CATALOGUE/TC-106, 06/2025

NBC Bearings is a leading brand of bearings owned by National Engineering Industries (NEI).

Part of the multibillion -dollar conglomerate CKA Birla Group known for its world -class businesses present in five continents, NBC was founded in 1946 in Jaipur and is India's first bearings manufacturer.

Since then, NBC Bearings has grown from a pioneer in India to become one of India's largest exporter of bearings and flexible engineering solutions, renowned for its superior quality, precision and durability. Over 20% of NBC's total revenue is generated from exports to over 30 countries.

In fact, NBC is the only bearing manufacturer in the world to receive the prestigious Deming Grand Prize (Japan) for Total Quality Management.

In 2020, NBC acquired Kinex Bearings in Europe to expand its product portfolio and global footprint.

In keeping with the spirit of the CKA Birla Group for setting exceptional standards through knowledge, innovation and constant R&D, NBC Bearings today form a critical part of the machinery used in Automotive, Railway, Industrial, Aerospace and many other sectors.

For over 75+ years, NBC is creating products that perform. With digitization across its five state-of-the-art plants and latest technology.

Founded in 1946, NBC is India's first bearing manufacturer and the last word in quality and durability. In 2020, the company acquired leading European manufacturer, Kinex Bearings to further boost its expertise.

75 years since its beginning, NBC remains India's leading bearings manufacturer and exporter. NBC is also the world's only bearings manufacturer to receive the prestigious Deming Grand Prize for Total Quality Management.

- 1946 India's first bearing manufacturer
- 200+ million bearings manufacturing capacity
- 3100+ variants of bearings offered
- 5 manufacturing locations
- 500+ Stockists 10000+ Retailers
- Happy customers in 30+ countries
- R&D centers in India, Slovakia, Germany
- 2800+People
- Automotive
- Industrial
- Railway
- Aerospace

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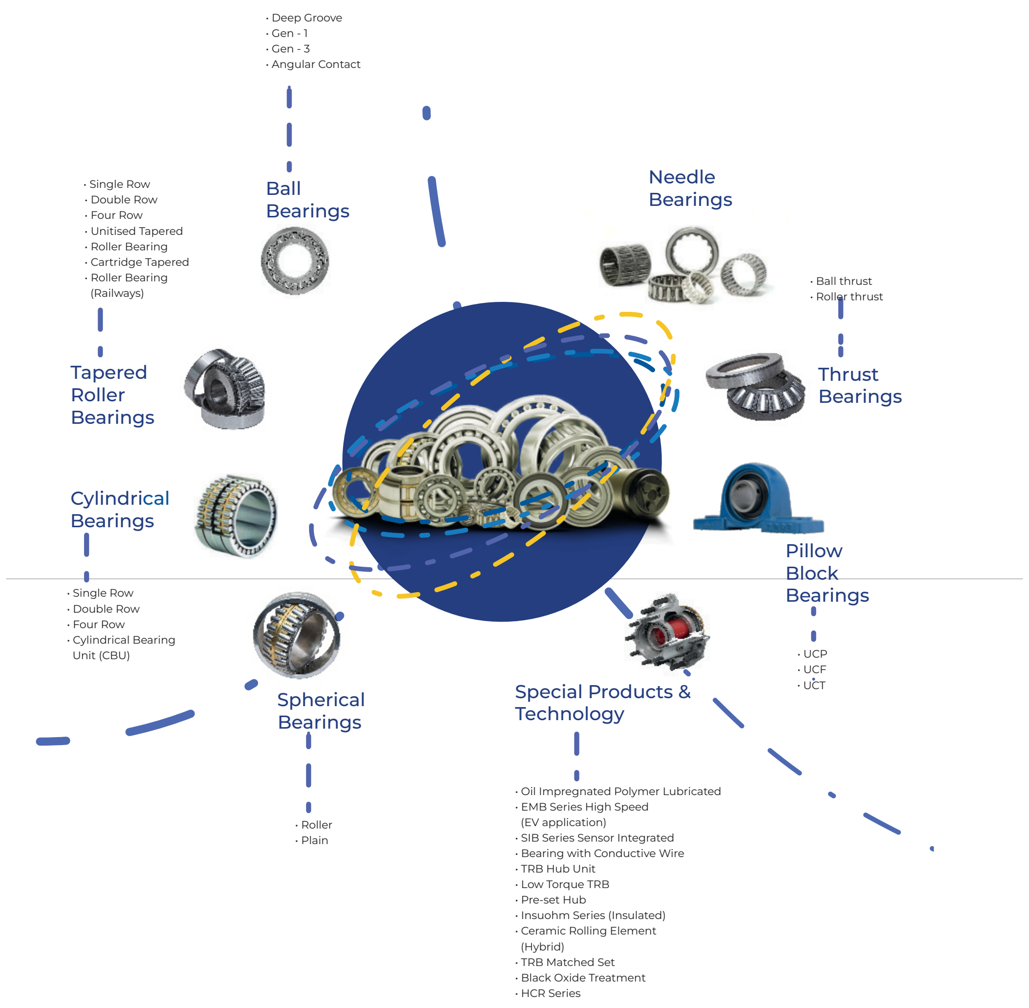
Products from NBC

Since the challenges faced by industry are many, NBC offers a diverse range of exceptional bearings. NBC bearings are available in sizes from 6 mm bore to 2000 mm outer diameter.



* Products with special features like high temperature application, special heat treatment, coated roller/races and cage options are also available across product range.

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MILESTONES

1946
National Bearing Company was established

1958
Renamed as National Engineering Industries Limited; the NBC trademark retained.

1981
Bearing production started in Newai, Rajasthan

1982
Technical collaboration with BRENCO, USA for Cartridge Taper Roller Bearings

1985
Technical collaboration with NTN Japan

1995
ISO 9001 certification

2000
ISO-14001 and QS-9001 certification

2003
Received TS 16949 certification

2005
Bearing production started in Manesar, Haryana

2006
Received AAR certification

2010

Deming Application Award

2014
Bearing production started in Savli, Gujarat.

2015

Became the world's only bearing manufacturing company to get the Deming Grand Prize

2017-18
- Industry 4.0 journey started
- Received the 'Great Place To Work' certification

2020
- Acquired Kinex Bearings, Europe.
- Featured in India's' top 100 companies to work for' list
- Launched Needle Roller Bearings
- The Jaipur plant received the IGBC Platinum certification

2021
- India's Best Workplaces in Manufacturing (Top 30)
- NEI Amsted JV Started in Bagru
- 75 years of incorporation.
- NBC Global Sales Office started in Switzerland

2022

- NBC Mascot Runningo launched
- Certified 'Great Place To Work' 5th year in a row
- NBC Kaili JV, China started
- NBC Global Technology Centre, Germany started

2023
- Certified 'Great Place to Work' 6th year in a row

2024
- Ventured into Aerospace segment.
- Established off ce in India

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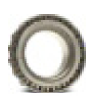
Manufacturing Capacities

- Four modern manufacturing plants with installed annual capacity of over 200 Million bearings.
- All manufacturing facilities equipped with cutting edge technology which helps producing best-in-class products with superior quality.
- Fully automatic plants with built in Poka-Yoke system ensures defect free jobs with minimal human interventions.
- Embraced Industry 4.0 and concept of connected enterprise to improve productivity, efficiency and become cost competitive to deliver value to customers.
- As a step towards sustainability, utilising alternate source of energy and making entire manufacturing process more efficient by leveraging power of digitalization.
- Well equipped to address volatile customer demand with multiple International and technical collaborations for state-of-the-art technology and advanced products.

Our Technology Partners



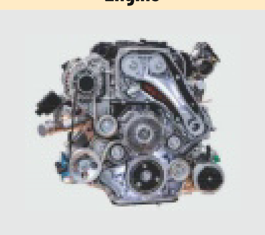
Technology Collaboration
with NTN Japan
for Ball & Taper Roller Bearings
(Since 1985)

Technology Partnership
with Amsted Rail Group (USA)
for Cartridge Taper Roller Bearings (CTRB)
for Railways (Since 1982) and
PreSet Hub Assembly for heavy duty trucks.

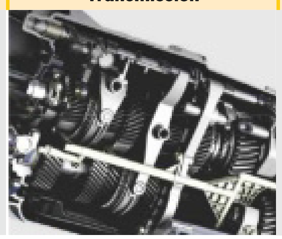
Technology Partnership
with IZUMI Machine Tools Japan
for Grinding & Super Finishing Machines
(Since 1996)

APPLICATIONS

Engine

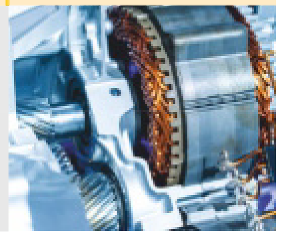


Transmission



PreSet Hub

Electric Vehicles



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Technology Centre

PRODUCT DEVELOPMENT
- Program Management
- Sourcing
- New Product Development

APPLICATION ENGINEERING
- Capturing voice of customers
- System Level Analysis
- Value Engineering

CENTRAL ENGINEERING
- Plant Support
- New Process Development

TECHNOLOGY FUNCTION
- Low Torque Bearings
- Fuel Efficient Bearings
- Tribiology & Metallurgical Enhancements

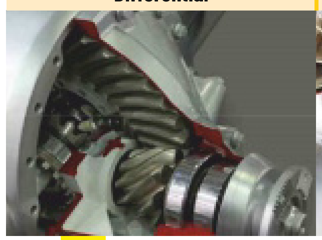
ADVANCED PRODUCTS & TECHNOLOGY
- Sensor Bearings
- Bearings for EV
- BSVI Compliant Bearings
- Special Coated Bearings

PRODUCT ENGINEERING
- Product Design
- Process Design
- Tool Design

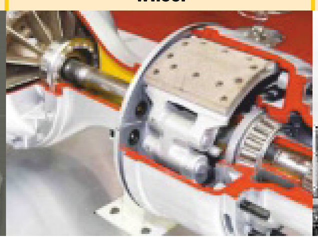
PRODUCT VALIDATION AND TESTING
- Fatigue Testing
- Seal Testing
- Application Testing

APPLICATIONS

Differential



Wheel



Industrial

Railway

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Value Prepositiion

- 150 days
- Assured Total Cost of Ownership (TCO) benefit
- Well-equipped to accommodate varying customer demands
- EDI capable warehouse facilities in North America & European Union
- Local Sales/Tech support in USA, Germany and Japan
- Leading R&D centre in India with state-of-the-art testing and research facilities
- Proven track record, as reliable bearing supplier to major Tier 1 and OEMs in India, North America & European Union

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01 Basics of Rolling Bearing

1.1 Type of Rolling Bearing

When two metal parts of a machine come in contact a large amount of friction is produced, and this can lead to the wear and tear of sliding parts. To reduce friction between sliding parts bearing was introduced. Bearings are mechanical elements designed to enable rotational movement in a device. They are used to reduce friction between moving parts and to enhance the speed and efficiency of a system. At the same time, bearings are used to support other parts of a machine by handling various amounts of stress.

The functions of the bearing are:

(1) Free rotation of the shaft or the axle with minimum friction.

(ii) Supports the shaft or the axle and holds it in the correct position.

(iii) Transmit forces by sliding or rolling

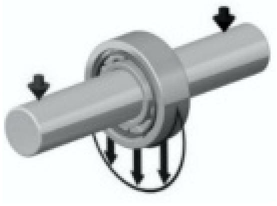
Due to their wide availability and versatility, rolling element bearings are, perhaps, the most widely used bearing type.

From a design perspective, bearings can be classified into:

Plain Bearings - They are used for sliding, rotation, oscillating or reciprocating motion. With a cylindrical shape and no moving parts, they are used in machines with a rotating or sliding shaft component. Plain bearings can be made of metal or plastic and can use a lubricant like oil or graphite for reducing the friction. Also referred to as bush or sleeve bearings.

Rolling Bearings - These bearings are used for supporting higher loads. They consist of rolling elements such as balls or rollers which are placed between turning and stationary raceways of rings. The relative motion of the rings causes the movement of the rolling elements. They are classified into radial bearings or thrust bearings depending upon the load direction. Radial bearing mainly take radial loads. Most types of radial bearings can also take thrust loads. Thrust bearings generally take thrust loads only and not radial loads

Radial Bearing



Thrust Bearing

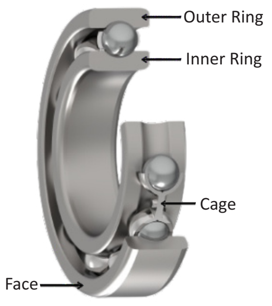
In addition depending upon the type of rolling elements these are further classified into

- Ball bearing (Bearing using ball as rolling element)
- Roller bearing (Bearing using rollers as rolling element)

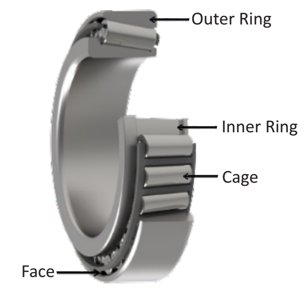
Due to their wide availability and versatility, rolling element bearings are, perhaps, the most widely used bearing type.

Depending on the design of the rolling bearing, the rolling surfaces may vary, but the standard configuration of a rolling element bearing comprises two rings (inner and outer), rolling elements like rollers or balls and a cage which keeps the rolling elements apart and guides them. Some bearings also have seals as integrated components.

Thrust bearings are used for carrying load in axial direction. In case of thrust bearing, the raceway of thrust bearing is called "raceway washer," the inner ring is called the "shaft raceway washer" and the outer ring is called the "housing raceway washer."



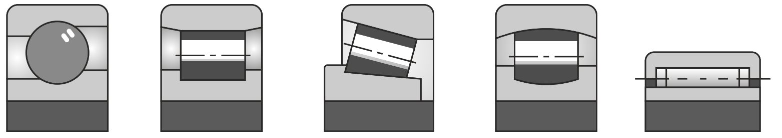
Ball Bearing



Taper Roller Bearing

Raceway: The surface on which rolling elements roll is called the "raceway surface". The load on the bearing is supported by the raceway in contact with rolling elements. Generally the inner ring fits on the axle or shaft and the outer ring in the housing.

Rolling Elements: Two type of rolling elements are present in bearing i.e. balls and rollers. Balls geometrically contact with the raceway surfaces of rings at a "point", while the contact surface of rollers is a "line" contact. Rollers come in four types: cylindrical, needle, tapered, and spherical.



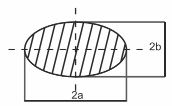
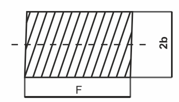
Cages: Main function is to separate rolling element & to maintain rolling at a uniform pitch such that load is never applied directly to the cage and also to prevent the rolling elements from falling out. Types of cages differ according the way they are manufactured, and include pressed, machined formed cages.

1.2 Characteristics of Rolling Bearings

When compared with sliding bearings, rolling bearings have the following advantages:

- The starting friction coefficient is lower
- They are internationally standardized, interchangeable
- They are easy to lubricate with oil or grease
- Bearing can carry both radial and axial loads at the same time.
- May be used in either high or low temperature applications.
- Bearing rigidity can be improved by preloading.
- Bearing can run at high rpm

Table 1.1 Comparison of Ball and Roller bearing

	Ball Bearing	Roller Bearing
Contact with raceway	 **Point Contact** Contact surface is oval when load is applied	 **Linear Contact** Contact surface is generally rectangular when load is applied.
Characteristics	Because of point contact there is little rolling resistance, ball bearing are suitable for low torque and high-speed applications. They also have superior acoustic characteristics.	Because of linear contact, rotational torque is higher for roller bearings than for ball bearings, but rigidity is also higher.
Load Capacity	Load capacity is lower for ball bearings. but radial bearing are capable of bearing loads in both the radial and axial direction.	Load capacity is higher for rolling bearing. Cylindrical roller bearing equipped with a lip can bear slight radial loads. Combining tapered roller bearings in pairs enables the bearings to bear an axial load in both directions.

1.3 Rolling Bearing Classification

Generally rolling bearings are classified based on rolling element and direction of load

. Depending upon the direction of load to be supported
. Depending upon the type of loading
(Steady or fluctuating load)
. Depending upon the type of rolling element (ball or roller)

Ball Bearing
- Radial Ball Bearings
  - Deep Groove Ball Bearings
  - Angular Contact Ball Bearings
  - Four-point Contact Ball Bearings
- Thrust Ball Bearings
  - Single Direction Thrust Ball Bearings
  - Double Direction Thrust Ball Bearings
  - Angular Contact Thrust Ball Bearings

Roller Bearing
- Radial Roller Bearings
  - Cylindrical Roller Bearings
  - Needle Roller Bearings
  - Tapered Roller Bearings
  - Spherical Roller Bearings
- Thrust Bearings
  - Cylindrical Thrust Roller Bearings
  - Needle Thrust Roller Bearings
  - Tapered Thrust Roller Bearings
  - Spherical Thrust Roller Bearings

1.3.1 Deep Groove Ball Bearing

The Single row radial ball bearings accommodate pure radial, pure axial or any combination of radial and axial loads within its capacity. These can operate at very high speeds. For these reasons and its economical price, it is the most widely used bearing. Owing to high degree of conformity between balls and raceways, the self-aligning capability of deep groove ball bearing is small.

Due to this these bearings are well aligned for mountings. Deep groove ball bearings include shield bearings and sealed bearings with grease. Deep groove ball bearings also include bearings with a locating snap-ring to facilitate positioning when mounting the outer ring, which absorb dimension variation of the bearing fitting surface due to housing temperature.

Dust Shield

Rubber Seal

N- Groove & Snap Ring

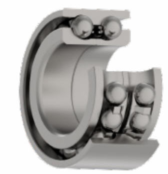
NBC offers TMB Ball bearings having the same boundary dimensions as standard deep groove ball bearings, but have undergone a special heat treatment that considerably extends wear life. These bearings were especially effective in countering reduced wear life due to the effects of infiltration of dust and other foreign matter.

1.3.2 Angular Contact Bearing

The single row angular contact ball bearings are generally designed with three angles 25, 30 & 40 degrees. These bearings have higher axial load capacity and must be used in pairs or in combinations. The bearings can carry axial load in one direction only and should be adjusted against another bearing, if axial load is coming from both the directions. An axial load acts directly along a straight line through the bearing, whereas a radial load acts obliquely and tends to separate the races axially. So the angle of contact on the inner race is the same as that on the outer race. Angular contact bearings better support combined loads (both the radial and axial). The larger the contact angle, the higher the axial load supported. Also there are four-point contact bearings which are radial single row angular contact bearings which can support an axial load in both directions. The outer ring with ball and cage assembly can be mounted separately from the two inner ring halves.

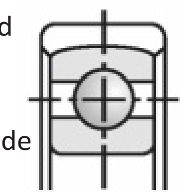
Single Row Angular Contact

Double Row Angular Contact



Four Point bearings

Single Row Externally Aligned Ball Bearing



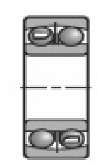
The Single Row Externally Aligning ball bearings are used where accurate alignment cannot be ensured between bearing positions. This bearing type can mainly take radial loads. Axial loads can also be accommodated.The shell housing must not be made an interference fit on their outside diameter. If an interference fit is used, the shell housing may contract and prevent alignment. These bearings can be located end wise in both the directions.

1.3.3 Self-Aligning Ball Bearing

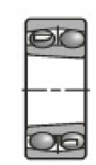
Self-aligning bearings have a common spherical raceway in outer ring and two groove in inner raceway. The self-aligning ball bearings are used where accurate alignment cannot be guaranteed between shaft and housing. The bearings have the same external dimensions as there equivalent single row radial ball bearings. They can take radial loads and very light axial loads. They can be located endwise in both the directions.

The double row self-aligning ball bearings with tapered clamping sleeve and nut are identical to double row self-aligning ball bearing except that these have a tapered bore. Bearing are mounted on the shaft using a sleeve and nut for clamping.

