 16 6310 110 6211 55 6311 120 6012 60 95 18	6308	40	90	23	
6309 100 25 6010 80 16 6310 110 27 6211 55 100 21 6311 55 120 29 6012 60 95 18	6209	45	85	19	
6310 50 6211 100 55 120 6311 29 6012 60 95 18	6309	45	100	25	
6310 110 27 6211 100 21 6311 120 29 6012 60 95 18	6010	50	80	16	
6311 120 29 6012 60 95 18	6310	50	110	27	
6311 120 29 6012 60 95 18	6211	55	100	21	
	6311	55	120	29	
6214 70 125 24	6012	60	95	18	
	6214	70	125	24	





Creep-Free Bearings

Creep may occur in EV motors used under high speed or in large motors with large unbalanced loads.

NSK's Creep-Free Bearings dramatically reduce the occurrence of creep by restricting the amount of clearance between the outer ring and housing.

Since boundary dimensions are identical to standard bearings, the housing does not need to be reworked when replacing the bearings, and assembly is easy.

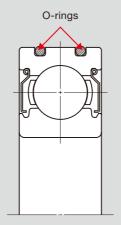
Features

Special Structure to Prevent Creep

Creep-Free Bearings come with two O-rings mounted in the outer ring and help prevent 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.





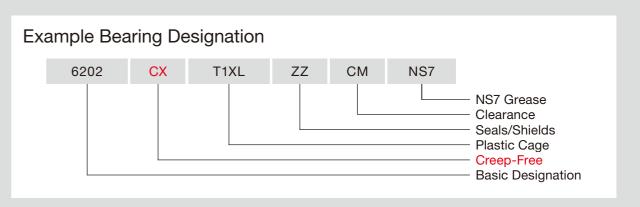
Structure of a Creep-Free Bearing

Usable Under High Speeds and Unbalanced Loads

In creep limit load tests, the more the housing clearance is reduced, the more creep can be prevented.

Creep-Free Bearings are up to four times more resistant to creep than conventional bearings.





Designation	Boundar	y Dimensio	ns (mm)	Designation	Boundar	y Dimensio	ns (mm)
Designation	Bore Dia.	Outside Dia.	Width	Designation	Bore Dia.	Outside Dia.	Width
6000		26	8	6009		75	16
6200	10	30	9	6209	45	85	19
6300		35	11	6309		100	25
6001		28	8	6010		80	16
6201	12	32	10	6210	50	90	20
6301		37	12	6310		110	27
6002		32	9	6011		90	18
6202	15	35	11	6211	55	100	21
6302		42	13	6311		120	29
6003		35	10	6012		95	18
6203	17	40	12	6212	60	110	22
6303		47	14	6312		130	31
6004		42	12	6013		100	18
6204	20	47	14	6213	65	120	23
6304		52	15	6313		140	33
6005		47	12	6014		110	20
6205	25	52	15	6214	70	125	24
6305		62	17	6314		150	35
6006		55	13	6015	75	115	20
6206	30	62	16	6215	7.5	130	25
6306		72	19	6016	80	125	22
6007		62	14	6216	00	140	26
6207	35	72	17	6017	85	130	22
6307		80	21	6217	00	150	28
6008		68	15	6018	90	140	24
6208	40	80	18	6019	95	145	24
6308		90	23	6020	100	150	24

[•] If oil or grease is applied to the outside surface of the bearing, use a mineral oil or a synthetic hydrocarbon oil (such as NSK EA2).

[•] The O-rings are made of nitrile rubber (operating temperature range: -30 to 120 °C) as standard. Please contact NSK for use under special environments, such as at high temperatures.

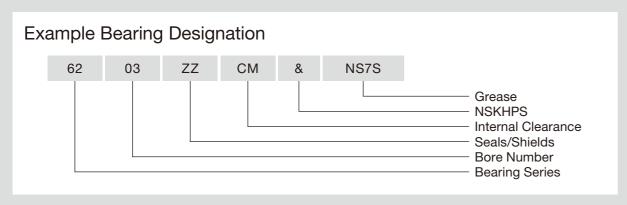
22

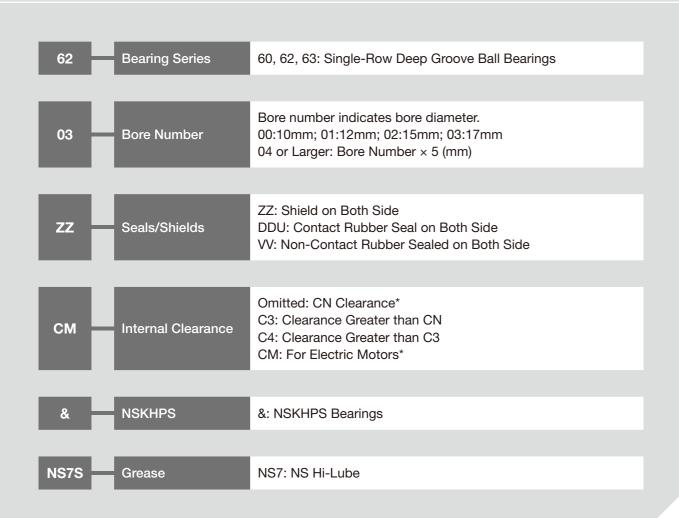
NSKHPS High-Performance Standard Series Deep Groove Ball Bearings -For High Efficiency Motors & General Motors

As motors become smaller and lighter, bearings must also become more compact, reliable, and capable of carrying

Our current NSKHPS Series has an extensive lineup based on the most commonly used bearing series.

heavy loads. NSK responds to these trends with NSKHPS: our new standard line of high-performance bearings. Compared to conventional bearings, NSKHPS Series deep groove ball bearings have 15% longer life and 15% higher limiting speed.

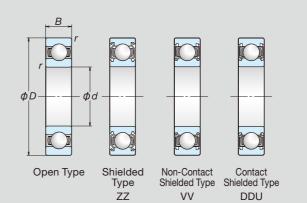








23



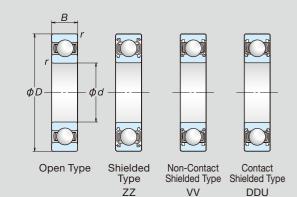
Dynamic Equivalent Load $P = XF_r + YF_a$											
$\frac{f_0F_a}{C_{0r}}$	е	$\frac{F_a}{F_r}$	≦ e	$\frac{F_a}{F_r}$ > e							
Our		Χ	Y	Χ	Y						
0.172	0.19	1	0	0.56	2.30						
0.345	0.22	1	0	0.56	1.99						
0.689	0.26	1	0	0.56	1.71						
1.03	0.28	1	0	0.56	1.55						
1.38	0.30	1	0	0.56	1.45						
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 90	0.44	- 1	Λ	0.56	1 00						

Static Equivalent Load $P_0 = 0.6 F_r + 0.5 F_a$ When $F_r > 0.6 F_r + 0.5 F_a$, use $P_0 = F_r$.

			_		· ·		Б	1 D 1'		Limiting	Speeds	s (min ⁻¹)		
	Des	gnatio	on		Bour	ndary [sions	Basic Loa		Factor	Gre		Oil
						(m	111)		(k	IN)		Open		
Open	Shielded	Seal	led	NSKHPS	d	D	В	<i>r</i> (min.)	C _r	C_{0r}	f_0	ZZ VV	DDU	Open
6200	ZZ	VV	DDU	&	10	30	9	0.6	5 350	2 390	13.2	28 000	18 000	34 000
6300	ZZ	VV	DDU	&	10	35	11	0.6	8 500	3 450	11.2	26 000	17 000	30 000
6001	ZZ	VV	DDU	&		28	8	0.3	5 350	2 370	13.0	32 000	18 000	38 000
6201	ZZ	VV [DDU	&	12	32	10	0.6	7 150	3 050	12.3	26 000	17 000	32 000
6301	ZZ	VV	DDU	&		37	12	1.0	10 200	4 200	11.1	24 000	16 000	28 000
6002	ZZ	VV	DDU	&		32	9	0.3	5 850	2 830	13.9	26 000	15 000	32 000
6202	ZZ	VV	DDU	&	15	35	11	0.6	8 000	3 750	13.2	22 000	14 000	28 000
6302	ZZ	VV	DDU	&		42	13	1.0	12 000	5 450	12.3	19 000	13 000	24 000
6003	ZZ	VV	DDU	&		35	10	0.3	6 300	3 250	14.4	24 000	13 000	28 000
6203	ZZ	VV	DDU	&	17	40	12	0.6	10 100	4 800	13.2	20 000	12 000	24 000
6303	ZZ	VV	DDU	&		47	14	1.0	14 300	6 650	12.4	17 000	11 000	20 000
6004	ZZ	VV	DDU	&		42	12	0.6	9 850	5 000	13.8	20 000	11 000	24 000
6204	ZZ	VV	DDU	&	20	47	14	1.0	13 400	6 600	13.1	17 000	11 000	20 000
6304	ZZ	VV	DDU	&		52	15	1.1	16 700	7 900	12.4	16 000	10 000	19 000
6005	ZZ	VV	DDU	&		47	12	0.6	10 600	5 850	14.5	18 000	9 500	22 000
6205	ZZ	VV	DDU	&	25	52	15	1.0	14 700	7 850	13.9	15 000	9 000	18 000
6305	ZZ	VV	DDU	&		62	17	1.1	21 600	11 200	13.2	13 000	8 000	16 000
6006	ZZ	VV	DDU	&		55	13	1.0	13 900	8 300	14.7	15 000	8 000	18 000
6206	ZZ	VV	DDU	&	30	62	16	1.0	20 400	11 300	13.8	12 000	7 500	15 000
6306	ZZ	VV	DDU	&		72	19	1.1	28 000	15 000	13.3	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
6207	ZZ	VV	DDU	&	35	72	17	1.1	27 000	15 300	13.8	11 000	6 300	13 000
6307	ZZ	VV	DDU	&		80	21	1.5	35 000	19 200	13.2	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
6208	ZZ	VV	DDU	&	40	80	18	1.1	30 500	17 900	14.0	9 500	5 600	12 000
6308	ZZ	VV	DDU	&		90	23	1.5	43 000	24 000	13.2	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
6209	ZZ	VV	DDU	&	45	85	19	1.1	33 000	20 400	14.4	9 000	5 300	11 000
6309	ZZ	VV	DDU	&		100	25	1.5	55 500	32 000	13.1	7 500	4 800	9 500
6010	ZZ	VV	DDU	&		80	16	1.0	22 900	16 600	15.6	9 500	4 800	11 000
6210	ZZ	VV	DDU	&	50	90	20	1.1	37 000	23 200	14.4	8 000	4 800	10 000
6310	ZZ	VV	DDU	&		110	27	2.0	65 000	38 500	13.2	7 100	4 300	8 500

*CM clearance can be used instead of CN clearance (the opposite is not possible).





Dynamic Equivalent Load $P = XF_r + YF_a$

$\frac{f_0F_a}{C_{0r}}$	е	$\frac{F_a}{F_r}$	≦ e	$\frac{F_a}{F_r}$ > e			
Cor		Χ	Y	Χ	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 $P_0 = 0.6 F_r + 0.5 F_a$ When $F_r > 0.6 F_r + 0.5 F_a$, use $P_0 = F_r$.

					Boundary Dimensions				s Basic Load Ratings			Limiting Speeds (min ⁻¹)		
	Des	gna	tion		Doui		m)	SIUIIS		N)	Factor	Gre	ase	Oil
						(111	,		(1)	1 1)		Open		
Open	Shielded	Se	aled	NSKHPS	d	D	В	<i>r</i> (min.)	C_{r}	C _{0r}	f_0	ZZ VV	DDU	Open
6011	ZZ	VV	DDU	&		90	18	1.1	29 700	21 200	15.3	8 500	4 500	10 000
6211	ZZ	VV	DDU	&	55	100	21	1.5	45 500	29 300	14.3	7 500	4 300	9 000
6311	ZZ	VV	DDU	&		120	29	2.0	75 000	44 500	13.1	6 700	4 000	8 000
6012	ZZ	VV	DDU	&		95	18	1.1	31 000	23 200	15.6	8 000	4 000	9 500
6212	ZZ	VV	DDU	&	60	110	22	1.5	55 000	36 000	14.3	6 700	3 800	8 000
6312	ZZ	VV	DDU	&		130	31	2.1	86 000	52 000	13.1	6 000	3 600	7 100
6013	ZZ	VV	DDU	&		100	18	1.1	32 000	25 200	15.8	7 500	4 000	9 000
6213	ZZ	VV	DDU	&	65	120	23	1.5	60 000	40 000	14.4	6 300	3 600	7 500
6313	ZZ	VV	DDU	&		140	33	2.1	97 500	60 000	13.2	5 600	3 400	6 700
6014	ZZ	VV	DDU	&		110	20	1.1	40 000	31 000	15.6	7 100	3 600	8 500
6214	ZZ	VV	DDU	&	70	125	24	1.5	65 500	44 000	14.5	6 000	3 400	7 100
6314	ZZ	VV	DDU	&		150	35	2.1	109 000	68 000	13.2	5 300	3 200	6 300
6015	ZZ	VV	DDU	&		115	20	1.1	41 500	33 500	15.8	6 700	3 400	8 000
6215	ZZ	VV	DDU	&	75	130	25	1.5	69 500	49 500	14.7	5 600	3 200	6 700
6315	ZZ	VV	DDU	&		160	37	2.1	119 000	77 000	13.2	4 800	2 800	6 000
6016	ZZ	VV	DDU	&		125	22	1.1	50 000	40 000	15.6	6 300	3 200	7 100
6216	ZZ	VV	DDU	&	80	140	26	2.0	76 500	53 000	14.6	5 300	3 000	6 300
6316	ZZ	VV	DDU	&		170	39	2.1	129 000	86 500	13.3	4 500	2 800	5 600
6017	ZZ	VV	DDU	&		130	22	1.1	52 000	43 000	15.8	6 000	3 000	7 100
6217	ZZ	VV	DDU	&	85	150	28	2.0	88 000	62 000	14.5	4 800	2 800	6 000
6317	ZZ	VV	DDU	&		180	41	3.0	139 000	97 000	13.3	4 300	2 600	5 000
6018	ZZ	VV	DDU	&		140	24	1.5	61 000	50 000	15.6	5 600	2 800	6 300
6218	ZZ	VV	DDU	&	90	160	30	2.0	101 000	71 500	14.5	4 500	2 600	5 600
6318	ZZ	VV	DDU	&		190	43	3.0	150 000	107 000	13.3	4 000	2 400	4 800
6019	ZZ	VV	DDU	&		145	24	1.5	63 500	54 000	15.8	5 300	2 600	6 000
6219	ZZ	VV	DDU	&	95	170	32	2.1	114 000	82 000	14.4	4 300	2 600	5 000
6319	ZZ	VV	DDU	&		200	45	3.0	160 000	119 000	13.3	3 400	2 400	4 300
6020	ZZ	VV	DDU	&	100	150	24	1.5	63 000	54 000	15.9	5 000	2 600	6 000
6220	ZZ	VV	DDU	&	100	180	34	2.1	128 000	93 000	14.4	4 000	2 400	4 800
6021	ZZ	VV	DDU	&	105	160	26	2.0	76 000	66 000	15.8	4 500	2 400	5 600
6221	ZZ	VV	DDU	&	103	190	36	2.1	140 000	105 000	14.4	3 800	2 200	4 500
6022	ZZ	VV	DDU	&	110	170	28	2.0	89 000	73 000	15.5	4 500	2 200	5 300
6024	ZZ	VV	DDU	&	120	180	28	2.0	92 500	80 000	15.7	4 000	2 200	4 800

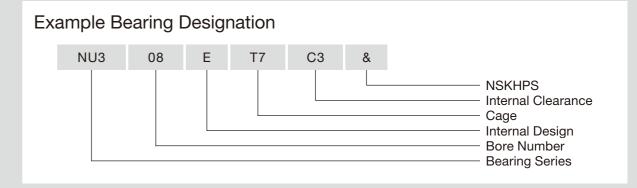


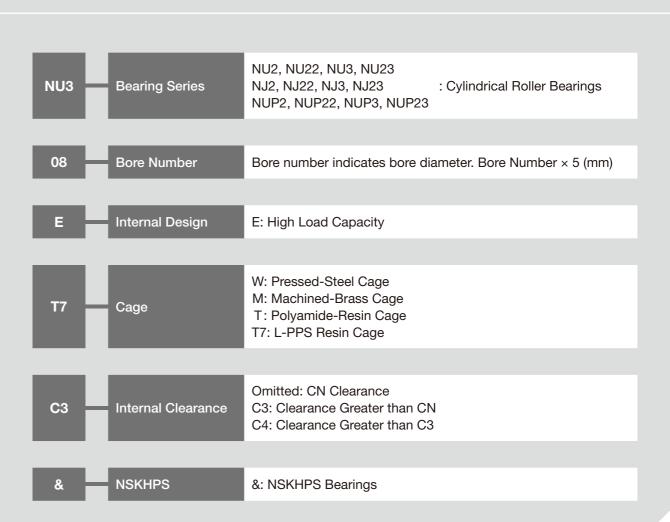
NSKHPS High-Performance Standard Series Cylindrical Roller Bearings -For General Motors

As motors become smaller and lighter, bearings must also become more compact, reliable, and capable of carrying heavy loads. NSK responds to these trends with NSKHPS: our new standard line of high-performance bearings. Compared to conventional bearings, the NSKHPS Series of cylindrical roller bearings has up to 60% longer life and 15% higher limiting speed.

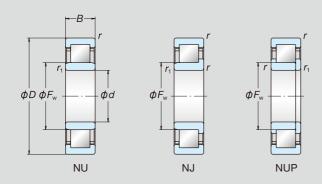
Our current NSKHPS Series has an extensive lineup based on the most commonly used bearing series.

DATA









	Designation* asic Number Cage						Bour	•	/ Dime mm)	ensior	ns	Basic Loa	d Ratings N)	s Limiting Speed (min ⁻¹)		Axial
& Internal Design Code	W				NSK HPS	d	D	В	r (min.)	r ₁ (min.)	Fw	Cr	C _{0r}	Grease	Oil	Movement S (mm)
NU205E	*	*	*	*	&		52	15	1	0.6	31.5	33 500	27 700	12 000	14 000	1.2
NU2205E		*	*	*	&	25	52	18	1	0.6	31.5	40 000	34 500	12 000	14 000	1.2
NU305E	*	*	*	*	&	23	62	17	1.1	1.1	34	48 000	37 500	10 000	12 000	1.2
NU2305E		*	*	*	&		62	24	1.1	1.1	34	65 500	56 000	9 000	11 000	1.2
NU206E	*	*	*	*	&		62	16	1	0.6	37.5	45 000	37 500	9 500	12 000	1.2
NU2206E		*	*	*	&	20	62	20	1	0.6	37.5	56 500	50 000	9 500	12 000	1.2
NU306E	*	*	*	*	&	30	72	19	1.1	1.1	40.5	61 000	50 000	8 500	10 000	1.2
NU2306E		*	*	*	&		72	27	1.1	1.1	40.5	86 000	77 500	8 000	9 500	1.2
NU207E	*	*	*	*	&		72	17	1.1	0.6	44	58 000	50 000	8 500	10 000	1.2
NU2207E		*	*	*	&	0.5	72	23	1.1	0.6	44	71 000	65 500	8 500	10 000	2.2
NU307E	*	*	*	*	&	35	80	21	1.5	1.1	46.2	76 500	65 500	7 500	9 500	1.2
NU2307E		*	*	*	&		80	31	1.5	1.1	46.2	107 000	101 000	6 700	8 500	1.2
NU208E	*	*	*	*	&		80	18	1.1	1.1	49.5	64 000	55 500	7 500	9 000	1.2
NU2208E		*	*	*	&	40	80	23	1.1	1.1	49.5	83 000	77 500	7 500	9 000	1.2
NU308E	*	*	*	*	&	40	90	23	1.5	1.5	52	95 500	81 500	6 700	8 000	1.2
NU2308E		*	*	*	&		90	33	1.5	1.5	52	131 000	122 000	6 000	7 500	1.2
NU209E	*	*	*	*	&		85	19	1.1	1.1	54.5	72 500	66 500	6 700	8 000	1.2
NU2209E		*	*	*	&	45	85	23	1.1	1.1	54.5	87 500	84 500	6 700	8 500	1.2
NU309E	*	*	*	*	&	45	100	25	1.5	1.5	58.5	112 000	98 500	6 000	7 500	1.4
NU2309E		*	*	*	&		100	36	1.5	1.5	58.5	158 000	153 000	5 300	6 700	1.4
NU210E	*	*	*	*	&		90	20	1.1	1.1	59.5	79 500	76 500	6 300	7 500	1.7
NU2210E		*	*	*	&	50	90	23	1.1	1.1	59.5	96 000	97 000	6 300	8 000	1.2
NU310E	*	*	*	*	&	50	110	27	2	2	65	127 000	113 000	5 000	6 000	1.4
NU2310E		*	*	*	&		110	40	2	2	65	187 000	187 000	5 000	6 300	1.9
NU211E	*	*	*	*	&		100	21	1.5	1.1	66	99 000	98 500	5 600	7 100	1.2
NU2211E		*	*	*	&	EE	100	25	1.5	1.1	66	117 000	122 000	5 600	7 100	1.2
NU311E	*	*	*	*	&	55	120	29	2	2	70.5	158 000	143 000	4 500	5 600	1.4
NU2311E		*	*	*	&		120	43	2	2	70.5	231 000	233 000	4 500	5 600	1.4

Desi	gn		on* ige				Bour	•	/ Dime mm)	ensio	ns	Basic Loa	d Ratings N)	Limiting (mi		Permissible Axial
Basic Number & Internal Design Code	W			Т7	NSK HPS	d	D	В	<i>r</i> (min.)	r ₁ (min.)	Fw	C _r	Cor	Grease	Oil	Movemen S (mm)
NU212E	*	*	*	*	&		110	22	1.5	1.5	72	112 000	107 000	5 300	6 300	1.2
NU2212E	·	*	*	*	&		110	28	1.5	1.5	72	151 000	157 000	5 300	6 300	1.2
NU312E		*	*	*	&	60	130	31	2.1	2.1	77	169 000	157 000	4 800	5 600	1.5
NU2312E		*	*	*	&		130	46	2.1	2.1	77	251 000	262 000	4 300	5 300	1.5
NU213E	*	*	*	*	&		120	23	1.5	1.5	78.5	124 000	119 000	4 800	5 600	1.4
NU2213E	-4-	*	*	*	&		120	31	1.5	1.5	78.5	171 000	181 000	4 800	6 000	1.4
NU313E		*	*	*	&	65	140	33	2.1	2.1	82.5	204 000	191 000	4 300	5 300	1.5
NU2313E		*	*	*	&		140	48	2.1	2.1	82.5	263 000	265 000	3 800	4 800	1.5
NU214E		*	*	*	&		125	24	1.5	1.5	83.5	136 000	137 000	5 000	6 300	1.4
NU2214E		*	*	*	&		125	31	1.5	1.5	83.5	179 000	194 000	4 500	5 600	1.4
NU314E		*	*	*	&	70	150	35	2.1	2.1	89	231 000	222 000	4 000	5 000	1.5
NU2314E		*	*	*	&		150	51	2.1	2.1	89	310 000	325 000	3 600	4 500	1.5
NU2314E NU215E		*	*	*	&		130	25	1.5	1.5	88.5	150 000	156 000	4 800	6 000	1.4
NU2215E		*	*	*	&		130	31	1.5	1.5	88.5	186 000	207 000	4 300	5 300	1.4
NU315E		*	*	*	&	75	160	37	2.1	2.1	95	271 000	263 000	3 800	4 800	1.4
NU2315E		*	*	*	&		160	55	2.1	2.1	95	370 000	395 000	3 400	4 300	4.4
NU2313L NU216E		*	*	*	&		140	26	2.1	2.1	95.3	160 000	167 000	4 500	5 300	1.4
NU2216E		*	*	*	&		140	33	2	2	95.3	214 000	243 000	4 000	5 000	1.4
NU316E		*	*	*	&	80	170	39	2.1	2.1	101	289 000	282 000	3 600	4 300	1.5
NU2316E				*	&		170	58	2.1	2.1	101	400 000	430 000	3 200	4 000	1.5
		*	*													
NU217E		*	*	*	&		150	28	2	2	100.5	192 000	199 000	4 300	5 000	1.3
NU2217E		*	*	*	&	85	150	36	2	2	100.5	250 000	279 000	3 800	4 500	1.3
NU317E		*			&		180	41	3	3	108	360 000	330 000	3 400	4 000	2.0
NU2317E		*			&		180	60	3	3	108	485 000	485 000	3 000	3 800	1.6
NU218E		*	*	*	&		160	30	2	2	107	205 000	217 000	4 000	4 800	1.4
NU2218E		*	*	*	&	90	160	40	2	2	107	274 000	315 000	3 600	4 300	1.9
NU318E		*	H		&		190	43	3	3	113.5	390 000	355 000	3 200	3 800	1.5
NU2318E		*			&		190		3	3		535 000		2 800	3 400	3.1
NU219E		*			&		170	32	2.1	2.1		249 000		3 800	4 500	1.4
NU2219E			*		&	95	170	43	2.1	2.1		325 000		3 400	4 000	1.4
NU319E		*			&		200	45	3	3		410 000	385 000	3 000	3 600	1.5
NU2319E		*			&		200	67	3	3			585 000	2 600	3 400	1.6
NU220E		*			&		180	34	2.1	2.1	119	305 000	305 000	3 600	4 300	1.4
NU2220E		*			&	100	180	46	2.1	2.1	119	410 000	445 000	3 200	3 800	1.4
NU320E		*			&		215	47	3	3	127.5	465 000	425 000	2 800	3 400	1.8
NU2320E		*			&		215	73	3	3	127.5		715 000	2 400	3 000	1.8
NU221E		*			&	105	190	36	2.1	2.1	125	320 000		3 400	4 000	1.4
NU321E		*			&		225	49	3	3	133	525 000	480 000	2 600	3 200	1.8
NU222E		*			&		200	38	2.1	2.1		360 000		3 200	3 800	1.4
NU2222E		*			&	110	200	53	2.1	2.1	132.5	470 000	515 000	2 800	3 400	1.4
NU322E		*			&		240	50	3	3	143		525 000	2 600	3 000	3.8
NU2322E		*			&		240	80	3	3	143	830 000	880 000	2 200	2 800	3.3

Technical Data

1. Bearing Sound and Vibration

Diagnosis with Sound and Vibration

Classification of sounds and vibrations

Sounds and vibrations accompany the rotation of rolling bearings. The tone and amplitude of such sounds and vibrations vary depending on the type of bearing, mounting conditions, operational conditions, etc. The sounds and vibrations of a rolling bearing can be classified under the following four chief categories and each category can be further classified into several subcategories, as described in Table 1 below.

However, boundaries between groups are not definite. Even if some types of sounds or vibrations are inherent in the bearings, the volume might be related to the manufacturing

process.

Conversely, some types of sounds or vibrations, even if caused by manufacturing, cannot be eliminated under normal conditions.

By recording the sounds and vibrations of a rotating machine and analyzing them, the cause may be inferred. As shown by the figures on the next page, a mechanically normal bearing shows a stable waveform. However, a bearing with damage such as a scratch shows a waveform with wide swings indicating large-amplitude sounds at regular intervals (refer to Figs.1 and 2).

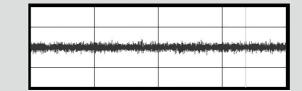


Fig. 1 Sound waveform of a normal bearing

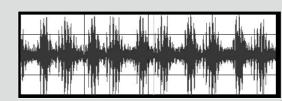


Fig. 2 Sound waveform of a scratched bearing

 f_{AIN} , f_{AM}

 f_{AIN} , f_{AM}

FFT After

Envelope

(Basic No.)

 Zf_c

?

auide surface

grease resistance

Rolling element waviness

rolling elements and raceways Irregular inner ring cross-section

Displacement of inner ring due to rolling element

Inner ring raceway waviness, irregularity of shaft

Outer ring raceway waviness, irregular housing

Nicks, dents, rust, flaking on inner ring raceway

Nicks, dents, rust, flaking on inner ring raceway

Lubricant or lubricant bubbles crushed between

Nicks, dents, rust, flaking on rolling elements

Generated Frequency (Frequency Analysis)

FFT of Original Wave

Radial (Angular) Direction | Axial Direction

Natural frequency of cage

Natural frequency of cage

Natural frequency of cage

Natural frequency of cage

 $nZf_i\pm f_r(nZ\pm 1 \text{ peaks})$ $nZf_i(nZ \text{ peaks})$

 $nZf_c(nZ\pm 1 \text{ peaks})$ $nZf_c(nZ \text{ peaks})$

 $2nf_b \pm f_c (2n \text{ peaks})$ $2nf_b (2n \text{ peaks})$

Natural frequency of seal

 f_{AiN}, f_{AM}

fain,fam

frin. fmi

 f_{RIN} , f_{MI}

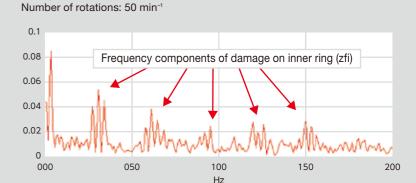
 $(=f_{R2N},f_{R3N})$

 Zf_c

frin .fmi

 f_{RIN}, f_{MI}

 f_r -2 f_c



Recording and analysis method: Envelope analysis sounds recorded by

Examp	le of	analy	/sis	re

When the inner ring raceway surface is damaged

Bore diameter: 100 mm

microphone for a test machine

Table 1	Classification of	of Sounds and	Vibrations in	a Rolling	Rearing
Iable I	Olassilleation (n odunus and	vibiations ii	ιαινοιιιια	Deamin

	Sou	und Type	V	ibration	Features			
	Race n	oise	Free vibration	on of raceway ring	Continuous noise: basic unavoidable noise that all bearings generate			
	Roller/ball click noise			tion of raceway	Regular noise at a certain interval: found in large bearings and horizontal shafts, radial loads and low rpm			
	Squeal	noise	Free vibration	on of raceway ring	Intermittent or continuous: generally found in large cylindrical roller bearing and under radial load, grease lubrication, and particular speeds			
Structural		"CK" sound	Free vibrat	tion of cage	Regular noise at a set interval: generated by all bearing types			
1	Cage noise	"CG" sound	Vibration of	of cage	Intermittent or continuous: lubrication with certain greases			
		Tapping sound	Free vibrat	tion of cage	Set interval: slightly irregular under radial load and during initial stage			
	Rumbling		Vibration for rolling eler	rom passage of ment	Continuous: found in all bearing types under radial load			
			Vibration	Inner ring	Continuous noise			
Manufacturing	Chatte	r noise	due to waviness	Outer ring	Continuous noise			
				Rolling element	Continuous with rollers, occasional with balls			
			Vibration	Inner ring				
l londline	Flaw no	oise	due to	Outer ring	Regular noise at a set interval			
Handling			flaw	Rolling element				
	Contan	nination noise	Vibration du	e to contamination	Irregular			
	Seal no	oise	Free vibrat	tion of a seal	Contact seal			
011	Lubrica	ant noise		_	Irregular			
Other				f_{r}	Continuous			
	Rumbli	ng	Runout	$f_{m{c}}$	Continuous			
				f_r -2 f_c	Continuous			

f_c: Orbital revolution frequency of rolling elements (Hz) : Rotation frequency of inner ring (Hz)

)	Source	Countermeasures
	Selective resonance from waviness (rolling friction)	Improve rigidity around bearings, provide appropriate radial clearance, use high-viscosity lubricant and high-quality bearings
	Collision of rolling elements with inner ring or cage	Reduce radial clearance, apply preload, use high-viscosity oil
	Self-induced vibration caused by sliding friction at rolling surface	Reduce radial clearance, apply preload, change grease, replace with bearings with countermeasures
	Collision of cage with rolling elements or rings	Apply preload, use high-viscosity lubricant, reduce mounting error

Self-induced vibration due to friction at seal contact area Change the seal, change the grease

Self-induced vibration caused by friction at cage Change grease brand, replace with cage with countermeasures

Collision of cage and rolling element caused by Reduce radial clearance, apply preload, use low-viscosity lubricant

Reduce radial clearance, apply preload

Use high-quality bearings, improve shaft accuracy

Use high-quality bearings, improve housing bore accuracy

Use high-quality bearings Replace bearing and take care when handling Replace bearing and take care when handling Replace bearing and take care when handling Wash the bearing, improve sealing

Change the grease

reduce mounting error

Use high-quality bearings Ball variation in bearing, rolling elements non-equidistant Use high-quality bearings Non-linear vibration due to rigid variation by ball variation Use high-quality bearings

 f_{AiN} : Ring natural frequency in axial bending mode (Hz) f_{AM} : Natural frequency in the mode of axial vibration in mass of an outer ring spring system (Hz) f_b: Rotation frequency of rolling element around its center (Hz)

Irregular Entry of dirt or debris

f_{RiN}: Natural frequency of ring in radial bending mode (Hz)

Natural frequency in the mode of angular vibration in inertia of outer ring-spring system (Hz)



2. Grease for Motors

Grease Properties Table

Name	Thickener	Base Oil	Dropping Point (°C)	Worked Penetration	Operating Temperature (°C)	Base Oil Viscosity (mm²/s) (40°C)
NS7	Lithium soap	Ester + Diester	192	250	-40 to +130	24.1
ENS	Urea	Polyolester	>260	264	-40 to +160	30.5
EA7	Urea	Poly- $lpha$ -olefin	>260	243	-40 to +160	46
EA9	Urea	Poly- $lpha$ -olefin	>260	314	-40 to +140	47
LGU	Urea	Poly- $lpha$ -olefin	>260	201	-40 to +120	95.8
KPM	PTFE	Perfluoro- polyether	None	290	-20 to +200	420

3. Grease Life Equations

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 (1), Equation (2), or Fig. 3:

(General-purpose grease (1))

$$log t = 6.54 - 2.6 \frac{n}{N_{\text{max}}} - \left(0.025 - 0.012 \frac{n}{N_{\text{max}}}\right)T$$

(Wide-range grease (2))

$$log t = 6.12 - 1.4 \frac{n}{N_{\text{max}}} - \left(0.018 - 0.006 \frac{n}{N_{\text{max}}}\right)T$$

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 are listed in the bearing tables)

T : Operating temperature °C

Equation (1), Equation (2), and Fig. 3 apply under the following conditions:

(a) Speed n

$$0.25 \leq \frac{n}{N_{\text{max}}} \leq \frac{1}{N_{\text{max}}}$$

when
$$\frac{n}{N_{\text{max}}}$$
 < 0.25, assume $\frac{n}{N_{\text{max}}}$ = 0.25

(b) Operating Temperature T

For general-purpose grease (1) $70 \, ^{\circ}\text{C} \le T \le 110 \, ^{\circ}\text{C}$

For wide-range grease (2) 70 °C ≤ *T* ≤ 130 °C When T < 70 °C, assume T = 70 °C

(c) Bearing Loads

The bearing loads should be about 1/10 or less the basic load rating C_r.