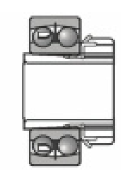
Self-Aligning Ball Bearing



Cylindrical Bore



Tapered Bore



Tapered Clamping Sleeve and Nut

1.3.4 Cylindrical Roller Bearing

The bearing consists of inner ring, outer ring, rollers and cage (mostly steel or brass). They have greater radial load capacity than ball bearings of same external dimensions. The bearing features a modified line contact between rollers and raceways to eliminate edge stressing. These bearings have a high radial load capacity and are suitable for high speeds. The inner and outer rings can be separated to facilitate assembly. Due to detachable design, have advantage of mounting inner ring and outer ring separately. The direction of axial load which a bearing can take depending upon the geometry of the bearing. Many variants are available such as NU, NJ, N, NF, NUP, NH. The bearings are also available in double-row and four row configurations.


Brass Cage


Steel Cage


Polyamide Cage


Full Complement


Single Row


Double Row


Four Row

1.3.5 Taper Roller Bearing

Tapered roller bearings consists of cup, cone, retainer and tapered rollers. Tapered roller bearings are designed in such a way that vertices of the cone for each roller and those for the cone and cup raceways coincides on the bearing axis or extensions of the raceways and rollers converge at a common point on the axis of rotation. This results in true rolling motion of the rollers on the raceways at every point along the rollers

Tapered roller bearings support radial loads and axial loads from one direction only. The line contact between rollers and raceways provide the bearings with a high load carrying capacity. Steep angle tapered roller bearing with exceptionally steep cone angle enables the bearings to take heavier axial load. The bearings are of separable type, enabling separate mounting of cups and cones. Since the tapered roller bearings can absorb thrust loads in one direction only, these bearings should generally be installed as opposed mountings. The correct amount of radial and axial clearance is obtained by adjusting the two bearings against each other.

Double row and four row tapered roller bearings are also widely used for heavy loads in rolling mills. These bearings are preset assemblies and mounted on roll neck. Bearing configuration is face to face or back to back arrangement.

Back to Back Arrangement


Double Row

Face to Face Arrangement

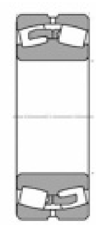

Double Row


Four Row

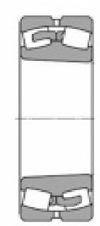
1.3.6. Spherical Roller Bearing

Spherical roller bearing permits low friction, and angular misalignment. The bearings consist of an inner ring with two raceways inclined at an angle to the bearing axis. It consists of an outer ring with a common spherical raceway, spherical rollers and cages (brass or steel). In certain designs, also internal guide rings are present to support cage. Typically these bearings support a rotating shaft in the bore of the inner ring that may be misaligned in respect to the outer ring. The misalignment is possible due to the spherical internal shape of the outer ring and spherical rollers. Bearing are available with straight and tapered bore.

Spherical Roller Bearing



Cylindrical bore



Tapered bore

1.3.7 Thrust Bearing

A thrust bearing permit rotation between parts, but they are designed to support mainly axial load. They have steel or brass cage. Thrust bearings are divided into single and double direction types. The single is able to accommodate axial load in one direction, while the double direction is able to accommodate the load in both the directions. Thrust bearings are not suitable for applications that involve radial load or high-speed rotation. This type of bearing is commonly used in automotive, pumps and marine applications

Thrust bearings come in several varieties.

• Thrust ball bearings, consists of balls supported in a ring, can be used in low thrust applications where there is little axial load.

• Cylindrical thrust roller bearings consist of cylindrical rollers arranged flat with their axes pointing to the axis of thebearing.

• Tapered roller thrust bearings consist of tapered rollers arranged so that their axes converge at a point on the axis of the bearing.

• Spherical roller thrust bearings use asymmetrical rollers of spherical shape. They can carry heavy axial load. They can accommodate combined radial and axial loads and also accommodate misalignment of the shafts.

Spherical Roller Thrust Bearing

Ball Thrust Bearing

Cylindrical Roller Thrust Bearing

Taper Roller Thrust Bearing

1.3.8 Bearing Units

Units consists of radial ball bearing, seal, and a housing which are greased and sealed. The outer surface of the bearing and the internal surface of the housing are spherical, so that the unit is self-aligning thus they are able to compensate for misalignment of the shaft with respect to the housing. These bearing units are ready-to-mount. Series 62 and 63 of the deep groove ball bearing are used in these units. A seal and a slinger is provided on both sides. They are completely sealed, and provided with a re-lubrication feature.

UCF

UCP

1.3.9 Needle Roller Bearing

Needle roller bearings are generally composed of needle rollers and cages. Several needle rollers placed between two hardened and smooth surfaces and cage prevent the needle rollers to contact each other to accommodate smooth rolling action. The diameter of rolling element in Needle roller bearing is relatively small and having relatively large length/diameter ratio, this allows for more load carting capacity and ideal for oscillation motion.

In comparison to other roller bearings, needle roller bearings are having small radial section height and smaller mass, which allows for more compact design and suitable for application where low inertia force is required.

Needle roller bearings depending upon different customer applications requirements

Needle Roller and Cage Assembly

A needle roller and cage assembly comprises of needle rollers and a cage that guides and hold the rollers on its position to accommodate smooth rolling action.

Needle roller and cage assembly for connecting rod bearings

A Needle roller and cage assembly for connecting rod bearings comprises of needle rollers and a cage that guides and hold the rollers on its position.

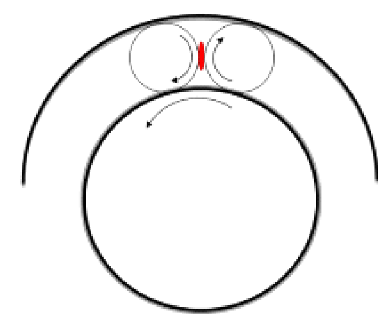
Shell Type Needle Roller Bearing

Shell type needle roller bearing comprises of an outer shell ring made from special thin steel, needle rollers and cage. A hardened and ground inner ring/shaft is used as the raceway.

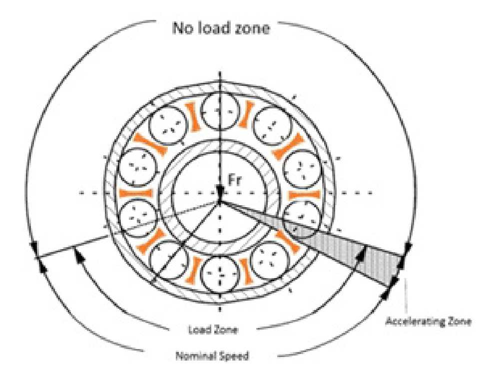
1.4 Cage

Function of cage

- Separates the rolling elements to prevent mutual contact and avoid rubbing.
- Guides the rolling elements (ball or roller) in a non-loaded zone and evenly spaces them for a consistent load zone.
- Prevents the rolling element from falling during mounting or swiveling out.



Contra rotation: The rubbing of two rolling elements at the pitch line due to relative opposite spin directions. It is prevented by separating the rolling elements with the help of cage.



1.4.1 Types of Cages

Sheet Metal Cages

- Stamped sheet metal cages are made of low carbon steel. These are lightweight with high strength and expansion coefficient.
- This cage occupy small space within the bearing and impart less restriction to the lubricant flow.
- Steel cage can accommodate extra rolling elements inside the bearing, thereby providing high load capacity.
- Also comes with low friction coating like amorphous carbon or silver (aircraft application) to reduce the sliding contact with rolling elements.

Rivetted type cage For deep groove ball bearing

Steel stamped cage for taper roller bearing

Steel stamped cage for cylindrical roller bearing

Machined Brass Cages

- Brass cages are precisely machined to optimize roller cage pocket clearance and have a reduced coefficient of friction with rolling elements.
- It has the ability to damp roller vibrations in the cage pocket aroused due to the bearing application.
- These are prominently used in large size bearings and high acceleration of rolling elements
- For higher strength silicon-iron - bronze cage has a reduced coefficient of friction.

Machined brass cage, cross piece rivetted with side rings for cylindrical roller bearing

Split type machined brass cage for spherical roller bearings

Window type machined brass cage for angular contact ball bearing

Brass cage for deep groove ball bearing

Polyamide Cage

- Polyamide cages are molded and reinforcement with glass fiber to provide strength.
- Cage pocket can be precisely molded
- Low sliding Friction with Rolling elements
- Optimized clearance between rolling element and cage pocket Can be used for higher speeds
- Good for reverse thrust like in pumps due to high elasticity (tilting condition)

Please note that:

- The oil with EP additives can decompose the cage.
- Hygroscopic (tending to absorbs moisture)
- Limited operating temperature, continuous well below 85°C.

Molded polyamide snap cage for deep groove ball bearing

Molded polyamide window type cage for taper roller

Polyamide cage for double row angular contact bearing

Pin-type Steel Cages

The Rollers are pierced throughout their length at the central axis and are primarily used in large-size roller bearings. Pin-type cage permits extra roller inside the bearing, which can even result in a 20% increase in dynamic load capacity.

Pin-type cage in TRB

1.5 Seals and Shield

Seals/shields have significant effect on the life of rolling bearing. The shields are non-contact type and made of sheet steel. Provides protection from dirt and dust. Mostly used in application with inner rotating.

The seals are made of rubber and are light heavy contact type. The materials used for seals are NBR & ACR (Acrylonitrile-butadiene rubber) or FKM (Fluoro rubbers) for higher temperatures.

The main function of the seal in rolling bearing is to:

- Retain lubricants
- Exclude - dirt/contaminants/dust/water ingress
- Confine pressure

If the sealing device fails to function, foreign matter or leakage will cause bearing damage, as a result bearing seizure can take place during operation. Temperatures, speeds, pressures, lubricants and other operating conditions greatly impact seal life and bearing performance. Therefore, it is necessary to choose the most suitable seals according to operating conditions.

Sealed Bearing (Contact Rubber Type)

For right choice of seal for an application, consider the following key factors:

- Bearing type
- Lubricant (oil or grease)
- Seal friction and torque
- Surface speed
- Physical space available

Shield Bearing (Non-Contact Type)

1.6 Bearing Material

The selected material must be suitable for the operating environment and must meet the technical requirements for the application. The components of rolling bearing during operation are subjected to cyclic load and deformation, still they must maintain dimensional accuracy.

To accomplish this, the raceways and rolling elements must be made of a material having following properties:

- High Hardness,
- Resistant to Rolling Fatigue,
- Wear Resistant,
- Good Dimensional Stability
- High Impact Strength
- Corrosion Resistance
- Uniformity of Structure

The bearings are made of either high carbon or low carbon steel. Depending upon the selection of material, process of hardening is selected. The bearing components are hardened by the following method.

Through-Hardening

Through hardening imparts a uniform hardness throughout the cross section. Mostly used in application which are not highly misaligned and shock loads are moderate. This is a regular process for most of bearing used in various applications.

Induction-Hardening

It is a type of surface hardening in which a 'metal part' is induction-heated and then quenched. Hardening may be done on the surface or throughout the entire surface and properties of the remaining part remains unaffected.

Case-Hardening

It is a process of heating the metal so that the surface is hard and the core is soft. This process is used when bearing are subjected to high impact loads. It can minimize wear & tear and increase the strength of the steel surface. This process can done by Carburizing and Nitriding.

The bearing operating temperature under standard heat treatment process with normal tempering is around 120°C. For bearing to operate at temperature higher than 120°C, special heat treatment process is required.

For case hardening steel the carbon content is reduced approximately 0.15% (low carbon steel) is the most common for roller bearings. High hardness up to 64HRC on the surface throughout circumference with soft Core.

02 Bearing Designation & Nomenclature

2.1 Bearing Designation

The bearing designation may consist of a basic designation with or without prefixes and suffixes. It includes

- Bearing type
- Boundary dimensions
- Basic design

The number and letter combinations indicates bearing type and dimensions. Basic design includes tolerances, internal clearances & other related specifications. In bearing designation system:

- The first digit indicates the bearing type.
- The second & third identify the ISO dimension series. The second digit indicates the width or height series. The third digit indicates the diameter series.
- The last two digits indicates the bearing bore, which multiplied by 5 gives the bearing bore diameter in mm.

There are exceptions in the basic bearing designation system:

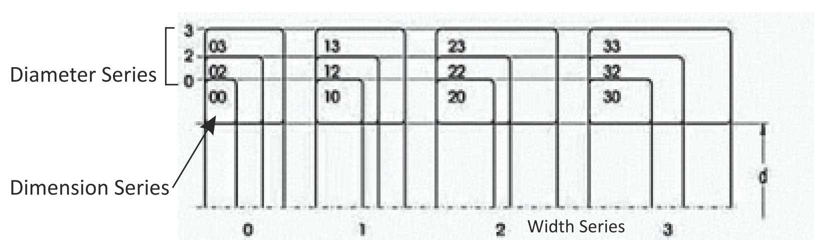
1. Bearings size code for the following bore diameter are:

    00=10mm
    01=12 mm
    02=15mm
    03=17 mm

2. For bearings with a bore diameter < 10 mm, or ≥ 500 mm, the bore diameter (d) is generally given as 617/7 (d = 7mm) or 294/530 (d=530 mm).

3. In case of standard bearing, when bearing diameter are non-standard, then it is denoted as 63/28 (d=28mm)

Bearing Series indicates the bearing type and the dimension series.



Deep Groove Ball Bearing	160XX, 68XX, 69XX 60XX, 62XX, 63XX,64XX,
Angular Contact Ball Bearing	32XX, 33XX, 72XX, QJ2XX, QJ3XX
Self-Aligning Ball Bearing	N2XX,, N3XX, N4XX,NJ2XX, NJ3XX, NJ4XX, NJ22XX,NJ23XX, NU2XX, NU3XX, NU4XX, NU10XX, NU22XX, NU23XX, NUP3XX,NUP4XX, NUP22XX,NUP23XX, NN30XX, NNU49XX
Needle Roller Bearing	K, HK, BK, N48, NA49, NA69,
Taper Roller Bearing	302XX, 303XX, 313XX, 320XX, 322XX, 323XX, 329XX, 330XX
Spherical Roller Bearing	213XX, 222XX,223XX,230XX,231XX,232XX,233XX,239XX,240XX
Thrust Ball Bearing	511XX, 512XX, 513XX, 532XX, 522XX, 523XX, 524XX,

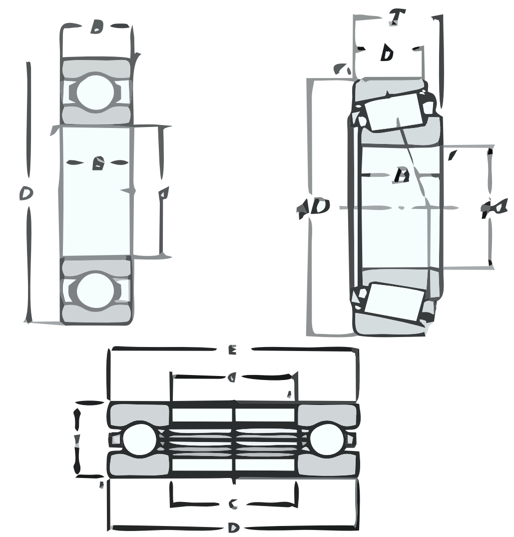
The bearing boundary /fitment dimensions consists of bore, outer diameter, width size & chamfer dimensions and are based on the ISO dimensional system which specifies the following dimensions for rolling bearings: bore diameter, d, outside diameter, D, width, B or T and chamfer dimension, r.

The boundary dimensions for metric bearings based on ISO standards are:

ISO15 for radial rolling bearings, except tapered roller bearings, insert bearings and needle roller bearings

ISO355 for tapered roller bearings

ISO104 for thrust bearings



Bearing Designation (Examples)

Rolling bearing part numbers indicate bearing type, dimensions, tolerances, internal construction & other related specifications.

6 2 07 Z C3

- Radial internal Clearance C3
- Shielded (one side)
- Nominal bore diameter 35mm
- Diameter series 2
- **Deep groove ball bearing**

2 2 3 28

- Nominal bore diameter 140mm
- Diameter series 3
- Diameter series 2
- **Spherical roller bearing**

7 2 12 C

- Contact angle 15°
- Nominal bore diameter 60mm
- Diameter series 2
- **Angular contact ball bearing**

NU 3 30 C3

- Radial internal clearance C3
- Nominal bore diameter 150mm
- Diameter series 3
- **Cylindrical roller bearing NU type**

3 0 2 04

- Nominal bore diameter 20mm
- Diameter series 2
- Width series 0
- **Tapered roller bearing**

1 2 06 K

- Tapered bore (1:12)
- Nominal bore diameter 30mm
- Diameter series 2
- **Self Aligning ball bearing**

CMJ 30 35 17 S

- Type of cage, S stands for weld cage
- Width
- Roller Set Outer Diameter
- Roller Set Bore Diameter
- **Cage Type based upon Profile**

Needle roller bearing

2.2 Bearing Nomenclature:

Bearing basic number

Series code	Interpretation			Bore diameter code	Interpretation
	Bearing type	Dimension series code			Bore dia., mm
		Width series	Dia. Series		
68 ***69*** ***60*** ***62*** ***63***	6- Deep groove ball bearings	-	8 9 0 2 3	***/0.6*** ***/1.5*** ***/xx***	0.6 1.5 xx
78 ***79*** ***70*** ***72*** ***73***	7- Angular contact ball bearings	-	8 9 0 2 3	***00*** ***01*** ***02*** ***03***	10 12 15 17
12 ***13*** ***22*** ***23***	1,2- Self aligning ball bearings	-	2 3 2 3	***04*** ***05*** . . ***92*** ***96***	dia. code multiplied by 5 gives the bore dia. Value in mm
NU10 ***NU2*** ***NU22*** ***NU3*** ***NU23*** ***NU4*** ***NNU49*** ***NN30***	NU, NJ, NH, NUP, N, NF, NNU, NN, RNU, RN- Cylindrical roller bearings	1 - 2 - 2 - 4 3	0 2 2 3 3 4 9 0	***/500*** ***/530*** ***/560*** . . ***/2,360*** ***/2,500***	500 530 560 - - 2,360 2,500
302 ***303*** ***313*** ***320*** ***322*** ***323*** ***329*** ***330*** ***331*** ***332***	3- Tapered roller bearings	0 0 1 2 2 2 2 3 3 3	2 3 3 0 2 3 9 0 1 2		
239 ***230*** ***240*** ***231*** ***241*** ***222*** ***232*** ***213*** ***223***	2- Spherical roller bearings	3 3 4 3 4 2 3 1 2	9 0 0 1 1 2 2 3 3		
292 ***293*** ***294***	2- Spherical roller thrust bearings	9 9 9	2 3 4		

CODE	INTERPRETATION (PREFIXES)
4T	Case carburized bearing (Inner ring, outer ring & roller)
TS1-	Bearing with special heat treatment for operating temp. up to 130°C
TS2-	Bearing with special heat treatment for operating temp. up to 160°C
TS3-	Bearing with special heat treatment for operating temp. up to 200°C
TS4-	Bearing with special heat treatment for operating temp. up to 250°C
TM-	Long life special heat-treated bearing (one ring)
TMB-	Long life special heat-treated bearing (both the rings)
AST-	Bearing with one of the components treated in carbo nitriding (rollers are with normal heat treatment)
ASTB-	Bearing with both the components treated in carbo nitriding (rollers are with normal heat treatment)
CR-	Creep resistance bearing with single side O-ring on outer race
CR2-	Creep Resistance bearing with both side 'O' ring on outer race
L-	Light series (taper roller bearing-inch series)
LM-	Light medium series (taper roller bearing-inch series)
HM-	Heavy medium series (taper roller bearing-inch series)
—	Medium series (taper roller bearing-inch series)
H-	Heavy series (non-interchangeable with other cones & cups- for taper roller bearing inch series)
HH-	Heavy heavy series (non-interchangeable with other cones & cups-for taper roller bearing-inch series)
N-	Taper bearing having non-standard boundary dimensions
–	Cylindrical bearing having non-standard boundary dimensions
NA-	Cones mated with double cup to form double row non-adjustable bearing (non-interchangeable with other cones & cups)
X-	Inch series tapered roller bearing converted into metric series
T-	Tapered roller thrust bearing
J-	Inch series bearing with metric designation
SP-	Standard bearing with deviations in Dimensions (OD/width ect.) from original bearing number
QJ-	Four point angular contact ball bearing
BB,LS,MS-	Ball bearing with non-standard boundary dimensions
Nxxxx	Ball bearing having non-standard boundary dimensions (xxx - is auto generated numeric digit i.e. 123 etc.)

Note: For any Prefix not found in the table, please contact NEI Engineering

Suffixes for Internal Design Modification Code

CODE	INTERPRETATION
A-	Internal design modification from A onward
B-	Contact angle 40°, angular contact ball bearing
B-	Contact angle 10° ~17°, Tapered roller bearings
C	contact angle 15°, angular contact ball bearing
C--	Contact angle 17° ~24°, Tapered roller bearings
C(n),CS(n	Deep groove ball bearing with increased/different load ratings (C1, CS1 etc.)
D-	Contact angle 24° ~32°, Tapered roller bearings
E-	Cylindrical/Spherical roller bearing with optimized internal geometry for increased load rating
E-	Tapered roller bearing with special crown on raceways
F-	For different bearing stand requirement other then ISO
M-	Modified design (ball bearing, tapered roller bearing)
X(n)-	Special feature (Inner ring or outer ring) e.g. X1, X2
SPL-	Optimized internal design for low torque
C-	Spherical roller bearing with symmetrical rollers, flangeless inner ring, a non-integral guide ring between the two rows of rollers centered on the inner ring and one pressed steel window-type cage for each roller row
CA-	Spherical roller bearing with one-piece machined brass cage (double pronged), symmetrical rollers and retaining ribs
CC-	Similar to 'C' configuration but with enhanced roller & raceways surface finish
v-	Full complementary cylindrical roller bearing
LT-	Optimized internal design for low torque
AN	Special groove profile for Inner or Outer ring.

Note: For any Suffix not found in the table, please contact NEI Engineering

Suffixes for Seal/Shield

CODE	INTERPRETATION
LB-	Synthetic rubber seal, non-contact type, on one side
LLB-	Synthetic rubber seal, non-contact type, on both side
LH-	Low friction synthetic rubber seal, contact type, double lip, on one side
LLH-	Low friction synthetic rubber seal, contact type, double lip, on both side
LU-	Synthetic rubber seal, contact type, double lip, on one side
LLU-	Synthetic rubber seal, contact type, double lip, on both side
LV-	Low friction synthetic rubber seal, contact type, triple lip, on one side
LLV-	Low friction synthetic rubber seal, contact type, triple lip, on both side
LUA-	Acrylic rubber seal (Contact type), single side with Seal groove on Inner race
LLUA-	Acrylic rubber seal (Contact type), both side with Seal groove on Inner race
LUA1-	Fluorine rubber seal (FKM), LU type, on one side, for high temperature up to 200° C
LLUA1-	Fluorine rubber seal, LU type, on both side, for high temperature up to 200° C
LUA2-	Silicone rubber seal, LU type, on one side, for extreme temperature-100 to +200° C
LLUA2-	Silicone rubber seal, LU type, on both side, for extreme temp. -100 to +200°C
RS-	NBR rubber seal (Contact type), single side with no Seal groove on Inner race
RSS-	NBR rubber seal (Contact type), on both with no Seal groove on Inner race
Z-	Metallic shield, single side
ZZ-	Metallic shield, double side
ZA-	Removable pressed steel shield, on one side
ZZA-	Removable pressed steel shield, on both side
LW-	Synthetic rubber (NBR) seal, contact type, four-lip, on one side, for wheel application
LLW-	Synthetic rubber (NBR) seal, contact type, four-lip, on both side, for wheel application
LWA-	Acrylic rubber (ACM) seal, contact type, four-lip, on one side, for wheel application

Note: For any Suffix not found in the table, please contact NEI Engineering

Suffixes for Seal/ Shield

LLWA-	Acrylic rubber (ACM) seal, contact type, four-lip, on both side, for wheel application
LWA1-	Fluorine rubber seal (FKM), contact type, four-lip, on one side, for wheel application
LLWA1	Fluorine rubber seal (FKM), contact type, four-lip, on both side, for wheel application
L-	Seal Groove for Flange type Polyamide cage
Lt1	Low torque seal for UTRB

Suffixes : Cage

J-	Pressed steel cage
T2X-	Polyamide cage
T2X1-	Pin type steel cage
G2-	Polyamide Cage with Flange
TF	Pressed steel cage with Tufftride Treatment
M	Machined brass cage, (spherical / cylindrical roller bearing)

Suffixes : External design modification code

D-	Double row outer ring or inner ring
K-	Tapered bore, 1/12 taper on dia.
K30-	Tapered bore, 1/30 taper on dia.
N-	Standard locating snap ring groove on outer ring
N1-	Locating snap ring groove on outer ring with knurling
NR-	Locating snap ring on outer ring
NX(n)-	Non-standard locating snap ring groove on outer ring (NX1, NX2...)
N2X(n)-	Both sides non-standard locating snap ring groove on outer ring (N2X2, N2X3...)
G-	Helical groove in bearing bore (Multi-row tapered / cylindrical roller bearing components)
W-	Lubrication grooves / slots in the side faces of the bearing rings (Multi-row tapered roller bearings)
W3	Bearing with blind hole in outer ring for Pin fitting(Ball Bearing)
W33-	Bearing with annular groove and three lubrication holes in the outer ring (Spherical roller bearing)
W33X-	Similar to 'W33' configuration but with six lubrication holes

Note: For any Suffix not found in the table, please contact NEI Engineering

Suffixes : Bearing arrangement type code

DB-	Two single-row deep groove/angular contact ball/ tapered roller bearing matched for mounting in a back-to-back arrangement
DF-	Two single-row deep groove/angular contact ball/ tapered roller bearing matched for mounting in a face-to-face arrangement
DT-	Two single-row deep groove/angular contact ball/ tapered roller bearing matched for mounting in a tandem arrangement
TSF-	Flanged cup

Suffixes : Internal clearance code

C2-	Clearance less than Normal
CN-	Normal clearance
C3-	Clearance greater than normal
C4-	Clearance greater than C3
C5-	Clearance greater than C4
CNL-	Radial clearance range on lower side of CN
C3L-	Radial clearance range on lower side of C3
C4L-	Radial clearance range on lower side of C4
C5L-	Radial clearance range on lower side of C5
CNH-	Radial clearance range on higher side of CN
C3H-	Radial clearance range on higher side of C3
C4H-	Radial clearance range on higher side of C4
C5H-	Radial clearance range on higher side of C5
CS(n)-	Special radial clearance as per customer requirement (e.g. CS1, CS2 etc.)

Suffixes : Tolerance class code

PO-	Normal Tolerance class (Class 0, 6X) specified by IS/ISO/JIS
P6-	Tolerance class 6 specified by IS/ISO/JIS
P5-	Tolerance class 5 specified by IS/ISO/JIS
P4-	Tolerance class 4 specified by IS/ISO/JIS
P2-	Tolerance class 2 specified by IS/ISO/JIS

Note: For any Suffix not found in the table, please contact NEI Engineering

Suffixes: Noise class code

EM-	Noise level class for electric motor application
EMB-	Bearing for Electric motor vehicle
EML-	Low Noise bearings

Suffixes for Internal Design Modification Code

CODE	INTERPRETATION (PREFIX)
C	Needle roller and machined cage assembly
PC	"Needle roller and machined cage assembly for piston pins"
CJ. S	"Needle roller and machined cage assembly for crank pins"
CMJ. S	Needle roller and weld cage assembly
CV. S	Needle roller and weld cage assembly
HC	Needle roller and weld cage assembly
HMC	Drawn-cup needle roller bearing
HC-F	Drawn-cup needle roller bearing for heavy loading
F	Speical Type Drawn-cup needle roller bearing
	Flat end type roller

CODE	INTERPRETATION (SUFFIX)
CAGE	
Q	Soft Nitriding on cage
E	Carburizing + Hardening + Tempering HT on cage
D	Black Oxide on cage
C	Copper Plating on cage
S	Silver Plating on cage
ROLLER	
-	Through Hardened treatment on roller
AS	Carbonitriding Treatment on Roller
E1	Crowning (End drop) on roller
SF	Improved surface finish on roller OD

Note: For any Suffix not found in the table, please contact NEI Engineering

03 Bearing Selection & Arrangement

3.1 Bearing Selection Process

The bearing selection is primarily dependent on application to which they are subjected to. A detailed study considering load magnitude, misalignment, rotational speed, fit, preload, operating and environmental conditions etc. at location and equipment to which bearing to be installed will in fact suggest the proper bearing to be selected. Other factors playing vital role in bearing selection includes housing & shaft parameters and service life of equipment. The lubricant and sealing also plays a critical role. This is important as cleanliness has effect on bearing life. As a general guideline basic steps can be followed for selecting appropriate bearing as shown in the flow chart.

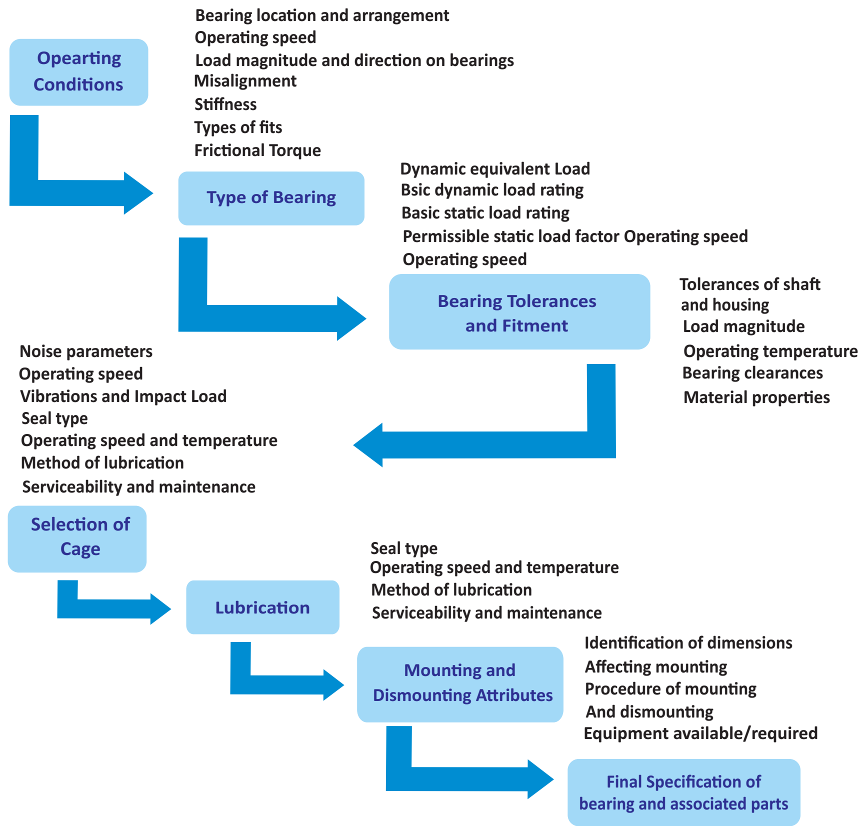


Figure 3.1 Flow Chart for Bearing Selection

3.1.1 Selection of type of bearing (Allowable installation space for bearing)

The limit of space available for bearing installation is a major factor according to which the type and size of bearing must be selected. Generally design of shaft initiates with fixing of shaft diameter followed by checking other parameters for feasible design. The bore of bearing is selected on the basis of shaft parameters. The wide variety of dimensions available in dimension series of rolling bearings provides the basis for selection of feasible bearing. The figure 3.2 shows the different types of bearing and dimension series of rolling bearing

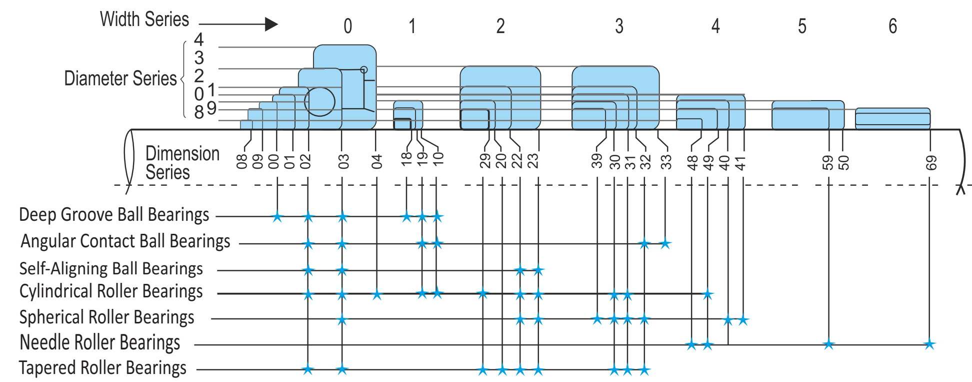


Figure 3.2 Different types of bearing and dimension series of rolling bearing

3.1.2 Load capacity and direction

Direction of load, magnitude of load and direction of application plays a vital role in selection of bearings. Apart from these vibration and impact also contributes significantly in bearing selection. It is seen that for shock /impact loads roller bearings have higher load capacity than ball bearings when bearings of the same dimension series are compared. The figure 3.3 shows the load capacity of different type of bearings.

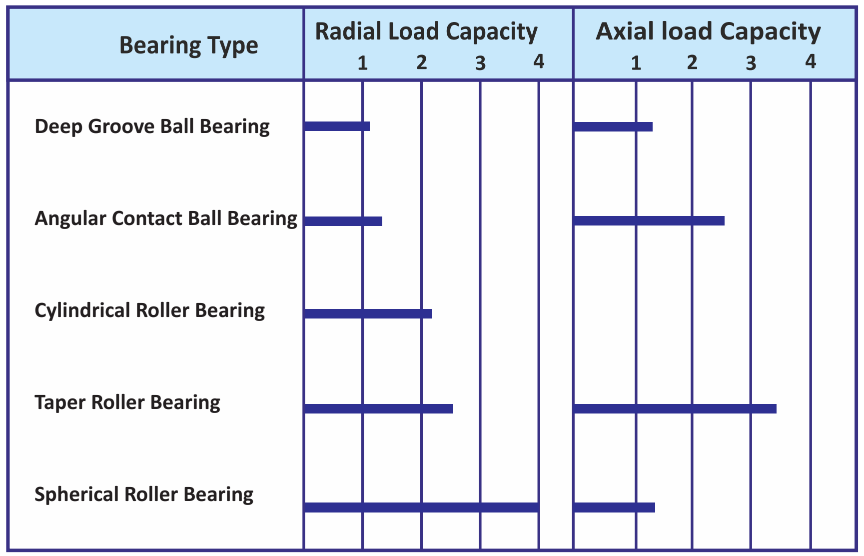


Figure 3.3 Load capacity of different type of bearings

3.1.3 Speed of rotation

Speed of rotation of particular type of bearing which in fact is allowable speed of bearing depends upon Bearing Size, Cage, Running accuracy, load magnitude and lubrication. It has been seen that generally ball bearings (both deep groove and angular contact) and cylindrical roller bearings are widely used in applications with requirement of high speed of rotation. The figure 3.4 shows the speed of rotation of different types of bearings with respect to each other.

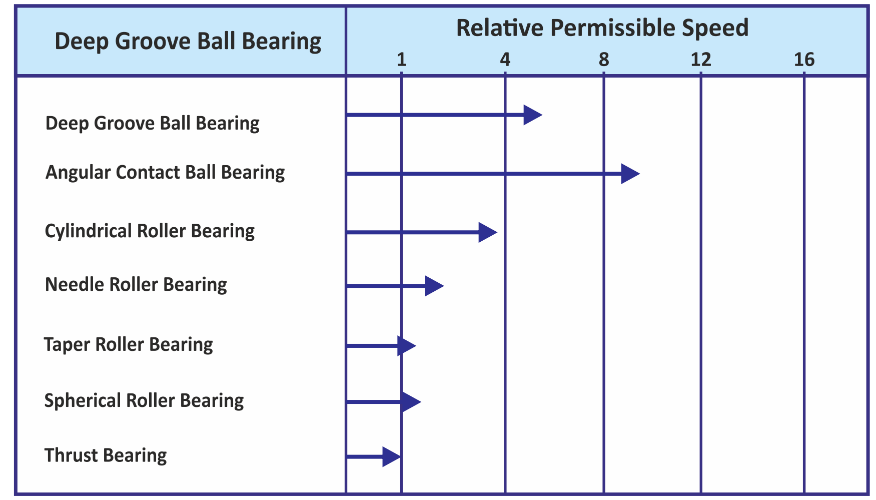


Figure 3.4. Speed of rotation of different types of bearings

3.1.4 Running accuracy

As bearings are designed for different applications which may consist of high running accuracy equipment such as rotary devices, spindle for machine tools etc. The tolerance class of 'class 5 or higher' is recommended in such type of applications. Deep groove ball bearing, Angular contact ball bearing and cylindrical roller bearings are precisely designed for applications with high accuracy requirement.

3.1.5 Rigidity

At the point of contact wherein rolling elements are in contact with bearing raceways under load, elastic deformation appears. This is known as rigidity of bearing. Elastic deformation in roller bearings in comparison to ball bearing is less under same loading conditions. It becomes essential for bearings to have sufficient rigidity for better performance as well to reach target life.

Ratio of bearing load to elastic deformation determines the rigidity of bearing. The rigidity of bearing can be enhanced by preload which gives bearing a negative clearance prior to operation. Mostly taper roller bearing and angular contact bearings are preloaded.

3.1.6 Misalignment of races and types of bearings

The shaft and housings plays a vital role in alignment particularly during operating conditions. Under the circumstances which causes accuracy in alignment such as shaft deflection under loads can leads to misalignment of inner and outer ring of bearing.

Misalignment which is excessive in nature can significantly damage the bearings involved. There is availability of bearings that can accommodate misalignments up to certain extent. It is always recommended to select such bearings in those conditions. Generally criteria for selection of bearings says higher the self-aligning capability of bearing, more is the misalignment it can accommodate.

Spherical roller bearings and self-aligning ball bearings can accommodate high misalignments followed by deep groove ball bearings and angular contact ball bearings. Cylindrical roller bearings can least accommodate misalignments.

3.1.7 Mounting and dismounting of bearings

Another way of classifying bearings depends upon their nature of separation based on which they are categorized into separable and non-separable types. Here separable type of bearings can offer ease of mounting and dismounting. Applications which require periodic inspections the separable type of bearings are recommended. The roller bearings such as taper roller bearings, cylindrical roller bearings and needle roller bearings are basically recommended for applications which require periodic mounting and dismounting. Also in case of spherical roller bearings with tapered bore and self-aligning ball bearings with tapered bore the use sleeve can ease the mounting of bearings.

3.1.8 Noise and torque

It is the level of precision to which the bearings are manufactured contribute to noise and torque outcomes. Here at NBC bearings high precisions are kept while manufacturing all types of bearings. Noise levels are many a times specified based on applications to meet the requirements as seen in the case of deep groove ball bearings and cylindrical roller bearings. Generally for very low noise and torque Deep groove ball bearings are recommended.

3.2 Selection of bearing arrangement

Generally, two or more bearings are used in various application for the purpose of supporting the operational load and locate & position the shaft. The operational load could be radial, axial or moment Loads. One important function of the bearing combination is to provide axial guidance of shaft. Axial guidance is the axial expansion of shaft without producing misalignment of shaft axis. The axial guidance or unrestricted expansion of shaft is possible by providing floating bearing. The combination becomes fixed and floating (free) bearing arrangement.

The following factors plays a vital role in bearing mounting arrangements.

Location of bearings in arrangement for ease of mounting and dismounting.

Variations in temperature leading to expansion and contraction of shaft.

Deflection of shaft as well as errors during mounting (if any) causing misalignment in bearing.

Bearing's ability to sustain loads at their mounting position.

Usually, bearing arrangement on shaft happens in way that bearing is mounted on fixed side followed by other bearing mounted on freeside.