Notes (1) Mineral-oil based greases (e.g. lithium-soap based grease) often used around -10 to 110 °C.

Notes (2) Synthetic-oil based greases used over a wide temperature range around -40 to 130 °C.

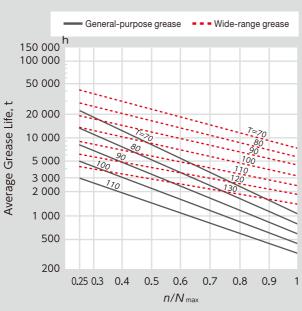


Fig. 3 Grease Life of Sealed Ball Bearings

4. Radial Internal Clearance

Radial Internal Clearances in Deep Groove Ball Bearings

Units: µm

Nominal Bo	re Diameter					Clear	rance				
d (m	nm)	C	2	С	N	C	3	C	4	C	5
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
Pamarke To of	htain the mose	urad valua	n uso the c	olograpao o	orrootion v	aluga in th	o table bel	ow For the	C2 cloars	noo olooo	the smaller

Remarks To obtain the measured values, use the clearance correction values 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.

Radial Clearance Correction Amount Nominal Bore Dia. d (mm) Measuring Load C2 10 (incl) 18 3 to 4 50 5 4 to 5 6 6 6 147 15 6 to 8

Remark For values exceeding 280 mm, please contact NSK.

Radial Internal Clearances in Bearings for Electric Motors

Deep Groove Ball Bearings for Electric Motors Units: um

		_	•			
Remarks			Nominal Bore			
Recommended Fi			(mm)	Dia. d (mm)		
aft	max.	min.	incl.	over		
(j5)	11	4	18	10 (incl)		
	12	5	30	18		
5	17	9	50	30		
.o	22	12	80	50		
	30	18	100	80		
	30	18	120	100		
15	38	24	160	120		

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.

Remark The radial internal clearance increase caused by the measuring load is equal to the correction amount for CN clearance listed in the table above.

Cylindrical Roller Bearings for Electric Motors Units: um

1	Nominal Bore		Clearance					emarks
	Dia. d	(mm)	Interchan	geable CT	Non-intercha	angeable CM	Reco	mmended Fit
(over	incl.	min.	max.	min.	max.	Shaft	Housing Bore
	24	40	15	35	15	30	k5	
	40	50	20	40	20	35		
	50	65	25	45	25	40		
	65	80	30	50	30	45		JS6, JS7
	80	100	35	60	35	55	m5	(J6, J7) (1)
	100	120	35	65	35	60		or
	120	140	40	70	40	65		K6, K7 (2)
	140	160	50	85	50	80		
	160	180	60	95	60	90	26	
	180	200	65	105	65	100	n6	

- 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.



5. Example Bearing Damage in Motors

Seizure

Damage	Possible Causes	Countermeasures
When sudden overheating occurs during rotation, the bearing becomes discolored. If operation continues, the raceway rings, rolling elements, and cage will soften, melt, and deform as damage accumulates.	-Poor lubrication -Excessive load (excessive preload) -Excessive rotational speed -Excessively small internal clearance -Entry of water and debris -Poor precision of shaft and housing, excessive shaft bending	Review the lubricant and lubrication method Re-investigate the suitability of the bearing type selected Review the preload, bearing clearance, and fitting Improve the sealing mechanism Check the precision of the shaft and housing Improve the mounting method



Photo 1

Part: Inner ring of an angular contact ball bearing Symptom: Raceway discoloration, melting at ball pitch intervals

Cause: Excessive preload



Photo 3

Part: Balls and cage of Photo 1

Symptom: Cage damaged by melting, balls discolored and melted

Cause: Excessive preload



Photo 5

Part: Inside a deep groove ball bearing

Symptom: Cage damage, grease nearly depleted, carbonization

Cause: Poor lubrication



Photo 2

Part: Outer ring in Photo 1

Symptom: Raceway discoloration, melting at ball pitch intervals

Cause: Excessive preload



Photo 4

Part: Inside a deep groove ball bearing Symptom: Grease nearly depleted, carbonization

Cause: Poor lubrication

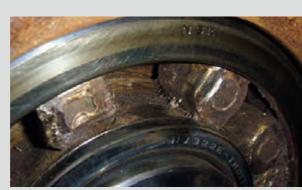


Photo 6

Part: Cylindrical roller bearing

Symptom: Seizure of roller at ring raceway surface

Cause: Excessively small internal clearance generated heat from motion of the inner ring and rollers under high

speed and light load

Creep

Damage	Possible Causes	Countermeasures
A phenomenon in bearings where relative slippage occurs at the fitting surfaces. Creep causes a shiny appearance, occasionally with scoring or wear.	-Insufficient interference or loose fit -Insufficient sleeve tightening	 Check interference and prevent rotation Correct the sleeve tightening Review precision of the shaft and housing Apply axial preload Tighten the raceway ring side face Apply adhesive to the fitting surface Apply a film of lubricant to the fitting surface



Photo 7

Part: Inner ring of a spherical roller bearing Symptom: Creep accompanied by scoring of bore surface

Cause: Insufficient interference



Photo 8

Part: Outer ring of a spherical roller bearing

Symptom: Creep over entire circumference of outside surface

Cause: Loose fit between outer ring and housing

Electrical Erosion

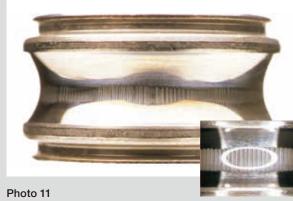
Damage	Possible Causes	Countermeasures
When electric current passes through a bearing, arcing and burning occur throughout the thin oil film at points of contact between the race and rolling elements. The points of contact are melted locally to form "fluting" or groove-like corrugations which can be seen by the naked eye. Magnification of these grooves reveals crater-like depressions that indicate melting by arcing.	-Electric potential difference between inner and outer rings -High-frequency electric potential difference generated by instruments or substrates used near a bearing.	 Design electric circuits that prevent current flow through the bearings Insulate the bearing



Part: Inner ring of a cylindrical roller bearing Symptom: Belt pattern of electrical erosion accompanied by pits on the raceway surface



Part: Balls of a deep groove ball bearing Symptom: A dark color covering the entire ball surface



Part: Inner ring of a deep groove

ball bearing

Symptom: Fluting on the raceway surface (high frequency)



Photo 12

Enlargement

Part: Outer ring of a deep groove ball bearing Symptom: Fluting on the raceway surface (high frequency)

Motor Bearings Specification Request

Please contact your nearest NSK branch with the following:

▶B	asic Para	ameters							
	Applica	ntion							
ters	Rotation	nal Speed							
Motor Parameters	Output		Max.:kw; Normal	:	kw				
or Pa	Position	n	☐ Horizontal ☐ Vertical ☐ Inclined (inclination angle):°						
Mot	Ambier	nt Temp.	Rangeto	°C ; I	Normal:	°C			
	Cooling	Method	☐ Water ☐ Oil ☐ Air ; ☐ Oth	er					
Drive Side Bearing					1	Non Drive Side B	earing		
	Design	ation							
	Dimens	sions	Bore dia. φ× Outside dia. φ× Wic	lthmm	Bore dia. φ	× Outside dia. φ	× Width	mm	
eters	Lubrica	tion Type	Grease (Brand:);	Brand:)	
Parameters	Seal/Sh	ield Type	☐ Open ☐ Shielded (ZZ) ☐ Sea	aled (VV/D[DU/DDW)				
	Load		Axial Fa:N; Radial	Fr:	N				
Bearing			Rotor weight:kg;	Side magne	etic force:	N			
	Bearing Temp.		Min. :°C ; Max. : _		_°C ; Norm	nal :	_°C		
	Required Life		Hours (or)	Yea	ars				
	E'u'	Housing	tomn	1		to	mm		
ပ	Fitting	Shaft	tomn	1		to	mm		
Parameters	Shaft Ho	ollow Dia.	φmm (0 for non-hollo	ow shafts)	φ	mm (0 for no	n-hollow s	hafts)	
Para	Shaft M	1aterial							
tting	Housing	Material							
İΞ	Bearing Preload		□ None; □ With preload: Type (□ Spring / □ Shim / □ Other) : Location (□ Drive side / □ Non drive side)						
►Ta	help an	alvze the	bearing load, please provide a layo	ut and dime	ensions.				
	otor Layo		a care, product provide a layo	Related Dimensions					
							mm		
							mm		

Motor Layout	Related Dimensions	
	Distance From Bearing Center:	mm
	Distance From Load Center to Front Bearing Center:	mm
	Distance From Load Center to Rear Bearing Center:	mm



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Handling Instructions for Spherical Roller Bearings





Handling Instructions for Spherical Roller Bearings

Thank you for your purchase of NSK Spherical Roller Bearings. We are confident that NSK Spherical Roller Bearings will provide reliable service. Spherical Roller Bearings have been adopted in many mechanical devices because they offer self-aligning and heavy load-carrying capacity. Therefore, in handling of spherical roller bearings, it is necessary to consider both individually and collectively the various factors including bearing structure, shape of shaft, bearing mounting method, and housing.

To give you a more complete understanding of how to handle Spherical Roller Bearings, we have published this manual. We hope that you find it useful.

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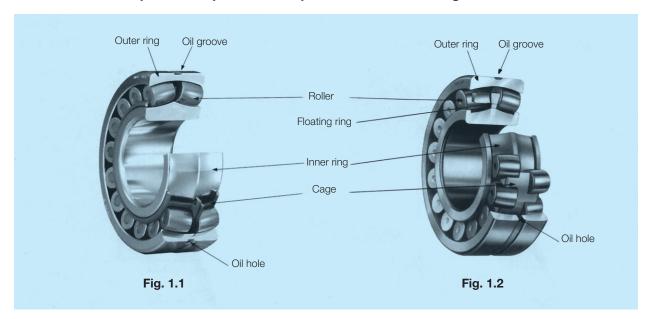
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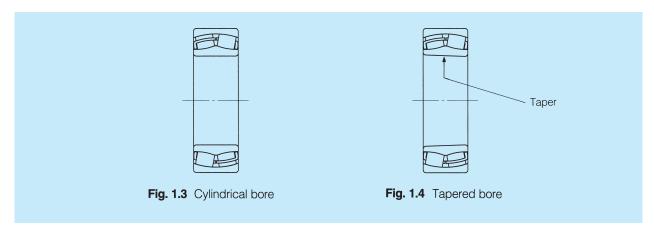
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1. Summary of Spherical Roller Bearings

1.1 Name and Shape of Components of Spherical Roller Bearings



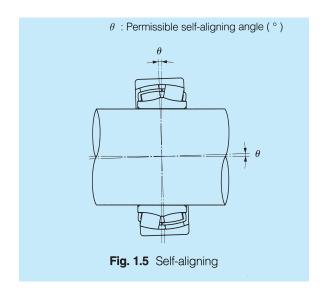
1.2 Shape of Bearing Bore



1.3 Bearings with Self-Aligning Capability

As shown in Fig. 1.5, the spherical roller bearing has an outer ring whose raceway is spherical and the center of curvature matches that of the bearing. Thus, inner ring, rollers and cage can be inclined (self-aligning property) relative to the outer ring.

The permissible self-aligning angle of a Spherical Roller Bearing varies depending on the dimensional series, loading conditions, but with a usual load, it is approximately 1° to 2.5°.



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1.4 Bearing Mounting Conditions

1.4.1 When shaft is cylindrical and bearing bore is cylindrical

Example using lock-washer Fig. 1.6 Example using lock plate Fig. 1.7

1.4.2 When shaft is tapered and bearing bore is tapered

Example using lock-washer	Fig. 1.8
Example using lock-washer with spacer ring	Fig. 1.9
Example using lock plate	Fig. 1.10
Example using lock plate with spacer ring	Fig. 1.11

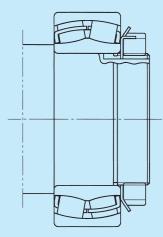


Fig. 1.6 Cylindrical shaft, lock-washer

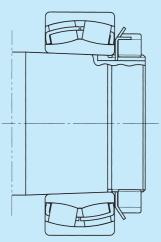


Fig. 1.8 Tapered shaft, lock-washer

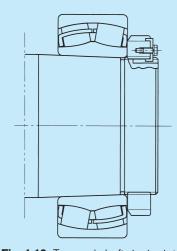


Fig. 1.10 Tapered shaft, lock plate

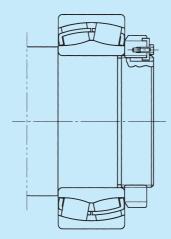


Fig. 1.7 Cylindrical shaft, lock plate

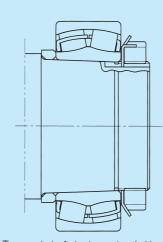


Fig. 1.9 Tapered shaft, lock-washer (with spacer ring)

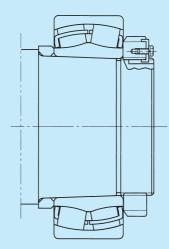


Fig. 1.11 Tapered shaft, lock plate (with spacer ring)

1.4.3 When the shaft is cylindrical and sleeve (adapter or removable sleeve) is used

Example using lock-washer and adapter sleeve
Example using lock-washer and adapter sleeve with spacer ring

Fig. 1.12

Fig. 1.13

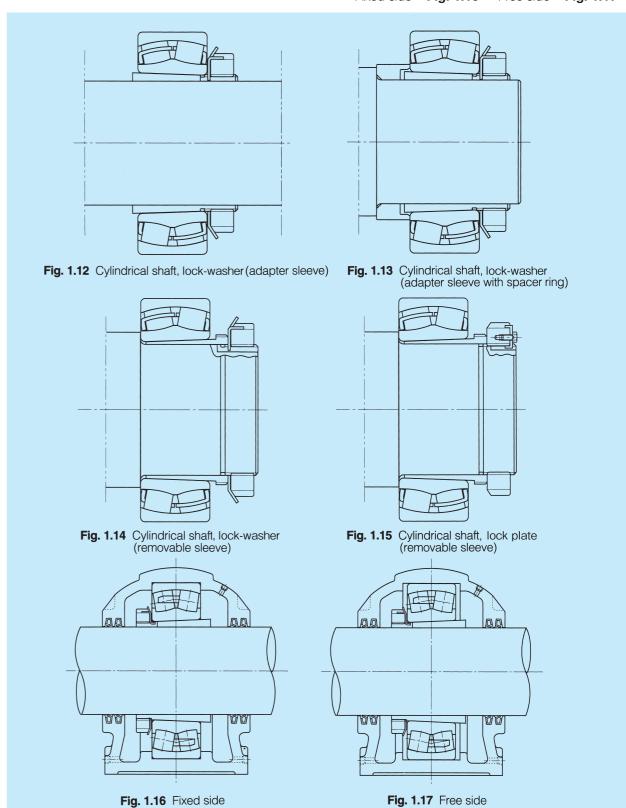
Example using lock-washer and removable sleeve
Example using lock plate and removable sleeve

Fig. 1.14

Fig. 1.15

1.4.4 Bearing outer ring and housing

Fixed side Fig. 1.16 Free side Fig. 1.17



2. Bearing Handling Precautions

2.1 Jigs, Tools, and Measuring Instruments

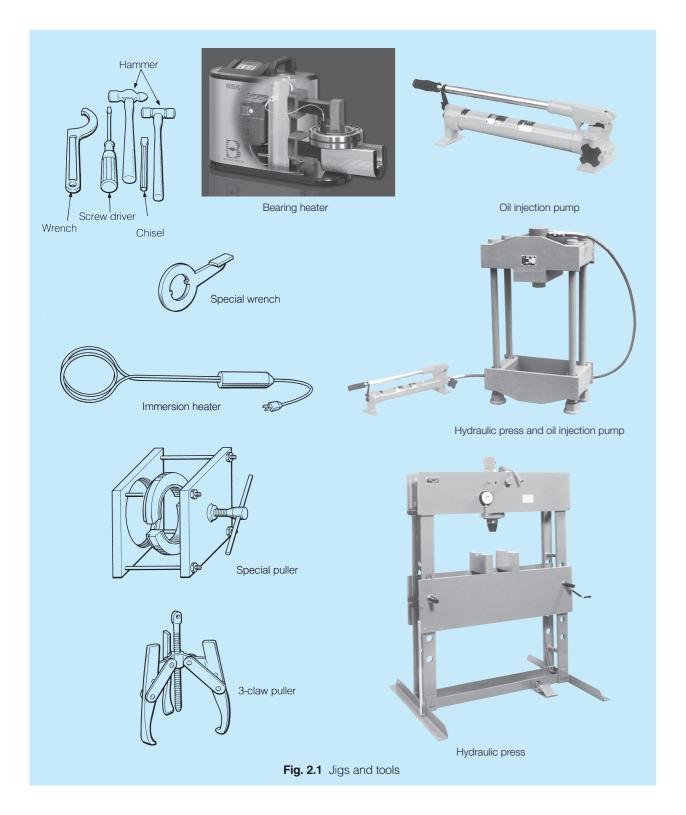
Jigs, tools and measuring instruments are necessary to handle bearings.

Jigs are required to hoist and carry bearings, mounting/dismounting of lock nut, etc. Measuring instruments are required to measure the bearing

clearance, temperature, etc. Let's give some examples of major jigs, tools and measuring instruments.

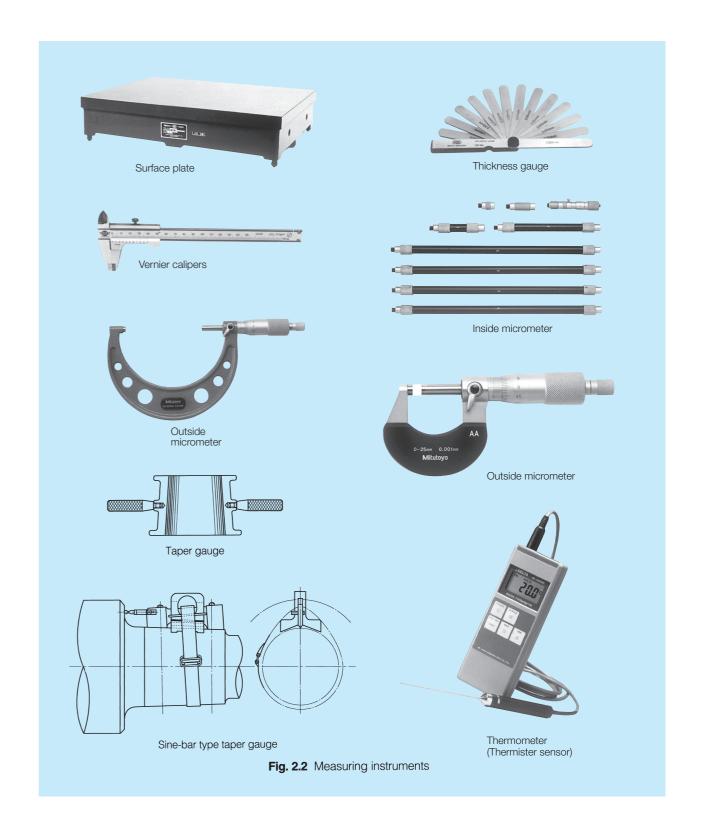
2.1.1 Jigs and Tools

Wire, belt for hoisting, hammer, chisel, screw driver, special wrench, special puller, 3-claw puller, hydraulic nut (see Section 14), oil injection pump, hydraulic press, bearing heater, immersion heater, etc. (**Fig. 2.1**)



2.1.2 Measuring Instruments

Surface plate, thickness gauge, vernier calipers, outside and inside measurement micrometers, thermometer, taper gauge, sine-bar type taper gauge, etc. (Fig. 2.2)



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2.2 Work Site

Select a work place that is as clean as possible. There must be enough space so that bearing parts can be moved about freely. Bearing, bearing accessory, shaft, and handling jig needed to freely movable.

Also, working table, surface plate, cleaning tank, bearing heater, oil heating tank, etc. shall be provided.

Since jigs, tools and measuring instruments are frequently used, be sure to keep them clean and in order.

2.3 Precautions When Mounting Bearings

2.3.1 Packing of New Bearing

New bearings are packed with an anticorrosive agent. Because if a bearing were to rust, it would prevent proper bearing rotation. As for their dimensional accuracy, bearings are manufactured precisely in units of 0.001 mm (micrometer). As a result, even powdery dust becomes a great obstacle to bearing running. Therefore, do not unpack bearings unless it is necessary.

2.3.2 Confirmation of Bearing Number

Before using a new bearing, confirm that its bearing number (Brg. No.), which consists of the basic number, appearance symbol and clearance symbol, matches or is equivalent to that of the bearing being removed from the equipment.

Confirmation example using 23136KE4C3

a) Basic Number

(Bearing Series Number + Bearing Bore Number)

The bearing series number is the first three digits, which are 231.

The bore number is the fourth and fifth numbers, which are 36.

b) Appearance symbol

The symbol consists of the following characters: KE4.

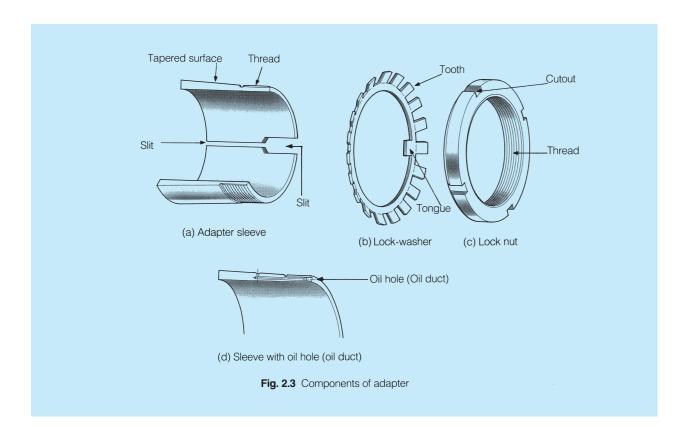
where,

- K: Indicates that the shape of bore face of bearing inner ring has a tapered bore of 1/12 (K30: this indicates that the shape of bearing bore has a tapered bore of 1/30.)
- E4: Indicates that oil groove and oil holes are provided on the outer ring outside.

c) Clearance symbol

The clearance symbol consists of two characters C3. The symbol C3 represents the bearing clearance alone and indicates the "geometrical or real clearance". The geometrical clearance may change depending on the shaft and housing fitting, temperature difference, or its operational condition, after mounting.

Confirm that the basic number, appearance symbol, and clearance symbol of the new bearing are identical or equivalent to that of the removed bearing.



2.3.3 Measurement of Bearing Clearance

After mounting a bearing with tapered bore, the measurement of clearance is important. Bearing clearance and measurement method are described in Section 3, please refer to it.

2.3.4 Preparation of Jigs to Mount Bearing

Prior to the start of bearing mounting work, examine the steps involved in the mounting method by referring to the drawing and checking the jigs and tools necessary for mounting. Depending on the work, preparation of a special jig may be necessary, thus, preliminary examination must be done.

- Prepare jigs, tools, measuring instruments, working table, surface plate, cleaning tank, and bearing heater or oil heating tank. Also, prepare bearings sleeve, shaft, and parts.
- Select a clean work site where working table, sur-

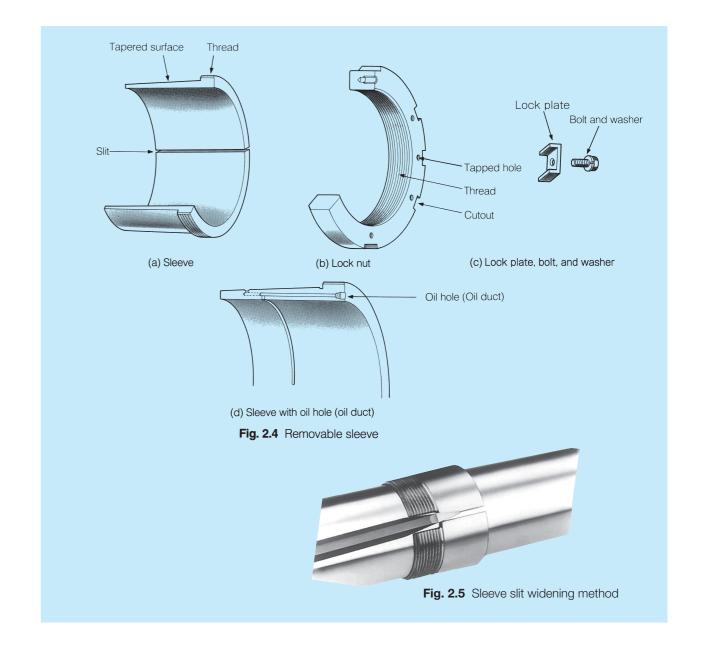
face plate, cleaning tank, and bearing heater or oil heating tank are provided and heavy material such as bearing, sleeve, shaft, etc. can be safely moved. Jigs, tools, measuring instruments and environment of work site shall be always kept clean to prevent entry of dust.

2.3.5 Parts to Be Used for Adapter, Removable Sleeve

a) Adapter

The adapter is used to mount the bearing and consists of adapter sleeve, lock nut, lock-washer, lock plate to prevent turning of adapter sleeve and lock nut. (Fig. 2.3 and Fig. 2.4)

To mount and dismount the adapter sleeve, it becomes easier when slit is widened slightly with a chisel. (**Fig. 2.5**) To tighten the lock nut, use a special wrench. (**Fig. 2.6**)



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b) Removable sleeve (Fig. 2.4)

The removable sleeve is used to mount the bearing. To fix the removable sleeve, the lock nut, end plate or end cap of shaft is used. To remove the bearing, the nut is mounted on the thread of the removable sleeve.

c) Lock-washer, lock plate, and nut

(1) How to mount lock-washer and lock plate
As a turning stopper of the lock nut, a lockwasher or lock plate is used.

Lock-washer

Procedure

1. Mounting method: With inclined teeth of lock-washer facing away from the bearing side, mate the lock-washer tongue to the key groove or to the slit of the shaft sleeve, then, insert.

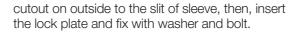
- 2. Mount the lock nut with its chamfered side facing the bearing's outer circumference side face.
- 3. To stop turning of the lock nut, mate one lock-washer tooth to the slit on outside of lock nut, then, bend that tooth with chisel. (Fig. 2.7)

Use a lock-washer as a standard for a nominal thread diameter that is smaller than 200 mm.

Lock plate

Procedure

- Mounting method: for a lock nut which fixes the bearing directly by mounting on the shaft, mate the cutout on outside diameter of lock nut to the key groove of shaft, then, insert the stopper for nut and fix with washer and bolt.
- 2. For the lock nut of an adapter sleeve, mate its



For the lock nut fixing removable sleeve, mate its cutout on outside to the key groove of sleeve, then, insert the lock plate and fix with washer and bolt.

To mount a Spherical Roller Bearing having a tapered bore inner ring, after adjusting the bearing clearance (Fig. 2.9), remove the lock nut temporarily, then, insert lock-washer, when a washer is used. (Fig. 2.10) Then, remount the lock nut. (Fig. 2.8) However, when a lock plate is used, after adjustment of bearing clearance, mate the key groove of shaft or slit of sleeve with the cutout on outside diameter of lock nut, then, insert the stopper for nut. Stopper for nut method is simpler than the lock-washer method. Therefore, the stopper for nut method is used for a large sized sleeves. (Fig. 2.11 and Fig. 2.12)

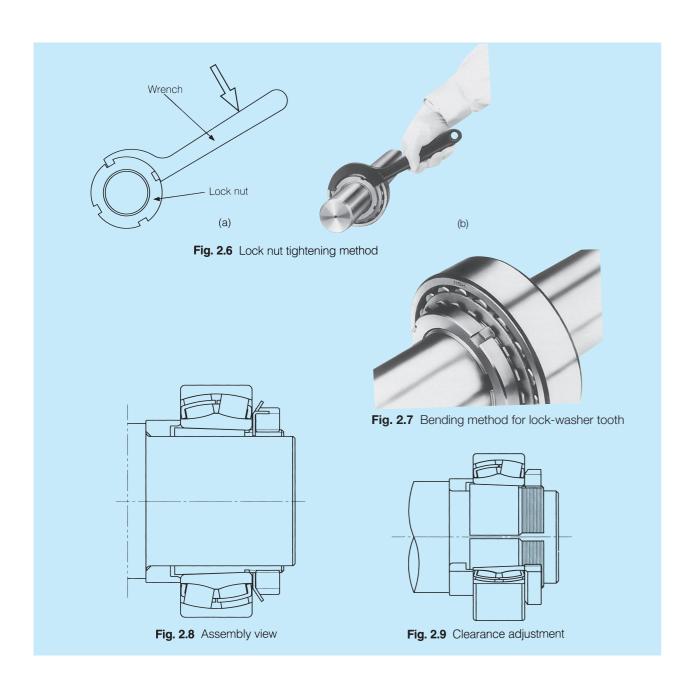
A lock plate is a standard part for applications

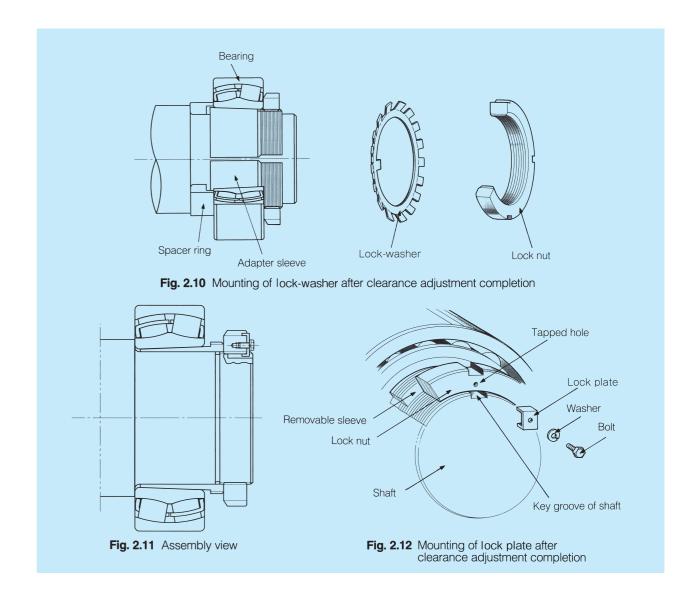
with a nominal thread diameter larger than 220 mm.

Nut

On the outside of a lock nut with a nominal thread diameter smaller than 200 mm, there are 4 equidistant cutouts. These are used to stop the turning of the lock nut with lock-washer. On the outside of a lock nut with a nominal thread diameter larger than 220 mm, there are 8 equidistant cutouts. And on the seat face of the lock nut corresponding to the cutouts, tapped holes to mount stopper for nut fixing bolts to prevent turning of lock nut are provided. The nut to be used to dismount bearing, being mounted on thread of removable sleeve has 4 equidistant cutouts on outside of nut. The claws of the special wrench fit into the cutouts on outside of each nut when mounting or dismounting the nut. (Fig. 2.6)

(2) Method to use lock-washer when mounting bearing





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To mount Spherical Roller Bearings having inner ring of tapered bore either on the tapered shaft or the cylindrical shaft using the adapter and when using the lock-washer as the turning stopper of lock nut, the lock-washer shall be inserted between the lock nut and bearing. While working to mount bearing, when the inner ring is pushed in by the lock nut, do it without insertion of lock-washer and mount the lock-washer finally as turning stopper of lock nut.

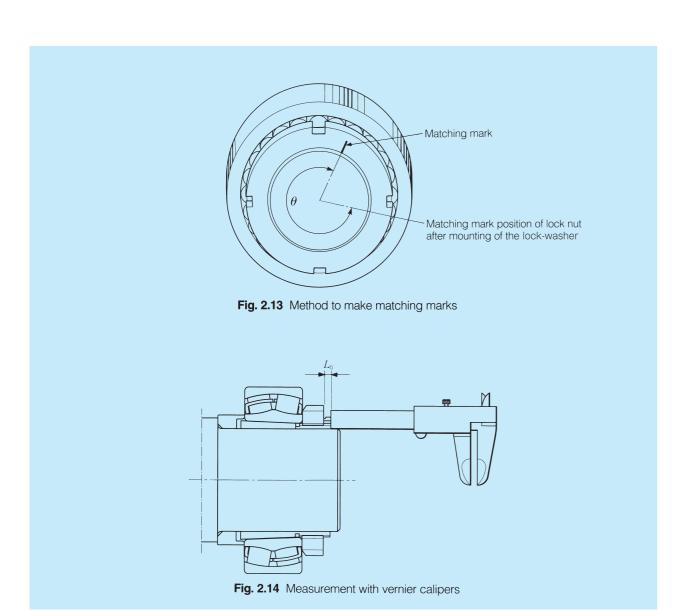
The reason is to avoid breakage of the lock-washer tongue which is subject to big force by the transmission of large torque from nut to seat face of lock-washer if lock nut is turned while lock-washer remains inserted by push-in of inner ring to realize a middle value between minimum and maximum radial internal clearance reduction (specified clearance).

By this reason, after adjustment of the specified clearance using directly the lock nut, remove once the lock nut, then, insert the lock-washer and remount the lock nut. At that time, mount position of lock nut displaces by the portion of plate thickness of lock-washer, as the confirming method of correct push-in of inner ring, even under lock-washer inserted state, the method to affix matching marks on lock nut and sleeve or method to measure distance between sleeve end face and nut seat face with vernier calipers is adopted. With those methods, by the portion of plate thickness of lock-washer, matching mark position or measured value varies, it is necessary to devise to correct such variation amount.

(a) Method to mark matching marks

Matching mark may be affixed on any place of lock nut and adapter sleeve. Adopt themethod to anticipate variation amount of matching mark position by mounting of the lock-washer while referring to the center angle of the shaft.

The variation amount is calculated by the fol-



lowing equation:

$$\theta = (t/p) \times 360^{\circ}$$
.....(**Fig. 2.13**)

where, p: Thread pitch of lock nut, (mm)

- t: Plate thickness of lock-washer, (mm)
- θ : Varied amount of matching mark dependingon plate thickness of lock-washer, it is center angle on the mounting shaft, (°)

(b) Method to measure distance between sleeve end face and nut seating face with vernier calipers

Measure the distance between the sleeve end face and nut seating face with vernier calipers. The target value is the measured value less the plate thickness of the lock-washer.

$$L = L_0 - t$$
(**Fig. 2.14**)

where, $L_{\rm 0}$: Measured value of distance between the sleeve end face and lock nut seating face, (mm)

t: Plate thickness of lock-washer, (mm)

L: Target value, (mm)

When the above method is used, you must confirm that the clearance is the specified one by measuring the bearing clearance and using the calculation equation.