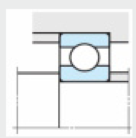
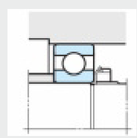
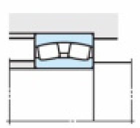
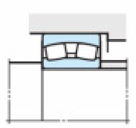
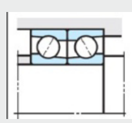
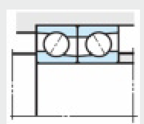
Fixed side bearing:

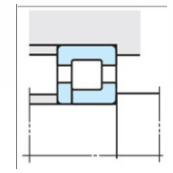
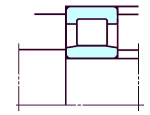
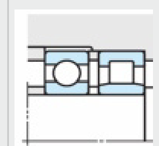
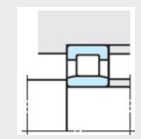
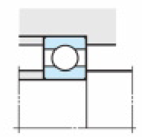
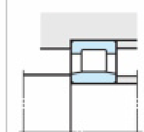
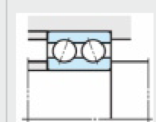
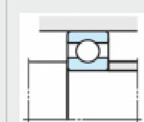
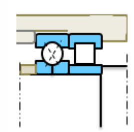
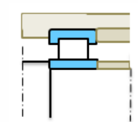
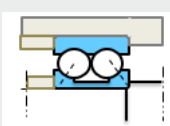
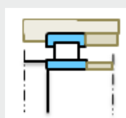
The bearing which prevents axial movement of the shaft relative to housing is fixed bearings. Fixed side bearing can support radial and axial loads. A bearing that can fix the axial movement in the direction must be selected.

Floating side bearing:

The bearing which allows axial movement of shaft relative to housing is floating bearing. The floating side bearing has more freedom of movement to help compensate for misalignment and thermal expansion or contraction. Floating bearing arrangements are common with self-aligning ball bearings, deep groove ball bearings and sphericalrollerbearings.

Table 3.2 Some Bearing arrangements and their applications

Application	Fixed side	Free side	Remarks
Transmissions and Pumps			The arrangement can accommodate partial radial loads as well as axial loads.
Overhead crane wheels			The arrangement is suitable in cases where there is the possibility of errors due to mounting and deflection of shafts.
Machine tool spindles			The arrangement is suitable for cases where under the action of light load, high speed of rotation and high accuracy is desired.

Application	Fixed side	Free side	Remarks
Traction Motors			The arrangement is suitable for applications involving the required to with stand heavy loads and shock loads. Moreover, this arrangement can take the axial load. Additionally is desired for both the rings.
Diesel Locomotive Transmission			The arrangement is used in applications with high speed and high radial load in the presence of axial load.
Blowers and medium sized electric motors			The arrangement is recommended for high-speed operating conditions but is not suitable in the case of shaft deflections.
Worm gear reducers			The arrangement is suitable for high axial load acting in both directions.
Screw Compressor Aircraft Engine Vertical Agitator			High axial, radial load and high speed, NU type CRB is for radial load and four-point contact ball axially clamped takes the axial thrust load in both dirесtion
Pumps and Booster Fans			Over Hung Impeller with Reverse Thrust

Bearing selection by NEI Advisory service:

Our Engineers will be pleased to recommend the most suitable bearing and best method of mounting for any specified conditions. If you wish to use this service you should send all relevant information on the following basis.

Provide a drawing or sketch showing layout of the parts involved and position in which the bearings are to be fitted, giving size of shaft and any dimensions limiting the space available.
Include a brief description of the mechanism if this is not clear from the drawing.
Give provide the data for the speed, load on each bearing, operating temperature.
Indicate any unusual features such as the possibility of shock or vibration, unbalanced load, high temperature, or the presence of dirt, moisture or fumes.
Give the bearing life requirements and indicate whether the duty is continuous for 24 hours a day or only intermittent. If intermittent, give periods of running and stand by.
If the working conditions vary considerably, give the normal duty and also the peak conditions with the frequency and duration of peaks. Say whether oil or grease lubrication is to be used. Say whether the bearings can be lined up accurately or bearing with alignment features are required.

Please consult NEI

If bearings are required in corrosion-resisting or in other special materials.
If two bearings are mounted close together, special pairing of the two bearings may be necessary to ensure that they share the load.
If the speed and temperature conditions are not provided for the information contained in this catalogue.

04 Load Rating and Life

4.1 BEARING LIFE

Bearings are integral component in any machinery application. The premature failure of a bearing can result in costly unplanned downtime that could have been prevented using the proper predictive measures. Bearing life, in the broad sense is the period during which bearings continue to operate and satisfy their required functions.

During operations bearing fail mainly due to

(1)Human error

Improper mounting
Improper bearing selection
Design not ok
Insufficient maintenance

(2) Metal Fatigue type of failure of a material, occurring under alternating loads

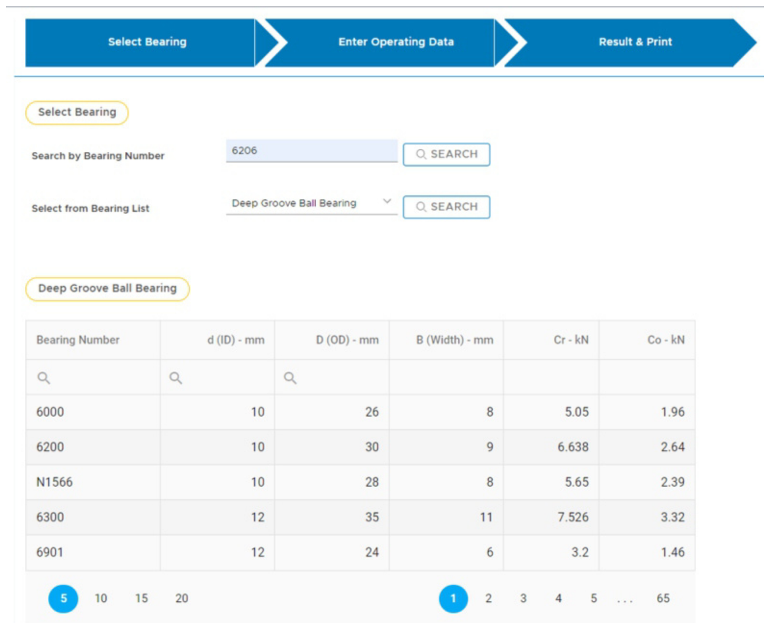
Under load zone as the rolling element rotate to the bottom of the bearing they are compressed between the rings. As they rotate back to the top, the compressed metal expands to its original state. This constant compression and expansion of metal after many revolutions of the bearing increases stress which causes cracks in the material. This leads to fatigue failure. This flaking is due to material Fatigue and will eventually cause the bearing to fail. The effective life of a bearing is usually defined in terms of the total numbers of revolutions a bearing can undergo before flaking of either the raceway surface or the rolling elements surfaces occurs. When a group of apparently identical bearings operate under identical load conditions, the life of individual bearings show a considerable dispersion. Therefore, a statistical definition of the life is applied for the calculation of the bearing life. When selecting a bearing, it is not correct to regard the average life of all bearings as the criterion of life: It is more practical to adopt the life that the majority of bearing will attain or exceed.

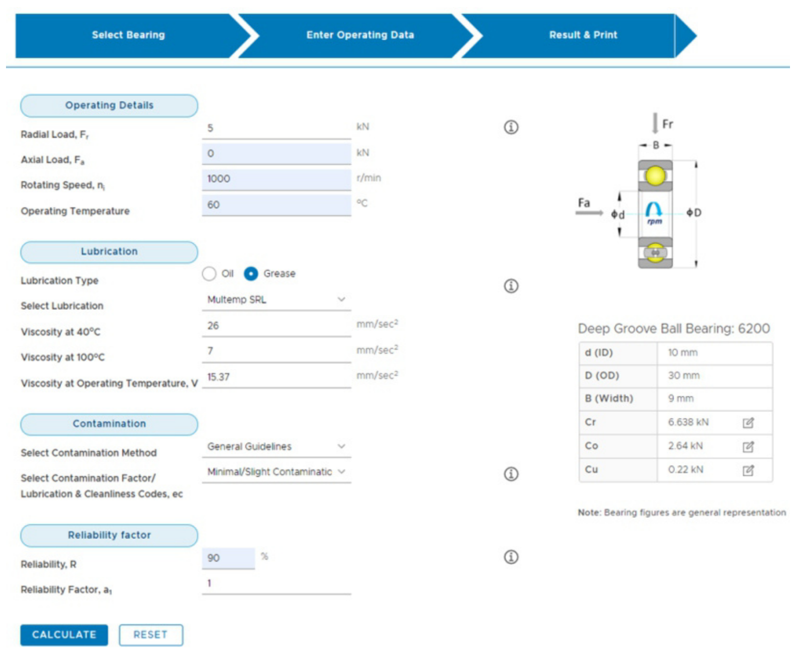
In simplest calculation the bearing life is calculated in terms, L10 life, with 90% reliability, how many hours a bearing will last under a given load and speed as per the formula given in ISO 281 STD. For this reason the basic rating life of a group of bearings is defined as the number of revolutions (or hours at some given constant speed) that 90% of the group of bearings will complete or exceed before the first evidence of fatigue develops. There is a 10% probability that at the applied load and speed, 10% of a population of identical bearings would suffer a fatigue failure. Note that this does not address failures caused by other conditions such as contamination, wear, misalignment, and improper lubrication.

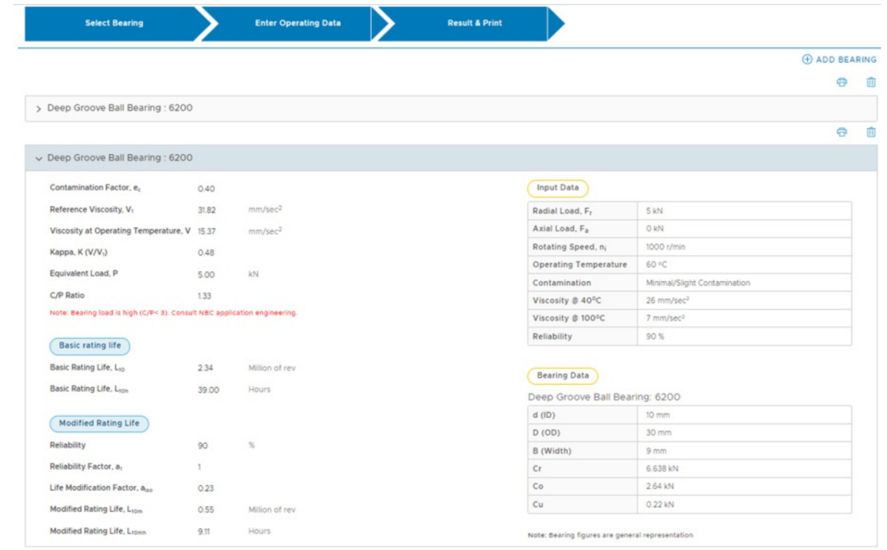
Another method is the use of adjusted or advanced life calculation procedures based on ISO 281 or a bearing manufacturer's in-house calculation methods. These methods take into account oil viscosity, oil temperature and the contamination level in the oil during operation.

The bearing life can be calculated using the tool on NBC.website (https://lifecalc.nbcbearings.com/bearingtool/#/bearingcalculator).

The tool is easy to use and gives quick calculations for Basic rating life & Modified rating life calculation at different reliability, considering environmental and application conditions with accurate ISO factor as per ISO281 and TS16281 standards. Flexibility to calculate life considering custom bearing data. With this tool it is easy to select bearing at an early stage and make initial assessment.


Select Bearing
Enter Operating Data
Result & Print
Select Bearing
Search by Bearing Number
6206
SEARCH
Select from Bearing List
Deep Groove Ball Bearing
SEARCH
Deep Groove Ball Bearing
Bearing Number | d (ID) - mm | D (OD) - mm | B (Width) - mm | Cr - kN | Co - kN
6000 | 10 | 26 | 8 | 5.05 | 1.96
6200 | 10 | 30 | 9 | 6.638 | 2.64
N1566 | 10 | 28 | 8 | 5.65 | 2.39
6300 | 12 | 35 | 11 | 7.526 | 3.32
6901 | 12 | 24 | 6 | 3.2 | 1.46
5 10 15 20
1 2 3 4 5 ... 65


Select Bearing
Enter Operating Data
Result & Print
Operating Details
Radial Load, Fr 5 kN
Axial Load, Fa 0 kN
Rotating Speed, ni 1000 r/min
Operating Temperature 60 °C
Lubrication
Lubrication Type Oil Grease
Select Lubrication Multemp SRL
Viscosity at 40°C 26 mm/sec²
Viscosity at 100°C 7 mm/sec²
Viscosity at Operating Temperature, V 15.37 mm/sec²
Contamination
Select Contamination Method General Guidelines
Select Contamination Factor/ Lubrication & Cleanliness Codes, ec Minimal/Slight Contaminatic
Reliability factor
Reliability, R 90 %
Reliability Factor, a1 1
CALCULATE
RESET
Fr
B
Fa
ϕd
ϕD
Deep Groove Ball Bearing: 6200
d (ID) 10 mm
D (OD) 30 mm
B (Width) 9 mm
Cr 6.638 kN
Co 2.64 kN
Cu 0.22 kN
Note: Bearing figures are general representation


Select Bearing
Enter Operating Data
Result & Print
ADD BEARING
Deep Groove Ball Bearing : 6200
Deep Groove Ball Bearing : 6200
Contamination Factor, ec 0.40
Reference Viscosity, V1 31.82 mm/sec²
Viscosity at Operating Temperature, V 15.37 mm/sec²
Kappa, K (V/V1) 0.48
Equivalent Load, P 5.00 kN
C/P Ratio 1.33
Note: Bearing load is high (C/P< 3). Consult NBC application engineering.
Basic rating life
Basic Rating Life, L10 2.34 Million of rev
Basic Rating Life, L10h 39.00 Hours
Modified Rating Life
Reliability 90 %
Reliability Factor, a1 1
Life Modification Factor, aiso 0.23
Modified Rating Life, L10m 0.55 Million of rev
Modified Rating Life, L10mh 9.11 Hours
Input Data
Radial Load, Fr 5 kN
Axial Load, Fa 0 kN
Rotating Speed, ni 1000 r/min
Operating Temperature 60 °C
Contamination Minimal/Slight Contamination
Viscosity @ 40°C 26 mm/sec²
Viscosity @ 100°C 7 mm/sec²
Reliability 90 %
Bearing Data
Deep Groove Ball Bearing: 6200
d (ID) 10 mm
D (OD) 30 mm
B (Width) 9 mm
Cr 6.638 kN
Co 2.64 kN
Cu 0.22 kN
Note: Bearing figures are general representation

Basic dynamic load rating (Cr)

Every bearing is designed for a certain load referred as the dynamic load rating (Cr). The basic dynamic load rating of a roller bearing is its capacity to support dynamic load. The dynamic load rating mentioned in the catalouge is based on optimum design, high quality material and improved manufacturing tecgniques.

Dynamic load rating is used for calculating basic rating life.

The basic dynamic load is defined as the constant stationary load which a group of bearings with stationary outer ring can endure for a rating life of one million revolutions of the inner ring. It refers to pure radial load for radial bearings and to pure axial load for thrust bearings.

Basic rating life(L)

It gives the calculation of basic rating life L, with 90% reliability. It is based on Lundberg and Palmgren fatigue theory which gives a rating life. The fatigue behaviourr of the material determines the dynamic load carrying capacity of the rolling bearing. The relationship among the bearing basic dynamic load rating, the bearing load and the basic rating life, is given by formula:

$L_{10h} = (C/P)^p$

L_{10h}= Basic Rated Life in millions of revolutions

C = Basic dynamic rated Load, N

(Cr: radial bearings, Ca: thrust bearings)

P = Equivalent Dynamic Load, N

(Pr: radial bearings, Pa: thrust bearings)

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

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

If the speed is constant, it is often preferable to calculate the life in terms of operating hours using the formula:

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

Where,

L_{10h}, basic rating life (at 90% reliability).........in hours

Another method to calculate life in hours is using the above formula

The basic rating life can also be expressed in terms of kilometers for wheel bearings as shown in formula below:

$$L_{10s} = \frac{\pi D}{1000} \times L\,10$$

Where ,

D = Wheel diameter in mm

L = Basic rating life in kms

The relationship between Rotational speed n and speed factor *fn* as well as the relation between the basic rating life L_{10h} and the life factor *fn* is shown in table 4.1

The value of *fn* and the rating life for ball and roller bearing can be found by means of this table.

$L_{10h} = 500(fn)^p$

$f_h = fn(\frac{C}{P})$

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

Where

L_{10h} = basic rating in hours of operation

f_h = life factor

fn = speed factor

n = operating speed, rev./min

Note: For a required life, the basic rated dynamic load (C) can be calculated using the formula and table 4.1, if for an operating condition, equivalent load (P) and speed (n) are given. Based on the dynamic load (C) value obtained, bearing can be selected from the catalogue. The values of 'fh and fn' can be taken from table 4.1

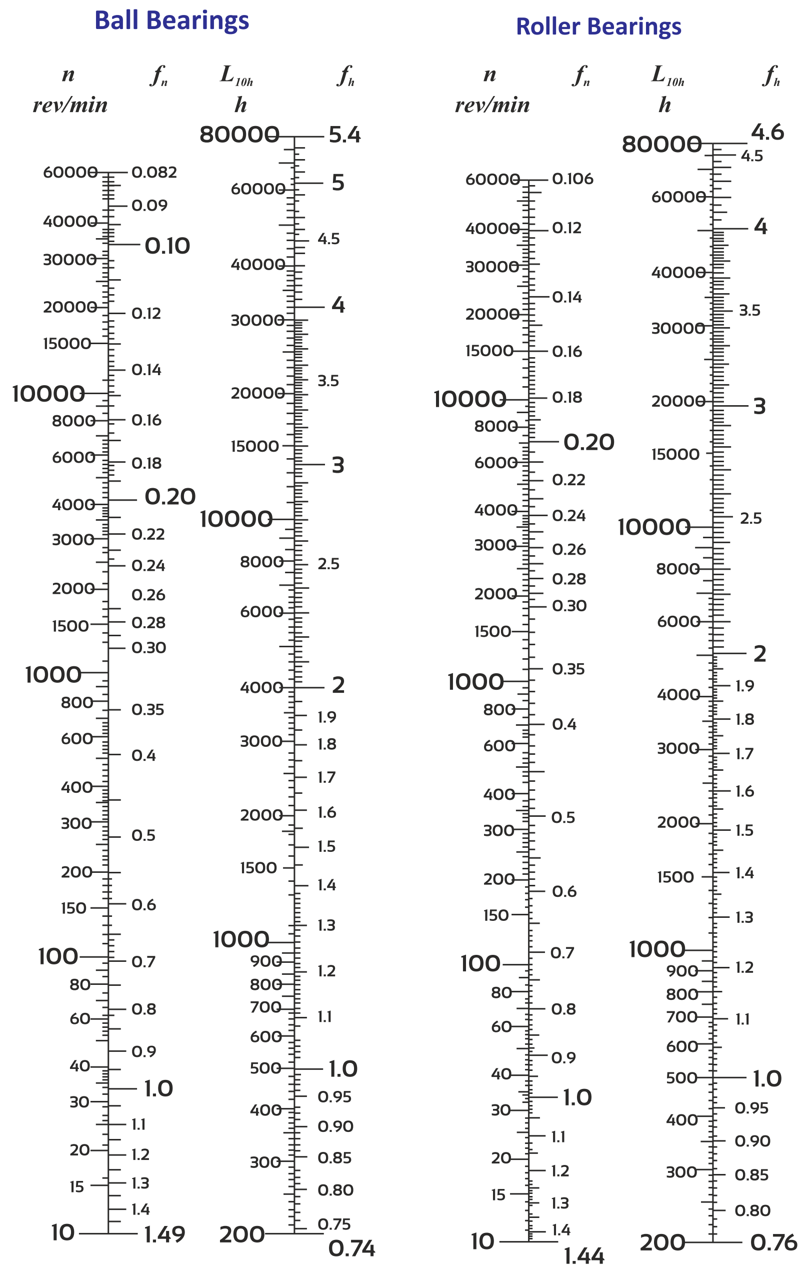
C = P(fh/fn)

Where, f_h = life factor

fn= speed factor

P= equivalent load

Table 4.1 Bearing rating life scale



Life calculation of multiple bearing

When several bearings are used in machines, all the bearings in the machine system are considered as a whole when computing bearing life.

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

where,

L : Total basic rating life of entire unit, h

L_1, L_2 ...Ln: Basic rating life of individual bearings, 1, 2....n, h

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

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

When the load conditions vary at regular intervals, the life can be given by formula

$$Lm = \left(\frac{\phi 1}{L_1} + \frac{\phi 2}{L_2} + \cdots \frac{\phi}{L_1}\right)^{-1}$$

Where,

L m: Total life of bearing

Φj : Frequency of individual load conditions (ΣΦ j = 1)

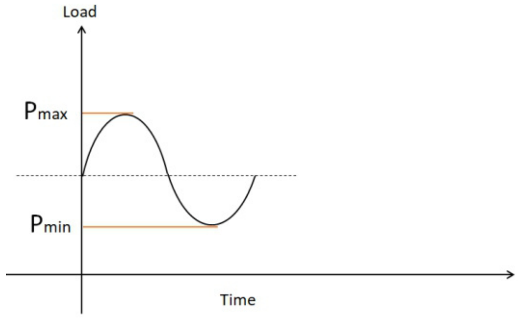
L j: Life under individual conditions

Equivalent load for operating conditions with variable loads and speeds

1. Sinusoidal Loads at constant Speed

Equivalent Load

$$P_e = 0.68\, P_{max} + 0.32\, P_{min}$$

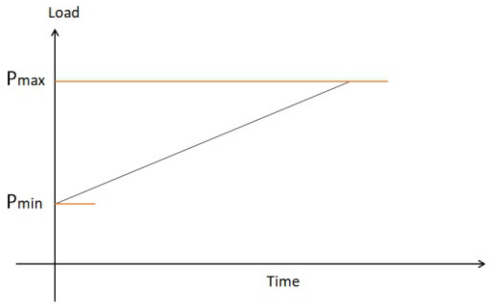


-Main Bearing , Big End Bearing of Crank Shaft .

2. Linear Load Variation

Equivalent Load

$$P_e = \frac{P_{min} + 2P_{max}}{3}$$

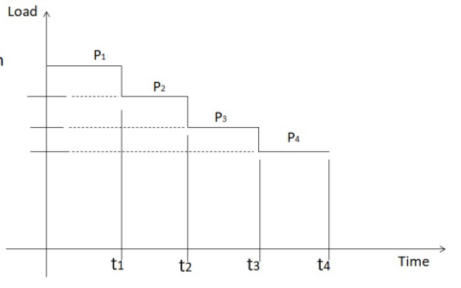


-Centrifugal Casting of Steel Pipes
-Basket Type centrifuges for Sugar Crystallization
-Pinching Roll Hot Strip Mill

3. Fluctuating Load at Constant Speed

Equivalent Load

$$P_e = \left(P_1^n t_1 + P_2^n t_2 + P_3^n t_3 + \text{------} P_z^n t_z\right)^{1/n}$$



n- life exponent Factor For Ball And Roller Bearings

$$P_e = \sum_{i=1}^{Z} P_i^n t_i$$

t - Total Time of duty circle

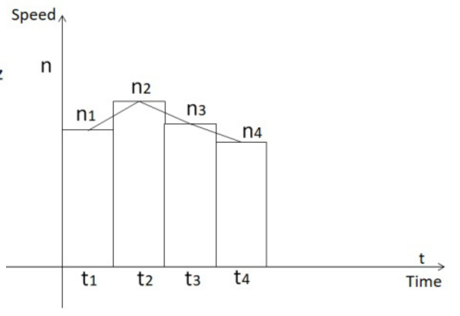
-Many steel Application
-Reversible 6 Hi Mill Skin Pass Mill
-Windmill

4. Variable Speed Constant Load

Equivalent Speed

$$n_e = n_1 t_1 + n_2 t_2 + n_3 t_3 + \text{-----} n_z t_z$$

$$n_e = \sum_{i=1}^{Z} n_i t_i$$



t - Total Time of duty circle

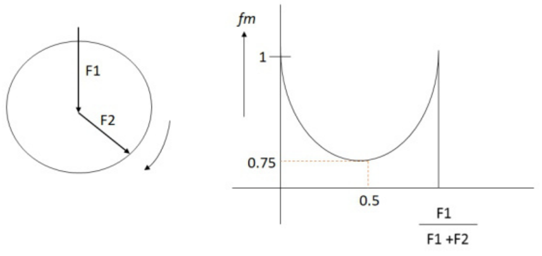
- Wind Mill

5. Rotating Load at Constant Speed

Equivalent Load

$$Pe = fm\,(F1 + F2)$$

- Vibratory Screen



6. Swivel Motion

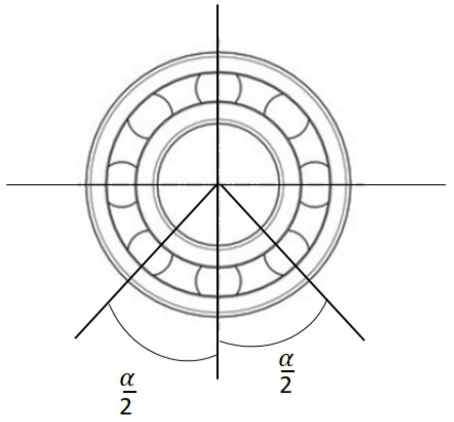
For Swivel Motion

Equivalent Speed

$$ne = \frac{n_{osc} \times \alpha}{180^{o}}$$

n_{osc}= Number of oscillations /min

α = swivel Angle in degrees



- Convertor Bearing in Steel

4.2 Life adjustment factor for Reliability,a

The values for the reliability adjustment factor, a, can be calculated for a reliability of 90 % or higher (a failure probability of 10% or less) are shown in Table 4.2

Table 4.2 Reliability adjustment factor,a

Reliability (%)	L_{nm}	a_1
90	L_{10m}	1
95	L_{5m}	0.64
96	L_{4m}	0.55
97	L_{3m}	0.47
98	L_{2m}	0.37
99	L_{1m}	0.25
99.2	$L_{0.8m}$	0.22
99.4	$L_{0.6m}$	0.19
99.6	$L_{0.4m}$	0.16
99.8	$L_{0.2m}$	0.12
99.9	$L_{0.1m}$	0.093
99.92	$L_{0.08m}$	0.087
99.94	$L_{0.06m}$	0.080
99.95	$L_{0.05m}$	0.077

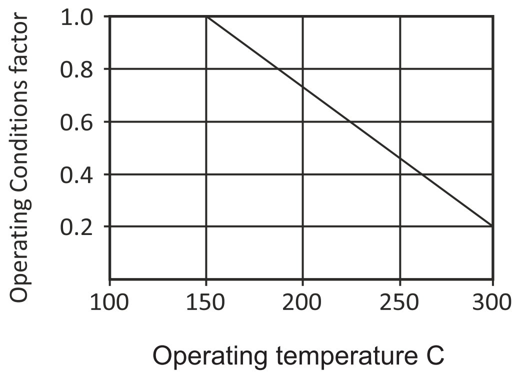
4.3 Thermal stabilization of Rolling bearings at high temperature

Bearing components are heat treated to ensure the performance under load and at the same time they must be stable enough to undergo limited dimensional changes over a period. Dimensional stability is an important parameter in rolling bearings. For bearings operating under high temperature (beyond 120°C) the components often softens and dimensional changes occur. For example, if inner ring bore size increases, it will result in creeping on shaft and loss of clearance in the bearing. For high temperature applications, NBC has developed unique heat treatment solutions (TS treatment) to stabilize bearing dimensions up to certain temperatures class.

Table 4.3 : Treatment class for stabilization

Stabilization Treatment Symbol	Max. Stabilization Temperature	Multiplication Factor
TS2	160°C	1.0
TS3	200°C	0.73
TS4	250°C	0.48

Note: However beyond the stabilization temperature class the treatment makes the bearing softer and life is affected. The life is adjusted by multiplying the values given in the table above (or use the graph below).



4.4 NEI life enhancement for Rolling Bearing

In addition to design parameters the service life of rolling bearings can be greatly enhanced by material and heat treatment processes. A special heat treatment is given to the bearings .This alter the microstructure which in turns improves the yield strength and rolling contact fatigue properties. The special heat treatment process leverages the combined advantage of having modified surface and core microstructure to significantly extend the bearing life. To prove the effectiveness of bearing made from special manufacturing process extensive laboratory and field tests were carried out. The positive results from the test helped in deciding the life multiplication factor for NEI bearings. However the selection of the special treatments depends on the application and type of bearing. Consult NEI representative for additional information and support. Refer the table 4.4 for special treatment factors.

Table 4.4 : Special treatment factors

Special Treatment	Life Multiplication factor
MLB	4.0
AST	2.0
TMB	2.2
4T	1.4

nbc
CKA Birla Group

4.5 Modified rating life (L_{nm})

The rating life modified for 90% or other reliability for bearing with fatigue load, and/or special bearing properties, and/or contaminated lubricant and other non – conventional operating conditions.

The modified rating life is calculated according to the formula prescribed in ISO281:2007.

$L_{nm} = a_1 \bullet a_{ISO} \bullet L_{10}$

L_{nm} modified rating life [10^6 revolutions]

a_1 reliability adjustment factor

a_{ISO} life modification factor for operating conditions

This method evaluates the bearing life by using the life modification factor (a_{ISO}) and the life adjustment factor for reliability (a_1).

a_{ISO} essentially takes account of:

- Load on bearing
- Internal geometry of the bearing,
- Manufacturing quality,
- Fatigue limit of material,
- Lubrication method, type of lubricant, viscosity, additives,
- Cleanliness and filtration,
- Operating temperature and bearing speed.

$$a_{ISO} = f\left[\frac{e_c\, c_u}{P}\, K\right]$$

Where,

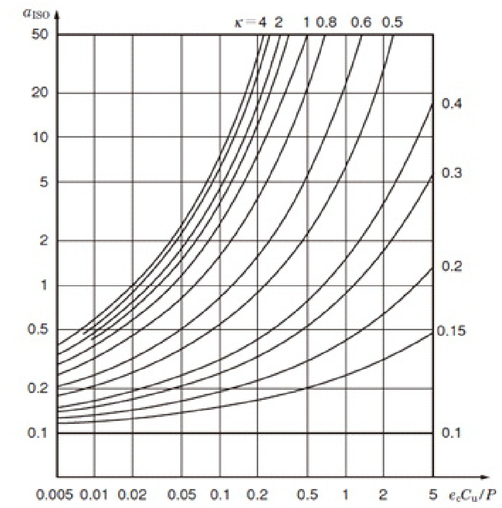
e_c - Contamination factor

C_u - Fatigue load limit in newton

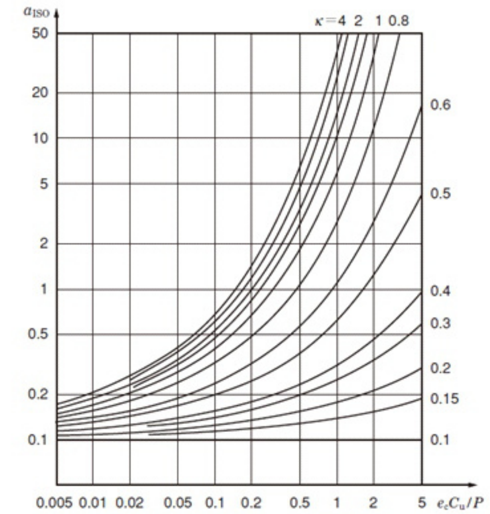
K - Viscosity ratio (kappa)

P - Dynamic Equivalent load in newton

The life modification factor (a_{iso}) can be estimated from graphs and equations given in ISO281:2007 standard.

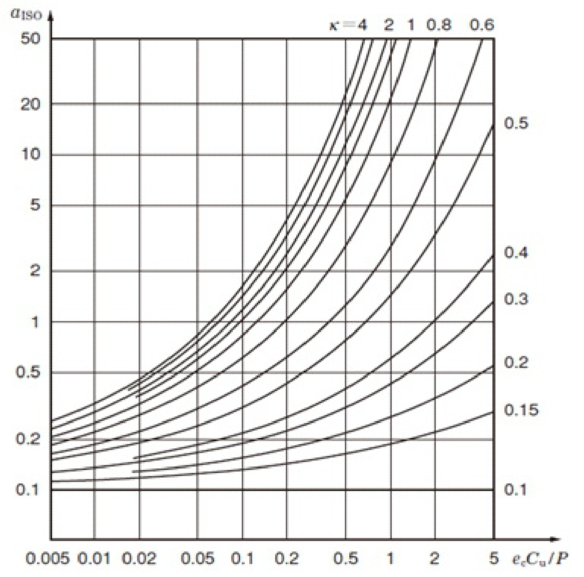


Life modification factor a_{ISO} (Radial ball bearings) Fig.4.1

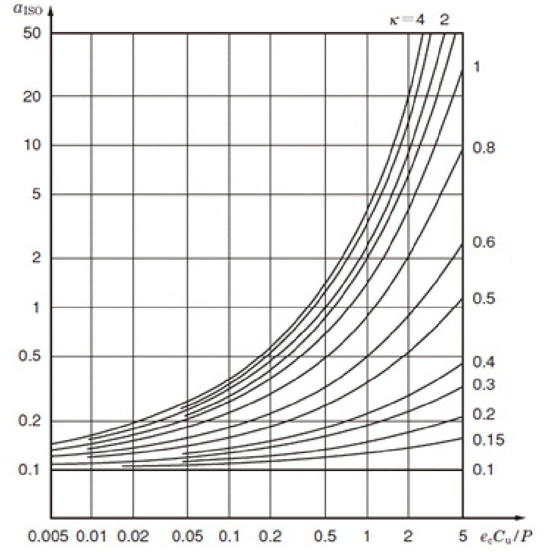


Life modification factor a_{ISO} (Radial roller bearings) Fig.4.2

The life modification factor (a_{iso}) can be estimated from graphs and equations given in ISO281:2007 standard.



Life modification factor a_{iso} (Thrust ball bearings) Fig.4.3



Life modification factor a_{iso} (Thrust roller bearings) Fig.4.4

4.6 Viscosity Radio (Kappa), K

The key characteristic of a lubricant is the ability of the lubricant to separate moving parts. Operating conditions play a key role in determining the appropriate viscosity for a given component and application. The condition of the lubricant is defined by the viscosity ratio, K for adequate lubrication.

$$K = \frac{V}{V_1}$$

Where

V is the actual Kinematic Viscosity

V_1 is the Reference Kinematic Viscosity

The viscosity ratio (k) is an indicator of the quality of the lubricant film thickness formation. The reference Kinematic viscosity takes account of the minimum oil film thickness, h min in relation to the contacting surface irregularities to provide adequate film formation. The lubricant must have minimum viscosity. Lubricant film thickness (h) min is affected by various factors including viscosity, temperature, relative surface velocity, load, contact area, deformation, and lubricant regime.

The influence of oil film thickness (h) on bearing life is given by a factor, Λ

At operating conditions, specific film thickness parameter, Λ is the ratio of lubricant film thickness (h) within the contact divided by the composite roughness (o) of the two contacting surfaces.. Λ is determined by,

$$\Lambda = \frac{h}{S}$$

Where,

'h' is the oil lubricant film thickness
's' is the root mean square surface roughness

$$S = \sqrt{s_1^2 + s_2^2}$$

S_1 is the surface roughness of contacting body 1
S_2 is the surface roughness of contacting body 2

$\wedge$ is used as an indicator of the lubricant regime. With $\wedge$ value, it can be identified which lubricant regime is present in an operating contact within bearings.

In Liquid Lubrication, regimes can be based on specific film thickness parameter, $\wedge$ as:

- $\Lambda > 3 \rightarrow$ full film (thick film) lubrication, hydrodynamics
- $1.2 > \wedge > 3 \rightarrow$ mixed or thin film lubrication
- $\Lambda < 1.2 \rightarrow$ boundary lubrication

In order to form an adequate lubrication film, viscosity ratio (K) is based upon mineral oil and contacting surfaces of machined bearing components. But the viscosity ratio, $K = V/V_1$ can only be approximated for synthetic oils.

Hence for more detail estimation of viscosity ratio K, specific film thickness parameter Λ can be applied. Calculation of Λ considers lubricant film thickness, surface roughness ,P-V coefficient etc.

When ratio (Λ) is calculated, the kappa value, K can be approximately estimated by the following equation as given below.

$$K \approx \wedge^{1,3}$$

Most of the application are designed for lubrication condition with viscosity ratio (kappa) ranging from 1 to 4. Refer table 4.5

Table 4.5 Viscosity ratio (Kappa), K condition

4	Full fluid-film lubrication
>4	In the regime of full fluid
<4	Mixed friction. Lubricating greases containing antiwear additives have to be used
1	The basic rating life of the roller bearing is acheived
<0.4	Mixed friction with increased solid contact; the grease has to contain EP additives.

Note: For K value below 1

- If the K value is low due to speed, then bearing selection is based on static safety factor.
- If the K value is low because of low viscosity, then select higher viscosity lubricant or improve cooling.

For K value less than 1, extreme pressure (EP)/ anti-wear (AW) additives are recommended.

Considering EP additive as per ISO281:

For viscosity ratio, k<1 and contamination factor, $e_c \geq 0,2$ calculation can be carried out using k=1 if a lubricant with proven effective EP additive is used. In this case the life modification factor, a_{ISO} shall be limited to $e_c \leq 3$ If the calculated value of aiso for the actual k is greater than 3 then this value can be used in calculation.

Viscosity grade in accordance with ISO 3448 are listed in the table 4.6 with grade at 40° C. Higher the K value, better is the bearing life.

Table 4.6 Kinematic viscosity limits at 40 C(105 F)

Viscosity grade	mean	min.	max.
	mm^2/s		
ISO VG 2	2,2	1,98	2,46
ISO VG 3	3,2	2,88	3,52
ISO VG 5	4,6	4,14	5,06
ISO VG 7	6,8	6,12	7,48
ISO VG 10	10	9,00	11,0
ISO VG 15	15	13,5	16,5
ISO VG 22	22	19,8	24,2
ISO VG 32	32	28,8	35,2
ISO VG 46	46	41,4	50,6
ISO VG 68	68	61,2	74,8
ISO VG 100	100	90,0	110
ISO VG 150	150	135	165
ISO VG 220	220	198	242
ISO VG 320	320	288	352
ISO VG 460	460	414	506
ISO VG 680	680	612	748
ISO VG 1 000	1 000	900	1 100
ISO VG 1 500	1 500	1 350	1 650

Calculation of Kappa value

Kappa value, k (Viscosity ratio)

$$\text{Kappa k} = \frac{\text{Viscosity under operating temperature}}{\text{Minimum viscosity under mean dia and operating speed (Reference viscosity)}}$$

More than 80% of all rolling bearings are lubricated with grease. Therefore selection of grease is critical. Not only will correct grease selection, prolong the life of the bearing, it also ensures smoother running. C/P ratio is the measure of the bearing dynamic capacity 'C' in relation to load (P). Based on C/P ratio, type of grease can be selected. Refer table below.

Load radio C/P

C/P	Load	Criteria for selection
>30	Very low loads	Max. permissible load for sllicone greases
20-30	low loads	Dynamically light greases
8-20	Medium loads	Greases containing antiwear addltivẽ
4-8	High loads	A Greases with EP and antiwear addltivesis to used. Reduced grease/bearing life to be expected
<4	Extremely High loads	A Greases with EP antiwear addltives + solid lubricants is to to be used.A consicerably reduced grases/ bearing life is to be expected

Induced Thrust Load Reaction Taper Roller Bearing

Taper roller bearing due to their design when loaded radially, produces thrust reaction (the thrust load in opposite direction is induced on shaft axis), which if not accommodated will push the inner and outer ring apart, the bearing will separate.
Radial load on bearing A for example will generate axial thrust on bearing B.
One of the reason taper roller bearings are always used in pairs.