2.4 Precautions When Removing Bearings

Removal of a bearing is done as part of the regular maintenance schedule or when replacement becomes necessary due to an abnormality. When the bearing is replaced based on the maintenance schedule, there is no special caution but when replacement becomes necessary due to occurrence of an abnormality during operation, it is recommended that you record and collect the following data items as a minimum. [This information is necessary for a thorough investigation into the causes of the problem and to develop effective countermeasures to prevent reoccurrence of the failure.]

1. Collect a sample of the used lubricant (about 200 cm³) and keep it.

- 2. Keep the damaged bearing.
- Describe any unusual phenomena during the operation.
- 4. Describe any symptoms when the abnormality occurred during operation (photos and sketch).

Preparation of removing jigs and tools

Prior to starting the bearing removal operation, check the drawing of the machine to examine dismounting method and its steps and prepare the jigs and tools necessary to do the removal procedure. In some case, the preparation of special tools may become necessary, therefore, a preliminary examination should always be done.

2.5 Bearing Storage

To prevent rusting, each bearing is treated and packed with an anticorrosive agent, but depending on the environment of the storing place, the effectiveness of the corrosion countermeasures varies greatly.

Careful attention is necessary to select a suitable place to keep and stock replacement bearings.

2.5.1 Bearing Storage Location

Bearings shall be stocked indoors in a place that is not exposed to wind or rain. Also, an indoor environment where temperature and/or humidity is high would be unsuitable for storage, because such a place would deteriorate the anticorrosion effect. Be sure to stock the bearings in a place where environmental temperature variation is small.

2.5.2 How to Store Bearings

After considering the size and weight of bearing to be stocked, secure enough space and proper carrying equipment to transport the bearing safely. It is recommended to provide proper storing shelves to stock bearings. The lowest tray of the storing shelves shall be at least 30 cm above the floor. Please avoid putting bearings directly on the floor.

The anticorrosive effectiveness of the package varies depending on the storing environment, but it is generally effective for about one to three years. Due to some special reason, if storing of the bearing for a longer time, or even up to nearly ten years is necessary, then a special storage method must be used. One such method is to immerse the bearing in a turbine oil which prevents corrosion.

3. 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.

3.1 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.

3.1.1 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 (Δ_r) . (**Fig. 3.1**)

3.1.2 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. 3.2**)

For the internal bearing clearance (Δ_r), take that value measured between 2 rows of just top of bearing and outer ring as respectively Δ_{rT1} and Δ_{rT2} and that value measured just at top of the bearing as Δ_{rT} .

$$\Delta_{rT} = 1/2 \left(\Delta_{rT1} + \Delta_{rT2} \right)$$

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 Δ_{rL1} and Δ_{rL2} . The internal clearance on the left side of the bearing is Δ_{rL} :

$$\Delta_{rL} = 1/2 (\Delta_{rL1} + \Delta_{rL2})$$

Take that measurement between 2 rows of rollers of right side respectively as Δ_{rR1} and Δ_{rR2} . The internal clearance of the right side of the bearing is Δ_{rR} :

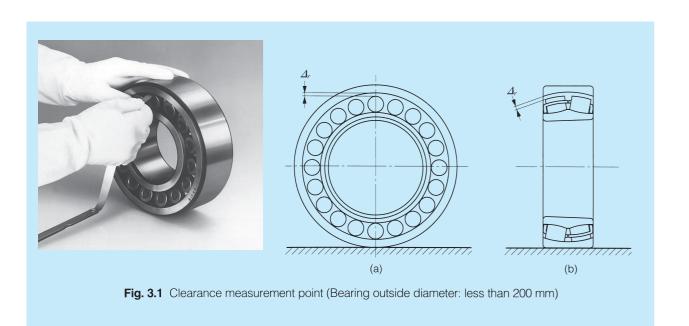
$$\Delta_{rR} = 1/2 (\Delta_{rR1} + \Delta_{rR2})$$

The internal bearing clearance (Δ_r) is given by the following equation:

$$\Delta_r = 1/2 \left(\Delta_{rT} + \Delta_{rL} + \Delta_{rR} \right)$$

3.2 Measuring Bearing Clearance When Mounted on Shaft or Sleeve

Basically, the measurement of the clearance is taken 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 but the measurement point varies slightly depending on the size of the outer ring outside diameter.

3.2.1 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 (Δ_{rS}). (**Fig. 3.3**)

3.2.2 Bearing Outside Diameter Is Larger Than

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. 3.3**) For the internal bearing clearance (Δ_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 Δ_{rS1} and Δ_{rS2} while that value measured at the exact bottom of the bearing is Δ_{rS} .

$$\Delta_{rS} = 1/2 \left(\Delta_{rS1} + \Delta_{rS2} \right)$$

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 Δ_{rL1} and Δ_{rL2} and the internal clearance of left side of bearing as Δ_{rL} .

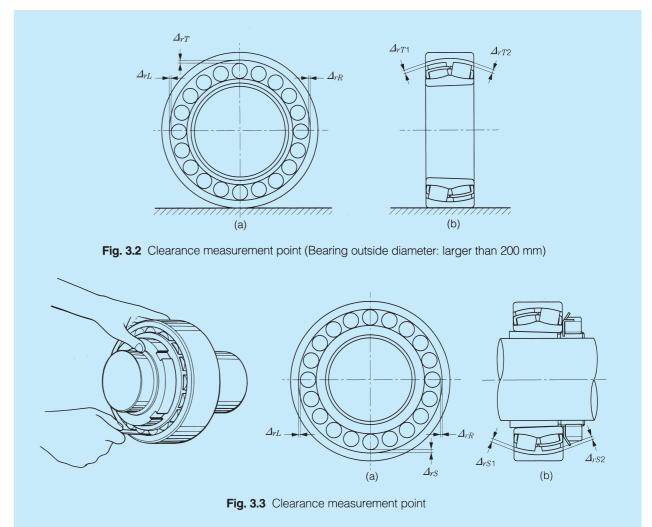
$$\Delta_{rL} = 1/2 (\Delta_{rL1} + \Delta_{rL2})$$

The internal clearances measured between 2 rows of rollers on the right side respectively as Δ_{rR1} and Δ_{rR2} . The internal clearance of right side of bearing is Δ_{rR} .

$$\Delta_{rR} = 1/2 \left(\Delta_{rR1} + \Delta_{rR2} \right)$$

The internal bearing clearance (Δ_r) is given by the following equation:

$$\Delta_r = 1/2 \left(\Delta_{rS} + \Delta_{rL} + \Delta_{rR} \right)$$



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3.3 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 without 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.

Radial internal clearance of spherical roller bearings

Table 4.1

Mounting of spherical roller bearings having tapered bore

Table 4.2

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 reduc-

 Table 4.1
 Radial internal clearances in spherical roller bearings

Units: µm

	Nominal E	Bore Dia.	Clearance in Bearings with Cylindrical Bores									Clearance in Bearings with Tapered Bores										
d (mm)		C2		CN		С3		C4		C5		C2		CN		С3		C4		C5		
ı	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	120 140	40 50	75 95	75 95	120 145	120 145	160 190	160 190	210 240	210 240	260 300	65 80	100 120	100	135 160	135 160	170 200	170 200	220 260	220	280 330
	140	160	60	110	110	170	170	220	220	280	280	350	90	130	130	180	180	230	230	300	300	380
			00							200		000		.00		.00		200		000		000
	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		1000
	500 560	560 630	150 170	280 310	280 310	440 480	440 480	600 650	600 650	780 850		1000 1100	290 320	410 460	410	540 600	540 600	680 760	680 760	870 980		1100 1230
	300	000	170	010	010	400	400	000	000	000	000	1100	020	400	400	000	000	100	100	300	300	1200
	630	710	190	350	350	530	530	700	700	920		1190	350	510	510	670	670	850		1090		
	710	800	210	390	390	580	580	770		1010			390	570	570	750	750	960		1220		1500
	800	900	230	430	430	650	650	860	860	1120	1120	1440	440	640	640	840	840	1070	1070	1370	1370	1690
	900	1000	260	480	480	710	710	930	930	1220	1220	1570	490	710	710	930	930	1190	1190	1520	1520	1860
	1000	1120	290	530	530	780	780	1020	1020	1330	_	_	530	770	770	1030	1030	1300	1300	1670	_	_
	1120	1250	320	580	580	860	860		1120		_	_	570	830	830	1120		1420			—	_
1	1250	1400	350	640	640	860	860	1240	1240	1620	_	_	620	910	910	1230	1230	1560	1560	2000	—	

tion amount to the specified value listed in the **Table 4.2** 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.

- 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
- 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

confirm that the specified value is secured.

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.

- 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

Table 4.2 Mounting of spherical roller bearings with tapered bores

Units: mm

Ŭ	ore Diameter		n in Radial		Axial Mo	ovement	Minimum Permissible Residual Clearance				
a ((mm)	Clea	rance	Taper	1 : 12	Taper	1 : 30	CNI	00	0.4	
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	1000	0.340	0.460	5.5	7.4	14.0	18.5	0.310	0.470	0.730	
1000	1120	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 ${
m CN}$ clearance.

For bearings with C3 or C4 Clearance, the maximum values listed should be used for the reduction in radial internal 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 3.2 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 5.1 Bearing mounting method

Work		inner ring ape	Shaft shape		Bearing mounting parts		Major jig tools	Working method	Describing	
VVOIK	Cylindrical Tapered bore		Cylindrical shaft	Tapered shaft	Added content	Part Added content		for handling	vvorking metriod	Section
Bearing mounting	0	0 -		Shaft with shoulder With or without spacer ring With oil duct		_	 Hammer Press Oil heating tank Bearing heater	Method to use a hammer Method to use press Method to use oil heating tank Method to use bearing heater	6.2.1 6.2.2 6.2.3 (1) 6.2.3 (2)	
	_	0		0	Shaft with shoulder With oil duct	With or without spacer ringt	_	Lock nut Hydraulic nut	Method to use lock nut Method to use hydraulic nut	6.2.6 (1) 6.2.6 (2)
	_	0	0	_	Shaft with shoulder	Adapter With or without spacer ring	With or without oil duct	· Lock nut · Hydraulic nut · O.I.P.*	Method to use lock nut Method to use hydraulic nut Oil injection method	6.2.4 (1) 6.2.4 (2) 6.2.4 (3)
	_	0	0	_	Shaft with shoulder	Removable sleeve	With or without oil duct	• Lock nut • Hydraulic nut • O.I.P.*	Method to use lock nut Method to use hydraulic nut Oil injection method	6.2.5 (1) 6.2.5 (2) 6.2.5 (3)

*O.I.P.: oil injection pump

Table 5.2 Bearing dismounting method

Work	Bearing i	nner ring ape		Shaft sha	ape	Bearing dismo	unting parts	Major jig tools	Mouling mothed	Describing
VVOIK	Cylindrical bore	Tapered bore	Cylindrical shaft	Tapered shaft	Added content	Part	Added content	for handling	Working method	Section
	0	_	0	_	Shaft with shoulder With oil duct	With or without spacer ring	_	• Special puller • Press • O.I.P.* + special puller	Method to use special puller Method to use press Oil injection method	7.2.1 7.2.4
	-	0	_	0	Shaft with shoulder With oil duct	With or without spacer ring	_			7.2.6
Bearing dismount- ing	_	0	0	_	Shaft with shoulder	Adapter With or without spacer ring	With or without oil duct	Hammer Special puller Press O.I.P.* + special puller	Method to use hammer Method to use special puller Method to use press Oil injection method	7.2.2 7.2.1 7.2.4 7.2.6
					Shaft with shoulder	Removable sleeve	With or without oil duct	• Nut • Hydraulic nut • O.I.P.** + removing nut	Method to use nut Method to use hydraulic nut Oil injection method	7.2.3 7.2.5 7.2.6

*O.I.P.: oil injection pump

5. Quick Reference for Bearing Mounting and Dismounting

Before mounting a bearing confirm that the bearing is still usable. When dismounting a bearing, confirm whether the bearing is still usable or is damabed. The bearing mounting operation is basically the method to fit bearing inner ring and shaft shape, but also there are numerous methods depending on size of bearing and shaft, and kind of mounting parts. For dismounting of a damaged bearing, there are even more methods available. Major mounting and dismounting operation methods are listed in **Tables 5.1** and **5.2**.

6. Bearing Mounting

Spherical roller bearings are mounted by combining the shaft and bearing inner ring. For example, a cylindrical shaft or tapered shaft is combined with a cylindrical bore or tapered bore bearing. Mounting is made using a suitable method. We will explain major mounting methods (**Table 5.1**).

6.1 Required Preparation for Mounting the Bearing

To mount the bearing there are diverse methods listed in **Table 5.1**. Prior to the start of the bearing mounting operation, confirm the bearing mounted condition while referring to the machine structure drawing. Select a suitable method corresponding to your particular situation. Next, prepare the work site, jigs, tools, measurement instruments necessary to do the operation. If there are no suitable jigs or tools, prepare some beforehand.

6.2 Bearing Mounting Work

There are different methods to mount the bearing, but the post-mounting treatment is the same.

After the bearing mounting is completed, always apply lubricant to the inclined outer ring as a post-mounting treatment.

- 1) Application of lubricant
 - In case of grease
 - Apply grease to all the rollers no that their surface is covered by grease, then, reset the outer ring tots original position.
 - In case of lubrication oil
 Apply lubrication oil to the surface of all the rollers, then, reset the outer ring to its original position.
- 2) After completion of lubricant application Cover the bearing with a vinyl sheet etc. to prevent adhesion of powdery dust, etc.

6.2.1 Hammer Method (Fig. 6.1)

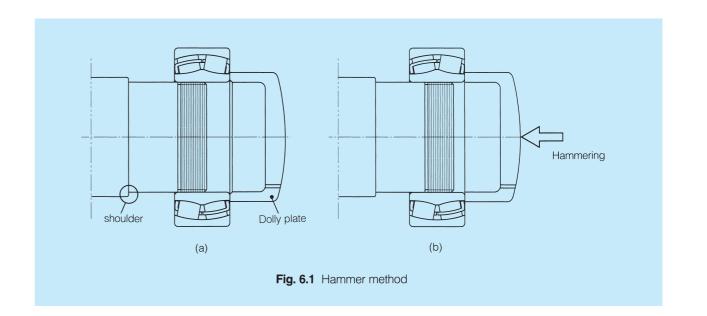
This method is used to mount small bearings when the interference of bearing with shaft is small.

Shaft shape: Cylindrical shaft
Bearing inner ring bore shape: Cylindrical bore

Procedure

- 1. Clean the surface of the shaft on which the bearing will be mounted, then, apply machine oil.
- 2. Insert the bearing onto the shaft.
- 3. After inserting the bearing, make the contact as even as possible between the chamfered part of inner ring end face of bearing and the bearing mounting place of shaft.

The aim is even contact between the flat face of the dolly plate and the end face of the inner ring on the shaft. (**Fig. 6.1** (a))



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- 4. When the flat face of the dolly plate is perpendicular to the shaft center, use a hammer to tap the top of the dolly plate on the hammering side. (Fig. 6.1 (b))
- 5. Tap with a hammer until the end face of the inner ring of the advancing direction approaches closely and touches the shoulder of the shaft.
- 6. When a lock-washer is used, insert it and mount the lock nut, then, fix it as a turning stopper.
- 7. After mounting the bearing, apply lubricant to the bearing and cover it with vinyl sheet to prevent entry of dust.

6.2.2 Press Method (Fig. 6.2 and Fig. 6.3)

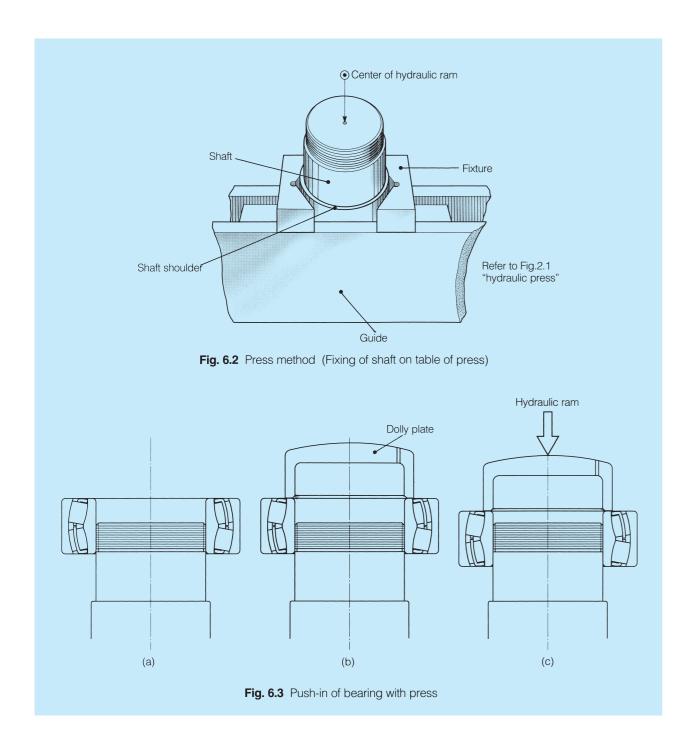
Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Cylindrical bore

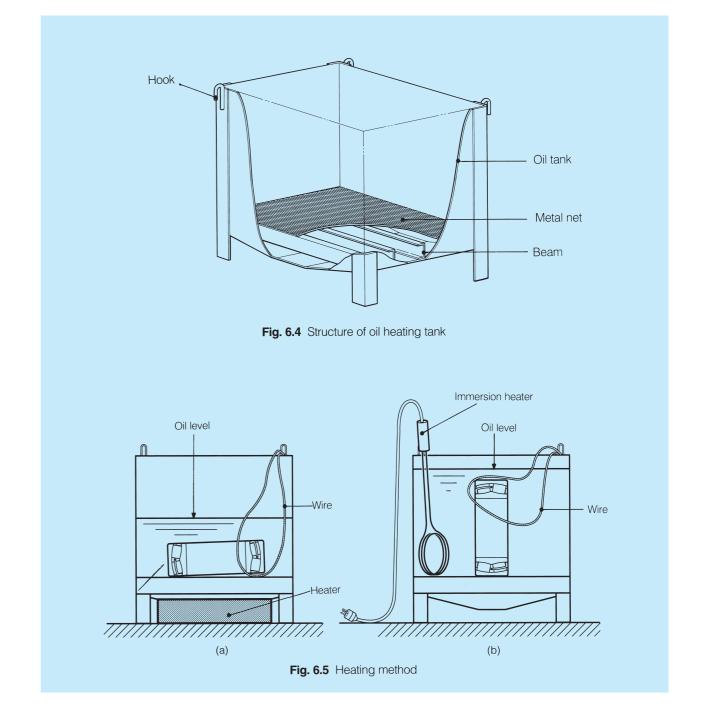
Procedure

- Set upright the shaft and place its lower end on the table of a hydraulic press so that the shaft center mates with that of the ram of hydraulic press. Adjust the height of the guide of hydraulic press and fix the shaft at the lower part of its shoulder. (Fig. 6.2)
- 2. Confirm that the moving stroke of hydraulic press ram is sufficient to push-in the bearing.

- 3. After making clean the shaft surface on which the bearing will be mounted, apply some machine oil.
- 4. Insert the bearing onto the shaft.
- 5. Insert the bearing so that the inner ring's chamfered part touches the dolly plate (Fig. 6.3 (a)) as evenly as possible in the advancing direction. The aim is to create even contact between the flat face of the dolly plate and the inner ring end face on the shaft. (Fig. 6.3 (b))
- The top part of dolly plate on the hammering should be in contact with the flat face of the hydraulic ram. At that time, confirm again that the

- center of shaft mates with the hydraulic ram.
- 6. Activate the hydraulic ram to push-in the bearing. Continue until the inner ring end face touches closely the shoulder of shaft. (**Fig. 6.3** (**c**))
- 7. When a lock-washer is used, insert it and mount the lock nut and fix it as a turning stopper. When a lock plate is used, insert it adjusting its position to the key groove of shaft with cutout on lock nut outside and fix the lock plate with washer and bolt.
- 8. After mounting the bearing, apply lubricant to the bearing and cover it with vinyl sheet to prevent entry of dust.





6.2.3 Heat Method

a) Oil heating tank method (Fig. 6.4 and Fig. 6.5 (a) (b))

Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Cylindrical bore

Procedure

- Heat the oil in the tank till 100°C to 110°C. The oil temperature shall be confirmed after sufficient agitation. (When heating the oil, do not raise the oil temperature over 120°C)
- 2. Immerse completely the bearing in the heated oil.
- 3. Keep the oil temperature in the tank to 100°C to 110°C and leave the bearing immersed till its temperature becomes the same as that of the oil.
- The time necessary for temperature of bearing to rise to 100°C to 110°C varies depending on the size of bearing but usually it takes about 30 minutes.
- Clean the surface of shaft with cleaning oil to remove dirt.
- 6. Take out the bearing from the oil tank and confirm that the bearing temperature is 100°C to 110°C. (To measure the bearing temperature, use a surface contact thermometer.) If the bearing temperature is not yet 100°C to 110°C, immerse again the bearing in the tank until it rises to 100°C to 110°C.
- 7. When the bearing temperature attains 100°C to 110°C, take the bearing out from the oil tank, while wearing heat insulating gloves. Next, insert and adjust the bearing to the center of the shaft. When inserting a bearing, if a caught feeling is felt, remove the bearing immediately and confirm the bearing temperature. If the bearing temperature is not yet 100°C to 110°C, immerse the bearing again in the oil tank until it rises to 100°C to 110°C. Then, insert and adjust the

- bearing to the center of the shaft. If insertion is forced beyond when the bearing is felt to be caught, then the bearing may get stuck on the shaft. Not only regular mounting becomes impossible but also removal becomes difficult.
- 8. After having inserted the bearing, turn the lock nut with the special wrench to mount the bearing. If the bearing temperatures lowers, increase tightening with lock nut.
- 9. If the lock plate is used as turning stopper of lock nut, adjust the key groove of shaft to the cutout of outside of lock nut, then, insert the lock-washer and fix it with the washer and bolt. If the lock-washer is used as turning stopper of lock nut:
- 1) When the bearing temperature lowers to room temperature, remove the lock nut.
- 2) Put the lock-washer's tongue into the shaft key groove and mount the lock nut.
- After adjusting the cutout on the outside of the lock nut to one tooth of the lock-washer, bend the tooth into the cutout by tapping it with chisel and hammer.
- After mounting the bearing, apply lubricant to it and cover with a vinyl sheet to prevent entry of dust.

b) Bearing heater method (Fig. 6.6)

Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Cylindrical bore

Procedure

- 1. For the heating method using a bearing heater, follow the instructions described in its Operation Manual for heating method and time.
- 2. For heating with a bearing heater too, the bearing temperature shall be within the range of 100°C to 110°C. However, the temperature to heat the bearing shall not exceed 120°C.

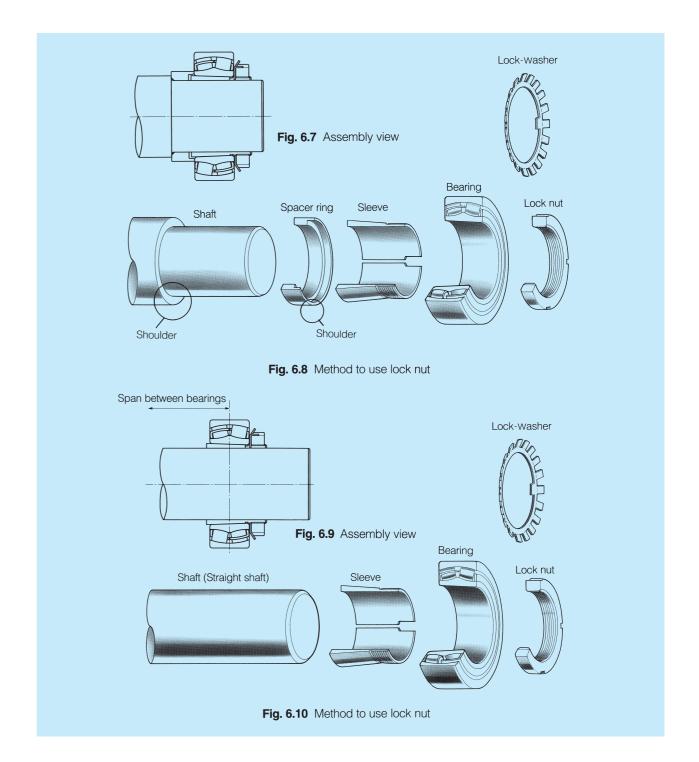


Fig. 6.6 NSK Bearing Heater

- Clean the surface of shaft with cleaning oil to remove any dirt.
- 4. When the bearing temperature attains 100°C to 110°C, while wearing heat insulating gloves, take the bearing out from the bearing heater, then, insert and adjust the bearing to the center of the shaft. When inserting the bearing, if a caught feeling is felt, remove the bearing immediately and confirm the bearing temperature. If the bearing temperature is not yet 100°C to 110°C, heat it again with the bearing heater until it rises to 100°C to 110°C and then insert and
- adjust the bearing to the center of the shaft. (If insertion is forced beyond when a caught feeling is felt, the bearing may become stuck on the shaft. Thus, not only regular mounting becomes impossible but also removal becomes difficult.)

NSK

- 5. After having inserted the bearing, turn the lock nut with the special wrench to tighten the bearing. If the bearing temperature is lower, increase the tightening of lock nut.
- 6. When the bearing temperature lowers till the room temperature, stop turning of the lock nut. If the lock plate is used as a turning stoppers of



- lock nut, adjust the key groove of shaft to the cutout on outside of lock nut, then, insert the washer and fix it with the washer and bolt. If the lock-washer is used as a turning stopper of lock nut:
- 1) After removal of the lock nut, insert the lockwasher's tongue into the key groove of shaft and mount the lock nut.
- After adjusting the cutout on the outside of lock nut to one tooth of the lock-washer, bend the tooth into the cutout by tapping it with chisel and hammer
- After mounting the bearing, apply lubricant to it and cover with vinyl sheet to prevent entry of dust

6.2.4 When an Adapter Is Used

As for shaft types, there are straight shafts without shoulder, shafts with shoulder on which a spacer ring is mounted or not mounted. As for adapter sleeves, there are sleeves with and without oil holes (oil duct).

a) Lock nut method (Fig. 6.7 to Fig. 6.10)

Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Tapered bore

Procedure

- Unpack the adapter while wearing clean thin rubber gloves. Put it upright on the surface plate and remove the lock nut mounted on the adapter.
- 2. Clean the surface of shaft with clean cleaning oil to remove dirt.
- 3. For the shaft with shoulder (**Fig. 6.7** and **Fig. 6.8**), if a spacer ring is needed, mount it.
- 4. Mount the adapter sleeve so that its thread comes to the shaft end side. When a spacer ring is needed, insert the adapter sleeve into a

bore of shoulder of spacer ring, then, mount. For straight shaft without shoulder (**Fig. 6.9** and **Fig. 6.10**), mount the adapter ring into the bearing mount span position so that its center is on top near the center of the bearing. To mount the adapter sleeve on the shaft, it is made easier by widening a little the slit of adapter sleeve by putting screw driver or chisel into the slit.

- 5. After mounting the adapter sleeve, adjust the direction of tapered bore of bearing inner ring to the taper of adapter sleeve and mount the bearing into the adapter sleeve. For a shaft with shoulder and equipped with a spacer ring, mount by letting the inner ring bore end face contact the spacer ring end face.
- 6. Mount the lock nut on the adapter sleeve. Advance the lock nut with the special wrench until it touches the bearing inner ring end face.
- 7. From the position where the lock nut touches the bearing inner ring end face, with the special wrench, turn further the lock nut and stop at once when the turning torque of special wrench increases

For a straight shaft without shoulder, back off the lock nut a little, adjust the position by moving the adapter sleeve to the bearing mounting span position so that the bearing's center comes to it. After position adjustment, turn again the lock nut, and stop at once when the special wrench's turning torque increases. (From this point in time, the clearance adjustment to secure "clearance" necessary to run the bearing starts. Follow the instructions given in Section 4 "Clearance Adjustment When Mounting Bearing on Tapered Shaft or Sleeve".)

- 8. Measure the bearing internal clearance and record the measured clearance value. (The clearance measured at that time is called "Measured initial clearance").
- Find the nominal bore and clearance symbol of the bearing being mounted, then confirm the radial internal clearance reduction amount (specified value) listed in **Table 4.2**.
- When the bearing radial internal clearance is CN clearance (normal clearance) as the specified value, then aim for the middle value between the minimum and maximum clearance reduction amount.
- When the bearing radial internal clearance is C3 or C4 as the specified value, then the maximum clearance reduction amount shall be aimed at.
- 10. Turn the lock nut, repeat the operation until the radial internal clearance varies. When the radial internal clearance value starts to vary, record the bearing internal clearance measured at that time. Here, calculate the difference between the measured initial value and this measured value. If the obtained difference is less than the speci-

- fied value, repeat this operation until the specified value is obtained.
- 11. When the specified value is obtained, prevent turn of lock nut by using either a lock-washer or lock plate. When a lock-washer is used, follow the instructions given in Section 2.3.5 3) (2) "Method to use lock-washer when mounting bearing". When a stopper for nut is used, adjust the stopper for nut so that the cutout on outside of lock nut mates with the slit of adapter sleeve and insert, then, fix the stopper for nut with the washer and bolt.
- 12. Upon accomplishment of turning prevention, measure again the bearing internal clearance to confirm that the specified value remains secured.
- 13. After mounting the bearing, apply lubricant to it and cover with vinyl sheet to prevent entry of dust.

b) Hydraulic nut method (Fig. 6.11 and Fig. 6.12)

Shaft shape: Cylindrical shaft
Bearing inner ring bore shape: Tapered bore

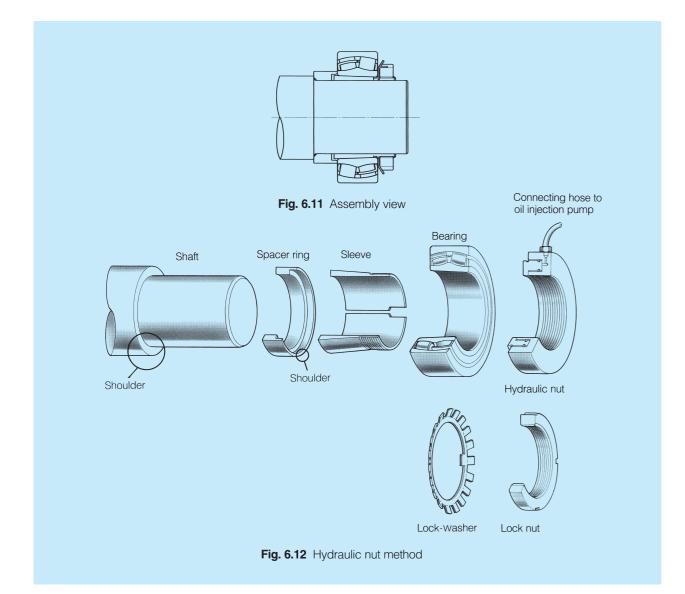
After execution of Step 1 to 5 of the Procedure in Section 6.2.4 1) Lock nut method, follow the instruction given below.

Procedure

- Mount the hydraulic nut to thread of adapter after adjusting the side face of piston side to the bearing inner ring end face. At that time, confirm that the piston is at position just prior to act.
- 7. Connect the hose of oil injection pump to the hydraulic nut.
- 8. Press down gently the oil injection pump lever to apply hydraulic oil pressure gradually. When change in the force to press the lever is felt (when an oil gauge is equipped, observe the value indicated by oil pressure gauge), stop at once the pressing and measure the bearing internal clearance ("Measured initial clearance") and record it.

(From this point in time, the clearance adjustment to secure the necessary "clearance" to run the bearing starts. Follow the instructions given in Section 4 "Clearance Adjustment When Mounting Bearing on Tapered Shaft or Sleeve".)

9. Find the nominal bore and clearance symbol of the bearing being mounted, then confirm the radial internal clearance reduction amount (specified value) listed in **Table 4.2**. When the bearing radial internal clearance is CN clearance (normal clearance) as the specified value, then aim for the middle value between the minimum and maximum clearance reduction amount. When the bearing radial internal clearance is C3 or C4 as the specified value, then aim for the



- maximum clearance reduction amount.
- 10. Press again gently the lever of oil injection pump, repeat the operation until the radial internal clearance varies. When the radial internal clearance value starts to vary, record the bearing internal clearance measured at that time, then, calculate the difference between the measured initial value and this measured value. If the obtained difference is less than the specified value, push the bearing into the sleeve with a hydraulic nut, stop at once the pump and measure the bearing internal clearance to confirm the clearance reduction amount, and repeat this operation until the specified value is obtained.

When the clearance reduction amount becomes close to its minimum or maximum value, feed

the hydraulic nut a little to obtain the specified value. Pay attention not to exceed the specified value by excessive feed of the hydraulic nut. (If the clearance reduction amount exceeds the specified value, it may cause too big an interference or too small a clearance which results in breakage of bearing inner ring and finally abnormal temperature rises or seizure may happen during bearing running.)

To measure the clearance for the confirmation of the specified value, at first drop the hydraulic oil pressure to zero, then, measure.

- 11. When the specified value is obtained, disconnect the oil injection pump hose and remove the hydraulic nut.
- 12. Mount the lock nut and fix its turning stopper.

When a lock plate is used, adjust the lock plate so that the cutout on outside of lock nut mates with the slit of adapter ring and insert, then, fix the lock plate with the washer and bolt. When a washer is used, follow the instructions given in Section 2.3.5 3) (2) Method to use washer when mounting bearing".

- 13. Upon accomplishment of turning prevention, measure again the bearing internal clearance to confirm that the specified value remains secured.
- 14. After mounting the bearing, apply lubricant to it and cover with vinyl sheet to prevent entry of dust.

c) Oil injection method (Fig. 6.13 and Fig. 6.14)

When oil hole (oil duct) is provided on adapter sleeve

> Shaft shape : Cylindrical shaft Bearing inner ring bore shape : Tapered bore

Among the adapter sleeves, there are some that have oil holes (oil duct). (**Fig. 2.3**) Their purpose is to make easier the bearing mounting/dismounting operation.

The method is to inject high pressure oil to the oil hole (oil duct) of adapter sleeve when mounting or dismounting the bearing. To execute large bearing

mounting by the above said Section 6.2.4 1) "Lock nut method", insert the bearing into the adapter sleeve mounted on the shaft and push the bearing in with the lock nut. To adjust the clearance, when turning the lock nut, it is necessary to apply a big force by a special wrench.