These thrust reaction are important part and needs to be taken into consideration

Thrust reaction factor K = 0.4 cota
a Half Included angle of cup

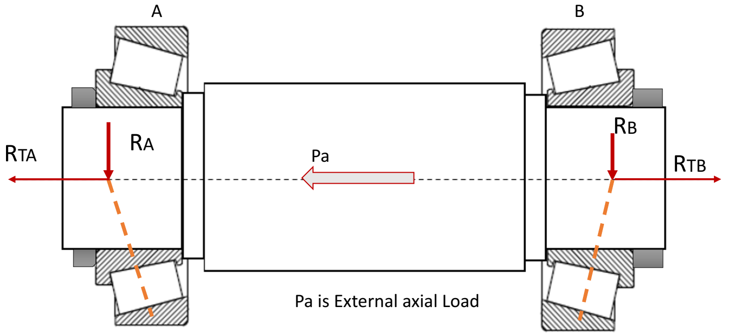
Thrust reaction due to radial load when load zone is equal less than 180°

$$R_T = \frac{0.47\ Fr}{K}$$

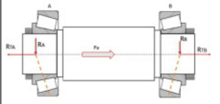
R, is the Induced thrust load due to radial load Fr when load zone approaches 360° quite obvious, load zone nearing 360° indicates combined radial and thrust load is applied

$$R_T = \frac{0.6\ Fr}{K}$$

Back-to-back Arrangement

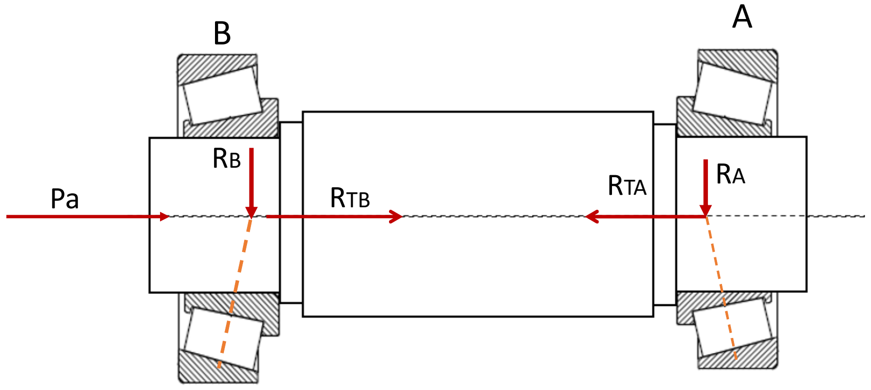


R_A - Radial Load on Bearing A
R_{TA} - Thrust Load Induced By radial load
R_B - Radial Load on Bearing B
R_{TB} - Thrust Load Induced By radial load

Load Centers		Load Condition	Axial Load Bearing A	Axial Load On Bearing B
		$R_{TA} = \frac{0.47\ R_A}{Y_A}$ $R_{TB} = \frac{0.47\ R_B}{Y_B}$		
Load Zone Less or equal to 180°	Case 1	If $R_{TA} \leq R_{TB} + Pa$	Then Axial Thrust Load on Bearing A $FaA = R_{TB} + Pa$ $FaA = \frac{0.47\ R_B}{Y_B} + Pa$	*No Axial Thrust is taken on Bearing B in Load Calculations*
	Case 2	If $Pa + R_{TB} \leq R_{TA}$	*No Axial Thrust on Bearing A in Load Calculations*	$FaB = R_{TA} - Pa$ $FaB = \frac{0.47\ R_A}{Y_A} - Pa$

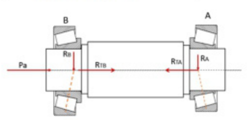
YA – Thrust Reaction Factor Bearing A
YB – Thrust Reaction factor Bearing B

Face To face arrangement



R_A - Radial Load on Bearing A
R_{TA} - Thrust Load Induced By radial load

R_B - Radial Load on Bearing B
R_{TB} - Thrust Load Induced By radial load
Pa - External axial load

Load Centers		Load Condition	Axial Load Bearing A	Axial Load On Bearing B
		$R_{TA} = \frac{0.47\,R_A}{Y_A}$ $R_{TB} = \frac{0.47\,R_B}{Y_B}$		
Load Zone Less or equal to 180°	Case 1	If $R_{TA} \leq R_{TB} + Pa$	Then Axial Thrust Load on Bearing A $FaA = R_{TB} + Pa$ $FaA = \frac{0.47\,R_B}{Y_B} + Pa$	*No Axial Thrust is taken on Bearing B in Load Calculations*
	Case 2	If $Pa + R_{TB} \leq R_{TA}$	*No Axial Thrust on Bearing A in Load Calculations*	$FaB = R_{TA} - Pa$ $FaB = \frac{0.47\,R_A}{Y_A} - Pa$

Y_A – Thrust Reaction Factor Bearing A
Y_B – Thrust Reaction factor Bearing B

4.7 Contamination facts (e_c)

The factor is used to consider the contamination level of the lubricant. The life reduction caused by contamination depends on lubricant film thickness, size and distribution of solid contaminant particles and types of contaminants (soft, hard etc.). As a general guideline the values for solid contamination factor, e,can be taken from the table (ISO281:2007)

Table 4.7 for contamination factor, e_c

Contamination level	e_c	
	$D_{pw} < 100$mm	$D_{pw} \geq 100$mm
Extreme cleanliness Particle size of order of lubricant film thickness laboratory conditions	1	1
High cleanliness Oil filtered through extremely fine filter: conditions typical for bearings greased for life and sealed	0.8 to 0.6	0.9 to 0.8
Normal cleanliness Oil filtered through fine filter: conditions typical for bearings greased for life and shielded	06. to 0.5	08. to 0.6
Slight contamination	0.5 to 0.3	0.6 to 0.4
Typical contamination Conditions typical of bearings without seals: course filtering: wear particles from surroundings	0.3 to 0.1	0.4 to 0.2
Severe contamination Bearing environment heavily contaminated and bearings arrangement with inadequate sealing	0.1 to 0	0.1 to 0
Very severe contamination	0	0

Dpw is the mean pitch diameter of bearing in mm
Note: For advance and detailed method for calculation of e. factor for different lubriation method in grease and oil (bath or circulation), refer ISO 16889 and ISO 4406 standards.

4.8 Estimating Contamination factor, ec, based on lubricant cleanliness

4.8.1 Lubricant system cleanliness level

The method for classifying the applicable contamination level for a range of cleanliness code is defined in ISO 4406.In this system the solid particle count data is converted into code using scale number. The code is assigned based on ISO 4406 which provides the method of measuring and describing the cleanliness level for lubricating system. Lubricant gets contaminated by debris resulting from wear or during assembly or dust in the air etc. To determine how clean the lubricant (oil or grease) is for a given application, a sample is taken for analysis.
There are two methods for checking contamination level in lubricant.

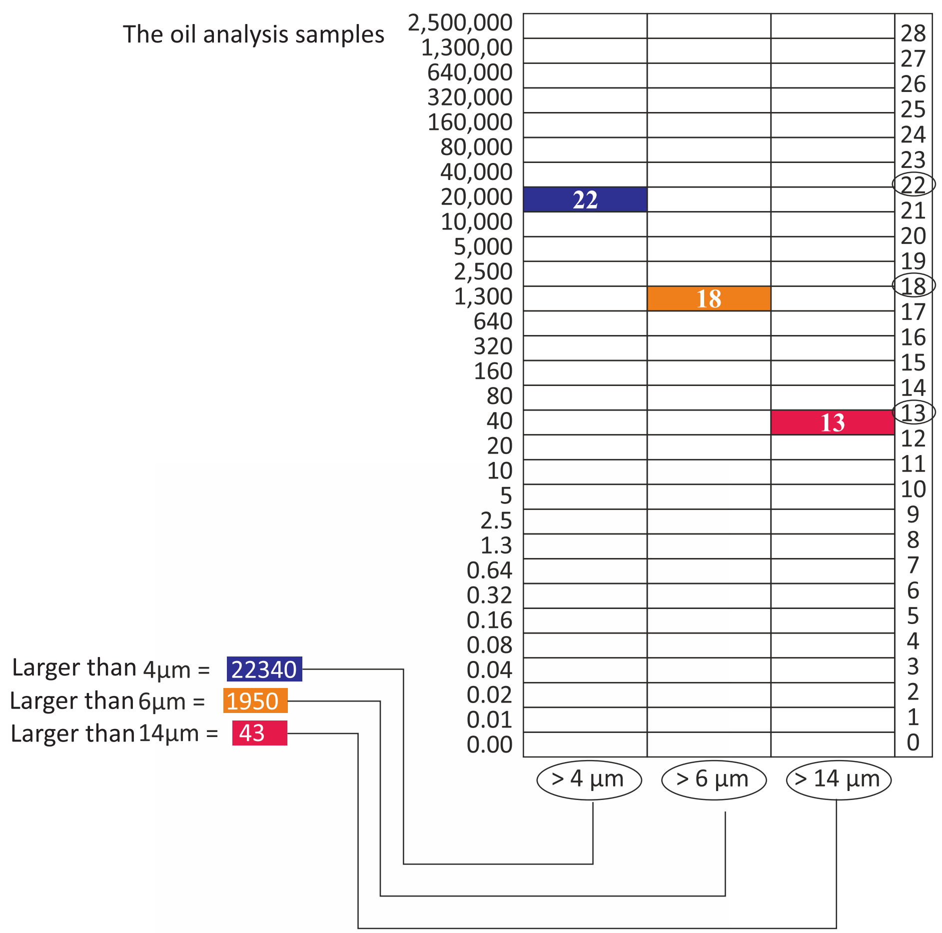
- Microscopic counting method. This method uses two particle sizes: ≥5 µm and ≥ 15 µm.
- Automatic Optical single particle counter in accordance with ISO 11171. It uses three particle sizes: ≥4 µm (c), ≥6 µm (c) and ≥ 14 µm(c).

ISO classification for scale number

Number of Particles per ml		ISO 4406
More than	Up to & including	Scale Number
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64,000	130,000	17
32,000	64,000	16
16,000	32,000	15
8,000	16,000	14
4,000	8,000	13
2,000	4,000	12
1,000	2,000	11
500	1,000	10
250	500	9
130	250	8
64	130	7
32	64	6
16	32	5
8	16	4
4	8	3
2	4	2

Example of contamination level classification for lubricatin system.

The oil analysis samples send through APC (Automatic optical particle counter). Amount of dirt particles in a 1ml sample larger than specified sizes 4um/6um/14um



Particle count data converted into ISO Code: 22/18/13

4.8.2 Filter Absolute Rating

An absolute rating gives the size of the largest particle that will pass through the filter or screen. Essentially, this is the size of the largest opening in the filter although no standardized test method to determine its value exists. Still, absolute ratings are better for representing the effectiveness of a filter. A filter rating is an indication of filter efficiency and is expressed as a reduction factor (B). The filter is for the specified particle size. Filter rating B is expressed as a ratio between the number of specified particles before and after filtering. This can be calculated using

$$\beta_{x(c)} = \frac{n_1}{n_2}$$

Where

$\beta_{x(c)}$	=	filter rating related to a specified particle size x
x	=	particle size(c)(µm) based on the automatic particle counting method, calibrated in accordance with ISO 11171
n_1	=	number of particles per volume unit larger than x, upstream of the filter
n_2	=	number of particles per volume unit larger than x, downstream of the filter

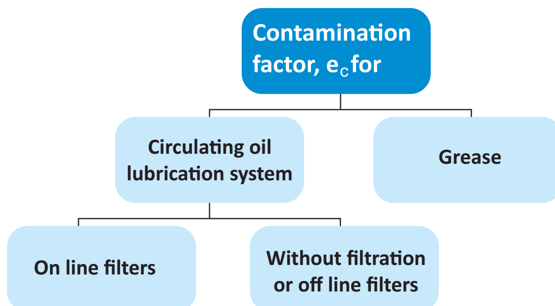
For example, a "B5© = 10" means that only 1 in 10 particles, 5µm or larger, passes through the filter.

4.9 Method for determing Contamination factor, e_c based on cleanliness code and filter ratio

Contamination factor can be estimated once the contamination level is known for lubricating system. The contamination factor apart from particle counts also depends on size of bearing and lubrication condition.

As per ISO 281, the contamination factor can be determined by means of diagram or equation for the following lubrication method.

- Circulating oil with oil filtered on line before supply to bearing.
- Oil bath lubrication or Circulating oil with off line filter
- Grease lubrication



4.9.1 Lubricating system

4.9.1.1 Contamination factor, e_C , for circulating oil lubrication system with in line filters.

For circulating oil systems with on line filters, before the oil is supplied to the bearing the contamination factor can be determined using graphs as per ISO 281 Standard.

Note: The diagram to be used is selected on the basis of the filter retention rate ßx(c) according to ISO 16889 and the oil cleanliness code according to ISO 4406. The index (c) is the particle size according to ISO 1171

Fig. 1. Contamination coefficient for circulating oil lubrication with on-line filter -filter rating $\beta_{6(C)}$= 200, cleanliness code acc. to ISO 4406 -/13/10

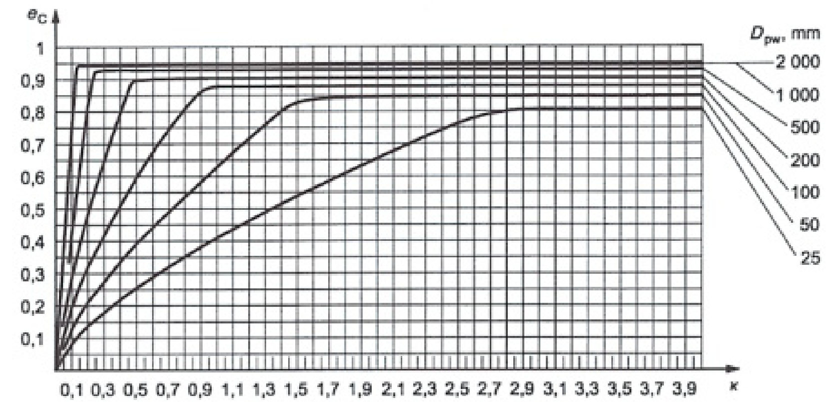
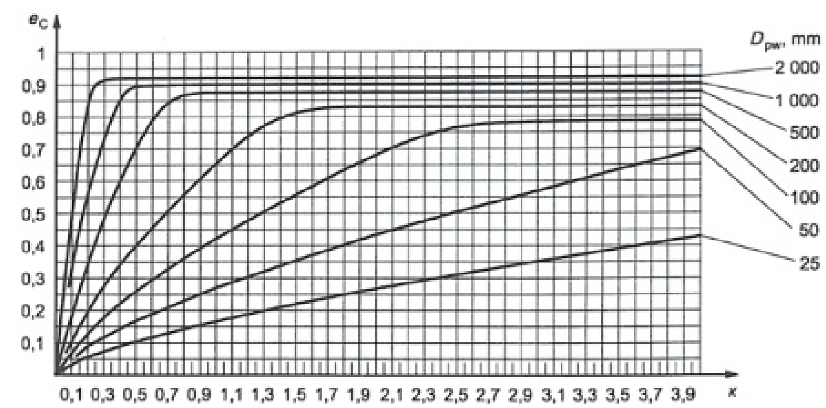
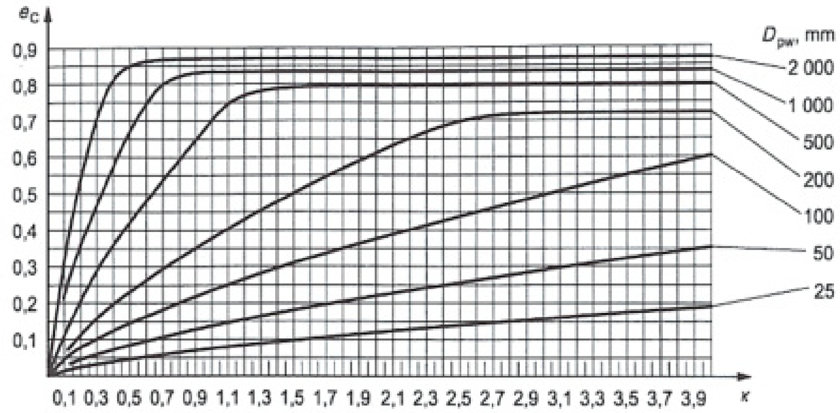


Fig. 1. Contamination coefficient for circulating oil lubrication with on-line filter -filter rating $\beta_{12(C)}$= 200, cleanliness code acc. to ISO 4406 -/15/12



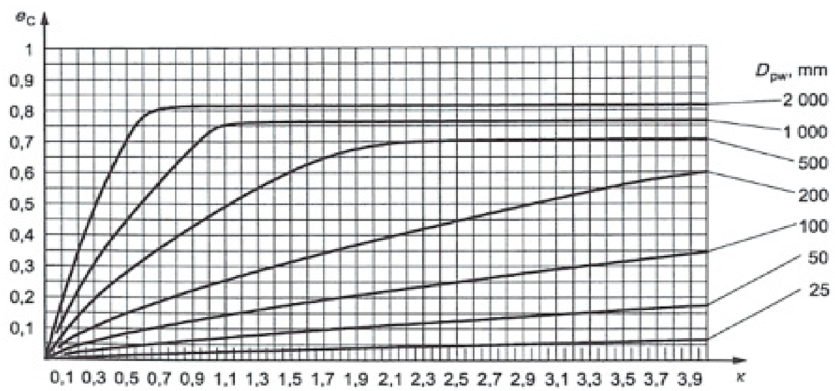
Cleanliness codes range ISO 4406: -/15/12,-/16/12, -/15/13,-/16/13

Fig. 3. Contamination coefficient for circulating oil lubrication with on-line filter -filter ra tingß 75, cleanliness code acc. to ISO 4406-/17/14



Cleanliness codes range ISO 4406: -/17/14, -/18/14, -/18/15, -/19/15

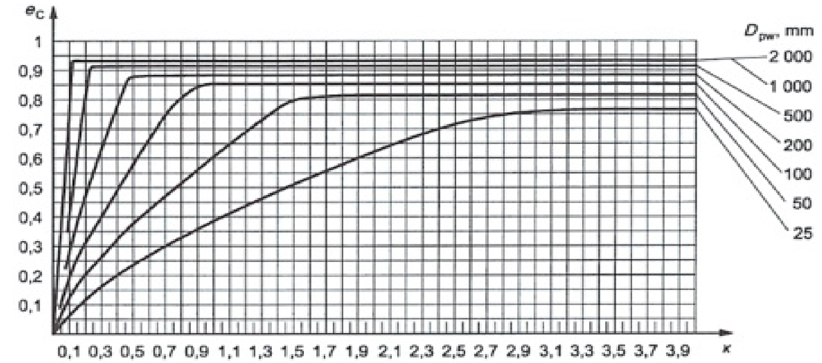
Fig. 4. Contamination coefficient for circulating oil lubrication with on-line filter -filter rating ß= 75, cleanliness code acc. to ISO 4406 -/19/16



Cleanliness codes range ISO 4406: -/19/16, -/20/17, -/21/18, -/22/18

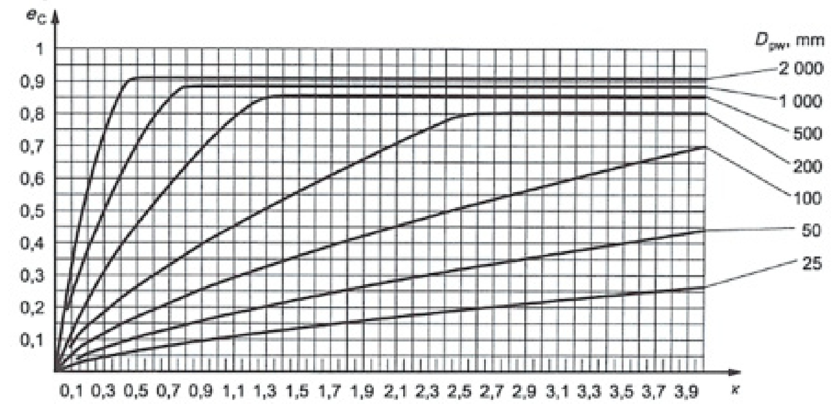
4.9.1.2 Contamination factor, e for circulating oil lubrication system without filteration or with off line filters.

Fig. 5. Contamination coefficient for oil lubrication without filters or with off-line filters - cleanliness code acc. to ISO 4406 -/13/10



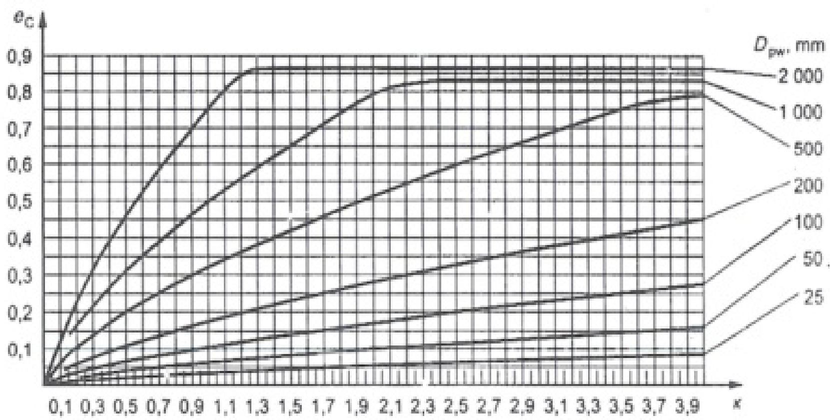
Cleanliness codes range ISO 4406: -/13/10, -/12/10, -/11/19, -/12/9

Fig. 6. Contamination coefficient for oil lubrication without filters or with off-line filters - cleanliness code acc. to ISO 4406 -/15/12



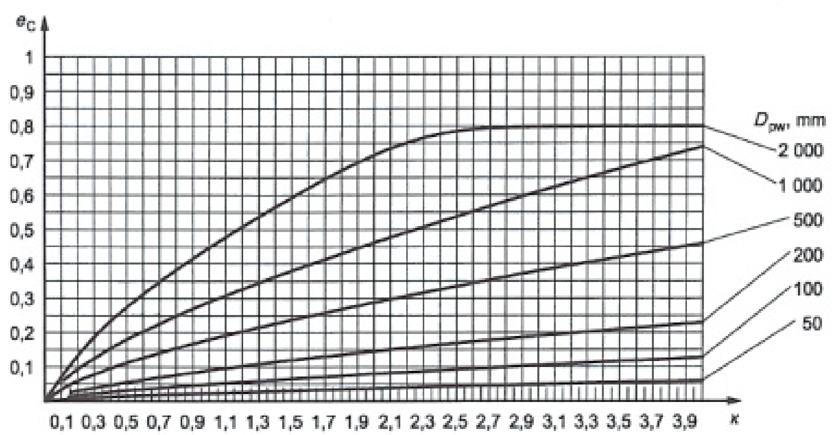
Cleanliness codes range ISO 4406: -/15/12, -/14/12, -/16/12, -/16/13

Fig. 7. Contamination coefficient for oil lubrication without filters or with off-line filters - cleanliness code acc. to ISO 4406 -/17/14



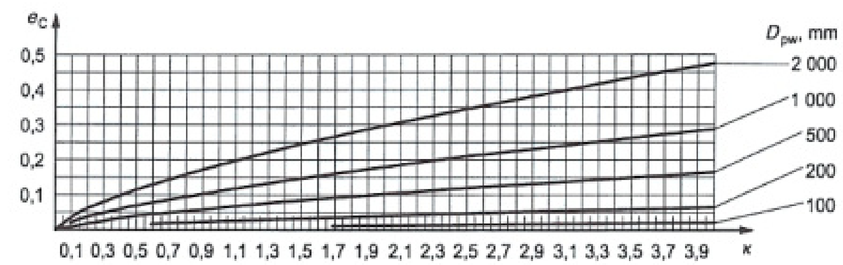
Cleanliness codes range ISO 4406: -/17/14, -/18/16, -/20/17,-/21/17

Fig. 8. Contamination coefficient for oil lubrication without filters or with off-line filters - cleanliness code acc. to ISO 4406 -/19/16



Cleanliness codes range ISO 4406: -/19/16, -/18/16, -/20/17,-/21/17

Fig. 9. Contamination coefficient for oil lubrication without filters or with off-line filters - cleanliness code acc. to ISO 4406 -/21/18



Cleanliness codes range ISO 4406: -/21/18, -/21/19, -/22/19,-/23/19

4.8.2 Contamination factor, e_c for grease lubrication

Working conditions	Contamination level
Very clean assembly with careful washing, rinse; very good sealing regard to working conditions; continuous regraessing or often lubrication;	High Cleanliness
Sealed bearings, greased for life with effective sealing with regard to working conditions	
Clean assembly with washing and rinse; good sealing with regard to working conditions; regreassing according to manufactures specifications;	Normal Cleanliness
Sealed bearings, greased for life with properly choosen sealing with regard to working conditions, e.g. bearing with Z type shields	
Clean assembly; sealing with regard to working conditions; regressing according to manufactures specification;	Slight or typical Cleanliness
Assembly in working; bearing and assembly insufficiently washed after mounting: poor sealing with regard to working conditions; regreasing intervals longer than recommended by manufacture	Severe contamination
Assembly in contaminated environment; insufficient sealing: very long regreasing intervals	Very Severe contamination

Refer to the figures below for contamination factor in grease lubrication.

Fig.10. Contamination coefficient for grease lubricant - High cleanliness

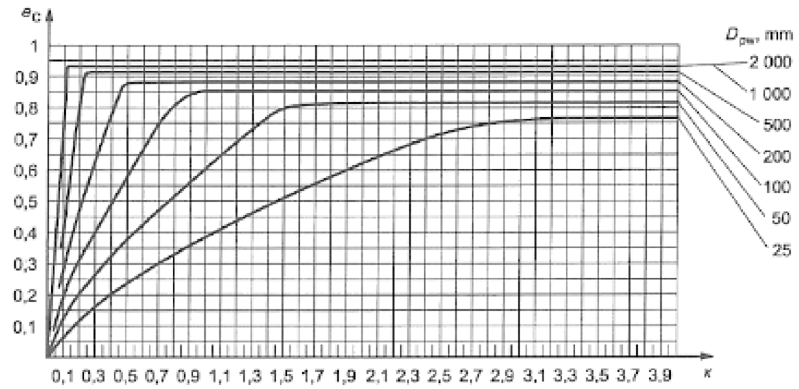


Fig.11. Contamination coefficient for grease lubricant - Normal cleanliness

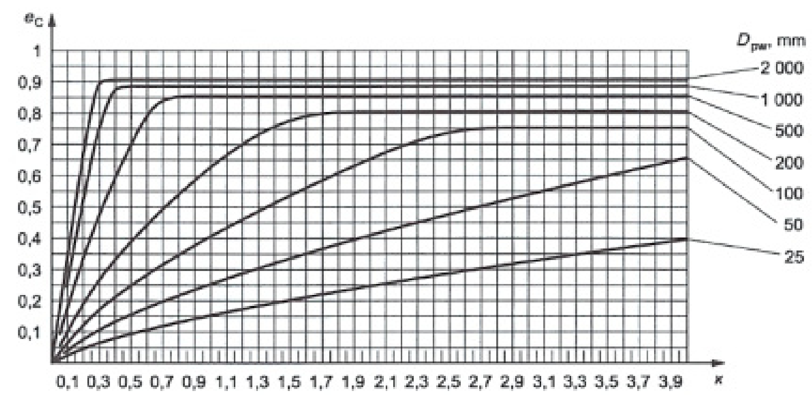


Fig.12. Contamination coefficient for grease lubricant - slight or typical cleanliness

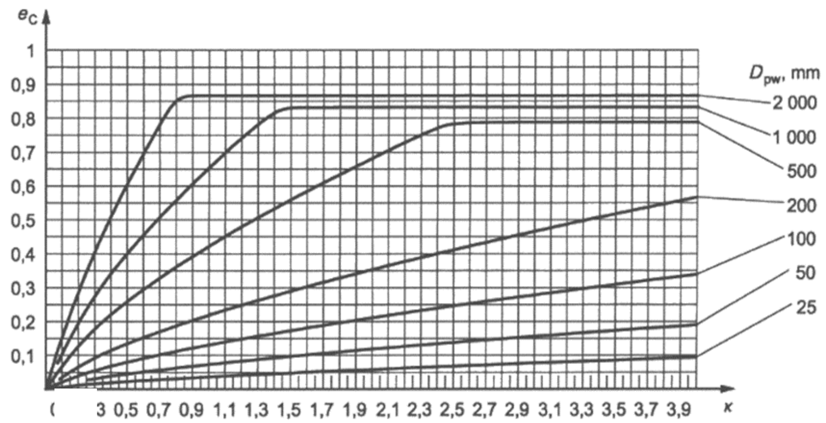


Fig.13. Contamination coefficient for grease lubricant - Severe contamination

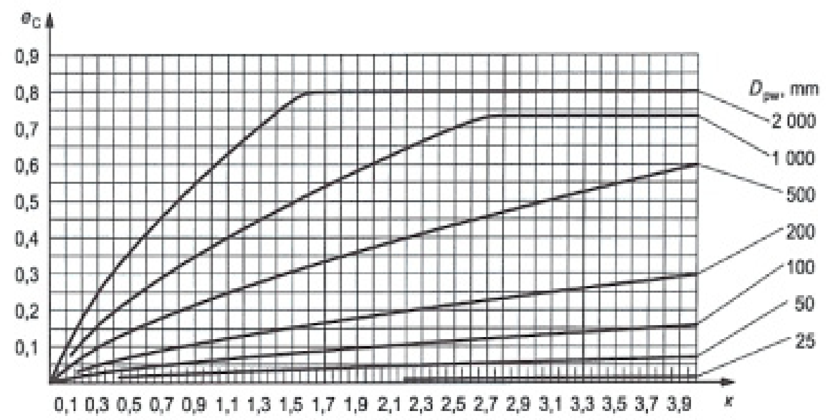
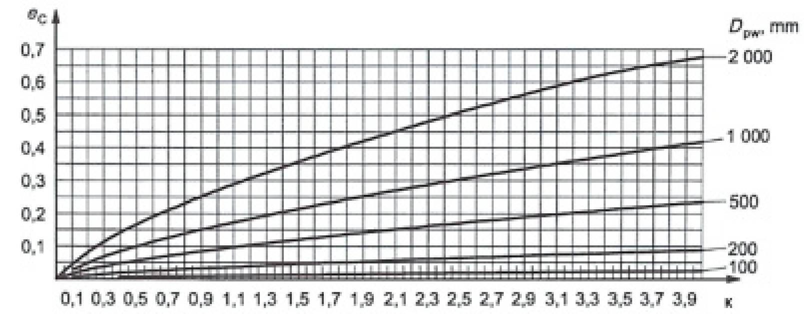


Fig.14. Contamination coefficient for grease lubricant - Very severe contamination



4.10 Basic Static Load Rating (co)

The Static load is defined in ISO 76. It is the load acting on a non-rotating bearing. Permanent deformation appears in rolling elements and raceways under static load of moderate magnitude and increases gradually with increasing load. The permissible static load, therefore, depends upon the permissible magnitude of permanent deformation.

Experience shows that total permanent deformation of 0.0001 times of the rolling element diameter,occurring at the most heavily loaded rolling element and raceway contact can be tolerated in most bearing applications without impairment of bearing operation.

In certain applications where subsequent rotation of the bearing is slow and where smoothness and friction requirements are not too exacting, a much greater total permanent deformation can be permitted. On the other hand, where extreme smoothness is required or friction requirements are critical, less-total permanent deformation may be tolerated.

For purpose of establishing comparative ratings, the basic static load rating therefore, is defined as that static radial load which corresponds to a total permanent deformation of rolling element and raceway at the most heavily stressed contact set at 0.0001 times of the rolling element diameter. It applies to pure radial load for radial bearing and pure axial load for thrust bearing. In single row angular contact bearing, the basic static load rating relates to the radial component of the load, which causes a purely radial displacement of the bearing rings in relation to each other. The maximum applied load values for contact stress occurring at the rolling element and raceway contact points are as follows:

For ball bearing	4200 MPa
For self-aligning ball bearing	4600 MPa
For roller bearing	4000 MPa

The static equivalent load is defined as that static radial load, which, if applied to Deep Groove Ball bearings, Angular Contact or Roller bearings would cause the same total permanent deformation at the most heavily stressed rolling element and raceway contact as that which occurs under the actual conditions of loading. For thrust bearings the static equivalent load is defined as that static, central, purely axial load which, if applied, would cause the same total permanent deformation at the most heavily stressed rolling element and raceway contact as that which occurs under the actual condition of loading.

4.11 Life factor for application

Service Requirements	Life factor f_h < 1.0	1.0-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-5.0	> 5.0
Machines used occasionally	Door mechanism measuring instruments							
Equipment for short period or intermittent service interruption permission		Medical equipment	Household appliances, electric hand tools, agriculture machines, lifting tackles in shop					
Intermittent service machines high reliability				Power station auxiliary equipment, construction machines, Crane Sheaves elevators, Conveyors, deck cranes, Cranes	Crane Sheaves			
Machines used for 8 hours a day but not always in full operation		Automobiles, motor cycles internal grinding spindles, ore tub axles	Buses, Trucks	Wood working machines, gear drives, plunger pumps vibrating screens	Small electric motors, grinding spindles, boring machine spindles rotary crushers, industrial Wagon axles	Lathe spindles, press flywheels printing machines	Agitators important gear units	
Machines fully used for 8 hours			Small rolling mill roll necks	Large rolling mill roll necks, rolling mill table rollers, excavators centrifugal separators continuous operation conveyors	Industrial electric motors, blowers, air conditioners street car or freight wagon axles, general machinery in shop, continuous operation cranes	Large electric motors, rolling mill gear units plastic extruders, rubber-plastics calendar rolls, railway vehicle axles, traction motors, conveyors in general use	Locomotive axles, railway vehicle gear units, false twist textile machines	
Machines continuously used for 24 hours a day					Loom	Electric motors in shop compressors, pumps	Textile machines, mine winches, iron industry conveyors	Paper making machine, main rolls machines
Machines continuously used for 24 hours a day with maximum reliability pumps								Power station equipment, water supply equipment for urban areas, mine drain

Reference life for machine application under operational conditions

Operation classification	L10h life (reference)				×10³ h
	～4	4～10	12～25	25～50	50～
Machines used for short periods or occasionally	Household appliances Electric hand tools	Farm machinery			
Short period or intermittent use, but with high reliability requirements	Medical appliances Measuring instruments	Home air conditioning motor Construction equipment Elevators Cranes	Crane (sheaves)		
Machines not in constant use	Automobiles	Small motors Buses/trucks gear drives Woodworking machine	Machine spindles Industrial motors Crushers Vibrating screens Coal pulverizer	Main gear drives Rubber/plastic Calendar rolls Printing machines Conveyor bearings	
Machines in constant use over 8 hours a day		Rolling mills Escalators Conveyors Centrifuges	Railway vehicle axles Air conditioners Large motors Compressor pumps	Locomotive axles Traction motors Mine hoists Pressed flywheels	Papermaking machines
24 hour continuous operation					Water supply equipment Pumps Power generating equipment

05 Accuracy and Tolerances

For a specific operation the bearing must have the right dimensions, tolerance & accuracies. Bearing consists of inner ring, outer ring, cage and rolling elements.

Bearing boundary dimensions are standardized by ISO (International Organization for Standardization)

This has been done to:

- Facilitate interchangeability of bearing
- Standardize shaft and housing dimensions

The dimensions which determine the fitment are standardized. This is not applicable to the internal dimensions, such as the size and quantity of the rolling elements. The main dimensions of metric rolling bearings are defined in the following ISO dimension plans:

- ISO 15:Radial rolling bearing excluding single row needle roller bearings, insert bearings and tapered roller bearings
- ISO104:Axial/Thrust bearings
- ISO 355:Taper roller bearing

The tolerances and accuracies of these components are specified by ISO 492/582/199 & DIN620 as given in table.

Standard	Applicable standerd	Bearings Types
Japanese industrial standard (JIS)	JIS B 1514	All type
International Organization for Standardization (ISO)	ISO 492	Radial bearings
	ISO 199	Thrust ball bearings
	ISO 578	Tapered toller bearings (Inch series)
	ISO 1224	Precision instrument bearings
Deutsches Institut fur Normung (DNI)	DIN 620	All type
American National Standards Institute (ANSI) American Bearing Manufacturer's Association (ABMA)	ANSI/ABMA Std.20	Radial bearings (Except tapered roller bearings)
	ANSI/ABMA Std.19.1	Tapered roller bearings (Metric series)
	ANSI/ABMA Std.19	Tapered roller bearings (Inch series)

Accuracy

The accuracy of rolling bearings is classified as 'Dimensional accuracy' and' Running accuracy'.

5.1 Dimensional Accuracy

Dimensional accuracy indicates the tolerance and tolerance limits of boundary dimensions. It is a measure of the bearing's external dimensions - bore diameter, outer diameter and assembled width and are important for bearing mounting on shaft & housing. Tolerances are a measure between the standard value and the actual bearing dimension measured along one plane. The symbols fo the mean bore and outer diameter tolerances are dmp and Dmp.

Dimensional accuracy includes

Tolerances for:

- Boundary dimensions
- Chamfer dimensions
- Width variation
- Tapered bore diameter

Form tolerances of individual rings are also included in dimensional accuracies. It relates how much a bearing can deviate from the standard shape (cylindricity, perpendicularity etc.).

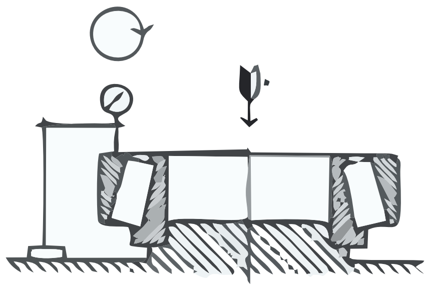
They are indicated by the letter V. The maximum variation in the mean bore and outer diameter tolerances are denoted by Vdmp and VDmp.

Inner ring form are indicated as:

- Single plane bore diameter variation-Vdp (roundness),
- Mean single plane bore diameter variation-Vdmp (taper),
- Width variation-VBs (parallelism of side faces),
- Raceway roundness & taper, flatness of faces

(D) Assembled bearing cup back face run-out with raceway 'Sea' (Taper roller bearing):

Difference between the largest and the smallest of the axial distances between the cup back face, in different angular positions of the cup, at a radial distance from the cup axis equal to half the cup raceway contact diameter, and a point in a fixed position relative to the cone. The cone and cup raceways and the cone back face rib are to be in contact with all the rollers, the bearing parts being otherwise in normal relative positions.



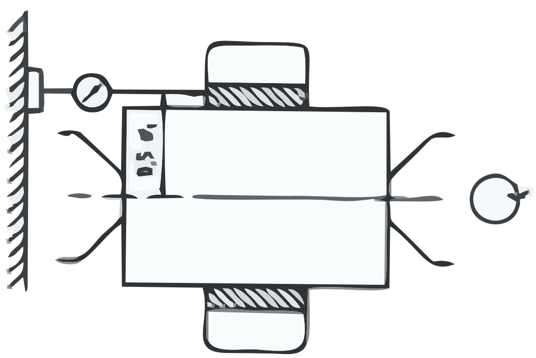
a = Load on Outter ring

SeaMEASUREMENT OF TAPER ROLLER BEARING

5.2.3 Face run-out with bore

Face run-out with bore 'Sd' (inner ring reference face):

Difference between the largest and the smallest of the axial distances between a plane perpendicular to the ring axis and the reference face of the ring, at a radial distance from the axial of half the inner ring raceway contact diameter.