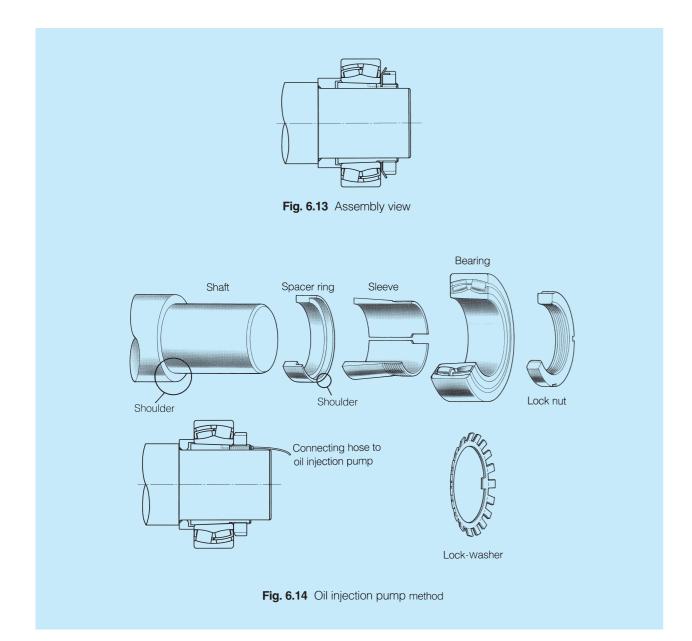
To reduce the required turning torque, high pressure oil is fed between fitted face of adapter sleeve and bearing by connection of the oil injection pump hose to the oil hole (oil duct) of the adapter sleeve in order to reduce the torque necessary to turn the lock nut by reduction of friction at the fitted face and expansion of bearing inner ring.

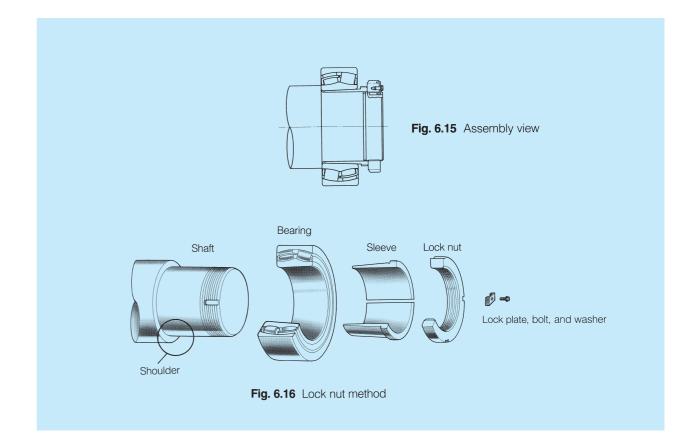
As cautions for the bearing mounting operation, it is necessary to work with a closely fitted face between adapter sleeve and bearing. The reason is to prevent reduction in the effect of the high pressure oil due to leak from the fitted face.

Procedure

After execution of Step 1 to 10 of the Procedure in Section 6.2.4 1) Lock nut method, then execute the following steps.

11. Connect the oil injection pump hose to the oil hole (oil duct) of adapter sleeve. Start the pump, at the same time turn the lock nut with the special wrench and push the bearing into the adapter sleeve.

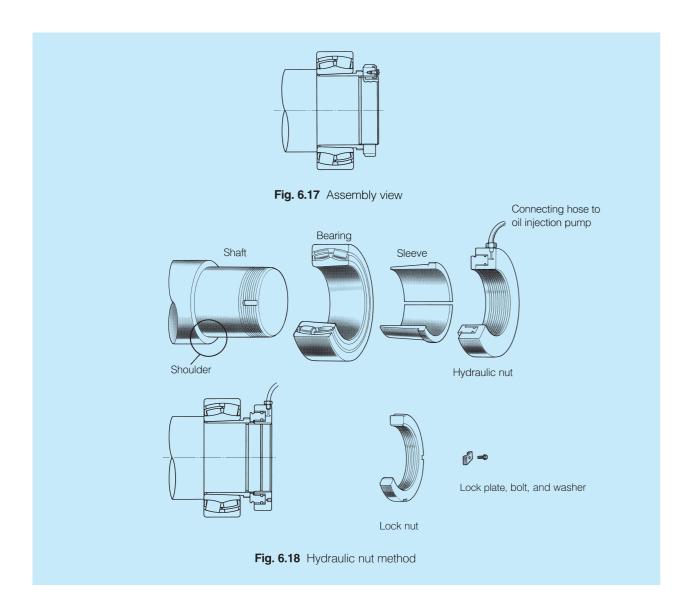




- 12. After insertion, measure the bearing internal clearance. When the radial internal clearance value varies, record that measured value and calculate the difference between the measured initial value and this value measured.
- If the obtained difference is less than the specified value, push the bearing into the sleeve by turning the lock nut with the special wrench while running the oil injection pump until the specified value is obtained. Then stop the pump and measure the bearing internal clearance to confirm the clearance reduction amount, and repeat this operation.
- As a caution for this operation, to measure the clearance for the confirmation of the specified value, at first drop the hydraulic oil pressure to zero, then, measure.
- 13. When the specified value is obtained, disconnect the oil injection pump hose from the hydraulic nut and stop turning of the lock nut.
 - When a lock plate is used.
 Adjust the lock plate so that the cutout on

- outside of the lock nut mates with the slit of adapter sleeve and insert the stopper for nut, then, fix the lock plate with the washer and bolt.
- When a lock-washer is used (For more detail, follow the instructions given in Section 2.3.5 3) (2) "Method to use lockwasher when mounting bearing".)
- Remove at once the lock nut and place the lock-washer's tongue into the slit of the shaft key way to push in, then, place the lock nut and adjust the washer's tooth into the slit on outside of lock nut and bend he tooth of washer into it to stop turning.
- 14. Upon accomplishment of turning prevention, measure again the bearing internal clearance to confirm that the specified value remains secured.
- 15. After mounting the bearing, apply lubricant to it and cover with a vinyl sheet to prevent entry of dust.

6.2.5 When Using Removable Sleeve



a) Lock nut method (Fig. 6.15 and Fig. 6.16)

Shaft shape: Cylindrical shaft
Bearing inner ring bore shape: Tapered bore

Procedure

- Unpack the removable sleeve, and while wearing clean thin rubber gloves, remove the anticorrosion oil applied onto the removable sleeve with clean cleaning oil.
- 2. Clean the surface of shaft with clean cleaning oil to remove dirt.
- 3. For the shaft with shoulder, if a spacer ring is needed, mount it.
- 4. Insert the bearing putting the larger diameter side of inner ring tapered bore to the shaft end side and push in until the inner ring end face touches the shaft shoulder or spacer ring end face.
- 5. Put the removable sleeve so that its thread comes to the shaft end side then insert it as close as possible to the bearing after adjusting it to the bearing inner ring tapered bore. When inserting the removable sleeve into the bearing, adjust the bearing side so that the top end of the removable sleeve does not hit too strongly against the bearing inner ring end face.
- 6. Mount the lock nut on the shaft and fix it to the place where the lock nut end face touches the removable sleeve end face.
- 7. Turn slowly the lock nut with a special wrench to insert the removable sleeve into the bearing. Immediately, stop the feeding of the lock nut when the special wrench's turning torque changes, and measure the bearing internal clearance ("Measured initial clearance") and record it. (From this point in time, follow the instructions in Section 4 "Clearance Adjustment When Mounting Bearing on Tapered Shaft or Sleeve".)
- 8. Find the nominal bore and clearance symbol of the bearing being mounted, then confirm the radial internal clearance reduction amount listed in **Table 4.2**.
- When the bearing radial internal clearance is CN clearance (normal clearance), aim the radial internal clearance reduction amount (specified value) for the middle value between minimum and maximum clearance reduction amount. When the bearing radial internal clearance is C3, C4, then aim the specified value for the maximum clearance reduction amount.
- 9. Turn again slowly the lock nut to push the removable sleeve into the bearing and measure the bearing clearance. Repeat this operation until the bearing clearance starts to vary. When the bearing clearance value starts to vary, record the bearing internal clearance measured at that time and calculate the difference between the measured initial value and this measured value.
- 10. If the obtained difference is less than the specified value, continue to perform clearance adjustment until the specified value is obtained.

- 11. When the specified value is obtained, prevent turning of the lock nut using either a washer or stopper for nut.
 - When a lock plate is used
 Adjust the lock plate so that the cutout on
 outside of lock nut mates with the key groove
 of shaft and insert, then, fix the lock plate with
 the washer and bolt.
 - When a washer is used (Follow the instructions given in Section 2.3.5
 3) (2) "Method to use washer when mounting bearing".)
 - Remove the lock nut, insert the washer's tongue into the shaft key groove, remount the lock nut, then, bend one tooth of the washer into the cutout on the outside of lock nut to stop turning.
- 12. Upon accomplishment of turning prevention, measure again the bearing internal clearance to confirm that the specified value remains secured.
- After mounting the bearing, apply lubricant to it and cover with vinyl sheet to prevent entry of dust.

b) Hydraulic nut method (Fig. 6.17 and Fig. 6.18)

Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Tapered bore

After execution of Steps 1 to 5 of the Procedure of the above Section 6.2.5 1) "Lock nut method" perform the following steps.

Procedure

- 6. Mount the hydraulic nut on the thread of shaft in placing the nut piston side end face to the sleeve end face. At that time, confirm that the piston is in the right position. (before operated)
- 7. Connect the oil injection pump hose to the hydraulic nut.
- 8. Press down gently the lever of oil injection pump to apply hydraulic oil pressure gradually. When there is a change in the force necessary to press the lever (when the oil gauge is equipped, observe the indicated oil pressure value), stop at once pressing and measure the bearing internal clearance ("Measured initial clearance") and record it.
 - After recognizing the nominal bore and clearance symbol of the bearing being mounted, confirm the radial internal clearance reduction amount (specified value) listed in **Table 4.2**.
- When the bearing radial internal clearance is CN clearance (normal clearance), aim the radial internal clearance reduction amount (specified value) for the range between the minimum and maximum clearance reduction amount. When the bearing radial internal clearance is C3 or C4, aim the specified value for the maximum clearance reduction amount.
- 9. Press again gently the oil injection pump lever, repeat this operation until the radial internal

clearance starts to vary.

When the radial internal clearance value starts to vary, record the bearing internal clearance measured at that time.

(From this point in time, follow the instructions of Section 4 "Clearance Adjustment When Mounting Bearing on Tapered Shaft or Sleeve".)

- Calculate the difference between the measured initial value and this measured value.
- 10. If the obtained difference is less than the specified value, repeat the clearance adjustment. When the clearance reduction amount becomes close to the specified value, feed the hydraulic nut a little to obtain the specified value. Pay attention not to exceed the specified value by excessive feed of the hydraulic nut.

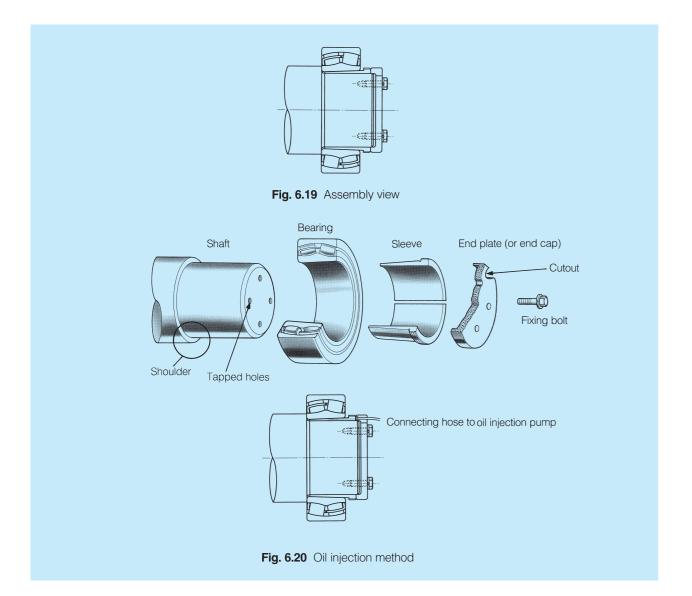
(If the clearance reduction amount exceeds the specified value, it may cause excess interference or too little clearance which results in breakage of the bearing inner ring and finally abnormal temperature rise or seizure may happen during bearing running.)

- 11. When the specified value is obtained, drop the hydraulic oil pressure to zero, then, after confirming again that the specified value remains constant, disconnect the hose of oil injection pump from the hydraulic nut and remove the lock nut.
- 12. Mount the lock nut on the thread of shaft and fix the removable sleeve, then, stop its turning.
- When a lock plate is used

 After mounting the leak put

After mounting the lock nut, insert the lock plate in the cutout on outside of lock nut and into the key groove of the shaft and fix the lock plate with the washer and bolt.

- When a lock-washer is used
- Follow the instructions given in Section 2.3.5 3) (2) "Method to use washer when mounting bearing". Insert the washer's tongue into the shaft key groove, mount the lock nut, adjust the cutout on outside of lock nut to the tooth of washer, then, bend the tooth of washer to prevent turning.
- 13. Upon accomplishment of turning prevention, measure again the bearing internal clearance to



confirm that the specified value remains constant

14. After mounting the bearing, apply lubricant to it and cover with a vinyl sheet to prevent entry of dust.

c) Oil injection method (Fig. 6.19 and Fig. 6.20)

Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Tapered bore

On the end face of the removable sleeve, an oil hole (oil duct) is provided. The purpose is to make easier bearing mounting/dismounting by injecting high pressure oil to the oil hole (oil duct) of the removable sleeve when mounting or dismounting the bearing in reducing the friction on the fitted face of the bearing and shaft and expanding the bearing inner ring by high pressure oil. As for the method, high pressure oil is fed to the oil hole of the sleeve when mounting or dismounting the bearing.

As the method to fix the removable sleeve, use either an end plate or end cap. To fix this end plate or end cap, screw bolts into the screw holes that are provided on the shaft end. Therefore, mounting of washer or stopper for nut is not necessary.

(When shaft nuts are mounted, direct mounting becomes impossible, since a lock nut covers the sleeve end face. For this reason, the use of an end plate or end cap is adopted to fix the sleeve.)

Clearance adjustment is performed by tightening mounting bolts to fix the end plate or end cap. When turning the mounting bolts, application of a big torque by the wrench is necessary.

To reduce the required turning torque, high pressure oil is fed between fitted faces of sleeve, bearing and shaft by connection of the oil injection pump hose to the oil hole (oil duct) of the removable sleeve (by reduction of friction on fitted faces and expansion of bearing inner ring with high pressure oil.)

Here we explain, as a representative example, about the removable sleeve. The side end face of the thread has an oil hole.

Procedure

Follow Steps 1 to 5 of the Procedure of the above Section 6.2.5 1) Lock nut method. Next, do the following steps.

6. To allow connection of the oil injection pump hose, adjust the cutout on external circumference of end plate or end cap to the oil hole on removable sleeve end face and mount the end plate or end cap on the shaft with fixing bolts. (If spring washers are used for fixing bolts, insert the spring washers.)

To screw fixing bolts, it is important to tighten each bolt as equally as possible. At first, tighten provisionally and evenly all the fixing bolts. And choose a bolt at random and tighten it until turning torque of wrench becomes a little heavier, then, tighten another bolt opposite to it to the

- same degree of tightness. Upon tightening accomplishment of the opposite bolt, tighten other bolts at a nearly perpendicular position or nearly opposite to the same degree of tightness.
- 7. Upon accomplishment of even tightening of all the bolts, measure the bearing internal clearance and record the "Measured initial clearance".
- Tighten again evenly all the bolts and push the removable sleeve into the bearing. Then, measure the bearing internal clearance.
 Repeat this operation until the bearing internal clearance starts to vary.
- When the bearing internal clearance starts to vary, record the clearance value measured at that time.
- 10. Connect the oil injection pump hose to the oil hole (oil duct) on the sleeve.
- 11. Find the "nominal bore and clearance symbol" of the bearing, then confirm the radial internal clearance reduction amount (specified value) listed in **Table 4.2**. When the bearing radial internal clearance is CN clearance (normal clearance) as the specified value, then aim for the middle value between the minimum and maximum clearance reduction amount.

When the bearing radial internal clearance is C3 of C4 as the specified value, then aim for the maximum clearance reduction amount. Calculate the difference between the measured initial clearance and the clearance measured in Step 9. If the obtained difference is less than the specified value, while running the oil injection pump and at the same time, turn the fixing bolts, push the bearing and into the removable sleeve and measure the bearing internal clearance until the specified value is attained.

- 12. When the specified value is obtained, reduce the oil pressure of the oil injection pump to zero and measure again the clearance to confirm that the specified value is obtained, then, disconnect the oil injection pump hose.
- 13. If fixing bolt has a hole in its head to stop turning, pass the wire through this hole to stop bolt turning.
- 14. After mounting the bearing, apply lubricant to it and cover with a vinyl sheet to prevent entry of dust.

6.2.6 When Mounting a Bearing Directly on Tapered Shaft

a) Lock nut method (Fig. 6.21 and Fig. 6.22)

Shaft shape: Tapered shaft (including the case where the oil hole (oil

duct) is provided on the shaft)
Bearing inner ring bore shape: Tapered bore

Procedure

- 1. Clean the surface of shaft with clean cleaning oil to remove dirt.
- 2. Insert the bearing while adjusting its inner ring bore taper to the shaft and mount it so that the

bearing is placed as close as possible against the shaft

(For shaft having shoulder and when it requires a spacer, at first mount the bearing without inserting the spacer.)

- 3. Mount the lock nut to the position where it touches the bearing inner ring end face.
- 4. Turn the lock nut with the special wrench, when increase in turning torque is felt, measure the bearing internal clearance and record the measured initial clearance. Turn again the special wrench then measure the bearing internal clearance.

Repeat this operation until the measured initial clearance value starts to vary. When a change in clearance appears, measure that value and calculate the difference between the measured initial clearance value and that value measured. Read the corresponding bearing clearance reduction amount (specified value) from **Table 4** 2

If the corresponding bearing clearance reduction amount is not yet attained, turn further the lock nut and repeat the clearance adjustment until the specified value is obtained.

- 5. When the specified value is obtained
- (a) In case of no spacer ring (Fig. 6.21 and Fig. 6.22)
 - To use stopper for nut as a turning stopper Adjust the cutout on outside of lock nut to the key groove of shaft. Insert the stopper for nut to this position and fix it with the washer and bolt.

 To use the washer as turning stopper of lock nut (For more detail, follow the instructions given in Section 2.3.5 3) (2) "Method to use washer when mounting bearing".)

Remove the lock nut temporarily, and place the washer's tongue into the slit of the shaft key way to push in, then place the lock nut and adjust the washer's tooth into the slit on outside of lock nut and bend the tooth of washer into it to stop turning. Measure the bearing internal clearance and confirm the specified value.

After mounting of the bearing, apply lubricant to it and cover with a vinyl sheet to prevent entry of dust

(b) When a spacer ring is used (Fig. 6.23 and Fig. 6.24)

Measure the distance (L_0) between the end face of shaft shoulder and bearing inner ring end face at each position on the circumference which is equally divided into 8 pitches. Next, calculate the mathematical mean value of the measured dimensions. Now, measure the width of the spacer ring at each of the same eight equalpitch positions. Next, calculate the mathematical mean value of the spacer ring width. And compare the mathematical mean value of the above distance and that of spacer ring width. If the mathematical mean value of the measured spacer ring width is the same as that of the distance between the end face of shaft shoulder and bearing inner ring end face, use them as they are. If the mathematical mean value of

Fig. 6.21 Assembly view (without spacer ring)

Rearing

Lock-washer

Lock nut

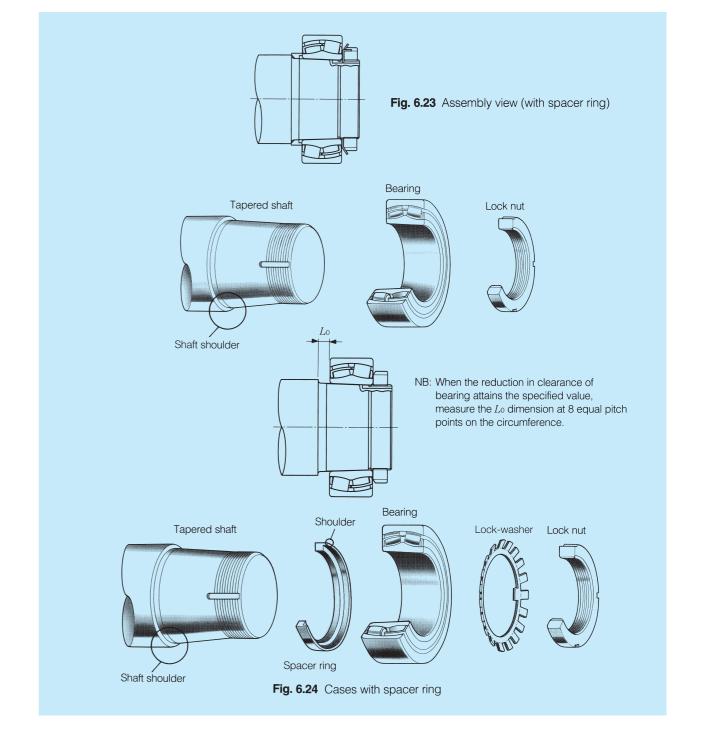
Key way

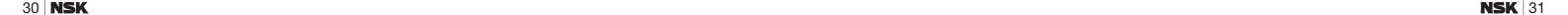
Fig. 6.22 Method to use lock nut

measured spacer ring width is larger than that of distance between the end face of shaft shoulder and the bearing inner ring end face, at first machine the spacer ring to reduce its width till attaining the mean value, then, use the machined spacer ring. If the mathematical mean value of the measured spacer ring width is smaller than that of distance between the end face of shaft shoulder and bearing inner ring end face, such a spacer ring cannot be used. Prepare a new spacer ring with a size that is equal to the mean value of the distance.

- After confirming the status of the spacer ring, perform the following steps.
- 6. Remove the lock nut.
- 7. After removal of the bearing, mount the spacer ring.
- 8. Here, perform the following operation regarding the method to stop turning of the lock nut.
- When using a lock plate

Mount the bearing, lock nut. Fix securely the bearing with the lock nut. At that time, adjust the cutout on lock nut outside to the key groove of shaft. Insert the lock plate to that





position and fix it with the washer and bolt.

When using a lock-washer

Mount the bearing, washer and lock nut. Insert the washer tongue into the key groove of shaft and mount the lock nut. At that time adjust the cutout on lock nut outside to any one of teeth of washer.

Bend the tooth of washer into the cutout on lock nut outside to stop turning of lock nut.

After mounting of the bearing, apply lubricant to it and cover with a vinyl sheet to prevent entry of dust.

b) Hydraulic nut method (Fig. 6.25 and Fig. 6.26)

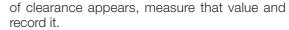
Shaft shape: Tapered shaft

(including the case where oil hole (oil duct) is provided on the shaft)

Bearing inner ring bore shape: Tapered bore

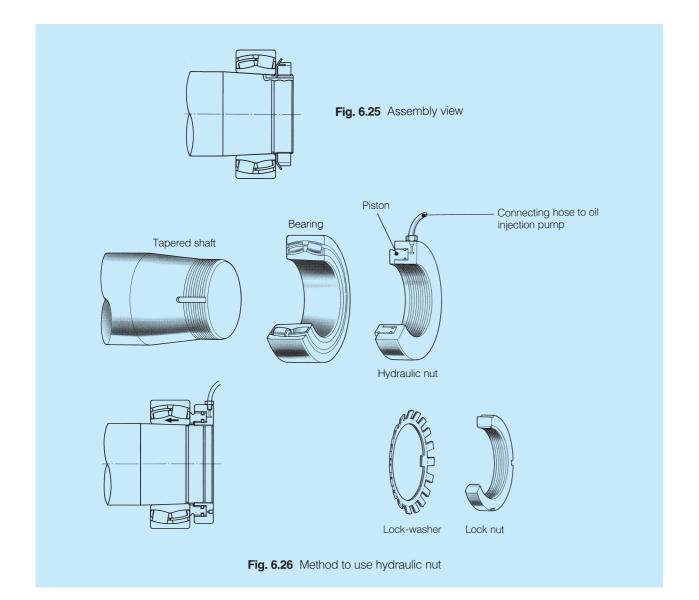
Procedure

- Clean the surface of shaft with clean cleaning oil to remove dirt.
- 2. Insert the bearing while adjusting its inner ring bore taper to the shaft and mount it so that the bearing is placed as close as possible against the shaft.
- 3. Mount the hydraulic nut to the thread of shaft so that its piston side contacts the bearing inner ring end face.
- 4. Connect the hose of the oil injection pump to the hydraulic nut.
- 5. Start the oil injection pump, and when a change in the force necessary to press the pump lever is felt (when the hydraulic oil pressure rises), stop it at once, and measure the bearing internal clearance ("Measured initial clearance") then, record it.
- 6. Repeat this operation until the measured initial clearance value starts to vary. When change



- 7. Calculate this difference between the measured initial clearance value and this measured value. Then, confirm the corresponding reduction in clearance (specified value) referring to **Table 4.2**.
- 8. Repeat this operation until the specified value is obtained.
- 9. When the specified value is obtained, stop the oil injection pump to reduce hydraulic oil pressure to zero and confirm again that the clearance is at the specified value.
- 10. Disconnect oil injection pump hose, then, remove the hydraulic nut.
- 11. Mount the lock nut and stop its turning.
- When using a lock plate as a turning stopper of a lock nut

- Mount the lock nut and tighten the bearing with a lock nut. At that time adjust the cutout on outside of lock nut to the key groove of shaft. Insert the stopper for nut to this position and fix it with the washer and bolt.
- When using a lock-washer as a turning stopper of lock nut
 Insert the washer's tongue into the shaft key groove and mount the bearing with the lock nut. At that time, adjust the cutout on outside of lock nut to any one of teeth of washer.
 Bend the tooth of washer into the cutout on outside of lock nut in order to stop its turning.
- 12. After mounting of the bearing, apply lubricant to it and cover with a vinyl sheet to prevent entry of



7. Dismounting the Bearing

7.1 Procedure for Bearing Dismounting

The bearing dismounting operation is basically the reversed sequence of the mounting operation.

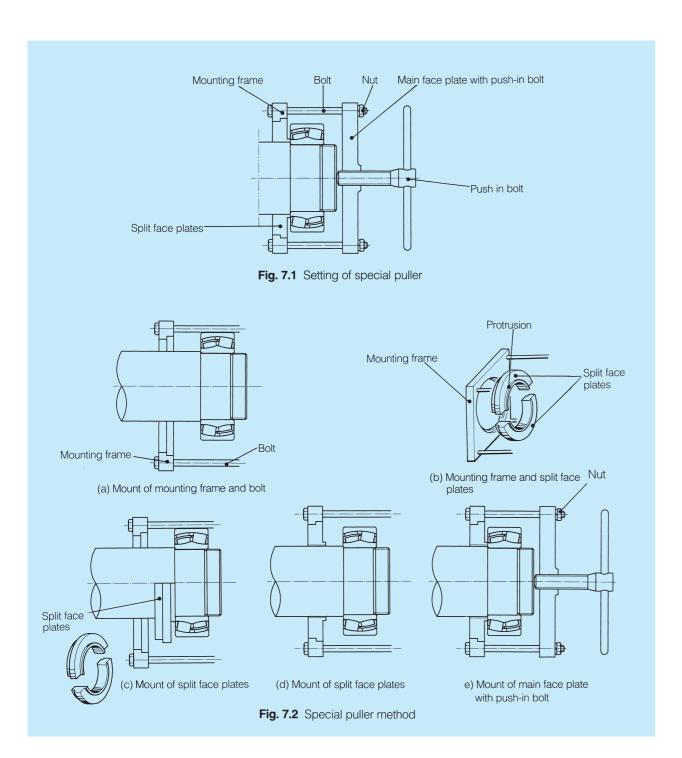
But compared to the mounting operation, due to changes that occur in the used bearing as a fitted part, a much bigger force is required to dismount it. For this reason, it is very important to examine beforehand the procedure and to prepare the necessary jigs and tools. It is also important to ask the machine manufacturer for advice on how to dis-

mount the bearing from the machine.

As for the bearing dismounting operation, the dismount starts from the respective state listed in **Table 5.2** "Bearing mounting operation" of Section 5 "Quick Reference for Bearing Mounting/Dismounting Operation Method".

(a) Shaft shape: Cylindrical shaft
Bearing inner ring bore shape: Cylindrical bore

(b) Shaft shape: Cylindrical shaft using sleeve (adapter, removable)
Bearing inner ring bore shape: Tapered bore



(c) Shaft shape: Tapered shaft
Bearing inner ring bore shape: Tapered bore

Comfirm the state of the bearing to be dismounted. Prepare the necessary jigs and tools. When ready, start the dismounting operation.

7.2 How to Disassemble the Bearing

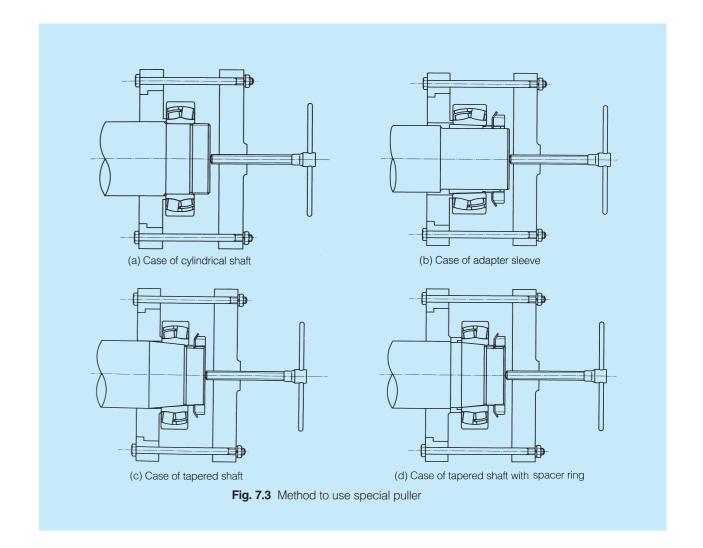
For the method using the commonly used special puller (**Fig. 7.1**) among the dismounting jigs and tools, refer to **Fig. 7.2**. The structure of the special puller consists of * main face plate with push-in bolt, split face plates, mounting frame and 4 bolts and nuts as shown in the said Figure.

(* Sometimes the hydraulic jack driving force is used after mounting the hydraulic jack between the shaft and main face plate instead of using a push-in bolt.)

The basic procedure is as follows:

- Insert the mounting frame after fixing 4 bolts to the back side of bearing (opposite side of shaft end).
 - (To do so, the diameter of the part on which split face plates are mounted shall be larger than the

- outside diameter of the bearing to be dismounted.) (Fig. 7.2 (a))
- 2. Mount each split face plate between mounting frame and bearing. At first apply the end face of protruded part on bore of split face plates to the bearing inner ring end face, connect the shaft with 2 split face plates. (Fig. 7.2 (b), (c)) For the bearing mounted with spacer ring, place the protruded part's end face on the split face plate's bore against the spacer ring end face that is opposite to the shaft end side, and connect the shaft with the 2-split face plates.
- 3. Mount the split face plates on the mounting frame. (Fig. 7.2 (d))
- 4. Pass 4 bolts through the main face plate and mount nuts. (**Fig. 7.2** (e))
- 5. Set the push-in bolt of main face plate to the center of shaft, and turn gently the 4 nuts so that the main face plate becomes parallel with the mounting frame. (**Fig. 7.2** (e))
- 6. Turn the push-in bolt. When a big change in the turning torque is felt, the bearing starts to move, continue the operation to remove the bearing. (When the bearing is removed from the shaft, split face plates may fall, so pay attention to



- avoid this problem.)
- Remove the special puller and remove the bearing.
- Clean the surface of shaft from which the bearing is removed to remove dirt and apply anticorrosion oil to it.

7.2.1 How to Use the Special Puller (Fig. 7.3)

When the bearing mounted condition is as follows, a method using a special puller is adopted.

- (a) Shaft shape: Cylindrical shaft
 Bearing inner ring bore shape: Cylindrical bore
- (b) Shaft shape: Cylindrical shaft using an adapter sleeve Bearing inner ring bore shape: Tapered bore
- (c) Shaft shape: Tapered shaft
 Bearing inner ring bore shape: Tapered bore

In the above cases, start the operation after having removed the turning stopper for the shaft lock nut and adapter sleeve lock nut to allow loosening of the lock nut.

In case of (a)

After removal of the lock nut, mount the special puller, then, turn the push-in bolt to dismount the bearing.

(Remarks: For big bearings, the main plate without a push-in bolt is used. Instead, mount a hydraulic jack between the main face plate and bearing, operate it to dismount the bearing.)

In case of (b) or (c)

After loosening the lock nut of shaft or that of adapter sleeve, return till 1/2 long of thread of shaft or adapter sleeve.

(This step is to prevent the bearing falling off from the shaft when it is pulled out by the special puller)

Then, mount the special puller, turn the pushin bolt to separate the bearing inner ring from the adapter sleeve or from the shaft. After complete separation is confirmed, remove the special puller. Remove the lock nut of shaft or that of adapter sleeve, then remove the bearing. The remaining adapter sleeve shall be removed after widening the slit with a screw driver, etc.

Also, after cleaning the lock nut, adapter sleeve and shaft, be sure to apply an anticorrosive agent.

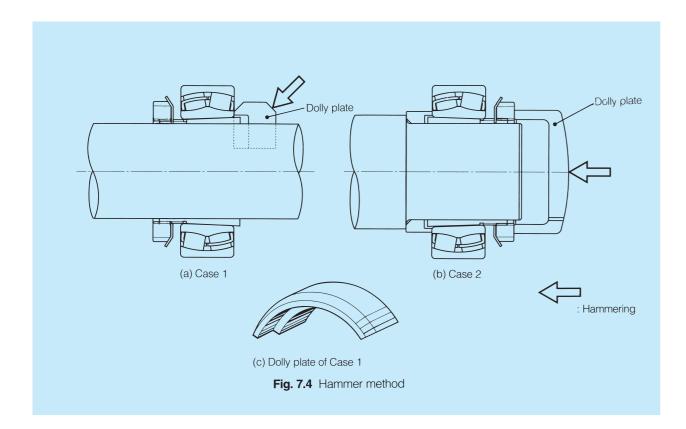
7.2.2 Hammer Method (Fig. 7.4)

When the bearing mounted condition is as follows, a method that uses a hammer is adopted.

Shaft shape: Cylindrical shaft using adapter sleeve

Bearing inner ring bore shape: Tapered bore

This method applies a guide jig called a "dolly plate" to the end face of the larger bore diameter side of the bearing inner ring. Next, you hammer this dolly plate with a hammer to remove the bearing. This method is used for small bearings which have an inner ring bore that is smaller than 80 mm. It is recommended to use a dolly plate having an appropriate shape and size in the hammering operation.



When a dolly plate is used, put it on the side face of the larger bore diameter side of the bearing inner ring, then, hammer it.

It is most important that the dolly plate have a shape that ensures a close contact with the bearing side face even when it is hammered.

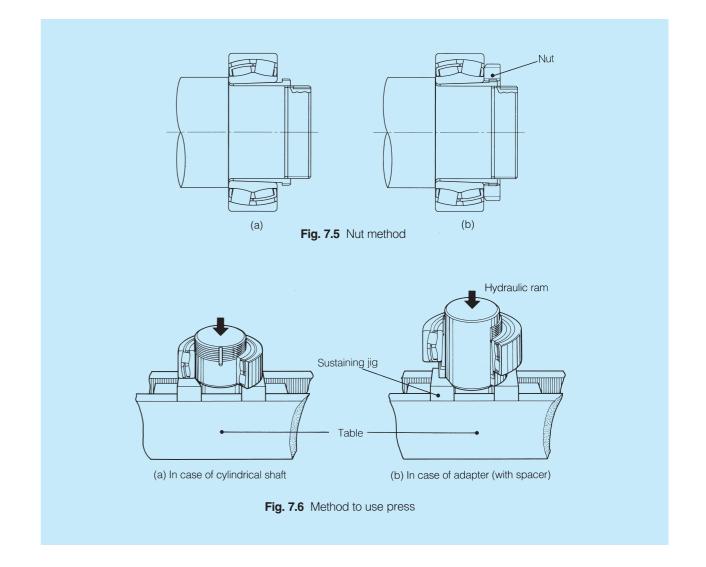
Procedure (Case 1: In case of straight shaft **Fig. 7.4** (a))

- 1. Remove the turning stopper of adapter sleeve lock nut and loosen once the lock nut till about one half of thread length of adapter sleeve, then, return a little.
- 2. Put the dolly plate on the end face of the bearing inner ring of the larger bore diameter side so that it is on the outside diameter of the adapter sleeve.
- 3. Hold the dolly plate by hand and contact it closely to the larger diameter side end face of bearing inner ring, then, hammer the dolly plate.
- 4. Even when no movement is observed on the bearing, at first hammer the dolly plate along the circumference of bearing inner ring while chang-

- ing position of the dolly plate.
- 5. When hammering the circumference of bearing inner ring by one turn, increase hammering force and continue it in the same way.
- 6. After the displacement of bearing is confirmed, remove the lock nut and remove the bearing completely.
- 7. Remove the retaining adapter sleeve after widening its slit slightly by inserting a flat-head screw driver or the like.
- 8. After cleaning the lock nut, adapter sleeve and shaft, apply an anticorrosive agent.

Procedure (Case 2: When spacer ring is used **Fig. 7.4** (b))

- 1. Remove the turning stopper of the adapter sleeve lock nut and loosen the lock nut till about 1/2 of thread length of adapter sleeve, then, back it off a little.
- 2. Put the dolly plate on the seat face of the lock nut.
- 3. Hammer the center of the dolly plate to move the lock nut together with the adapter sleeve.



- When the adapter sleeve starts to move together with the lock nut, hammer the dolly plate until the adapter ring touches the spacer ring.
- 5. Remove the lock nut and washer, then, remove the bearing.
- 6. Remove the retaining adapter sleeve after widening the slit slightly by inserting a flat-head screw driver. Finally remove the spacer ring.
- 7. After cleaning the lock nut, adapter sleeve and shaft, apply an anticorrosive agent.

7.2.3 Nut Method (Fig. 7.5)

The nut method is adopted when the bearing to be mounted is as follows:

Shaft shape: Cylindrical shaft using a removable sleeve

Bearing inner ring bore shape: Tapered bore

Procedure

- 1. Remove the turning stopper from the lock nut and remove the lock nut.
- 2. Mount the nut on the thread of the removable sleeve and advance it until it touches the bearing inner ring end face.
- 3. Turn the nut with a special wrench. When the turning torque of the wrench increases, then the movement of the removable sleeve starts. After a while, the turning torque of the wrench decreases.
 - Confirm the separation of the bearing from the removable sleeve.
- 4. Remove the removable sleeve and remove the bearing.
- 5. Remove the lock nut, removable sleeve, shaft and nut. Clean them and apply an anticorrosive agent.

7.2.4 Press Method (Fig. 7.6)

This method uses a press (hydraulic press, mechanical press, etc) instead of a special puller. As an example of a press (hydraulic press), see the photo in Subsection 2.1.1. of Section 2 "Bearing Handling Precautions". The basis of this method is to put a sustainer underneath the lower part of the bearing to sustain it on the table and then press the shaft side with the hydraulic ram in order to remove the bearing. Therefore, the shaft side is in a hung state when the bearing is held by the sustaining jig on the press table. At that time, secure space for the press pushing stroke between the lower side of hung shaft end and the press base.

Cautions when using a press

At first, check the shaft length on which bearing is to be mounted, because the distance between the table and the base of the press determines whether this method is a possible option.

To mount an integrated assembly of shaft with bearing, perform following operations:

- (a) Mount correctly the bearing mounted part on the press table. To accomplish it, use an appropriate sustaining jig.
- (b) Mount the integrated unit so that the shaft center mates exactly with the ram center.
- (c) Make necessary arrangement beforehand to prevent shaft damage by dropping. For example, it could fall off when the bearing is separated from the shaft.

When the bearing mounted condition is as follows, the press method can be adopted.

- (a) Shaft shape: Cylindrical shaft
 Bearing inner ring bore shape: Cylindrical bore
- (b) Shaft shape: Cylindrical shaft using adapter sleeve

Bearing inner ring bore shape: Tapered bore

(c) Shaft shape: Tapered shaft

Bearing inner ring bore shape: Tapered bore

For case (a) Procedure

- Remove the turning stopper from the lock nut and loosen the lock nut, then, set the integrated assembly of shaft and bearing on the hydraulic press table. At that time, arrange so that the upper face of hydraulic press table comes underneath the bearing to be dismounted.
- 2. Insert the sustaining jig under the bearing.
- 3. After the integrated assembly of shaft and bearing are set up and hang down from the hydraulic press table onto the sustaining jig, adjust so that the shaft center mates with the ram center of hydraulic press by moving the sustaining jig. Also, secure the space for the press pushing stroke between the hung shaft end and the press base.
- 4. After confirming that the bearing sustaining jig touches the bearing inner ring end face closely, fix the bearing sustaining jig.
- 5. After removal of the lock nut, activate the hydraulic ram to push the shaft. After a while, when the shaft starts to move slowly, the shaft separates from the bearing. After removal of the bearing from the shaft, remove the shaft from the press.
- After cleaning the lock nut and shaft, apply anticorrosion treatment.

Case (b) or (c) Procedure

- Remove the turning stopper from the lock nut of shaft or that of adapter sleeve and return it till about one half of thread length of shaft or adapter sleeve.
- 2. Mount the integrated assembly of shaft and bearing on the hydraulic press table. At that time, arrange so that the upper face of the hydraulic press table comes underneath the bearing to be removed.

- Insert the sustaining jig under the bearing, when the spacer ring is used, insert the sustaining jig under it.
- 4. After the integrated assembly of shaft and bearing are set up and hang from the hydraulic press table on the sustaining jig, adjust so that the shaft center mates with the ram center of hydraulic press by moving the sustaining jig. And secure space for the press pushing stroke betwenn the hung shaft end and the press base.
- 5. After confirming that the bearing sustaining jig touches the bearing inner ring end face closely, fix the bearing sustaining jig.
- 6. Activate the hydraulic ram to push the shaft. After a while, the shaft starts to move slowly, the shaft separates from the bearing. At that time when the shaft falls down as the lock nut is loosened, never touch the shaft or bearing while the press is working.
- 7. Remove the lock nut of shaft or that of adapter sleeve, then, remove the bearing from the shaft.
- 8. Remove the shaft from the press.
- 9. Remove the retaining sleeve after widening its slit slightly with a flat-head screw driver. If a spacer ring is used, remove it.

10. After cleaning the lock nut, adapter sleeve, spacer ring and shaft, apply an anticorrosive agent.

7.2.5 Hydraulic Nut Method (Fig. 7.7)

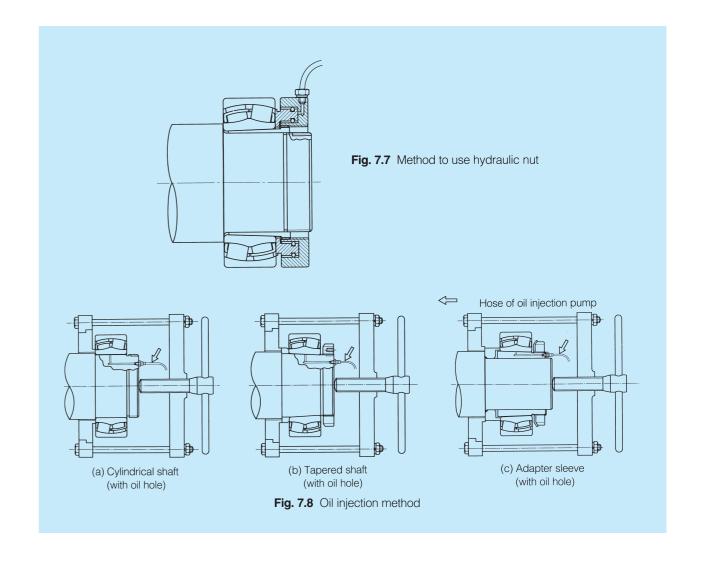
When the bearing mounted condition is as follows, the method to use hydraulic nut is adopted

Shaft shape: Cylindrical shaft using removable

Bearing inner ring bore shape: Tapered bore

Procedure

- 1. Remove the turning stopper from the lock nut and remove the lock nut.
- 2. Mount a hydraulic nut having a matching size with the thread of removable sleeve. At that time, confirm that the piston of hydraulic nut is at the position just prior to action. Mount it in with the piston side facing the bearing side, then, adjust the position so that the hydraulic nut piston end face touches the bearing inner ring end face.
- 3. Connect the hose of the oil injection pump to the hydraulic nut.



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- 4. Start the oil injection pump. The piston end face of hydraulic nut starts to protrude to push the bearing inner ring end face. Then, a pop sound is produced when the bearing is separated from the removable sleeve.
- 5. After confirming that the bearing is separated from the removable sleeve, remove the injection oil pump hose and remove the hydraulic nut.
- 6. Remove the removable sleeve and remove the bearing.
- 7. After cleaning the lock nut, removable sleeve and shaft, apply an anticorrosive agent.

7.2.6 Oil Injection Method (Fig. 7.8)

When the bearing mounted condition is as follows, the method that uses an oil injection pump can be adopted.

- (1) When the oil hole (oil duct) is provided on the shaft
- (a) Shaft shape: Cylindrical shaft
 Bearing inner ring bore shape: Cylindrical bore
- (b) Shaft shape: Tapered shaft
 Bearing inner ring bore shape: Tapered bore

Procedure

- Remove the turning stopper from the lock nut and remove the lock nut in case of the cylindrical shaft. (Fig. 7.8 (a)) In case of the tapered shaft (Fig. 7.8 (b)), return the nut until about 1/2 of thread length of lock nut mounting thread.
- 2. Mount the special puller. At that time, secure space around the shaft end to allow connection of oil injection pump hose to the oil hole of shaft.
- 3. Turn the push-in bolt, continue to turn until its turning torque increases.
- 4. Connect the hose of oil injection pump to the oil hole of shaft and make ready the pump for action
- 5. Turn the push-in bolt until reaching a state where the turning torque constantly increases, then start the oil injection pump. After a while, either a sound is heard or hydraulic oil of pump starts to ooze out from the fitted part of shaft and bearing. When the state becomes such, turn the push-in bolt of the special puller and separate the bearing from the shaft. During this operation, let the pump continue to work. Prepare for the possibility of hydraulic oil oozing out from the fitted part of shaft and bearing, by placing an oil pan underneath to catch any dripping oil. (If hydraulic oil drops directly on the floor, it may create a safety hazard.)
- 6. In case of the cylindrical shaft, after removal of the hose of oil injection pump and special puller, remove the bearing. In case of the tapered shaft, after removal of the oil injection pump hose and special puller, remove the lock nut, then, remove the bearing.
- 7. After cleaning the lock nut and shaft, apply an anticorrosion treatment.

(2) When the oil hole (oil duct) is provided on the adapter sleeve

Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Tapered bore

In the case of an adapter sleeve (**Fig. 7.8** (**c**)), a special puller can be used jointly. Basically, perform the procedure of Section 7.2.1. "Special puller method" but with the only differences being the connection and action of the oil injection pump.

The operation shall be performed by turning the push-in bolt of the special puller while letting the pump run.

Procedure

- After removal of the turning stopper from lock nut, back it off about 1/2 of the lock nut thread length. (This is to prevent dropping of the bearing when it is pulled out by a special puller from the shaft.)
- 2. Then, mount the special puller and turn the push-in bolt until an increase in the turning torque is felt.
- 3. Connect the oil injection pump hose to the oil hole of the adapter sleeve, and prepare the pump for action.
- 4. Turn the push-in bolt until reaching a state where the turning torque constantly increases, then start the oil injection pump. After a while, either a sound is heard or the hydraulic oil of the pump starts to ooze out from the fitted part of shaft and bearing. When the state becomes such, turn the push-in bolt of the special puller and separate the bearing from the shaft. During this operation, let the pump continue to run.
 - Since hydraulic oil might ooze out from the fitted part of shaft and bearing, place an oil pan to catch any dripping oil. (If hydraulic oil drops directly on the floor, it creates a safety hazard.)
- 5. When the bearing becomes movable, confirm that the bearing inner ring is completely separated from he adapter sleeve.
- 6. Remove the hose of the oil injection pump and remove the special puller.
- 7. After removal of the lock nut and bearing, remove the adapter sleeve.
- 8. After cleaning the lock nut, adapter sleeve and shaft, apply anticorrosive agent.
- (3) When the oil hole (oil duct) is provided on the removable sleeve.

Shaft shape: Cylindrical shaft Bearing inner ring bore shape: Tapered bore

Mount a nut on the removable sleeve to remove the bearing. Basically, perform the procedure of Section 7.2.3. "Nut method", with the only difference being the connection of the oil injection pump hose to the sleeve. When performing this operation, turn the nut mounted on the removable sleeve while letting the pump run.

Procedure

- After removal of the mounting bolts, remove the end cap or end plate.
- 2. Mount the nut to the removable sleeve and turn the nut until its turning torque increases.
- 3. Connect the oil injection pump hose to the oil hole of the adapter sleeve, and make ready the pump for action.
- 4. Turn the nut and when the turning torque increases, start the oil injection pump. After a while, either a sound is heard or hydraulic oil of the pump starts to ooze out from the fitted section between the shaft and bearing. When such a state is achieved, turn the nut and separate the bearing from the shaft.
- During this operation, let the pump continue to work. When the hydraulic oil oozes out from the fitted section between the shaft and bearing, place an oil pan to catch any dripping oil. (If hydraulic oil drips directly on the floor, it creates a safety hazard.)
- 5. When the bearing becomes movable, confirm that the bearing inner ring is completely separated from the removable sleeve.
- 6. Remove the oil injection pump hose, then, remove the nut and removable sleeve.
- 7. Remove the bearing. When the spacer ring is used, remove it.
- Clean the nut, removable sleeve, spacer ring, shaft and end cap or end plate and its mounting holts

Next, apply an anticorrosive agent.

8. Checking of Shaft and Housing

8.1 Checking of Shaft

8.1.1 Cylindrical Shaft

- (1) Dimensional check of shaft
 - Measure the shaft size at the place where the bearing will be mounted to confirm that the bearing size is correct. The measurement positions are shown in **Fig. 8.1**. Use an outside micrometer.
- (2) Observation of the shaft outside surface Observe the surface of shaft where the bearing was mounted to check whether there are scratches, dents, rust or stepped wearing.
 - When there are scratches, dents
 Round edge with oil stone and/or sand paper
 to smoothen the surface.

- When there is rust Remove rust with oil stone and/or sand paper to smoothen the surface.
- When there is stepped wearing
 After the dimensional measurement of the shaft, decide whether correction is possible.
- (3) Anticorrosive agent
 After completion of check, apply an anticorrosive

8.1.2 Tapered Shaft

- (1) Check of shaft shape
 - Measure the shape of shaft where the bearing will be mounted to confirm that its shape is correct.

The measurement positions are shown in **Fig. 8.2**. As for the measurement instrument, use a taper gauge (sine bar system). (**Fig. 2.2** and **Fig. 8.2**)

- (2) Observation of the shaft outside surface Observe the shaft surface where the bearing was mounted to check whether there are scratches, dents, rust or stepped wearing.
 - When there are scratches, dents
 Round edge with oil stone and/or sand paper
 to smoothen the surface.
 - When there is rust Remove rust with oil stone and/or sand paper to smoothen the surface.

(In this case if the zone to be corrected is wide, it is necessary to inspect the shape of the tapered part by using a taper gauge. The inspection method is: apply a thin coat of bluing over the entire surface of taper gauge bore face, insert it slowly after adjusting the taper gauge to the shaft center tapered shaft, then, do a run-in by moving back-and-forth. Then, pull the taper gauge out slowly when adjusting

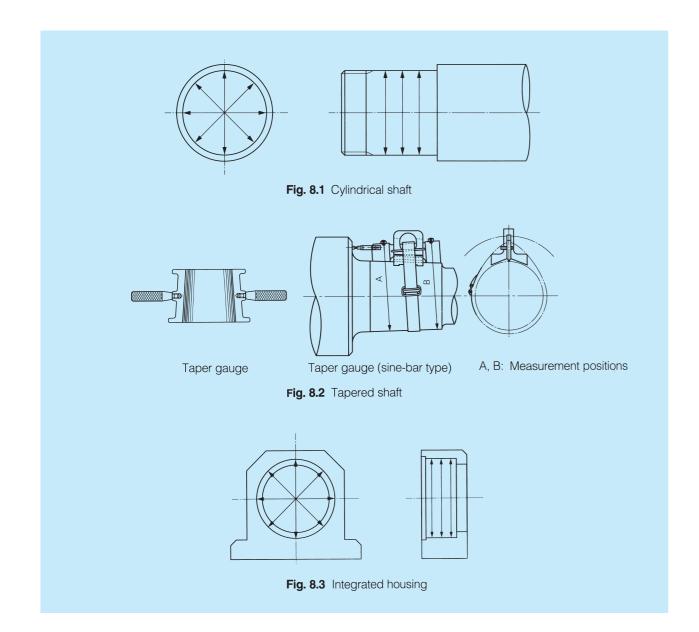
- to the shaft center. Observe where blue dye is attached to the surface of tapered shaft. If the blue ares is bigger than 80%, the shaft may be reused. When using a taper gauge (sine-bar type), follow the instructions given in the Operation Manual issued by the manufacturer).
- When there is stepped wearing
 After the dimensional measurement of the shaft, decide whether correction is possible.
- (3) Anticorrosive agent

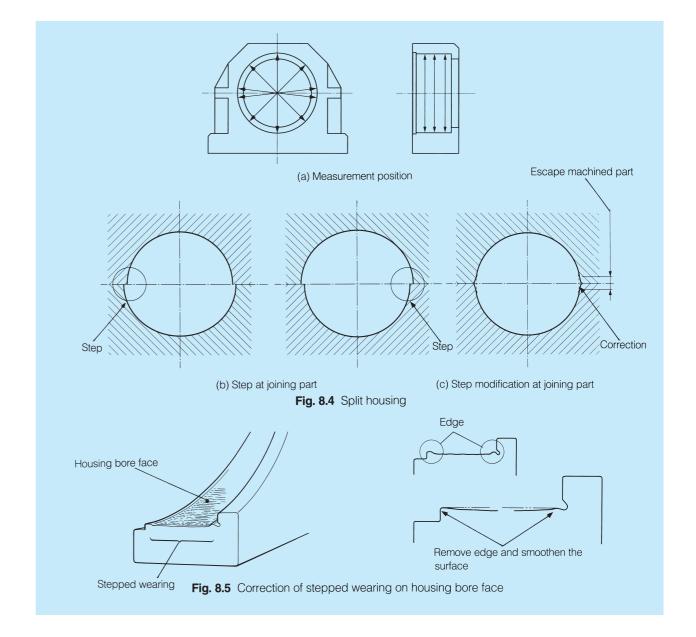
After completion of check, apply an anticorrosive agent.

8.2 Checking of Housing

8.2.1 Integrated Type Housing

- (1) Check of bore size of housing
- Measure the housing bore size where the bearing will be mounted to confirm that the size is





correct.

The measurement position is shown in **Fig. 8.3**. As for the measurement instrument, use an inside micrometer.

(2) Observation of housing bore face
Observe the surface of the housing bore where
the bearing was mounted to check whether there
are scratches, dents, rust or stepped wearing.

- When there are scratches, dents
 Round edge with oil stone and/or sand paper to smoothen the surface.
- When there is rust
 Remove rust with oil stone and/or sand paper
 to smoothen the surface.
- When there is stepped wearing (Fig. 8.5) After the dimensional measurement of the housing bore, decide whether correction and reuse is possible. In this case, if the measured value of the housing bore is within its tolerance, remove the stepped worn part with oil stone and/or sand paper, etc. and smoothen the surface, then, reuse. If the stepped wearing is severe, either plate or apply thermal spraying to reconstitute to the correct housing size before reusing.
- (3) Anticorrosive agent
 After completion of check, apply an anticorrosive agent.

8.2.2 Split Housing

(1) Check of the housing bore size

In case of a split housing, assemble correctly the housing without bearing, and measure its bore dimension at the place where the bearing will be mounted to confirm that the dimension is correct. The measurement position is shown in **Fig. 8.4** (a). As for the measurement instrument, an inside micro-meter shall be used.

(2) Observation of housing bore face

Observe the surface of the housing bore where the bearing was mounted to check whether there are scratches, dents, rust or stepped wearing.

- When there are scratches, dents
 Round edge with oil stone and/or sand paper to smoothen the surface.
- When there is rust Remove rust with oil stone and/or sand paper to smoothen the surface.
- When there is stepped wearing (Fig. 8.5)
 After the dimensional measurement of the housing bore, decide whether correction is possible.

In this case, if the measured value of housing bore is within its tolerance, remove the stepped worn portion with oil stone and/or sand paper, etc. and smoothen the surface, then, reuse.

- When the stepped wearing is severe
 If the stepped wearing is severe, either plate or
 apply thermal spraying to reconstitute to the
 correct housing size and reuse.
- When there is a step
 As step may occur at the joining part of the
 split halves housing, confirm whether there is
 a step.
- If a step is found, correct it in the way as shown in Fig. 8.4 (c).
- (3) Anticorrosive agent After completion of check, apply an anticorrosive agent.

9. Check of Adapter, Removable Sleeve, Nut, Lock-washer and Lock plate

9.1 Check of Adapter and Removable Sleeve

After removal of adapter or removable sleeve, check the appearance as follows:

- Check whether there are crushed thread ridges or rust in thread vallies.
- Check whether there are scratches, dents, rust or uneven wearing on bore and outside surface.
- Check whether there are deformation or chips in the slit.
- (1) Thread

If crushed thread ridges or rust in thread vallies are found, do not reuse.

- (2) Bore and outside surface
 - When there are scratches
 If scratches are found, round the edge with oil stone and/or sand paper etc. and smoothen the surface, then, reuse.
 - When there are dents
 If the dents are severe, do not reuse. If dents
 are slight, round edge with oil stone and/or
 sand paper etc. and make it smooth, then,
 reuse.
 - When rust is found Remove rust with oil stone and/or sand paper etc. and smoothen the surface, then, reuse.
 - When uneven wearing is found If uneven wearing is found, do not reuse.
- (3) Slit

agent.

If deformation or chips are found in slit, do not reuse.

(4) Anticorrosive agent After completion of check, apply an anticorrosive

9.2 Check of Nut

After removal of lock nut and nut, check the appearance as follows.

- Check whether there are crushed thread ridges or rust in thread vallies.
- Check whether there are scratches, dents, rust or uneven wearing on end face.
- Check whether there is deformation at the cutout of the outside.
- (1) Nut threads

If crushed thread ridges or rust in thread vallies are found, do not reuse.

- (2) Nut end face
 - When scratches are found

If scratches are found, round edge with oil stone and/or sand paper etc. in order to smoothen the surface, then, reuse.

When dents are found

If dents are severe, do not reuse. If dents are slight, round edge with oil stone and/or sand paper etc. to smoothen the surface, then, reuse.

When rust is found

When rusting is severe, do not reuse. But if rust is slight, remove rust with oil stone and/or sand paper etc. and smoothen the surface, then, reuse.

- When uneven wearing is found If uneven wearing is found, do not reuse.
- (3) Cutout of nut outside

If deformation is found on cutout, do not reuse.

(4) Anticorrosive agent

After completion of check, apply an anticorrosive agent.

9.3 Check of Lock-washer and lock plate

Check lock-washer or lock plate, when chips or severe deformation is found, discard them and use new ones.

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10. Check of Damaged Bearing

10.1 Investigation of Damaged Bearings

If a damaged bearing is found, investigate its cause by examination of records and phenomena observed during operation, condition of residual lubricant when bearing was dismounted, appearance photo or sketch, check results of shaft and housing, that of sleeve (adapter, removable sleeve) to find out the cause of damage and record it, and take countermeasures to prevent reoccurrence.

When investigating the cause of damage, refer to the "New Bearing Doctor" (CAT. No. E7005) issued by NSK.

10.2 Results of Damage Investigation

If the results of damage investigation reveal that the shaft, housing, sleeve and nut mounted on the bearing are normal, mount a new spare bearing. Repair the faulty part as determined by the damage investigation to prevent any reoccurrence.

11. Precautions When Assembling the Machine

As precautions when mounting bearings into a machine, the following items shall be followed.

11.1 Confirmation of Sustaining by Bearing

In general, a shaft is sustained by two bearings which are mounted in the housing. When the bearing rotates, temperature difference is caused between the shaft and housing and the shaft expands. By this reason, it is designed that among two bearings one is fixed to the housing (fix side) and another is movable (free side) as the shaft elongates. (**Fig. 1.16** and **Fig. 1.17**)

When mounting the bearing in the housing on the free side, confirm that there is a mounting clearance in the axial direction relative to the bearing width dimension.

11.2 Lubrication and Piping for Lubrication

Follow the instructions given by the machine manufacturer regarding the kind and amount of lubricant.

When the lubricant is oil

Apply lubricant to surface of all the rollers of the bearing. For oil bath lubrication or drip oil lubrication, secure the required oil level. The oil level shall be set so that half of the bearing's lowest roller is immersed in the oil.

• When the lubricant is grease

Pack the bearing with enough grease. Then, apply grease evenly to housing walls. Pack grease in the free space surrounding the rollers as follows according to operating speed of application as follows:

 For bearings in applications operating at less than 50% of the bearing limiting speed, pack grease from one half to two-thirds of the free space. For bearings in applications operating at more than 50% of the bearing limiting speed, pack grease from one-third to one half of the free space.

The housing space volume excludes the shaft and bearing.

(Note: For the limiting speed, refer to the NSK General Catalog: "Rolling Bearings".)

Oil Lubrication Piping (Tubing):

Confirm that there are no metallic wear particles or debris (dust, contaminants, etc.) within the piping. Inspect the piping to ensure that portions or sections of the pipe have not become clogged, crushed, or damaged.

11.3 Mount of Seal

When handling the seal to be mounted in the housing, pay attention not to damage the seal lip. And when mounting it to the housing, pay attention to the seal direction and avoid deforming it.

12. Operation Check

After mounting the bearing, in order to confirm that its mounting is correct, check it by running the machine. As the machine running method, for a small machine, turn shaft by hand and confirm that the shaft turns smoothly and that there is no abnormality.

Check if the bearing gets caught during turning, has uneven roration torque or produces an abnormal running noise.

- Caught during turn occurs often when there are scratches or dents on bearing or foreign matter.
 This problem may also be caused by faulty mounting.
- Faulty mounting may cause uneven torque. The cause may be too small of a bearing clearance, mounting error, friction of seal, etc.
- If abnormal noise is heard while running, its cause may be contact between an object and a rotational part. Other possible causes include caught foreign matter or improper lubricant or not enough lubricant.

If any of the above listed states are observed, determine the cause and remedy it. If the operation of the machine continues without confirming the cause of abnormality, a serious accident related to the bearing may happen. Therefore, when any abnormality is found, be sure to investigate the cause even if it requires dismounting the machine again to remove the cause.

If no abnormality is found by a running test by manual turning then, perform an operation test by turning with its motive force. The power operation may be done for the unit alone or after mounting in the machine. In both cases, start the operation with no load at a low speed, and if no abnormality is observed, then increase the speed gradually and confirm at each step that there is no abnormality.

Power operation test check items:

- (1) Whether there is abnormal noise or vibration while running.
- (2) Measurement of bearing temperature to detect abnormal temperature rise while running.

The abnormal noise while running shall be checked using a stethoscope or an electronic bearing monitor. The bearing temperature is generally measured on the outside face of the housing. For oil lubrication, the bearing outer ring temperature may be directly measured through the oil hole of the oil supplying system.

The bearing temperature starts to rise gradually from the start of operation and usually reaches a stabilized state after 1 to 3 hours of operation. If the bearing clearance is too small, then mounting is wrong or sealing device has excessive friction. If there is too much or too little lubricant, the bearing temperature suddenly rises and results in an abnormal high temperature. If an abnormal temperature rise is found during operation, stop the operation immediately and inspect the machine. If required, dismount and check the bearing.

As long as abnormal temperature rise or abnormal noise or vibration are not observed, increase the speed gradually till the rated speed is reached. If abnormal noise, vibration of rotating part and abnormal temperature rise of bearing are not observed, then the operation test is OK.

For large machines, a running test by manual turning is not possible, so the test is done by power operation. In this case, perform on a stand-alone unit or with the unit mounted in a machine. It is recommended to test the unit alone, since it is easy to make an emergency stop if any abnormality occurs.

As for the operation, start with no load at low speed. After starting, turn the power OFF immediately and let it coast by inertia. During running by inertia, check for abnormal noise using a stethoscope or an electronic bearing monitor. For the power operation test, similarly to that of small machine, check for abnormal noise or vibration of rotating part, or abnormal temperature rise of the bearing. The bearing temperature is generally measured on the outer face of the housing. As the power operation method, at first start with no load at low speed. At that time when running by inertia, as long as no abnormal sound or vibration is observed, increase gradually till reaching the specified speed. As for the bearing temperature, in case of oil lubrication, check for leaks or foul smells. discoloration of lubricant. If there is no abnormal noise or vibration of rotating part, and the bearing temperature measurement does not show abnormal temperature rise, the operation test is OK.

In case of high speed, if the rotating sound of the bearing is heard through the stethoscope, then an abnormality such as high metallic tone, specific sound or irregular sound may be heard. The cause may be poor accuracy of shaft or housing, entry of foreign matter, damage of bearing, etc. and improper selection of lubrication method, thus, review of lubrication method may become necessary especially when the machine specification is modified to enable high speed operation.

13. Maintenance Check

13.1 Maintenance Check and Remedies for Abnormalities

In order to keep the performance of bearing in a good state, periodic maintenance and checks are indispensable. Regular maintenance and inspection of bearings allow trouble prevention, more reliable operation, increased productivity and better economical performance. The maintenance shall be systematically executed in accordance with a maintenance schedule appropriate to the actual machine operating conditions. Proper maintenance shall be executed after establishing the maintenance schedule or procedure for monitoring the operating conditions, check and change of lubricant, periodic inspection of the machine after dismounting, necessary working days, method, etc.

As for inspection items during operation, be sure to check running sound, vibration, temperature of bearing while operating and state of lubricant. If any abnormality is found during operating, determine its cause by referring to **Table 13.1** and take measure. If needed, dismount the bearing to investigate. For the dismounting procedure, refer to the previous Section 7 "Bearing dismounting method".

13.2 NSK Bearing Monitor (Bearing failure detecting device)

It is very important to predict abnormality of bearing. The NSK Bearing Monitor features an indicator of the running bearing condition. It generates an alarm and/or stops the machine automatically when any abnormality is detected. This function serves to prevent accidents and streamline the maintenance.

(See Section 14 "Presentation of Products".) **13.3 Damage of Bearing and Measures**

In general, when the bearing is correctly handled, it can be used until its fatigue life but occasionally it may break prematurely. Such premature damage is called failure or accident to distinguish it from the fatigue life. Premature damage is often caused by insufficient consideration given to fundamentals such as mounting, handling, lubrication, entry of foreign matter from outside, insufficient examination of thermal influence of shaft, housing.

Examples of damaged bearings include scoring on race ring of spherical roller bearing, shortage, improper lubricant, defective oil supply/discharge system, entry of foreign matter, error in bearing mounting or excessive bend of shaft, etc. And several of these factors may jointly contribute to the bearing trouble. Therefore, it may be difficult to determine the real cause of the trouble merely by investigating the damaged bearing. It is often possible to prevent a reoccurrence of similar trouble by gaining a complete knowledge of the machine on which the bearing was used, operating conditions, the structure surrounding the bearing, the situation before and after the trouble occurred. (See **Table 13.2**).

For more details, see "New Bearing Doctor" (CAT. No. E7005) issued by NSK. Bearing damages and

measures are described in "New Bearing Doctor".

Table 13.1 Causes of and measures for operating irregularities

Ir	rregularities	Possible Causes	Measures		
		Abnormal load	Improve the fit, internal clearance, preload, position of housing shoulder, etc.		
	Loud Metallic Sound	Incorrect mounting	Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting method.		
		Insufficient or improper lubricant	Replenish the lubricant or select another lubricant.		
		Contact of rotating parts	Modify the labyrinth seal, etc.		
Noise	Loud Regular	Flaws, corrosion, or scratches on raceways	Replace or clean the bearing, improve the seals, and use clean lubricant.		
	Sound	Brinelling	Replace the bearing and use care when handling bearings.		
		Flaking on raceway	Replace the bearings.		
		Excessive clearance	Improve the fit, clearance and preload.		
	Irregular Sound	Penetration of foreign particles	Replace or clean the bearing, improve the seals, and use clean lubricant.		
		Flaws or flaking on roller	Replace the bearing.		
		Excessive amount of lubricant	Reduce amount of lubricant, select stiffer grease.		
		Insufficient or improper lubricant	Replenish lubricant or select a better one.		
Abnor	mal Temperature	Abnormal load	Improve the fit, internal clearance, preload, position of housing shoulder.		
	Rise Incorrect mounting		Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting, or mounting method.		
		Creep on fitted surface, excessive seal friction	Correct the seals, replace the bearing, correct the fitting or mounting.		
		Brinelling	Replace the bearing and use care when handling bearings.		
	Vibration	Flaking	Replace the bearing.		
(A	Axial runout)	Incorrect mounting	Correct the squareness between the shaft and housing shoulder or side of spacer.		
		Penetration of foreign particles	Replace or clean the bearing, improve the seals.		
Leakage or Discoloration of Lubricant		Too much lubricant. Penetration by foreign matter or abrasion chips	Reduce the amount of lubricant, select a stiffer grease. Replace the bearing or lubricant. Clean the housing and adjacent parts.		

 Table 13.2
 Causes and measures for bearing failures

Type of Failure	Probable Causes	Measures	
Flaking Flaking of one-side of the raceway of radial bearings.	Abnormal axial load.	A loose fit should be used when mounting the outer ring of free-end bearings to allow axial expansion of the shaft.	
Flaking of the raceway in symmetrical pattern.	Out-of-roundness of the housing bore.	Correct the faulty housing.	
Flaking near the edge of the raceway and rolling surfaces.	Improper mounting, deflection of shaft, inadequate tolerances for shaft and housing.	Use care in mounting and centering, select a bearing with a large clearance, and correct the shaft andhousing housing shoulder.	
Flaking of raceway with same spacing as rolling elements.	Large shock load during mounting, rusting while bearing is out of operation for prolonged period.	Use care in mounting and apply a rust preventive when machine operation is suspended for a long time.	
Premature flaking of raceway and rolling elements.	Insufficient clearance, excessive load, improper lubrication, rust, etc.	Select proper fit, bearing clearance, and lubricant.	
Premature flaking of duplex bearings.	Excessive preload.	Adjust the preload.	

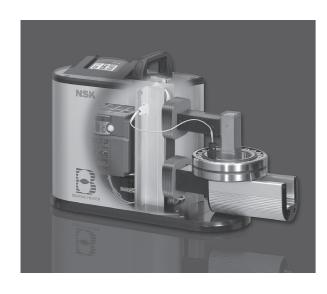
Type of Failure	Probable Causes	Measures
Scoring Scoring or smearing between raceway and rolling surfaces.	Inadequate initial lubrication, excessively hard grease and high acceleration when starting.	Use a softer grease and avoid rapid acceleration.
Scoring or smearing between the end face of the rollers and guide rib.	Inadequate lubrication, incorrect mounting and large axial load.	Select proper lubricant and modify the mounting.
Cracks Crack in outer or inner ring.	Excessive shock load, excessive interference in fitting, poor surface cylindricality, improper sleeve taper, large fillet radius, development of thermal cracks and advancement of flaking.	Examine the loading conditions, modify the fit of bearing and sleeve. The fillet radius must be smaller than the bearing chamfer.
Crack in rolling element. Broken rib.	Advancement of flaking, shock applied to the rib during mounting or dropped during handling.	Be careful in handling and mounting.
Fractured cage.	Abnormal loading of cage due to incorrect mounting and improper lubrication.	Reduce the mounting error and review the lubricating method and lubricant.
Indentations Indentations in raceway in same pattern as rolling elements.	Shock load during mounting or excessive load when not rotating.	Use care in handling.
Indentations in raceway and rolling elements.	Foreign matter such as metallic chips or sand.	Clean the housing, improve the seals, and use a clean lubricant.
Abnormal Wear False brinelling (phenomenon similar to brinelling)	Vibration of the bearing without rotation during shipment or rocking motion of small amplitude.	Secure the shaft and housing, use oil as a lubricant and reduce vibration by applying a preload.
Fretting	Slight wear of the fitting surface.	Increase interference and apply oil.
Wearing of raceway, rolling elements, rib, and clearance.	Penetration by foreign matter, incorrect lubrication, and rust.	Improve the seals, clean the housing, and use a clean lubricant.
Creep	Insufficient interference or insufficient tightening of sleeve.	Modify the fit or tighten the sleeve.
Seizure Discoloration and melting of raceway, rolling elements, and ribs.	Insufficient clearance, incorrect lubrication, or improper mounting.	Review the internal clearance and bearing fit, supply an adequate amount of the proper lubricant and improve the mounting method and related parts.
Electric Burns Fluting or corrugations	Melting due to electric arcing.	Install a ground wire to stop the flow of electricity or insulate the bearing.
Corrosion & Rust Rust and corrosion of fitting surfaces and bearing interior	Condensation of water from the air, or fretting. Penetration by corrosive substance (especially varnish-gas, etc).	Use care in storing and avoid high temperature and high humidity, treatme for rust prevention is necessary when operation is stopped for long time. Selection of varnish and grease.

14. Presentation of Products

Here we introduce some NSK products to be used when handling bearings.

☆ Bearing Heater

A bearing heater is used in the shrink fitting and mounting operations.



Feature

• Fast, uniform heating

Induction heating reduces bearing mounting time and cost.

No oil tanks required

Since no oil is necessary, it is free from spills and other messes, and environmentally-friendly. Bearings prelubricated with grease can be heated cleanly and simply.

Safety

It is in conformity with CE Standard and UL Standards.

Safe operation

Since there are no flames, there is no fire hazard, and an internal circuit breaker guards against electrical short.

Compact and light

Most NSK Bearing Heaters are light enough to be carried easily and used any where.

Automatic temperature control

A thermostat control can be set at any temperature up to $250^{\circ}\mathrm{C}$. When the desired level is reached, a buzzer sounds and constant temperature is maintained.

Automatic demagnetizing

When the heating is finished, the bearing is quickly and automatically demagnetized.

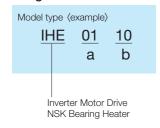
Horizontal guide

After heating, the bearing can be taken out easily by sliding along the guide.

Versatility

Besides bearings, other metallic rings such as inner ring spacers can also be heated for shrink fitting or for other purposes.

Composition of Bearing Heater Model Numbers



	а			b		
С	apac	ity	Voltage			
01:	1.0	kVA	10:	100 V	class	
03:	3.3	kVA	20:	200 V	class	
06:	6.6	kVA	40:	400 V	class	
11:	11.8	kVA				
23:	23	kVA				

Specifications

Model No.		IHE0110	IHE0120	IHE0320	IHE0340	IHE0620	IHE0640	IHE1120	IHE1140	IHE2320	IHE2340	
Heating Capacity (kVA)			1		3.3		6.6		11.8		23	
	Minimum bore diameter (mm)	20		3	35		35	50			50	
Applicable Bearing	Maximum outside diameter (mm)	20	00	30	00	40	00	60	00	8	800	
Size	Thickness (mm)	7	70	1.	110		200		00	4	100	
	Weight (kg)	1	12	4	40	8	30	30	00	6	600	
Heating Bearing	Seal type bearing					Ye	es					
type	Open type bearing	Yes										
	No. of phases	Single Three										
Power Supply	Voltage (V)	100-120	200-240	200-240	380-440	200-230	380-440	200-230	380-440	200-220/50 Hz 200-230/60 Hz	380-440	
Characteristics	Frequency (Hz)	50/60										
	Input rated (Maximum) Current (A)	7.2	4.0	5.3	2.7	8.1	4.0	13.2	6.6	27	13.5	
	Height (mm)	34	17	56	35	74	15	1 20	00	1 4	40	
Dimensions of body	Width (mm)	17	75	295		380		600		850		
Dimensions of body	Length (mm)	47	70	75	55	975		1 250		1 600		
	Body weight (kg)	1	14	4	43	8	31	241		3	35	

Precautions

- 1. Do not heat bearings to 120°C or above.
- Do not heat bearings to 120°C or above.
 Handle heated bearings or works with care. Do not touch then directly, or get your fingers burned.

Special catalog "Inverter Motor Drive NSK Bearing Heater™" CAT. No. 1275 is available.

☆ Hydraulic Nut

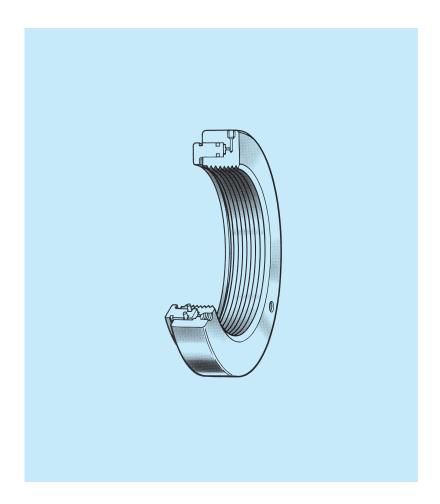
This is used to mount and dismount bearings.

This is used with high pressure oil after connection of the oil injection pump hose to mount the bearing having a tapered bore to the tapered shaft or adapter sleeve or to dismount the bearing mounted to a removable sleeve.

Features

Since the ring type piston is driven by the high pressure hydraulic oil, a big piston force can be generated.

A wide variety of hydraulic nut bore threads are available. They can be mated with the shaft threads. Both adapter sleeve and removable sleeve types are available.



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Handling Instructions for Bearings





For Proper Handling of Rolling Bearings

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Precautions for Proper Handling of Rolling Bearings

Rolling bearings are used under various operating conditions with a wide variety of light to heavy loads. Since they are manufactured to a high level of accuracy, they must be handled carefully and properly; the purpose for which they are used is just as important as careful

Incorrect mounting and improper handling are the most common causes of premature failure. Consequently, it is clear that proper handling, as well as appropriate selection and usage, are essential. Instructions for the proper handling of rolling bearings are summarized as

- (1) Keep bearings and related components clean.
- (2) Confirm that the dimensions and finish of related components are correct for the desired use.
- (3) Keep bearings free from harmful substances, including foreign particles and moisture.
- (4) Be sure to mount bearings in compliance with their designed purpose and specified operating conditions.
- (5) Use the proper tools for mounting and dismounting.

- (6) Exercise care to not damage or distort bearings in the course of mounting and dismounting.
- (7) Use the correct quantities of the appropriate
- (8) Keep hands as clean as possible when handling bearings to prevent corrosion. Wearing gloves, if possible, is recommended.

Although sophisticated devices are not necessarily required for handling bearings, proper tools should be used depending on specific circumstances to facilitate work operations and ensure flawless performance. Obviously, engineers who engage in design and inspection must also be well versed in the proper handling and mounting methods in conformity with the intended use of the bearings.

The goals of proper handling are to protect the bearings from any potential damage and ensure they serve their intended uses as effectively as possible.

Mounting

Fits with Shafts

2.1.1 Fits and Clearances

Standard bearings with cylindrical bores are often mounted by providing interference fit to the corresponding shafts. At the same time, significant force is required to press-fit the inner ring on the shaft. A certain degree of interference fit has been provided for mounting, as the inner ring may expand somewhat, generally reducing the amount of clearance in proportion to the expansion of the inner ring.

Although clearance for tapered roller bearings is adjustable after they are mounted, clearance adjustments cannot be made for ball bearings and cylindrical roller bearings. Therefore, bearings with sufficient clearance must be selected according to the level of interference. Bearings are generally manufactured based on a CN clearance suited for normal load conditions. To the extent that an interference fit is larger than the CN clearance, bearings with a larger

clearance (C3, C4, etc.) must be selected. In general, the decrease in clearance resulting from the fitting between the inner ring and the shaft may be expressed by the following equations (1) and (2):

$$\delta_f = k \cdot \Delta d = k \frac{d}{d+3} \Delta d_a \cdot \dots (1)$$

$$\delta_f = k \cdot \Delta d = k \frac{d}{d+2} \Delta d_a \cdot \dots (2)$$

 δ_f : Decrease in clearance due to fitting (mm)

 Δd : Effective interference (mm)

 $\Delta d_{\rm a}$: Apparent interference for measurement (mm)

 $k: d/D_i = 0.70 \text{ to } 0.90$

d: Bearing nominal bore diameter (mm)

 D_i : Raceway diameter of inner ring (mm)

Table 1 Fits of Radial Bearings with Shafts

Fits of Radial Bearings with Shafts

			5	Shaft Diameter (mi	n)						
Load Conditions		Examples	Ball Bearings	Cylindrical Roller Bearings Tapered Roller Bearings Bearings		Tolerance of Shaft	Remarks				
	Radial Bearings with Cylindrical Bores										
Rotating Outer Ring	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				
Load	Easy axial displacement of inner ring on shaft unnecessary	Tension pulleys, rope sheaves	,	All Shart diameters	h6	bearings, f6 can be used to allow easy axial movement.					
		Electrical home	≤ 18	_	_	js5	Use class 5 and high precision bearings				
	Light loads or variable loads	appliances, pumps, blowers,	18 to 100	≤ 40	_	js6 (j6)	where accuracy is required. For high				
	(≤ 0.06 C _r (¹))	transport vehicles, precision machinery,	100 to 200	40 to 140	_	k6	precision ball bearings with bore diameter shorter than 18 mm, use h5.				
		machine tools	_	140 to 200	_	m6					
	Normal loads (0.06 to 0.13 <i>C</i> _r (¹))		≤ 18	_	_	js5 to 6 (j5 to 6)					
Rotating Inner Ring		General bearing applications, medium and large motors, turbines,	18 to 100	≤ 40	≤ 40	k5 to 6	k6 and m6 can be used for single-row tapered roller bearings and single- row angular contact ball bearings instead of k5 and m5				
Load or			100 to 140	40 to 100	40 to 65	m5 to 6					
Direction of Load			140 to 200	100 to 140	65 to 100	m6					
Indeteminate		pumps, engine main bearings, gears,	200 to 280	140 to 200	100 to 140	n6					
		woodworking machines	_	200 to 400	140 to 280	p6					
			_	_	280 to 500	r6					
			_	_	> 500	r7					
		Railway axleboxes,	_	50 to 140	50 to 100	n6					
	Heavy loads or shock loads	industrial vehicles, traction motors,	_	140 to 200	100 to 140	p6	More than CN bearing				
	(> 0.13 C _r (¹))	construction equipment,		> 200	140 to 200	r6	internal clearance is necessary.				
		crushers			200 to 500	r7					
Cen	tral axial load only	Used part of each type of bearings	All shaft diameters			js6 (j6)	_				
		Radial E	Bearings with Ta	pered Bores an	d Sleeves						
		General bearing				h9/IT5 (²)	IT5 and IT7 mean that the deviation of the shaft				

All type of loading	General bearing applications	All shaft diameters	h9/IT5 (²)	IT5 and IT7 mean that the deviation of the shaft from its true geometric form, e.g. roundness	
All type of loading	Transmission shafts, woodworking spindles	All Shalt diameters	h10/IT7 (²)	and cylindricity should be within the tolerances of IT5 and IT7, respectively.	

Note (1) Cr represents the basic load rating of the bearing.

(2) Refer to Appendix Table 3 (page 29) for values of IT.

Remarks This table is applicable only to solid steel shafts.

Fits of Thrust Bearings with Shafts

Lo	oad 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	Stationary inner ring load	Cone crushers	All shaft diameters	js6 (j6)		
radial and axial loads	Rotating inner ring load		≤ 200	k6		
(Spherical thrust roller	or direction of load	Paper pulp refiners, plastic extruders				
bearings)	indeterminate		> 400	n6		

1 NSK NSK 2

■ Fits of Radial Bearings with Housings

	Load Co	nditions	Examples	Tolerances for Housing bores	Axial Displacement of Outer Ring	Remarks	
		Heavy loads on bearing in thin-walled housing or heavy shock loads	Automotive wheel hubs (roller bearings) Crane travelling wheels	P7			
Solid Housings	Rotating outer ring load	Normal or heavy loads	Automotive wheel hubs (ball bearings) Vibrating screens	N7			
	load	Light or variable loads	Conveyor rollers Rope sheaves Tension pulleys	M7	Impossible	_	
		Heavy shock loads	Traction motors				
	Direction of load indeterminate	Normal or heavy loads	Pumps	K7	Generally impossible	If axial displacement of the outer ring is not required.	
Solid or Split	indeterminate	Normal or light loads	Crankshaft main bearings Medium and large mortors	JS7 (J7)	Possible	Axial displacement of outer ring is necessary.	
Housings	Rotating inner ring load	Loads of all kinds	General bearing applications Railway axleboxes	H7			
		Normal or light loads	Plummer blocks	Н8	Possible	_	
		High temperature rise of inner ring through shaft	Paper dryers	G7			
		Accurate running	Grinding spindle real ball bearings Grinding centrifugal compressor free bearings	JS6 (J6)	Possible	_	
Solid Housings	Direction of load indeterminate	desirable under normal or light loads	Grinding spindle front ball bearings Grinding centrifugal compressor fixed bearings	K6	Generally fixed	For heavy loads, interference fit tighter than K is used. When high accuracy is required, very	
	Rotating	Accurate running and high rigidity desirable under variable loads	Cylindrical roller bearings for machine tool main spindle	M6 or N6	Fixed	strict tolerances should be used for fitting.	
	inner ring load	Minimum noise is required	Electrical home appliances	H6	Easily possible	-	

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 NSK catalogs for special fittings such as drawn cup needle.

■ Fits of Thrust Bearings with Housings

	Load Conditions	Bearing Types	Tolerances for Housing Bores	Remarks
		Thrust Ball Bearings	Clearance ≥ 0.25 mm	For general applications
		must ball bearings	H8	When precision is required
	Axial loads only	Spherical Thrust Roller Bearings Steep Angle Tapered Roller Bearings	Outer ring has radial clearance	When radial loads are sustained by other bearings
Combined	Stationary outer ring loads		H7 or JS7 (J7)	_
radial and		Spherical Thrust Roller Bearings	K7	Normal loads
axiai loads	Rotating outer ring loads or direction of load indeterminate	J.	M7	Relatively heavy radial loads

Therefore, 70 % to 90 % of the interference appears as reduction in clearance. (Smaller reduction in clearance is adopted for bearings of diameter series 4.) Moreover, the difference in operating temperature

between inner and outer rings ranges from 5 °C to 10 °C. However, this temperature difference will exceed that range if the inner ring's temperature rises or the outer ring is cooled.

Reduction in clearance due to temperature difference between inner and outer rings:

$$\delta_{t} \doteq \alpha \cdot \Delta_{t} \cdot D_{e} \cdot \cdots \cdot (3)$$

Where

- δ_t : Reduction in radial clearance due to temperature difference between inner and outer rings (mm)
- α : Coefficient of linear expansion of bearing steel **≒** 12.5 × 10⁻⁶ (1/°C)
- $\Delta_t :$ Temperature difference between inner and outer rings (°C)
- $D_{\rm e}$: Outer ring raceway diameter (mm)

- d: Nominal bearing bore diameter (mm)
- D: Nominal bearing outside diameter (mm)

Tables 1 and 2 provide examples of how the degree of these fits is determined based on load and temperature conditions, etc. Bearings with C3 or C4 clearance (larger than CN clearance) must be used depending on the degree of fit and temperature conditions.

2.1.2 Press Fitting Force and Heating Temperature for Tight Fitting

When attaching the inner ring firmly to the shaft, the force to press-fit an inner ring in the axial direction varies depending on interference and shaft diameter. However, the required force rises as surface pressure on the fitted surface and friction coefficient increase. When a stronger press fitting force is required, the inner ring is usually expanded by heating in oil before mounting, but in some cases, the ring is press-fitted using a press or similar tool while measuring the degree of interference as measured in the press fitting force.

The surface pressure $p_{\rm m}$, and press fitting force or withdrawal force of the fitted surface, which are applied to a solid shaft, can be expressed by the following equations (4)

$$p_{\rm m} = \frac{1 - k^2}{2} \cdot \frac{\Delta d}{d} \cdot E \cdot \cdots \cdot (4)$$

$$K = \mu p_{m} \pi d B$$

$$= \frac{1}{2} \mu E \pi B (1 - k^2) \Delta d \cdots (5)$$

Table 3 Values of μ

Example of application	μ value (average)
Press-fitting inner ring to cylindrical shaft	0.12
Withdrawing inner ring from cylindrical shaft	0.18
Press-fitting inner ring to tapered shaft or sleeve	0.165
Withdrawing inner ring from tapered shaft	0.135
Press-fitting sleeve onto the area between shaft and bearing's tapered hole	0.30
Withdrawing sleeve from the area between shaft and bearing's tapered hole	0.33

Where

 $k:d/D_i$

d: Nominal bearing bore diameter (mm)

 D_i : Raceway diameter of inner ring (mm)

B : Nominal inner ring width (mm)

 Δd : Effective interference (mm)

E: Modulus of longitudinal elasticity = 208 000 MPa

 μ : Friction coefficient of the fitted surface

Friction on the fitted surface differs substantially depending on the fitted-surface conditions. In general, the values listed in the **Table 3** can apply to the values of μ . Also, the value of $(1-k^2)$ with respect to each ratio D/d of outside diameter to bore diameter of a bearing can be approximately expressed as shown in Table 4. This is how to calculate the press fitting force to press an inner ring onto the shaft. In many cases, however, it is easier to mount the inner ring in place after heating it in oil to expand it. Although the applicable temperatures vary according to interference and shaft diameter, it is recommended to heat the bearing at 120 °C or lower whenever possible since the hardness of the bearing will decrease when heated to 150 °C or higher. Fig. 1 shows the heating temperature and bearing bore diameter expansion with respect to shaft diameter, in which the required heating temperature differences can be found, since it also shows the maximum interference of various fits. The bearing cannot be easily mounted to the shaft during the shrink fitting process since the inner ring will cool a little during mounting. Therefore, heat the bearing

Table 4 Values of $(1-k^2)$

D/d	$(1-k^2)$
1.5	0.25
2.0	0.41
2.5	0.52
3.0	0.61
3.5	0.67

D: Nominal outside diameter, d: Nominal bore diameter

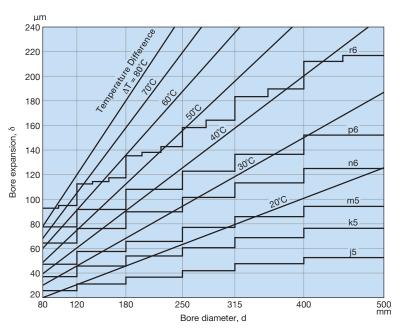


Fig. 1 Temperature and Thermal Expansion of Inner Ring

to a temperature of 20 °C to 30 °C higher than the lowest temperature required for mounting without interference. The recommended amount of time for immersing the bearing in heated oil is approximately 20 minutes. For example, if a bearing with a bore diameter of 120 mm is mounted with an interference fit of n6, the maximum interference fit is 65 um. In this case, the required temperature for heating the bearing would be 50 °C above ambient temperature as shown in Fig. 1. From that point on the heat scale, the temperature would then need to be raised an additional 20 °C to 30 °C in order to easily press fit the bearing onto the shaft. Consequently, the overall required heating temperature would be an additional 70 °C to 80 °C above ambient temperatures. Press fitting force and shrink fit for tight fitting have already been briefly discussed. However, excessive interference can sometimes produce abnormally large stress in the inner ring, which may cause the inner ring to crack or be otherwise damaged. Of the stress produced in the inner ring, the circumferential stress on the fitted surface in its inner diameter is the largest, and its magnitude can be expressed by equation (6) as

$$\sigma_{\rm \,tmax} = p_{_{\rm m}} \, \frac{1 + k^{_2}}{1 - k^{_2}} \quad \cdots \qquad (6)$$
 where,

*p*_: Surface pressure (MPa) $k: d/D_i$

As a general rule, it is desirable to choose a fit for which the maximum stress value may be set to 98 MPa or less for bearing steel or, in the worst case, to 127 MPa or less.

2.1.3 Fitting Work

The inner ring is usually mounted on a shaft by means of press fitting or shrink fitting. Press fitting, however, requires a large force. The required force for press fitting can be determined by the aforementioned equation (5).

During press fitting work, brinelling indentations may be caused on the raceway surfaces by rolling elements (balls or rollers) if force is applied to the outer ring. Furthermore, direct shock applied to the small ribs of the inner ring may cause the ring to crack. At the same time, no force should be applied to the cage. Therefore, exercise considerable care when performing press fitting work.

Since only a small press fitting force is required for medium- or small-sized bearings with a smaller interference, the inner ring can be pressed onto the shaft corresponding to the bearings at room temperature. As shown in Fig. 2, tap the brass bar on the lateral face of the inner ring, then hammer it to press-fit the ring onto the shaft. At this point, the tip of the brass bar, which has been cut crosswise in advance, comes into contact with the inner ring's lateral face, so that the outside face of the ring's lateral face will not be struck and the ring will be brought into firm, proper contact with the shaft shoulder. Take care not to allow brass chips to enter the bearings. A more effective method involves using a tubular fitting tool (Fig. 3) made of mild steel that contacts the entire side face of inner ring. Using this tool, press fitting can be done while exerting a heavy but non-damaging impact on the ring.

Using a press, compressed air, or hydraulic pressure, facilitates parallel push-in and enables grasping press-fit pressure for proper mounting. Consequently, these tools are useful since the interference can be checked to see if it is too tight or too loose.

Before conducting press fitting work, a high-viscosity oil, preferably an extreme-pressure lubricant, must be applied to the inner surface of the inner ring and the outer surface of the shaft. Also note that applying a lubricant made of molybdenum disulfide (MoS₂), in a paste form, to the areas for press fitting work prevents scoring and facilitates easier dismounting because it

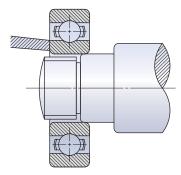


Fig. 2 Mounting of Bearing

prevents the bearing from adhering to the fitted surface during dismounting.

Shrink fitting is recommended as an easy mounting method for bearings with tighter interference. Heating temperature can be determined from Fig. 1 according to the specific bearing dimension and the intended interference. A high-quality mineral oil should be used for the heating oil.

The oil bath should be large enough to accommodate two to five bearings, with a sufficient amount of oil to completely cover the bearings. Precautions for use of the oil bath are shown in Fig. 4. Be sure to use a wire net or equivalent device in the bath to support the bearings in the oil without allowing them to directly contact either the heater or the bottom of the bath. For easy handling, place a long bar across the top of the oil bath with an attached hook from which to suspend the bearings. When tight-fitting inner rings are used for cylindrical roller bearings for rolling mills, as well as for axle bearings for railway rolling stock, a stronger press fitting force and withdrawal force are required for mounting and dismounting. For this reason, the bearings or shafts may be damaged due to operating difficulties under normal working conditions. For cylindrical roller bearings whose inner rings are not provided with ribs, it is recommended to use induction current to heat and expand the inner rings for mounting and dismounting to speed up the operation. Using this mechanism, NSK has devised a heating-type mounting/dismounting device that can be powered by an AC factory power supply with commercial frequency, and markets it for various industrial fields. Moreover, NSK has also made commercially available a bearing heater, as shown in Fig. 5, for heating a single unit, such as a small bearing.

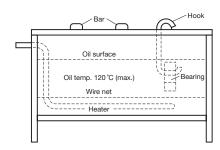


Fig. 4 Oil heating bath

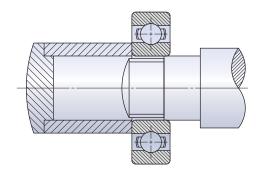


Fig. 3 Mounting of Bearing

A bearing attached to a shaft cools rapidly, and after heating, an expanded bearing shrinks in a crosswise direction. In some cases, therefore, in order to avoid a clearance between the inner ring and shoulder, press the bearings firmly against the shoulder by means of a shaft nut or other appropriate tool.

After mounting a bearing in place, cool it and apply lubricant to its inner and outer surfaces. At that point, make sure the bearing is free of any dirt.

Except when preload is applied to a bearing, a clearance is usually needed for the bearing after mounting; therefore, confirm that the bearing rotates smoothly. For roller bearings, clearance can be measured using a clearance gauge.

Since the inner ring can be separated from the outer ring in cylindrical roller bearings, the outer ring must be removed when mounting the inner ring. Avoid applying undue force in the later stage at which the outer ring is fit to the inner ring, which is attached to the shaft, since the rollers and raceway may be easily damaged. This kind of damage should be avoided because it may result in noise and premature failure. Also, roller bearings must be compatible. Consequently, confirm compatability in advance, and take special care to avoid mistakenly collating incompatible types in combinations. Although there is no problem with a mounting in which there is a loose fit with the shaft, clearance between the shaft and the inner ring must be minimal.

Usually, the fit between the inner ring and shaft of a thrust bearing should be about is6 (i6). Some clearance is usually provided, except for machine tools, which require a higher degree of accuracy.



Fig. 5 Heating by bearing heater

2.1.4 Mounting Bearings with **Tapered Bores**

Bearings with tapered bores are mounted in place using adapter sleeves or withdrawal sleeves, or directly on tapered shafts. The degree of fit is determined by reduction in clearance and push-in amount of the sleeves (or bearings).

For spherical roller bearings, a decrease in clearance during mounting is usually measured by a clearance gauge. The reduction in the clearance and residual clearance after mounting are shown in Table 5. Spherical roller bearings with tapered bores have generally been manufactured taking into account the reduction in clearance as shown in Table 5. When a very large load will be applied, increase the reduction in clearance by about 20 % more than the corresponding listing in Table 5.

In some cases, the push-in amount (axial movement) of the inner ring or withdrawal sleeve is measured instead of directly measuring the reduction in clearance. However, since it is difficult to determine the initial measurement position, it is safer to directly measure the reduction in clearance.

When a clearance gauge cannot be used for small roller bearings because of the small clearance after mounting them in position, the amount of axial movement must be measured instead of the reduction in clearance. Also, in cases where a large bearing is mounted in such a way that the bearing is heated in oil to expand it to ease mounting, axial movement must also be measured. In this case, the bearing should be initially mounted on the shaft before it is heated and this initial position measured, then the final mounting position can be determined by the amount of axial movement from the initial mounting position after the bearing has been heated. At this stage, the intended reduction in clearance must be confirmed by measuring the initial clearance prior to heating and the final clearance after cooling.

2.2 Mounting in a Housing

Bearings are usually mounted in housings after they have been attached to a shaft. Mounting methods and precautions vary depending on such factors as housing design, fit, and the configuration of horizontal and vertical shafts. The general information discussed in this section should apply to all applications.

The fit between the housing and the outer ring is determined based on load conditions, surface roughness, material hardness, etc. However, if the actual fit is tighter than specified, modifications must be manually performed through operations such as grinding. When the only method for enlarging a housing is to use a scraper, exercise care to avoid deforming the bearing seat into an oval shape or slope.

For a split housing, avoid inserting a thin shim between the upper and lower parts to loosen the fit. In fact, when the fit is too loose, the insertion of a sheet of paper or metal foil into the area between the housing and the outer ring must be avoided by all means. Only when absolutely necessary, the housing may be modified by plating its inner planes or inserting a bushing so that the housing dimensions can be corrected to meet the specified requirements.

When mounting a housing, do not allow labyrinth seals and other components to rub against each other. Take measures to avoid applying excessive load or eccentric load to the bearing, which may result from improper mounting on the base or defective joints.

Select only one of the bearings to be laid to serve as the fixed-end bearing for fixing and maintaining the mounted bearings in the exact position in an axial direction. For the fixed-end bearing, choose a type of bearing that can bear both radial and axial loads.

Bearings other than the fixed-end bearing should function as free-end bearings on which only radial load can be applied, to relieve expansion and contraction of the shaft due to temperature change. They should also be used to adjust the mounting position in the axial direction. Unless adequate measures are taken to prevent shaft shrinkage due to temperature changes, abnormal axial load will be applied on the bearings, resulting in premature failure.

Cylindrical roller bearings (NU or N type), in which the inner ring can be separated from the outer ring and which can also move in the axial direction, are suitable for free-end bearings. The use of these types of bearings often increases the ease of mounting and dismounting procedures.

If non-separable bearings are used as free-end bearings, the outer ring and housing should have a loose fit to allow for shaft expansion during operation and to allow for the expansion of the bearings. This can sometimes be accommodated away from the fitted surface between the inner ring and the shaft.

If the distance between bearings is short and shaft shrinkage has less effect on the bearings, use angular contact ball bearings and tapered roller bearings or other types of bearings which can handle the application of axial load in only one direction, and mount them face-toface or back-to-back to form a duplex set. The axial clearance (movement in axial direction) after mounting should be adjusted with a nut or a shim.

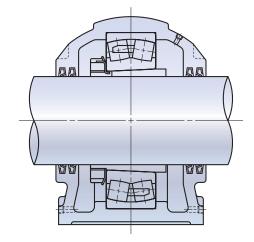
When mounting an outer ring with a tighter fit, use a tubular attachment tool made of mild steel as shown in Fig. 7. Should either the outer or inner rings be mounted with a tight fit and either the inner ring is already mounted on the shaft or the outer ring is already attached to a bearing housing, use tools such as shown in Figs. 8 and 9 to avoid the possible impact of press fitting on a bearing ring through the rolling elements. Furthermore, be sure to use an appropriate method to avoid applying impact load on a bearing when mounting a joint, for example, after having mounted the bearing on a shaft with its housing.

Table 5 Mounting Spherical Roller Bearings with Tapered Bores

Units: mm

Bearing Bo	ore Diameter	Reduc Radial C	tion in learance		Axial Mo	ovement			Permissible Clearance
over	d incl.	min.	max.	Taper min.	1:12 max.	Taper ⁻ min.	1:30 max.	CN	C3
30	40	0.025	0.030	0.40	0.45	_	_	0.010	0.025
40	50	0.030	0.035	0.45	0.55	_	_	0.015	0.030
50	65	0.030	0.035	0.45	0.55	_	_	0.025	0.035
65	80	0.040	0.045	0.60	0.70	_	_	0.030	0.040
80	100	0.045	0.055	0.70	0.85	1.75	2.15	0.035	0.050
100	120	0.050	0.060	0.75	0.90	1.9	2.25	0.045	0.065
120	140	0.060	0.070	0.90	1.1	2.25	2.75	0.055	0.080
140	160	0.065	0.080	1.0	1.3	2.5	3.25	0.060	0.100
160	180	0.070	0.090	1.1	1.4	2.75	3.5	0.070	0.110
180	200	0.080	0.100	1.3	1.6	3.25	4.0	0.070	0.110
200	225	0.090	0.110	1.4	1.7	3.5	4.25	0.080	0.130
225	250	0.100	0.120	1.6	1.9	4.0	4.75	0.090	0.140
250	280	0.110	0.140	1.7	2.2	4.25	5.5	0.100	0.150
280	315	0.120	0.150	1.9	2.4	4.75	6.0	0.110	0.160
315	355	0.140	0.170	2.2	2.7	5.5	6.75	0.120	0.180
355	400	0.150	0.190	2.4	3.0	6.0	7.5	0.130	0.200
400	450	0.170	0.210	2.7	3.3	6.75	8.25	0.140	0.220
450	500	0.190	0.240	3.0	3.7	7.5	9.25	0.160	0.240
500	560	0.210	0.270	3.4	4.3	8.5	11.0	0.170	0.270
560	630	0.230	0.300	3.7	4.8	9.25	12.0	0.200	0.310
630	710	0.260	0.330	4.2	5.3	10.5	13.0	0.220	0.330
710	800	0.280	0.370	4.5	5.9	11.5	15.0	0.240	0.390
800	900	0.310	0.410	5.0	6.6	12.5	16.5	0.280	0.430
900	1 000	0.340	0.460	5.5	7.4	14.0	18.5	0.310	0.470
1 000	1 120	0.370	0.500	5.9	8.0	15.0	20.0	0.360	0.530

Remarks Values for reduction in radial internal clearance are for bearings with CN clearance. For bearings with C3 Clearance, the maximum values listed should be used for the reduction in radial internal clearance.



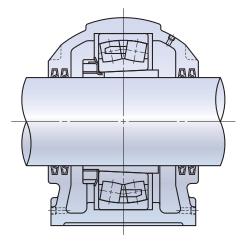
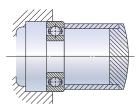
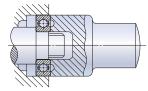


Fig. 6 Fixed-end (left) and free-end (right)





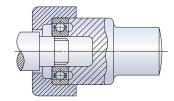


Fig. 7 Preload fitting of outer ring

Fig. 8 Preload fitting of outer ring

Fig. 9 Preload fitting of inner ring

2.3 Mounting with Preload **Applications**

2.3.1 Preload for Radial Bearings

When mounting angular contact ball bearings and tapered roller bearings, preload must be applied depending on specific usage conditions. Preload refers to the assembly adjustment in which the required load is applied in advance to the balls or rollers of a bearing while no load is applied externally (or under the conditions where rolling elements maintain their position during mounting). The purpose of preload is to minimize shaft deflection in radial or axial directions during operation within the requisite minimum allowances. Mounting with preload application is a very effective way to lessen deflection. However, under no circumstances should you ever apply a larger preload to a bearing than necessary. The amount and application method, therefore, should always be carefully observed to avoid mistakes, with due consideration for the purpose of preload.

Fig. 10 shows a situation in which two radial ball bearings' outer rings are mounted after a preload is applied to them by means of end cover screws. Although this mounting method is simple, sufficient results are not possible without careful adjustment by a skilled worker. Moreover, it is difficult to accurately measure the amount of preload using this method. Therefore, the starting frictional moment and the amount of preload of a bearing must be known in advance.

The lighter the load a bearing is required to handle during operation, the weaker the preload that would be necessary for mounting. In this connection, there is

another way in which preload may be applied to a bearing: using a spring as shown in Fig. 11. In this preloading method, the size and compression of the spring can be determined from the amount of preload. Several springs of proper size are placed at the circumference. In many cases, preloading by means of springs is conducted to lessen radial deflection. As shown in Fig. 12, applying preload to a bearing with spacers inserted into both inner and outer rings is an excellent method. This method facilitates mounting and ensures the proper application of preload. One spacer is slightly longer than another, and the dimensions of individual bearings differ slightly. For this reason, since we cannot say that similar length spacers can be applied to all bearings, the specific length must be measured and determined individually when combining bearings. Single-row angular contact ball bearings are not used independently, but always in pairs. They can be combined as front-to-front duplex bearings (DF) as shown in Fig. 13, or back-to-back duplex bearings (DB) as shown in Fig. 14.

Fig. 15 shows a situation in which no axial preload is applied, where the required deflections of inner and outer rings in the axial direction for the preload are 'a' and 'b', respectively, and preload T_1 will be obtained only after 'a' and 'b' move in an axial direction when tightened by a nut. Typically, 'a' equals 'b' for bearings of the same type. In any case, as long as 'a' and 'b' are properly designed and fabricated for the specific conditions of use, mounting can be easily carried out by simply tightening the nut firmly.

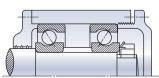
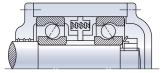


Fig. 10 Preload application by screw



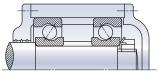
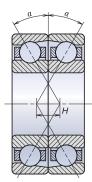
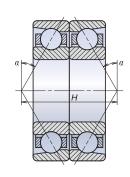
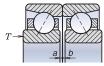
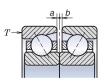


Fig. 11 Preload application by spring Fig. 12 Preload application by spacer (on free-end)









(Front-to-front duplex bearings)

Fig. 13 Front-to-front duplex bearings Fig. 14 Back-to-back duplex bearings

Fig. 15 Amount of preload

The relation between axial load and displacement in the axial direction of single-row angular contact ball bearings can be approximately expressed by equation (7) below.

$$\delta_{\rm a} = \frac{4.4 \times 10^{-4}}{\sin \alpha} \left(\frac{Q^2}{D_{\rm a}}\right)^{\frac{1}{3}} \cdot \dots (7)$$

 δ_a : Displacement in axial direction (mm)

Q: Load applied to a single ball (N)

 α : Contact angle

Da: Diameter of ball (mm)

If the axial load to be applied to the entire bearing is T, then load Q, which is applied to a single ball when the number of balls of the bearings is Z, can be expressed by the following equation (8):

$$Q = \frac{T}{Z \sin \alpha} \cdot \dots \cdot (8)$$

Therefore, deflection in axial direction, δ_a , can be generally expressed by the following equation:

 C_{a} is a constant determined by the individual type and dimension of the bearing.

In Fig. 16, clearances, a and b, between the bearings can be expressed by axial deflection (δ_a). And, as preload increases, clearances a and b will decrease, and the preload will become T_1 after the clearances reach zero. If the axial load, T, is applied externally to bearing A, A will further deflect by δ_i in the axial direction. Deflection of bearing B will also decrease by the same amount. Then the deflections of bearings A and B will become as follows:

$$\delta_{aA} = \delta_a + \delta_i$$
, $\delta_{aB} = \delta_a - \delta_i$

To be more specific, the force, including preload, applied to bearing A is $(T_1 + T - G)$, and $(T_1 - G)$ is applied to bearing B.

If only δ_T deflects under axial load T when no preload is applied to a bearing, the resulting decrease in deflection of the bearing from the preload can be expressed as $(\delta_T - \delta_i)$.

Also, in the case of $G = T_1$ or $\delta_i = \delta_a$, bearing B is under no-load conditions, and the deflection of bearing A, δ_{aA} , becomes as follows:

$$\delta_{aA} = 2\delta_a = 2C_a \cdot T_1^{\frac{2}{3}} = C_a (2^{\frac{3}{2}} T_1)^{\frac{2}{3}} \cdot \cdot \cdot (10)$$

Moreover, the force applied to bearing A is equal to $G=T_1$, the following equation holds:

$$T_1 + (T - G) = G + (T - G) = T \cdot \cdot \cdot \cdot \cdot \cdot \cdot \cdot (11)$$

Then, from the equations, (9), (10) and (11), the following equation holds:

$$\delta_{aA} = C_a \cdot T^{\frac{2}{3}} = C_a (2^{\frac{3}{2}} T_1)^{\frac{2}{3}} \cdot \cdots (12)$$

$$T = 2\sqrt{2} \cdot T_1$$

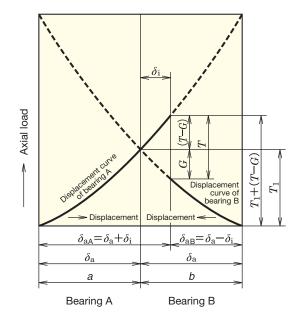


Fig. 16 Axial displacement with preload

When preload is provided, bearing A needs a load capacity that withstands axial load $(T_1 + T - G)$ relative to the required life and speed conditions.

2.3.2 Preload for Thrust Bearings

Care should be taken not to allow balls or bearing rings of bearings to get out of position when the thrust ball bearings are mounted on horizontal shafts. This is especially important for double-direction thrust ball bearings or two single-direction thrust ball bearings on horizontal shafts.

In other words, if the balls on the side where no load is applied, and cages and/or bearing rings are displaced downward or off center, and load is applied to the row of bearings, damage or failure caused by heat generation will inevitably occur. For this reason, preload in the axial direction is required as a preventive measure. This misalignment of the balls and cages or bearing rings causes an uneven application of load on the balls, which leads to slippage in their motion to return to the home position, which in turn results in heat generation and

As in the case of radial bearings, the preloading method can be applied by a screw or adjustment plate by which axial adjustment is made, or by a spring. Figs. 17 and 18 show some examples of these applications. However, as the former method requires difficult adjustment and requires experience, the latter method, using a spring, is

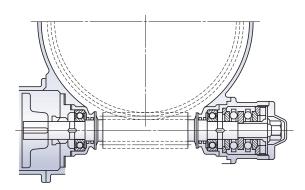


Fig. 17 Preload of thrust ball bearings (by screw)

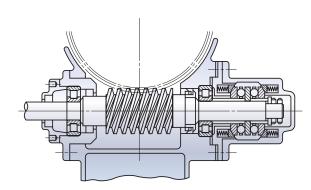


Fig. 18 Preload of thrust ball bearings (by spring)

easier and may provide better results. This preloading method can apply not only to thrust ball bearings, but also to thrust roller bearings, as shown in Fig. 19. 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 (13) and (14) below should be adopted as the minimum axial load in order to prevent such sliding.

$$F_{\text{a min}} = \frac{C_{\text{oa}}}{100} \left(\frac{n}{N_{\text{max}}}\right)^2 \cdot \dots \cdot (13)$$

$$F_{\rm a \ min} = \frac{C_{\rm 0a}}{1000} \dots (14)$$

 $F_{\rm a\ min}$: Minimum axial load (N) C_{0a} : Basic static load rating (N)

n: Speed (min⁻¹)

 $N_{
m max}$: Limiting speed (oil lubrication) (min⁻¹)

When spherical thrust roller bearings are used, damage such as scoring may occur due to sliding between the rollers and outer ring raceway while in use. The minimum axial load $F_{\rm a\,min}$ necessary to prevent such sliding is obtained from the following equation:

$$F_{\text{a min}} = \frac{C_{0\text{a}}}{1000} \quad \dots \tag{15}$$

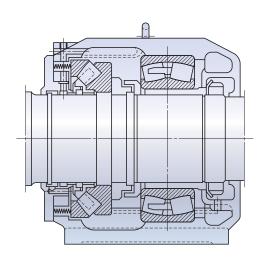


Fig. 19 Preload of thrust roller bearings (by spring)

General Mounting Precautions

To fix a radial bearing to a shaft, generally bring the bearing into close contact with the shaft shoulders and spacer and fix it in position by tightening the shaft nut. The ends of the shaft shoulders and the spacer must be perpendicular to the shaft center line. If the components are not perpendicular, bearing rotation accuracy and roller contact performance will be adversely affected, resulting in heat generation and premature fatigue. The same care must be taken to ensure the proper contact between the housing shoulders and the lateral face of the outer rings. Since shaft shoulder height and the outer diameters of spacers or the housing shoulder height are closely related to the dismounting of bearings, their standard dimensions are described in the JIS as well as in our catalogues for reference purposes. Along with these shoulder heights, the fillet radius in the corners of shafts and housings is also important. Table 6 shows the values of these shoulder heights and fillet radii in the corners.

The spherical washers of thrust ball bearings are usually mounted in place, with a clearance between the washers and the housing, except for the highly accurate main shafts of machine tools. For thrust ball bearings with flat seats, in particular, perpendicularity between shafts and housing shoulders must be achieved with a high degree of accuracy, in the same way as described previously. Mounting should be done with utmost attention to eccentricity as well.

Although bearings with greater accuracy may be required for ensuring the overall accuracy of a machine, the accuracy of shafts, housings, and other related components should also be improved in conformity with bearing accuracy; inaccuracy of related components is a leading cause of bearing damage.

Furthermore, as a general precaution to ensure proper mounting, it is important to keep bearings and related components as clean as possible. This means they should be handled in an environment free from debris or high humidity, using clean rinsing oil, with due consideration for guarding against corrosion or rust. Be sure to check each part before mounting. Inspect the sealed areas as well as dimensions, shape, appearance and accuracy of shafts and housings. While checking, use care to prevent perspiration from the hands, or debris present at the site, from coming into contact with the bearings. Fitting work for bearings and clearance measurement methods have already been discussed. Ideally, plan carefully before proceeding to mounting procedures, and always maintain a well-documented record of each operation. Tapered roller bearings are mounted by setting the outer ring and inner ring subunit (inner ring, cage, and rollers)

independently of each other. The outer ring is pressed into the housing and the inner ring subunit is pressed onto the shaft. The shaft is then set into the housing to seat the tapered roller bearing assembly. During the mounting/assembly process, rotate the bearing to ensure that the large inner ring rib is in close contact with end faces of each roller (initial run-in process).

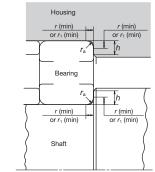


Fig. 20 Chamfer dimensions, fillet radius of shaft and housing, and shoulder height

Table 6 Recommended minimum shoulder heights and fillet radius of shaft and housing for use with metric radial bearings

Nominal		Shaft or Housin	g
Chamfer Dimensions		Minimum Should	ler Heights h (min)
r (min) or r_1 (min)	Fillet Radius $r_{ m a}$ (max)	Deep Groove Ball Bearings (¹), Self-Aligning Ball Bearings, Cylindrical Roller Bearings (¹), Solid Needle Roller Bearings	Angular Contact Ball Bearings, Tapered Roller Bearings (²), 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

(1) When heavy axial loads are applied, the shoulder greater must be sufficiently higher than the values listed.

(2) For bearings with axial loads, the shoulder height must be sufficiently greater than the values listed.

Remarks 1. The fillet radius of the corner is also applicable to thrust bearings.

2. The shoulder diameter is listed instead of shoulder height in the bearing tables.

2.5 Lubrication

The lubricating methods for rolling bearings are roughly classified into oil and grease applications.

Grease lubrication is the preferred method for rolling bearings, since it allows a simpler structure for bearing seals and is convenient. This method has recently become more widely used because of improvements and development in the grease itself. Nevertheless, special attention must be paid to rotating speed, operating temperature, grease quantity, grease life, etc. Grease lubrication becomes more difficult as the rotating speed of bearings increases. The upper limit of revolution

speed varies according to bearing type, dimensions,

Table 7 Brands of Lubricating Greases and Comparison of Properties

	ne / Branus on	Lubricating Greases and C	Jonipa	115011 01	Properties	5	
Brands	Thickeners	Base Oils	Dropping Point (°C)	Consistency	Working Temperature Range (¹) (°C)	Pressure Resistance	Usable Limit Compared to Listed Limiting Speed (²) (%)
ADLEX	Lithium	Mineral oil	198	300	0 to +110	Good	70
APPOLOIL AUTOLEX A	Lithium	Mineral oil	198	280	-10 to +110	Fair	60
ARAPEN RB 300	Lithium/Calcium	Mineral oil	177	294	-10 to + 80	Fair	70
EA2 GREASE	Urea	Poly- α -olefin oil	≥ 260	243	-40 to +150	Fair	100
EA3 GREASE	Urea	Poly-α-olefin oil	≥ 260	230	-40 to +150	Fair	100
EA5 GREASE	Urea	Poly-α-olefin oil	≥ 260	251	-40 to +160	Good	60
EA7 GREASE	Urea	Poly-α-olefin oil	≥ 260	243	-40 to +160	Fair	100
ENC GREASE	Urea	Polyol ester oil + Mineral oil	≥ 260	262	-40 to +160	Fair	70
ENS GREASE	Urea	Polyol ester oil	≥ 260	264	-40 to +160	Fair	100
ECZ GREASE	Lithium + Carbon black	Poly-α-olefin oil	≥ 260	243	-10 to +120	Fair	100
ISOFLEX NBU 15	Barium Complex	Diester oil + Mineral oil	≥ 260	280	-30 to +120	Poor	100
ISOFLEX SUPER LDS 18	Lithium	Diester oil	195	280	-50 to +110	Poor	100
ISOFLEX TOPAS NB 52	Barium Complex	Poly-α-olefin oil	≥ 260	280	-40 to +130	Poor	90
AEROSHELL GREASE 7	Micro Gel	Diester oil	≥ 260	288	-55 to +100	Poor	100
GREASE SH 33 L	Lithium	Silicone oil	210	310	-60 to +120	Poor	60
GREASE SH 44 M	Lithium	Silicone oil	210	260	-30 to +130	Poor	60
NS HI-LUBE	Lithium	Polyol ester oil + Diester oil	192	250	-40 to +130	Fair	100
NSA GREASE	Lithium	Poly-α-olefin oil + Ester oil	201	311	-40 to +130	Fair	70
NSC GREASE	Lithium	Alkyldiphenyl ether oil + Polyol ester oil	192	235	-30 to +140	Fair	70
NSK CLEAN GREASE LG2	Lithium	Poly-α-olefin oil + Mineral oil	201	199	-40 to +130	Poor	100
EMALUBE 8030	Urea	Mineral oil	≥ 260	280	0 to +130	Good	60
MA8 GREASE	Urea	Alkyldiphenyl ether oil + Poly-α-olefin oil	≥ 260	283	-30 to +160	Fair	70
KRYTOX GPL-524	PTFE	Perfluoropolyether oil	≥ 260	265	0 to +200	Fair	70
KP1 GREASE	PTFE	Perfluoropolyether oil	≥ 260	280	-30 to +200	Fair	60
COSMO WIDE GREASE WR No.3 N	Sodium Terephtalamate	Polyol ester oil + Mineral oil	≥ 230	227	-40 to +130	Poor	100
G-40M	Lithium	Silicone oil	223	252	-30 to +130	Poor	60
SHELL GADUS S2 V220 2	Lithium	Mineral oil	187	276	0 to + 80	Good	60
SHELL ALVANIA GREASE S1	Lithium	Mineral oil	182	323	-10 to +110	Fair	70
SHELL ALVANIA GREASE S2	Lithium	Mineral oil	185	275	-10 to +110	Fair	70
SHELL ALVANIA GREASE S3	Lithium	Mineral oil	185	242	-10 to +110	Fair	70
SHELL CASSIDA GREASE RLS 2	Aluminum Complex	Poly-α-olefin oil	≥ 260	280	0 to +120	Fair	70
SHELL SUNLIGHT GREASE 2	Lithium	Mineral oil	200	274	-10 to +110	Fair	70
WPH GREASE	Urea	Poly-α-olefin oil	259	240	-40 to +150	Fair	70
DEMNUM GREASE L-200	PTFE	Perfluoropolyether oil	≥ 260	280	-30 to +200	Fair	60
NIGACE WR-S	Urea	Mixed oil	≥ 260	230	-30 to +150	Poor	70
NIGLUB RSH	Sodium Complex	Polyalkylene Glycol oil	≥ 260	270	-20 to +120	Fair	60
PYRONOC UNIVERSAL N6B	Urea	Mineral oil	238	290	0 to +130	Fair	70
PALMAX RBG	Lithium Complex	Mineral oil	216	300	-10 to +130	Good	70
BEACON 325	Lithium	Diester oil	190	274	-50 to +100	Poor	100
MULTEMP PS No.2	Lithium	Poly-α-olefin oil + Diester oil	190	275	-50 to +110	Poor	100
MOLYKOTE FS-3451 GREASE	PTFE	Fluorosilicone oil	≥ 260	285	0 to +180	Fair	70
UME GREASE	Urea	Mineral oil	≥ 260	268	-10 to +130	Fair	70
UMM GREASE 2	Urea	Mineral oil	≥ 260	267	-10 to +130	Fair	70
RAREMAX AF-1	Urea	Mineral oil	≥ 260	300	-10 to +130	Fair	70

Notes (1) If grease will be used at the upper or lower limit of the temperature range or in a special environment such as vacuum, please

lubricating methods and service conditions. In the dimension table of NSK's rolling bearing catalogue, the limiting speeds are listed by bearing, assuming normal operation conditions.

The operating temperature range of grease varies depends on the type of grease used. Table 7 shows the generally recommended temperature range. When grease is used outside this temperature range, care should be used for replenishing the lubricant. Sufficient grease must be packed inside the bearing, including the cage guide face. The available space inside the housing to be packed with grease, excluding the bearing and shaft, depends on the speed, as follows:

- 1/2 to 2/3 of the space (Less than 50 % of the limiting speed)
- 1/3 to 1/2 of the space (More than 50 % of the limiting speed) Since the quality and property of greases change as they are used, they must be replaced after a given period has elapsed. Serviceability limits cannot be readily determined for all applications, since changes in quality and properties are affected by operating and external conditions. Operators may also find it difficult to determine the timing of replacement based on appearance.

Assuming that the greases are used under normal operating conditions, refer to Figs. 23 and 24 on page 16 concerning replacement time intervals.

Oil lubrication is widely used. Oil features excellent flowability and heat dissipation capacity and is suitable for circulating and forced lubrication, from which debris and abrasive particles are easily removed. It also has a positive effect on vibration and acoustic properties, and therefore is the optimum choice as a lubricant. However, oil lubrication clearly adds complexity to the lubrication system and requires careful maintenance. Furthermore, bearing seals must be carefully tended to

prevent oil leakage.

Selecting the proper lubrication oil involves considering its viscosity at the operating temperature of the applicable bearing. It is generally better to choose an oil having the following viscosity or higher at the respective operating temperature for the applicable bearing types:

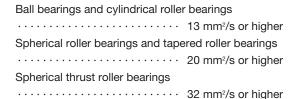


Fig. 22 shows the general relationship between oil viscosity and temperature, although some variations from these numbers can be found.

Lubricating methods include oil bath lubrication, splash lubrication, forced circulating lubrication, and oil mist lubrication. The selection of the proper lubricating methods depends on the structures in the vicinity of the bearings and operating conditions. The most typical limiting speeds for bearings adopting oil bath lubrication are also listed in our catalog's dimension table.

2.6 Test Operation

A test operation should be performed after mounting has been completed. Items to be checked during the test include the existence of abnormal noise and excessive rise in bearing temperature. Needless to say, bearing rotation must be smooth during test operation. If any abnormality is found during the test operation, immediately discontinue the test, dismount the bearing and conduct an inspection depending on the specific

Especially for high-speed machines, start the operation

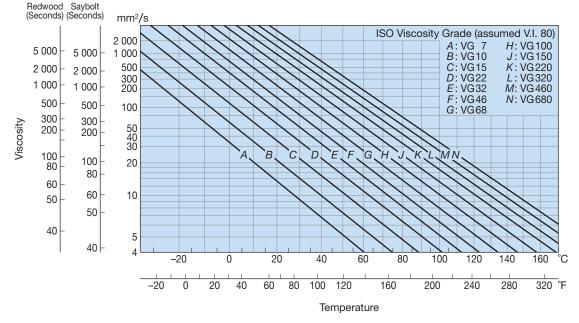


Fig. 22 Temperature-Viscosity chart

⁽²⁾ For short-term operation or when cool, grease may be used at speeds exceeding the above limits provided the supply of grease is appropriate

at lower speeds, then gradually increase speed. Although bearing temperature can generally be estimated by the temperature of the outside surface of the housing, it is better to directly measure the temperature of the outer ring using oil holes for access. Changes in temperature can also be estimated by the temperature of the lubricant. Since, in general, bearing temperature gradually rises and reaches saturation temperature over time, it is possible to confirm that mounting has been done correctly by monitoring the rise in temperature. In the event of problems with the bearing, its mounting, or both, bearing temperature may not level off but will increase to an abnormal level.

The saturation temperature of a bearing varies depending on heat capacity, heat release, number of revolutions and load of the host machine. Usually the rise in temperature will range from 20 °C to 30 °C.

The probable causes of unrestrained temperature rise to abnormal levels are:

- Excessive supply of grease or oil
- Excessive friction of the bearing seals
- Insufficient bearing clearance

- Excessive speed with respect to bearing type and lubricating method
- Abnormal load on bearing
- Improper contact of bearing due to inaccurate shaft, housing, or shoulders
- Defective bearings, etc.

Moreover, there may be cases involving improper mounting, inaccurate fabrication, or the incorrect selection of a bearing.

The sound of a bearing may be checked with a noise locator or other listening instrument placed in contact with the housing. Abnormal conditions, such as a loud metallic sounds, strange noises or other irregular sounds, may be caused by insufficient lubricant, inaccurate shaft or housing, the entry of foreign particles or debris into the bearing, or defective bearings.

For reference purposes, probable causes of various types of bearing failure and related measures are shown in **Table 8**.

The results of the test operation must always be recorded for reference after mounting has been completed, as a future reference for troubleshooting.

Table 8 Causes of and Measures for Operating Irregularities

Ir	regularties	Possible Causes	Measures
		Abnormal Load	Improve the fit, internal clearance, preload, position of housing shoulder, etc.
	Loud Metalic Sound (1)	Incorrect mounting	Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting method.
	Wetalic Sound (1)	Insufficient or improper lubricant	Replenish the lubricant or select another lubricant.
		Contact of rotating parts	Modify the labyrinth seal, etc.
Noise		Flaws, corrosion, or scratches on raceways	Replace or clean the bearing, improve the seals, and use clean lubricant.
	Loud Regular Sound	Brinelling	Replace the bearing and use care when handling bearings.
		Flaking on raceway	Replace the bearing.
		Excessive clearance	Improve the fit, clearance and preload.
	Irregular Sound	Penetration of foreign particles	Replace or clean the bearing, improve the seals, and use clean lubricant.
		Flaws or flaking on balls	Replace the bearing.
		Excessive amount of lubricant	Reduce amount of lubricant, select stiffer grease.
		Insufficient or improper lubricant	Replenish lubricant or select a better one.
Abnorma	I Temperature Rise	Abnormal load	Improve the fit, internal clearance, preload, position of housing shoulder.
		Incorrect mounting	Improve the machining accuracy and alignment of shaft and housing, accuracy of mounting, or mounting method.
		Creep on fitted surface, excessive seal friction	Correct the seals, replace the bearing, correct the fitting or mounting.
		Brinelling	Replace the bearing and use care when handling bearings.
	Vibration	Flaking	Replace the bearing.
(A	xial runout)	Incorrect mounting	Correct the squareness between the shaft and housing shoulder or side of spacer.
		Penetration of foreign particles	Replace or clean the bearing, improve the seals.
	Leakage or ration of Lubricant	Too much lubricant. Penetration by foreign matter or abrasion chips	Reduce the amount of lubricant, select a stiffer grease. Replace the bearing or lubricant. Clean the housing and adjacent parts.

Note (') Squeaking may be heard in medium- to large-sized cylindrical roller bearings or ball bearings that are operating under grease lubrication in low-temperature environments. Under such conditions, even when squeaking occurs, the bearing temperature will not rise and fatigue or grease life will not be affected. Consequently, such a bearing can continue to be used.

3

Maintenance and Inspection

3.1 Procedures of Maintenance and Inspection

Consistent maintenance and regular inspections are required to ensure continued use of the bearing throughout its operating life so that problems are identified and resolved early to avert future (and potentially escalating) problems or accidents. Inspection of bearings during operation is integrated into such activities as occasionally listening to the sound of the bearings, monitoring bearing temperature, or investigating bearing vibration. Even a slight flaking of the bearing will create abnormal or irregular noise that can be readily distinguished from normal sound by a skilled worker using a noise locator. Although bearing temperature can be roughly determined by simply touching the housing surface, please insert a thermometer into a lubrication hole or similar point of entry to directly measure bearing temperature. Bearings for moving units that cannot be monitored for noise or temperature during operation, such as roller bearings for vehicles, should be periodically inspected, and fresh grease should applied.

Examining the condition of the grease during operation is also a useful method for determining the operational condition of the bearing. The operational condition can be determined by the amount of dirt and fine iron powder contained in the grease as well as any sign of leakage or deterioration of the grease.

Whenever such inspections reveal abnormality or failure of the bearing, the bearing should be disassembled for further detailed inspection to identify the cause.

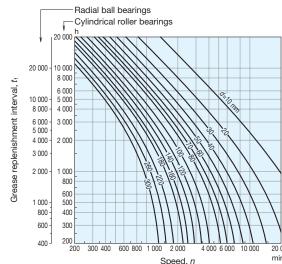


Fig. 23 Grease Replenishment Intervals for Radial Ball Bearings, Cylindrical Roller Bearings

3.2 Lubrication Method

3.2.1 Grease Lubrication

Lubricant is indispensable for bearings; however, only a small amount of lubricant is required and typically does not need to be replenished often. The interval varies depending on bearing type, dimension, number of revolutions and other operational conditions. These factors can often be determined empirically.

Figs. 23 and 24 are the guidelines of replenishment time interval for the condition of high-quality lithium soapmineral oil grease, bearing temperature of 70 °C, and normal load (*P*/*C*=0.1). 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. Also, the replenishment time interval depends on the magnitude of the bearing load, and it should be used by multiplying Load factor shown in table 9. In the case of ball bearings especially, the replenishment time interval can be extended depending on the grease type used.

(For example, high-quality lithium soap-synthetic oil grease may extend about two times of replenishing time interval shown in Figs. 23 and 24.)

The lubrication performance of grease declines by the emulsification or the deterioration due to intrusion of foreign matter or water. Therefore, if the bearing is used in such harsh conditions, it is necessary to shorten the replenishment time interval in Figs. 23 and 24 by a half to a tenth.

A housing should be designed in consideration of the need to replenish or replace the grease. For example, a

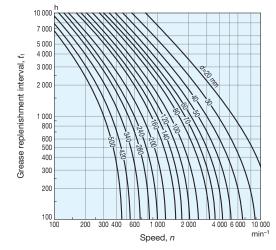


Fig. 24 Grease Replenishment Intervals for Tapered Roller Bearings, Spherical Roller Bearings

Table 9 Load factor

P/C	≦0.06	0.1	0.13	0.16
Load factor	1.5	1	0.65	0.45

housing used for machines requiring occasional replacement of grease should be easy to disassemble, and, since grease will be frequently replenished in situations in which the entry of water through a sealing device cannot be avoided, the housing must be designed so that the old grease can be readily discharged. Although the housing may be filled with grease when the bearing is used for extremely low-speed operation, avoid complete filling with grease in high-speed applications. When a housing can be regularly disassembled, it is better not to drill a grease supply hole. In practical terms, grease will only reach the periphery of the supply hole without reaching the bearing, and thus may actually impair performance.

However, larger bearings or bearings used for higher-speed operations require frequent, proper greasing. In this case, a grease supply hole should be drilled since it is difficult to disassemble the housing at every greasing. It is recommended to partition the housing space on the side of the supply hole into several grease sectors (Fig. 25) in order to infuse new grease into the bearing without filling up the housing. A wide housing space should be provided at the opposite side of the supply hole in order to collect old grease, which should be occasionally discharged by opening the cover.

Bearings used for high-speed operation can be greased more easily using a grease valve. This is appropriate for bearings used for long-term continuous operations, such as electric motors or turbine pumps. The grease valve is intended to obviate grease repletion. Fig. 26 illustrates the location of grease sectors and the provision of a

grease valve with a housing.

Fig. 27 shows a plummer block provided with a grease valve, where a thin iron plate b partitions grease sectors.

3.2.2 Oil Lubrication

An oil gauge, provided with a bath lubrication housing, should be read when the bearing is not in use in order to determine the oil level and lessen the chance of error occurring. In principle, if the quantity of oil is less than the proper oil level, oil should be supplied; however, if the sealing device is functioning properly with no hydraulic leakage, there is less need for lubrication replenishment. The need for oil replacement depends on operating conditions. If a bearing is used at a temperature of 50 °C or lower in a favorable environment with little dust or dirt, an oil change intervals up to one year should be sufficient.

If the bearing is used at an operating temperature exceeding 100 °C with an external heat source, the oil should be replaced every two or three months or more frequently, even if the used oil is thermally stable. In case of drop lubrication, the number of drops should be appropriately adjusted according to the specific conditions; however, several drops per minute should be sufficient under normal conditions. In case of high-speed operation, where the bearing is lubricated by oil-jet lubrication, the lubricant quantity will be adjusted by the oil pressure and the nozzle bore diameter. It is important to ensure that the supplied oil will not accumulate at the bearing section.

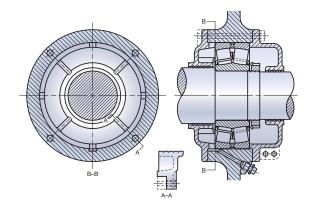


Fig. 25 Grease sectors

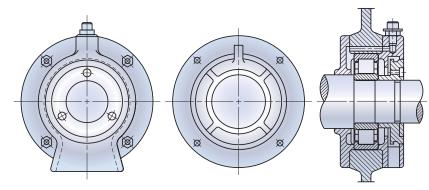


Fig. 26 Grease valve Fig. 27 Grease valve (plummer block)

3.3 Bearing Failure

Carefully observing a bearing that failed prematurely and inspecting the lubrication conditions and the mounting conditions to investigate the process leading to failure of the bearing is important to prevent recurrence. Likely causes include improper mounting, handling or lubrication; incomplete sealing structure; and insufficient consideration for thermal effect. For instance, rib scoring, one example of premature failure, may be the result of shortage of oil, faulty lubrication system, use of improper lubricant, entry of water or foreign matter, excessive relative tilt angle between the inner ring and the outer ring due to excessive mounting error or excessive deflection of the shaft, or any combination of these. Thus, it is too difficult to find the real cause by only inspecting the failed bearing itself. However, by tracing down the conditions before and after the occurrence of

failure, and after checking the machine and the area which the bearing was applied, and also the operating conditions and handling/operating histories, it becomes possible to determine several probable causes. This will help prevent recurrence of bearing failure. The quickest way to identify the cause is to painstakingly note all aspects of the failed bearing, including contact corrosion or flaws on the inner diameter surface and the outer diameter surface, as well as the condition of the bearing interior, such as the running track on the raceway and the sliding area, including the rib. At the same time, studying undamaged bearings used under similar operating conditions is often useful. To sum up, comprehensive examination of the machinery using the bearing is important. Representative cases of bearing failure are provided below for your reference.

Running Traces and Applied Loads

As the bearing rotates, the raceways of the inner ring and the outer ring make contact with the rolling elements. This results in a wear path on both the rolling elements and raceways. It is normal for the running trace to be marked on the raceway, and the extent and shape of this running trace provides a useful indication of loading conditions.

It is possible to determine from careful observation of the running traces whether the bearing is carrying a radial load, a large axial load, or a moment load, or if there is extreme rigidity variations of the housing. Unexpected load applied on the bearing or excessive mounting error or the like can also be determined, providing a clue to the investigation of

causes for bearing failure. Representative running traces of deep groove ball bearings are shown in Fig. 28.

Fig. 28 (a) to (d), show general running traces under radial load or axial load. The running traces vary according to whether the load is fixed to the inner ring or the outer ring, and according to load conditions. Fig. 28 (e) shows running traces with a shaft inclined due to misalignment; (f) is a running trace under a moment load; (g) is a running trace in a housing which is elliptically shaped and has poor inner diameter accuracy; and (h) is a running trace in a bearing with insufficient internal clearance. Running traces (e) to (h) often cause bearing failure, and must be carefully observed.

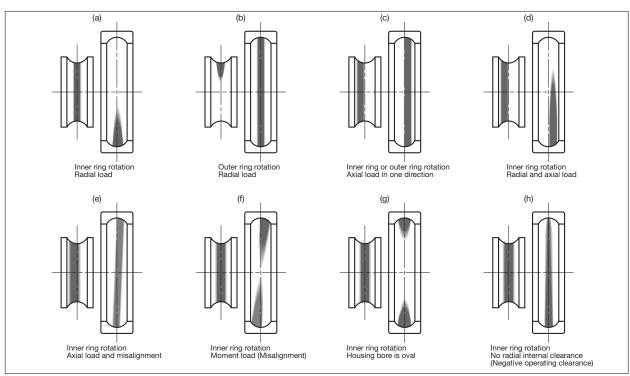


Fig. 28 Typical Running Traces of Deep Groove Ball Bearings

Flaking

Although flaking on a bearing appears to an extremely small extent at first, it will extend significantly in a relatively short time (Fig. 29). It cannot be easily determined whether the flaking can be attributed to bearing life, where flaking appears in the course of normal operation, or as a result of abnormal load. In addition, unlike other failures, flaking is often caused by the complicated interplay of lubrication, load and vibration factors, and thus, it is difficult to narrow down to a single cause. However, since the probability of premature cracks is extremely low where the bearing is used under proper lubrication and load, lubrication and the scale of load should be investigated as possible sources of trouble. Fig. 30 shows early-stage flaking that occurred only on one side of a spherical roller bearing as a result of an excessive axial load. In addition to such abnormal load, causes of early-stage flaking include mounting in a tilted position, improper selection of bearing clearance, and poor accuracy of housing.



Fig. 29 Flaking



Fig. 30 Flaking

Fracture and Cracks

Fig. 31 shows fracture on the large rib of the inner ring of a tapered roller bearing. This occurs when an abnormal axial load or a shock load is applied to a bearing or when an abnormal force is applied to the rib when mounting or dismounting the bearing. Causes of cracks include application of a heavy shock load (Fig. 32) and excessive interference. Where the bearing is supported only by the two edges of the outer ring, it may break along the axial plane and where there is slippage between the inner outer ring and the shaft or housing, a crack will occur at right angles to the direction of slippage. This phenomenon is seen in cases where the outer ring is loosely fit with the shaft and creeping occurs.

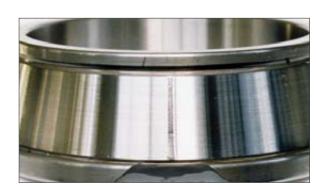


Fig. 31 Fracture



Fig. 32 Crack

Denting

Raceway dents (Brinell dents) can occur as a result of careless handling of the bearing, catching particles, or a heavy shock load applied to the bearing at rest. In addition, a dent similar to a Brinell dent may be caused by advanced abrasion in the contact area between the rolling element and the raceway resulting from vibration or oscillatory motion. This phenomenon, known as false brinelling, is often seen, especially in cases where a bearing is transported while mounted in a machine (Fig. 33).



Fig. 33 Denting

Scoring

Scoring occurs in a roller bearing where the roller end face (or faces) comes in contact with the rib surface of either the inner ring or outer ring (or both) as a result of small seizures, which are caused by insufficient lubrication or the entry of debris. This damage occurs on the rib surface or roller end face before any damage occurs on the rolling contact surface (Figs. 34 and 35).



Fig. 34 Scoring on the Rib of Spherical Roller Bearing



Fig. 35 Scoring on the Roller End Face

Wear

Factors influencing wear include entry of debris, insufficient lubricant and improper lubricant (Fig. 36), or where entry of water causes corrosive wear on the sliding surface or on the rolling surface.

In addition, abrasion may be caused on the fitted shaft surface by creep resulting from inappropriate fitting.



Fig. 36 Wear

Rust

Rust in the bearing interior is caused by the entry of moisture or improper lubricant. Fig. 37 shows an example of rust caused by poor lubrication due to the entry of moisture. Reddish brown or black abrasive powder may appear on the fitted shaft surface between the shaft/housing and inner ring/outer ring. The oxide is generated by oxidation of the fitted shaft surface resulting from the slight sliding between the shaft/housing and inner ring/outer ring that occurs when contact between them is poor and is often seen in areas where vibration or heavy loads have been applied. This phenomenon, known as fretting (also called fretting corrosion), is similar to rust at first glance.



Fig. 37 Rust

Electrical Corrosion

When electric current passes through a bearing in operation, the contact area between the inner/outer ring and the ball/roller will locally melt due to electric arcing through the extremely thin oil film to form groove-like corrugations. In a conspicuous case, these grooves may appear as a pitted surface or a striped uneven surface. (Fig. 38). When the extent of the electric corrosion is significant, flaking will be induced or the hardness of the raceway surface will be impaired resulting in advanced abrasion.



Fig. 38 Electric Corrosion

Smearing

Smearing is surface damage which occurs between the raceway surface and the rolling surface caused during operation by a collection of small seizures resulting from sliding and oil film rupture. The failure surface becomes rough as a result of the accumulation of minute adhesions as shown in Fig. 39. Improved lubricant and lubrication method are required.



Fig. 39 Smearing

Creep

Creep is a phenomenon in bearings where relative slipping occurs at the fitting surfaces (between the bore surface of inner ring and the shaft; and between the outside surface of outer ring and the housing), and thereby creates a clearance at the fitting. A creeping fitting surface causes a shiny or smoky surface, with the occasional appearance of scoring or wear. Fig. 40 shows an example of this failure. Checking the interference of fitting surfaces and lateral tightening of the outer ring are effective in preventing creep. Lubrication between the bearing and the shaft/housing is effective for preventing scoring or wear.



Fig. 40 Creep



Dismounting

Bearings are dismounted for periodic inspection or replacement. If the removed bearing is to be reused or it is removed only for inspection, dismounting needs to be conducted as carefully as mounting, taking care not to damage the bearing or individual components. Since it is particularly difficult to dismount bearings that are tightly fitted, sufficient consideration should be given at the design stage to the structure surrounding the bearing so that the bearing can be easily dismounted. It is also important to design and manufacture dismounting tools as required.

All possible preparations must be made for dismounting bearings by studying the dismounting method, the sequence of procedures, and the fitting conditions of the bearing as displayed in drawings.

When investigating the cause of bearing failure, the bearing also needs to be treated carefully, as described above, to preserve the condition of the bearing prior to dismounting. In the course of dismounting a bearing, take care not to scratch the bearing, wipe off any grease, or remove dust, dirt or iron powder, since these actions may prevent identifying the cause of the failure. Although a loosely fitted bearing can be easily dismounted, exercise extreme care when the bearing is tightly fixed.

Dismounting Outer Rings

Fig. 41 shows an easy, effective method for dismounting a bearing with a tightly fitted outer ring. In this method, dismounting bolts are first placed into push-out holes at

three points in the housing that are plugged except when dismounting the bearing.

The method shown in Fig. 42 is recommended for housings with back and front covers fitted by through bolts. The inner ring/outer ring grooves must be protected from dents or scratches as the bearing is pulled out using a special nut that simultaneously supports both the inner and outer rings of the bearing. Depending on circumstances, the bearing may be dismounted by heating the housing; however, the circumference must be uniformly heated or the housing may be contorted or cracked. Also note that if the housing is heated for too long, the bearing may expand and become difficult to pull out.

4.2 Dismounting Inner Rings

Dismounting an inner ring is more difficult than mounting the ring when it is tightly fitted. Although a claw tool is often used to hook and then dismount an inner ring, using the same tool to pull out an outer ring may dent the raceway or spoil the bearing.

An easy method, which is often used when the inserted interference is relatively small (Fig. 43-a), involves making two or three notches on the shaft shoulder and then tapping with a hammer and patch to pull out the inner ring. However, the blow can be more safely applied using a doubled ring as shown in Fig. 43-b, since there is a risk of tapping so hard that the patch may slip and allow the small rib of the inner ring to be damaged.

Other safer methods include using a tube as an

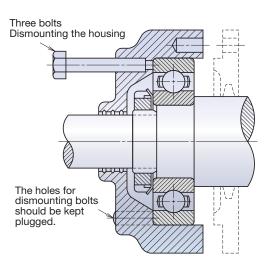


Fig. 41 Dismounting the Outer Ring

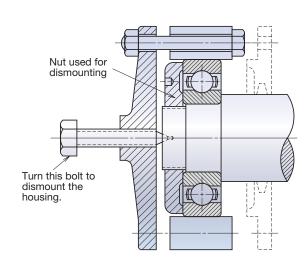


Fig. 42 Dismounting the Outer Ring

intermediary as shown in Fig. 43-c. Using a screw or a press is also recommended.

The tool shown in Fig. 44 is also effective for withdrawing an inner ring. Back plate A, consisting of an upper board and a lower board, is fastened with bolts. Inserting a steel ball (thrust ball bearing for a large-size bearing) between front plate B and bolt C increases reliability. Appropriate bolt holes should be drilled in A and B according to the size of the individual bearing. The force required for pulling out the inner ring can be obtained using the aforementioned equation (5) and Tables 3 and 4. The back cover of the housing may be used instead of back plate A, depending on specific conditions. Large-size roller bearings with large interference can be dismounted more easily without damaging the inner ring, in accordance with the previously described mounting/dismounting method by induction heating. When this device is not available, the inner ring may be expanded by heating the circumference with a burner or similar equipment. This method is intended to prevent damage to the shaft without regard for the possible reuse of the bearing.

The dismounting of bearings must be sufficiently considered well in advance, at the design stage, and the appropriate method must be selected and prepared for prior to implementation.

In other words, no aspect of bearing design is complete unless the processes of mounting and dismounting have been taken into account.

4.3 Bearing Cleaning

When bearings used for a given period of time are dismounted for inspection, they should be cleaned. First inspect the old grease coating the bearing, then clean

(a)

Fig. 43 Dismounting the Inner Ring

the bearing and examine its condition.

Dismounted bearings should first be given a preliminary cleaning followed by a finishing rinse. During preliminary cleaning, it is better to use a brush to gently remove any grease containing dust, dirt, or abrasive powder, without rotating the bearing.

New bearings are always coated with an anti-corrosion agent prior to packaging. Generally, these bearings do not need to be cleaned only to remove the anti-corrosion agent. Since only a thin coating of anti-corrosion agent covers the surface of the bearing, there should not be any harmful effect from leaving the agent on the bearing, even when mixed with a lubricant or lubrication grease. Greater damage can be caused by cleaning the bearing in an environment exposed to contaminated oil, dust, or dirt. Nevertheless, removing the anti-corrosion agent is recommended for small bearings used in high-speed operations or for bearings that will use low-viscosity or mist lubrication.

Therefore, in principle, bearings should be cleaned when they are being examined; when dust and dirt have adhered to the bearing; or when the machine using the bearing operates at a level of speed or accuracy that would be impaired by even the slightest resistance to bearing rotation.

Kerosene is generally used as a cleaning agent. Lowviscosity spindle oil may be jet-sprayed.

Compressed air is also used to remove dust and dirt from the bearing, unless the applied air contains moisture or dust/dirt; air usually contains moisture that often condenses into water droplets at the tip of the nozzle. Therefore due care must be exercised when using compressed air. In addition, since cleaning a bearing while rotating the bearing by blowing it with compressed air can damage the raceway, the inner ring/outer ring

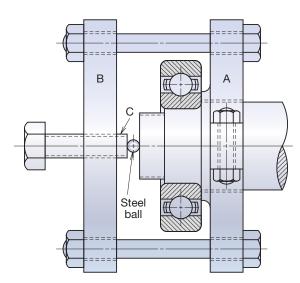


Fig. 44 Tool for Withdrawing an Inner Ring

must be fixed to prevent the bearing from rotating. When storing a cleaned bearing, it should be thoroughly dried and coated with an anti-corrosion agent. When applying grease, be sure to rotate the bearing to ensure uniform distribution to every part of the bearing.

4.4 Bearing Inspection

The term "inspection" here does not refer to the quantitative measurement of dimensional or rotational accuracy of the bearing, but simply refers to visual examination.

Specifically, in order to investigate the condition of a bearing used for a given period, carefully note the presence of any abnormality and determine whether the bearing can easily be reused, completely clean the bearing as described above, and then look for visible

abnormalities such as rust, dents, or flaking in the raceway or the rolling element. Carefully inspect ball bearings for rotational smoothness.

In addition, also check for creep in the fitting surface of the inner ring or the outer ring as well as any signs of serious abrasion.

Also inspect the cage for wear, loose rivets or head defects. Defects most frequently occur when the rotational speed of the bearing is too high for the cage or when the lubricant is poor or insufficiently applied.

Although a relatively large roller bearing can be measured for clearance with a clearance gauge, small bearings such as ball bearings cannot be measured by simply moving them by hand. An appropriate method must be applied to reliably determine the correct clearance. Refer to International Standards ISO 1132-2.



Bearing Storage

Since bearings are not intended for permanent use but must be replaced at given intervals, spare bearings must be stored in warehouse environments that are similar to operational conditions so they can be replaced immediately.

When storing bearings, pay special attention to preventing rust. Although bearings are usually coated with an anti-corrosion agent and then packaged, the wrapping paper cannot completely provide protection from the circulation of ambient air. Therefore, bearings should be stored in a moisture-free location.

In addition, bearings should be stored in clean, well-ventilated spaces with little humidity and no direct exposure to sunlight, in a locker or on a shelf, at least 30 cm above the floor. The bearings must be kept wrapped unless otherwise required, since unwrapping them can allow rust to occur.

When bearings are unwrapped for inspection prior to acceptance, they must be stored with due attention to the subsequent application of anti-corrosion agent and then re-packaged.

Reference Catalog

New Bearing Doctor (CAT. No. 7002)
Instruction Manual for Spherical Roller Bearing (CAT. No. 9003)
Technical Report (CAT. No. 728)
Instruction Manual for Roll Neck Bearing (CAT. No. 9001)

6 Appendices

Appendix Table 1 Tolerances for Shaft Diameters

Units: µm

Class	meter ification nm)	Single Plane Mean B.D. Deviation	d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6	j5	j6	j7	k5	k6	k7	m5	m6	n6	р6	r6	r7	Diam Classificat	
over	incl.	(Normal) $\Delta_{d\mathrm{mp}}$															-	-										over	incl.
3	6	- 8	- 30 - 38	- 20 - 28	- 10 - 18	- 4 - 9	- 4 - 12	0 - 5	0 - 8	0 - 12	0 - 18	0 - 30	0 - 48	± 2.5	± 4	+ 3 - 2	+ 6 - 2	+ 8 - 4	+ 6 + 1	+ 9 + 1	+ 13 + 1	+ 9 + 4	+ 12 + 4	+ 16 + 8	+ 20 + 12	+ 23 + 15	+ 27 + 15	3	6
6	10	- 8	- 40 - 49	- 25 - 34	- 13 - 22	- 5 - 11	- 5 - 14	0 - 6	0 - 9	0 - 15	0 - 22	0 - 36	0 - 58	± 3	± 4.5	+ 4 - 2	+ 7 - 2	+ 10 - 5	+ 7 + 1	+ 10 + 1	+ 16 + 1	+ 12 + 6	+ 15 + 6	+ 19 + 10	+ 24 + 15	+ 28 + 19	+ 34 + 19	6	10
10	18	- 8	- 50 - 61	- 32 - 43	- 16 - 27	- 6 - 14	- 6 - 17	0 - 8	0 - 11	0 - 18	0 - 27	0 - 43	0 - 70	± 4	± 5.5	+ 5 - 3	+ 8 - 3	+ 12 - 6	+ 9 + 1	+ 12 + 1	+ 19 + 1	+ 15 + 7	+ 18 + 7	+ 23 + 12	+ 29 + 18	+ 34 + 23	+ 41 + 23	10	18
18	30	0 - 10	- 65 - 78	- 40 - 53	- 20 - 33	- 7 - 16	- 7 - 20	0 - 9	0 - 13	0 - 21	0 - 33	0 - 52	0 - 84	± 4.5	± 6.5	+ 5	+ 9 - 4	+ 13 - 8	+ 11 + 2	+ 15 + 2	+ 23 + 2	+ 17 + 8	+ 21 + 8	+ 28 + 15	+ 35 + 22	+ 41 + 28	+ 49 + 28	18	30
30	50	0 - 12	- 80 - 96	- 50 - 66	- 25 - 41	- 9 - 20	- 9 - 25	0 - 11	0 - 16	0 - 25	0 - 39	0 - 62	0 –100	± 5.5	± 8	+ 6 - 5	+ 11 - 5	+ 15 - 10	+ 13 + 2	+ 18 + 2	+ 27 + 2	+ 20 + 9	+ 25 + 9	+ 33 + 17	+ 42 + 26	+ 50 + 34	+ 59 + 34	30	50
50	80	0	-100	- 60	- 30	- 10	- 10	0	0	0	0	0	0	. 65	. 0.5	+ 6	+ 12	+ 18	+ 15	+ 21	+ 32	+ 24	+ 30	+ 39	+ 51	+ 60 + 41	+ 71 + 41	50	65
30	00	- 15	-119	- 79	- 49	- 23	- 29	- 13	- 19	- 30	- 46	- 74	-120	± 6.5	± 9.5	- 7	- 7	- 12	+ 2	+ 2	+ 2	+ 11	+ 11	+ 20	+ 32	+ 62 + 43	+ 73 + 43	65	80
80	120	0	-120	- 72	- 36	- 12	- 12	0	0	0	0	0	0	± 7.5	± 11	+ 6	+ 13	+ 20	+ 18	+ 25	+ 38	+ 28	+ 35	+ 45	+ 59	+ 73 + 51	+ 86 + 51	80	100
80	120	- 20	-142	- 94	- 58	- 27	- 34	- 15	- 22	- 35	- 54	- 87	-140	± 7.5	± 11	- 9	- 9	- 15	+ 3	+ 3	+ 3	+ 13	+ 13	+ 23	+ 37	+ 76 + 54	+ 89 + 54	100	120
																										+ 88 + 63	+103 + 63	120	140
120	180	0 - 25	-145 -170	- 85 -110	- 43 - 68	- 14 - 32	- 14 - 39	0 - 18	0 - 25	0 - 40	0 - 63	0 –100	0 –160	± 9	± 12.5	+ 7	+ 14 - 11	+ 22 - 18	+ 21 + 3	+ 28 + 3	+ 43 + 3	+ 33 + 15	+ 40 + 15	+ 52 + 27	+ 68 + 43	+ 90 + 65	+105 + 65	140	160
																										+ 93 + 68	+108 + 68	160	180
																										+106 + 77	+123 + 77	180	200
180	250	- 30	-170 -199	-100 -129	- 50 - 79	- 15 - 35	- 15 - 44	0 - 20	0 - 29	0 - 46	0 - 72	0 –115	0 –185	± 10	± 14.5	+ 7 - 13	+ 16 - 13	+ 25 - 21	+ 24 + 4	+ 33 + 4	+ 50 + 4	+ 37 + 17	+ 46 + 17	+ 60 + 31	+ 79 + 50	+109 + 80	+126 + 80	200	225
																										+113 + 84	+130 + 84	225	250
250	315	0	-190	-110	- 56	- 17	- 17	0	0	0	0	0	0	± 11.5	± 16	+ 7	± 16	± 26	+ 27	+ 36	+ 56	+ 43	+ 52	+ 66	+ 88	+126 + 94	+146 + 94	250	280
230	313	- 35	-222	-142	- 88	- 40	- 49	- 23	- 32	- 52	- 81	-130	-210	± 11.5	± 10	- 16	1 10	1 20	+ 4	+ 4	+ 4	+ 20	+ 20	+ 34	+ 56	+130 + 98	+150 + 98	280	315
315	400	0	-210	-125	- 62	- 18	- 18	0	0	0	0	0	0	± 12.5	± 18	+ 7	± 18	+ 29	+ 29	+ 40	+ 61	+ 46	+ 57	+ 73	+ 98	+144 +108	+165 +108	315	355
313	400	- 40	-246	-161	- 98	- 43	- 54	- 25	- 36	- 57	- 89	-140	-230	± 12.5	± 10	- 18	1 10	- 28	+ 4	+ 4	+ 4	+ 21	+ 21	+ 37	+ 62	+150 +114	+171 +114	355	400
400	500	0	-230	-135	- 68	- 20	- 20	0	0	0	0	0	0	± 13.5	± 20	+ 7	± 20	+ 31	+ 32	+ 45	+ 68	+ 50	+ 63	+ 80	+108	+166 +126	+189 +126	400	450
400	500	- 45	-270	-175	-108	- 47	- 60	- 27	- 40	- 63	- 97	-155	-250	± 13.5	± 20	- 20	± 20	- 32	+ 5	+ 5	+ 5	+ 23	+ 23	+ 40	+ 68	+172 +132	+195 +132	450	500
500	630	0	-260	-145	- 76		- 22		0			0			. 22				_	+ 44	+ 70	_	+ 70	+ 88	+122	+194 +150	+220 +150	500	560
300	030	- 50	-304	-189	-120	_	- 66	_	- 44	- 70	-110	–175	-280	_	± 22	_	_	_	_	0	0	_	+ 26	+ 44	+ 78	+199 +155	+225 +155	560	630
620	900	0	-290	-160	- 80		- 24		0	0	0	0	0		± 25					+ 50	+ 80		+ 80	+100	+138	+225 +175	+255 +175	630	710
630	800	- 75	-340	-210	-130	_	- 74	_	- 50	- 80	-125	-200	-320	_	± 23	_	_	_	_	0	0	_	+ 30	+ 50	+ 88	+235 +185	+265 +185	710	800
000	1 000	0	-320	-170	- 86		- 26		0	0	0	0	0		. 00					+ 56	+ 90		+ 90	+112	+156	+266 +210	+300 +210	800	900
800	1 000	-100	-376	-226	-142	_	- 82	_	- 56	- 90	-140	-230	-360	_	± 28	_	_	_	_	0	0	_	+ 34	+ 56	+100	+276 +220	+310 +220	900	1 000
4 000	4.050	0	-350	-195	- 98		- 28		0	0	0	0	0		. 00					+ 66	+105		+106	+132	+186	+316 +250	+355 +250	1 000	1 120
1 000	1 250	-125	-416	-261	-164	_	- 94	_	- 66	-105	-165	-260	-420	_	± 33	_	_	_	_	+ 66 0	0	_	+ 40	+ 66	+120	+326 +260	+365 +260	1 120	1 250
1.050	1.000	0	-390	-220	-110		- 30		0	0	0	0	0		. 20					+ 78	+125		+126	+156	+218	+378 +300	+425 +300	1 250	1 400
1 250	1 600	-160	-468	-298	-188	_	-108	_	- 78	-125	-195	-310	-500	_	± 39	_	_	_	_	0	0	_	+ 48	+ 78	+140	+408 +330	+455 +330	1 400	1 600
1 600	2.000	0	-430	-240	-120		- 32		0	0	0	0	0		. 46					+ 92	+150		+150	+184	+262	+462 +370	+520 +370	1 600	1 800
1 600	2 000	-200	-522	-332	-212		-124		- 92	-150	-230	- 370	-600		± 46		_	_		0	0		+ 58	+ 92	+170	+492 +400	+550 +400	1 800	2 000

Appendix Table 2 Tolerances for Housing Bore Diameters

Units: µm

Diam Classifi	eter cation	Single Plane Mean B.D.																								Dian	
over		Deviation (Normal) $\Delta D_{\rm mp}$	E6	F6	F7	G6	G7	Н6	Н7	Н8	Ј6	Ј7	JS6	JS7	K5	K6	K7	M5	M6	M7	N5	N6	N7	P6	P7	Classifica over	incl.
10	18	0 - 8	+ 43 + 32	+ 27 + 16	+ 34 + 16	+ 17 + 6	+ 24 + 6	+ 11	+ 18	+ 27 0	+ 6 - 5	+ 10 - 8	± 5.5	± 9	+ 2 - 6	+ 2 - 9	+ 6 - 12	- 4 - 12	- 4 - 15	0 - 18	- 9 - 17	- 9 - 20	- 5 - 23	- 15 - 26	- 11 - 29	10	18
18	30	- 9	+ 53 + 40	+ 33 + 20	+ 41 + 20	+ 20 + 7	+ 28 + 7	+ 13 0	+ 21	+ 33	+ 8 - 5	+ 12 - 9	± 6.5	± 10.5	+ 1	+ 2 - 11	+ 6 - 15	- 5 - 14	- 4 - 17	0 - 21	- 12 - 21	- 11 - 24	- 7 - 28	- 18 - 31	- 14 - 35	18	30
30	50	0 - 11	+ 66 + 50	+ 41 + 25	+ 50 + 25	+ 25 + 9	+ 34 + 9	+ 16 0	+ 25	+ 39	+ 10 - 6	+ 14 - 11	± 8	± 12.5	+ 2 - 9	+ 3 - 13	+ 7 - 18	- 5 - 16	- 4 - 20	0 - 25	- 13 - 24	- 12 - 28	- 8 - 33	- 21 - 37	- 17 - 42	30	50
50	80	0 - 13	+ 79 + 60	+ 49 + 30	+ 60 + 30	+ 29 + 10	+ 40 + 10	+ 19 0	+ 30	+ 46	+ 13 - 6	+ 18 - 12	± 9.5	± 15	+ 3 - 10	+ 4 - 15	+ 9 - 21	- 6 - 19	- 5 - 24	0 - 30	- 15 - 28	- 14 - 33	- 9 - 39	- 26 - 45	- 21 - 51	50	80
80	120	0 - 15	+ 94 + 72	+ 58 + 36	+ 71 + 36	+ 34 + 12	+ 47 + 12	+ 22 0	+ 35	+ 54	+ 16 - 6	+ 22 - 13	± 11	± 17.5	+ 2 - 13	+ 4 - 18	+ 10 - 25	- 8 - 23	- 6 - 28	0 - 35	- 18 - 33	- 16 - 38	- 10 - 45	- 30 - 52	- 24 - 59	80	120
120 150	150 180	0 - 18 0 - 25	+110 + 85	+ 68 + 43	+ 83 + 43	+ 39 + 14	+ 54 + 14	+ 25 0	+ 40	+ 63	+ 18 - 7	+ 26 - 14	± 12.5	± 20	+ 3 - 15	+ 4 - 21	+ 12 - 28	- 9 - 27	- 8 - 33	0 - 40	- 21 - 39	- 20 - 45	- 12 - 52	- 36 - 61	- 28 - 68	120	180
180	250	0 - 30	+129 +100	+ 79 + 50	+ 96 + 50	+ 44 + 15	+ 61 + 15	+ 29	+ 46	+ 72	+ 22 - 7	+ 30 - 16	± 14.5	± 23	+ 2 - 18	+ 5 - 24	+ 13 - 33	- 11 - 31	- 8 - 37	0 - 46	- 25 - 45	- 22 - 51	- 14 - 60	- 41 - 70	- 33 - 79	180	250
250	315	0 - 35	+142 +110	+ 88 + 56	+108 + 56	+ 49 + 17	+ 69 + 17	+ 32	+ 52 0	+ 81	+ 25 - 7	+ 36 - 16	± 16	± 26	+ 3 - 20	+ 5 - 27	+ 16 - 36	- 13 - 36	- 9 - 41	0 - 52	- 27 - 50	- 25 - 57	- 14 - 66	- 47 - 79	- 36 - 88	250	316
315	400	0 - 40	+161 +125	+ 98 + 62	+119 + 62	+ 54 + 18	+ 75 + 18	+ 36	+ 57 0	+ 89	+ 29 - 7	+ 39 - 18	± 18	± 28.5	+ 3 - 22	+ 7 - 29	+ 17 - 40	- 14 - 39	- 10 - 46	0 - 57	- 30 - 55	- 26 - 62	- 16 - 73	- 51 - 87	- 41 - 98	315	400
400	500	0 - 45	+175 +135	+108 + 68	+131 + 68	+ 60 + 20	+ 83 + 20	+ 40 0	+ 63	+ 97	+ 33 - 7	+ 43 - 20	± 20	± 31.5	+ 2 - 25	+ 8 - 32	+ 18 - 45	- 16 - 43	- 10 - 50	0 - 63	- 33 - 60	- 27 - 67	- 17 - 80	- 55 - 95	- 45 -108	400	500
500	630	0 - 50	+189 +145	+120 + 76	+146 + 76	+ 66 + 22	+ 92 + 22	+ 44 0	+ 70	+110	_	_	± 22	± 35	_	0 - 44	0 - 70	_	- 26 - 70	- 26 - 96	_	- 44 - 88	- 44 -114	- 78 -122	- 78 -148	500	630
630	800	0 - 75	+210 +160	+130 + 80	+160 + 80	+ 74 + 24	+104 + 24	+ 50 0	+ 80	+125 0	_	-	± 25	± 40	_	0 - 50	0 - 80	_	- 30 - 80	- 30 -110	_	- 50 -100	- 50 -130	- 88 -138	- 88 -168	630	800
800	1 000	0 –100	+226 +170	+142 + 86	+176 + 86	+ 82 + 26	+116 + 26	+ 56 0	+ 90	+140	_	_	± 28	± 45	_	0 - 56	0 - 90	_	- 34 - 90	- 34 -124	_	- 56 -112	- 56 -146	-100 -156	-100 -190	800	1 000
1 000	1 250	0 –125	+261 +195	+164 + 98	+203 + 98	+ 94 + 28	+133 + 28	+ 66 0	+105 0	+165 0	_	-	± 33	± 52.5	_	0 - 66	0 –105	_	- 40 -106	- 40 -145	_	- 66 -132	- 66 -171	-120 -186	-120 -225	1 000	1 250
1 250	1 600	0 –160	+298 +220	+188 +110	+235 +110	+108 + 30	+155 + 30	+ 78	+125 0	+195 0	_	-	± 39	± 62.5	_	0 - 78	0 -125	_	- 48 -126	- 48 -173	_	- 78 -156	- 78 -203	–140 –218	-140 -265	1 250	1 600
1 600	2 000	0 –200	+332 +240	+212 +120	+270 +120	+124 + 32	+182 + 32	+ 92 0	+150 0	+230 0	_	-	± 46	± 75	_	0 - 92	0 -150	_	- 58 -150	- 58 -208	_	- 92 -184	- 92 -242	–170 –262	–170 –320	1 600	2 000
2 000	2 500	0 –250	+370 +260	+240 +130	+305 +130	+144 + 34	+209 + 34	+110 0	+175 0	+280 0	_	-	± 55	± 87.5	_	0 –110	0 -175	_	- 68 -178	- 68 -243	_	–110 –220	–110 –285	–195 –305	-195 -370	2 000	2 500

Appendix Table 3 Values of Standard Tolerance Grades IT

Bas	ic Size									Standard	Grades									Basi	c Size
(r	mm)	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16	IT17	IT18	(n	nm)
over	incl.					То	lerances (µm)								Т	olerances (µn	m)			over	incl.
-	3	0.8	1.2	2	3	4	6	10	14	25	40	60	0.10	0.14	0.25	0.40	0.60	1.00	1.40	-	3
3	6	1	1.5	2.5	4	5	8	12	18	30	48	75	0.12	0.18	0.30	0.48	0.75	1.20	1.80	3	6
6	10	1	1.5	2.5	4	6	9	15	22	36	58	90	0.15	0.22	0.36	0.58	0.90	1.50	2.20	6	10
10	18	1.2	2	3	5	8	11	18	27	43	70	110	0.18	0.27	0.43	0.70	1.10	1.80	2.70	10	18
18	30	1.5	2.5	4	6	9	13	21	33	52	84	130	0.21	0.33	0.52	0.84	1.30	2.10	3.30	18	30
30	50	1.5	2.5	4	7	11	16	25	39	62	100	160	0.25	0.39	0.62	1.00	1.60	2.50	3.90	30	50
50	80	2	3	5	8	13	19	30	46	74	120	190	0.30	0.46	0.74	1.20	1.90	3.00	4.60	50	80
80	120	2.5	4	6	10	15	22	35	54	87	140	220	0.35	0.54	0.87	1.40	2.20	3.50	5.40	80	120
120	180	3.5	5	8	12	18	25	40	63	100	160	250	0.40	0.63	1.00	1.60	2.50	4.00	6.30	120	180
180	250	4.5	7	10	14	20	29	46	72	115	185	290	0.46	0.72	1.15	1.85	2.90	4.60	7.20	180	250
250	315	6	8	12	16	23	32	52	81	130	210	320	0.52	0.81	1.30	2.10	3.20	5.20	8.10	250	315
315	400	7	9	13	18	25	36	57	89	140	230	360	0.57	0.89	1.40	2.30	3.60	5.70	8.90	315	400
400	500	8	10	15	20	27	40	63	97	155	250	400	0.63	0.97	1.55	2.50	4.00	6.30	9.70	400	500
500	630	9	11	16	22	32	44	70	110	175	280	440	0.70	1.10	1.75	2.80	4.40	7.00	11.00	500	630
630	800	10	13	18	25	36	50	80	125	200	320	500	0.80	1.25	2.00	3.20	5.00	8.00	12.50	630	800
800	1 000	11	15	21	28	40	56	90	140	230	360	560	0.90	1.40	2.30	3.60	5.60	9.00	14.00	800	1 000
1 000	1 250	13	18	24	33	47	66	105	165	260	420	660	1.05	1.65	2.60	4.20	6.60	10.50	16.50	1 000	1 250
1 250	1 600	15	21	29	39	55	78	125	195	310	500	780	1.25	1.95	3.10	5.00	7.80	12.50	19.50	1 250	1 600
1 600	2 000	18	25	35	46	65	92	150	230	370	600	920	1.50	2.30	3.70	6.00	9.20	15.00	23.00	1 600	2 000
2 000	2 500	22	30	41	55	78	110	175	280	440	700	1 100	1.75	2.80	4.40	7.00	11.00	17.50	28.00	2 000	2 500
2 500	3 150	26	36	50	68	96	135	210	330	540	860	1 350	2.10	3.30	5.40	8.60	13.50	21.00	33.00	2 500	3 150

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Remarks 1. Standard tolerance grades IT 14 to IT 18 must not be used for basic sizes less than or equal to 1 mm.

2. Values for standard tolerance grades IT 1 to IT 5 for basic sizes over 500 mm are included for experimental use.

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