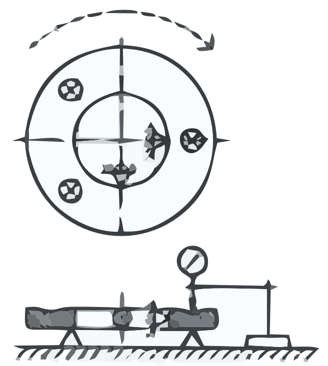
Sd MEASUREMENT

5.2.4 Raceway parallelism with face

Raceway parallelism with face, 'Si' or 'Se'

(inner or outer ring of groove type radial ball bearing reference face):

Difference between the largest and the smallest of the axial distances between the plane tangential to the reference face and the middle of the raceway.



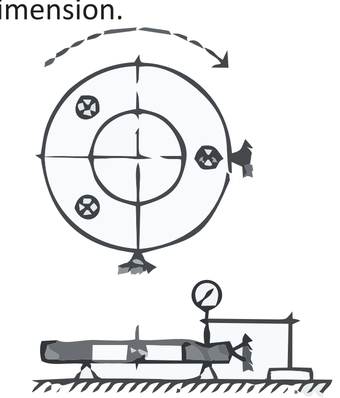
Si MEASUREMENT

5.2.5 Out side surface inclination

Variation of outside surface generatrix inclination with face, 'SD'

(outer ring basically cylindrical surface reference face):

Total variation of the relative position in a radial direction parallel with the plane tangential to the reference face of the outer ring, of points on the same generatrix of the outside surface at a distance from the side faces of the ring equal to the maximum limits of the axial chamfer dimension.



Se MEASUREMENT

Outer ring Form are indicated as:

- Single plane outside diameter variation-VDp (roundness),
- Mean single plane outside diameter variation-VDmp (taper),
- Width variation-VCs (parallelism of side Faces),
- Raceway roundness & taper, flatness of faces.

5.2 Running Accuracy (As per ISO: 1132-1 & 2)

Running accuracy indicate allowable limit for bearing run out during operation. It provides radial & axial run out on bore & outside cylindrical surface.

Running accuracy includes

Allowable limit for:
- Radial runout for inner & outer
- Outside cylindrical surface variation
- Face runout with bore

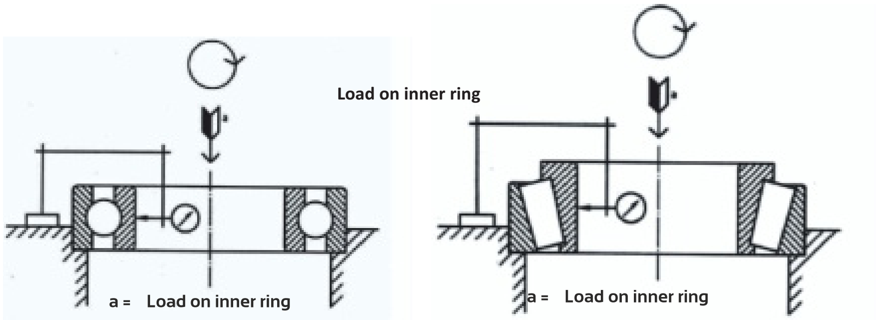
Running accuracies in bearing are:

Radial Runout	• **Kia**-Radial run-out of assembled bearing inner ring • **Kea**-Radial runout of assembled bearing outer ring
Face run-out with raceway	• **Sia**-Assembled bearing inner ring face run-out with raceway • **Sea**-Assembled bearing outer ring face run-out with raceway
Thickness variation	• **Ki**-Inner ring raceway to bore thickness • **Ke**-Outer ring raceway to outside surface thickness variation
Face runout with bore	• **Sd**-Face runout with inner ring bore reference face
Raceway parallelism with face	• **Sa**-Raceway parallelism inner ring face • **Se**-Raceway parallelism outer ring face
Outside surface inclination	• **SD**-Variation of outside surface inclination with face

5. 2.1 Radial Run-out

(A) Radial run-out of assembled bearing inner ring, 'Kia'(radial bearing):

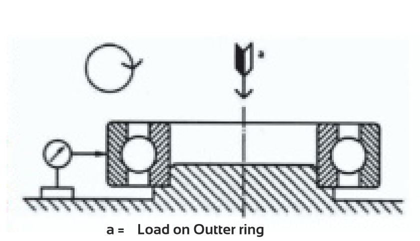
Difference between the largest and the smallest of the radial distances between the bore surface of the inner ring, in different angular positions of this ring and a point in fixed position relative to the outer ring. At the angular position of the point mentioned, or on each side and close to it, rolling elements are to be in contact with both the inner and outer ring raceways and (in a tapered roller bearing) the cone bad face rib, the bearing parts being otherwise in normal relative positions.



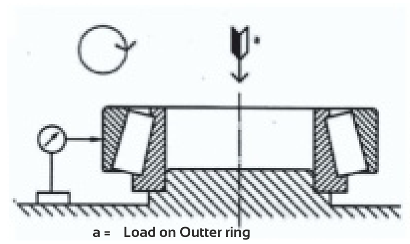
Kia MEASUREMENT OF BALL BEARING   Kia MEASUREMENT OF TAPER ROLLER BEARING

(B)Radial runout of assembled bearing outer ring. 'Kea' (radial bearing):

Difference between the largest and the smallest of the radial distance between the outside surface of the outer ring in different angular positions of this ring and a point in a fixed position relative to the inner ring. At the angular position of the point mentioned, or on each side and close to it, rolling elements are to be in contact with both the Inner and outer ring raceways and (in a tapered roller bearing) the cone back face rib, the bearing parts being otherwise in normal positions.



Kea MEASUREMENT OF BALL BEARING

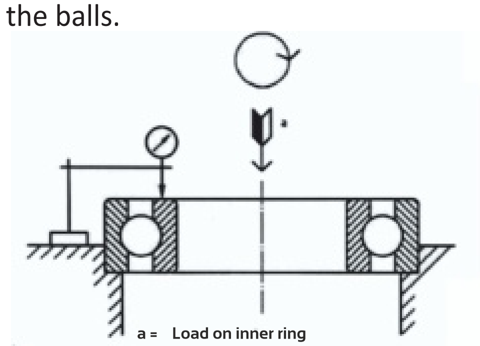


Kea MEASUREMENT OF TAPER ROLLER BEARING

5.2.2 Face run-out with raceway

(A) Assembled bearing inner ring face run-out with raceway, 'Sia' (Groove type radial ball bearing):

Differences between the largest and the smallest of the axial distances between the reference face of the inner ring, in different relative angular positions of this ring, at a radial distance from the inner ring axis equal to half the inner ring raceway contact diameter, and a point in a fixed position relative to the outer ring. The inner and the outer ring raceways are to be in contact with all the balls.

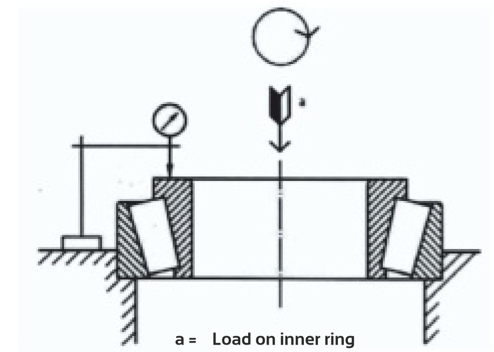


Sia MEASUREMENT OF BALL BEARING

(B) Assembled bearing cone back face run-out with raceway 'Sia' (Taper roller bearing):

Difference between the largest and the smallest of the axial distances between the cone back face, in different angular positions of the cone, at a radial distance from the cone axis equal to half the cone raceway contact diameter and a point in a fixed position relative to the cup. The cone and cup raceways and the

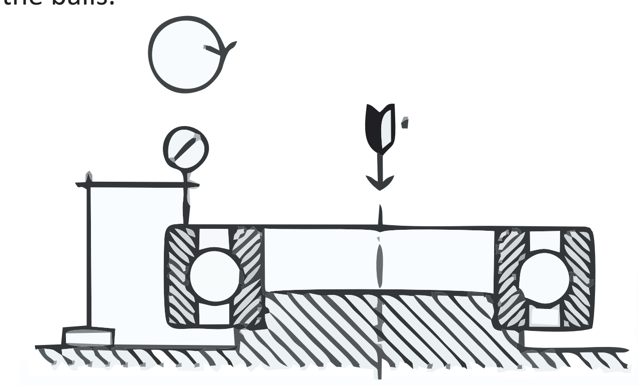
cone back face rib are to be in contact with all the rollers, the bearing parts being otherwise in normal relative positions.



Sia MEASUREMENT OF TAPER ROLLER BEARING

(C) Assembled bearing outer ring face run-out with raceway 'Sia' (Groove type radial ball bearing):

Difference between the largest and the smallest of the axial distances between the reference face of the outer ring,in different relative angular positions of this ring, at a radial distance from the outer ring axis equal to half the outer ring raceway contact diameter, and a point in a fixed position relative to the inner ring. The inner and outer ring raceways are to be in contact with all the balls.



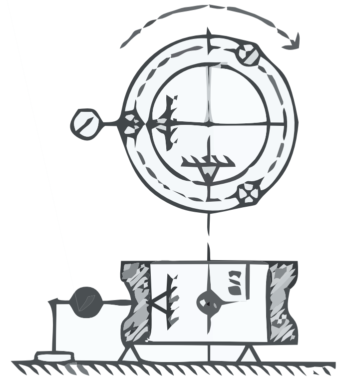
Load on Outter ring

Sea MEASUREMENT OF BALL BEARING

5.2.6 Thickness-variation

(A) Inner ring raceway to bore thickness variation, 'Ke' (radial bearing):

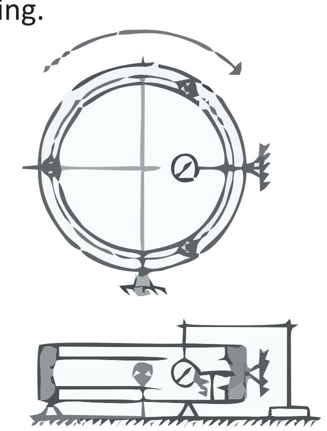
Difference between the largest and the smallest of the radial distances between the bore surface and the middle of a raceway on the outside of the ring.



Ki MEASUREMENT

(B) Outer ring raceway to outside surface thickness variation, 'Ke' (radial bearing):

Difference between the largest and the smallest of the radial distances between the outside surface and the middle of a raceway on the inside of the ring.

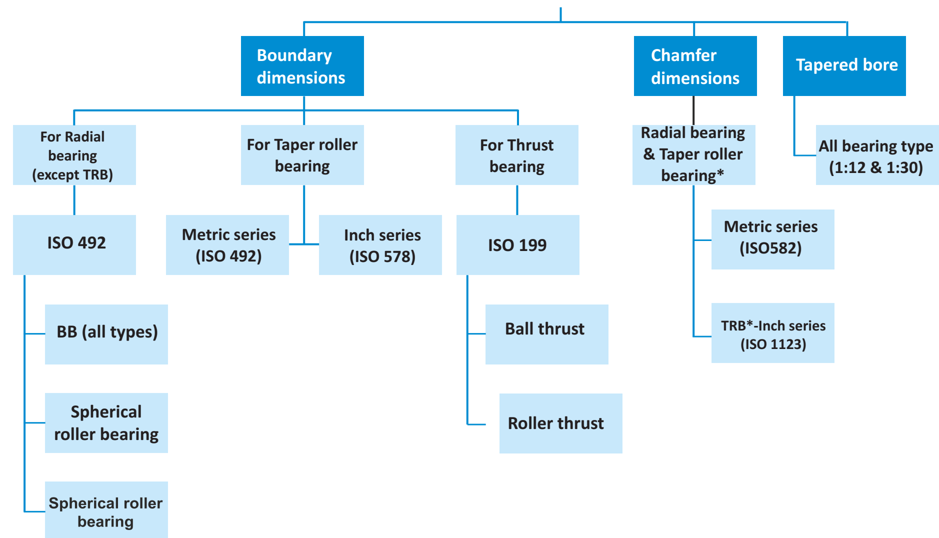


Ke MEASUREMENT

Tolerances

The fit of the bearing on the shaft and in the housing significantly affects the operational behavior of Rolling bearings. Tolerance is "the total amount a specific dimension is permitted to vary." It is the difference between the maximum and minimum limits. This can be shown as upper and lower limits or an allowable amount above and below a nominal dimension. Tolerances for the rolling bearing include tolerances for boundary dimensions, chamfer dimensions and tapered bore.

Tolerances As Per standard



Consolidated table for applicable STD for different tolerance classes for Rolling bearing.

Bearing type		Applicable Standards	Tolerance classes & comparison among standards					Reference table no
Radial ball bearings		ISO 492	Class 0,6X	Class 6	Class 5	Class 4	Class 2	Table 5.3.1, 5.3.2
		JIS B 1514	Class 0,6X	Class 6	Class 5	Class 4	Class 2	
		DIN 620	P0	P6	P5	P4	P2	
		ABMA Std. 20	ABEC - 1	ABEC - 3	ABEC - 5	ABEC - 7	ABEC - 9	
Radial roller bearings (except tapered roller bearings)		ISO 492	Class 0,6X	Class 6	Class 5	Class 4	Class 2	Table 5.3.1, 5.3.2
		JIS B 1514	Class 0,6X	Class 6	Class 5	Class 4	Class 2	
		DIN 620	P0	P6	P5	P4	P2	
		ABMA Std. 20	RBEC - 1	RBEC - 3	RBEC - 5	-	-	
Tapered roller bearings	Metric series	ISO 492	Class 0,6X	Class 6	Class 5	Class 4	Class 2	Table 5.4.1, 5.4.2
		JIS B 1514	Class 0,6X	Class 6	Class 5	Class 4	Class 2	
		DIN 620	P0	P6	P5	P4	P2	
		ABMA Std. 20	Class K	Class N	Class C	Class B	Class A	
	Inch series	ISO 578	Class 4	-	Class 3	Class 0	Class 00	Table 5.5.1, 5.5.2, 5.5.3
		JIS B 1514	Class 0,6X	Class 6	Class 5	Class 4	Class 2	
		DIN 620	P0	P6	P5	P4	P2	
		ABMA Std. 19	Class 4	Class 2	Class 3	Class 0	Class 00	
Thrust bearings (all types		ISO 199	Normal class	Class 6	Class 5	Class 4	-	Table 5.6.1, 5.6.2
		JIS B 1514	Class 0,6X	Class 6	Class 5	Class 4	Class 2	
		DIN 620	P0	P6	P5	P4	P2	
		ABMA Std.	-	-	-	-	-	

Note: Reference Standards and organizations
JIS: Japanese Industrial Standard
BAS: The Japan Bearing Industrial Association Standard
ISO: International Organization for Standardization
ANSI : American National Standards Institute, Inc.
ABMA: American Bearing Manufactures Association
DIN: Deutsches Institut für Normung
BS: British Standards Institution
F: Association Française de Normalisation

5.3 Tolerances For Radial Bearings as per ISO 492, IS 5692

(Except Tapered Roller Bearings)

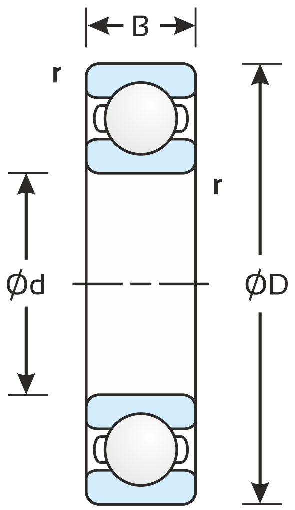
d = bearing bore diameter, nominal
d1 = basic diameter at theoretical large end of a basically tapered bore
Λds = deviation of a single bore diameter
Λdmp = single plane mean bore diameter deviation (for a basically tapered bore Λdmp refers only to the theoretical small end of bore)
Ad1mp = mean bore diameter deviation at theoretical large end of a basically tapered bore
Vdp = bore diameter variation in single radial plane
Vdmp = mean bore diameter variation (this applies only to a basically cylindrical bore)
α = half of the total angle of inner ring bore (for taper bore bearings)
D = bearing outside diameter, nominal
D1 = outer ring flange outside diameter, nominal
ΛDs = deviation of single outside diameter
ΛDmp single plane mean outside diameter deviation
Vdp = outside diameter variation in a single radial plane
VDmp = mean outside diameter variation
B = inner ring width, nominal
ΛBS = deviation of single inner ring width
VBs = inner ring width variation
C = outer ring width, nominal
C1 = outer ring flange width, nominal
ΛCs = deviation of single outer ring width
ΛC1s = deviation of a single outer ring flange width
VCs = outer ring width variation
VC1s = outer ring flange width variation
Kia = radial run out or assembled bearing inner ring
Kea = radial run out or assembled bearing outer ring
Sd = inner ring reference race (back face, where applicable) run out with bore
SD = variation of bearing outer surface generatrix inclination with outer ring reference face (back face)

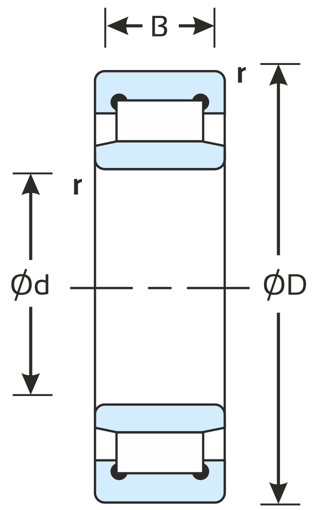
SD1 = variation of bearing outside surface generatix inclinationwith flange back race

Sia = assemble bearing inner ring race (back face) runout with raceway

Sea = assembled bearing outer ring face (back face) runout with raceway

Seal = assembled bearing outer ring flange (back face) runout with raceway





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Tolerances for Normal Torelance Class Radial Bearings (Except Tapered Roller Bearing) - Metric Series

Table 5.3.1: Inner Ring

Values in microns

d (mm)		Δ dmp		Vdp Diameter Series			Vdmp	Kia	ΔBS			VBS
				9	0,1	2,3,4			All	Normal	Modified	
Over	Including	High	Low	Max			Max	Max	High	Low		Max
2.5	10	0	-8	10	8	6	6	10	-	-120	-250	15
10	18	0	-8	10	8	6	6	10	-	-120	-250	20
18	30	0	-10	13	10	8	8	13	-	-120	-250	20
30	50	0	-12	15	12	9	9	15	-	-120	-250	20
50	80	0	-15	19	19	11	11	20	-	-150	-380	25
80	120	0	-20	25	25	15	15	25	-	-200	-380	25
120	180	0	-25	31	31	19	19	30	-	-250	-500	30
180	250	0	-30	38	38	23	23	40	-	-300	-500	30
250	315	0	-35	44	44	26	26	50	-	-350	-500	35
315	400	0	-40	50	50	30	30	60	-	-400	-630	40
400	500	0	-45	56	56	34	34	65	-	-450	-	50
500	630	0	-50	63	63	38	38	70	-	-500	-	60
630	800	0	-75	94	94	55	55	80	-	-750	-	70
800	1000	0	-100	125	125	75	75	90	-	-1000	-	80

Table 5.3.2: Outer Ring

Values in microns

D (mm)		Δ Dmp		VDP Open Bearings Diameter Series			VDP Capped Bearing	VDmp	Kea	ΔCS ΔC1S		VCS VC1s
				9	0,1	2,3,4	2,3,4					
Over	Including	High	Low	Max			Max	Max	Max	High	Low	Max
6	18	0	-8	10	8	6	10	6	15	Identical to Δ Bs and VBs or Inner ring of same bearing		
18	30	0	-9	12	9	7	12	7	15			
30	50	0	-11	14	11	8	16	8	20			
50	80	0	-13	16	13	10	20	10	25			
80	120	0	-15	19	19	11	26	11	35			
120	150	0	-18	23	23	14	30	14	40			
150	180	0	-25	31	31	19	38	19	45			
180	250	0	-30	38	38	23	-	23	50			
250	315	0	-35	44	44	26	-	26	60			
315	400	0	-40	50	50	30	-	30	70			
400	500	0	-45	56	56	34	-	34	80			
500	630	0	-50	63	63	38	-	38	100			
630	800	0	-75	94	94	55	-	55	120			
800	1000	0	-100	125	125	75	-	75	140			
1000	1250	0	-125	155	155	94	-	94	160			
1250	1600	0	-160	200	200	120	-	120	190			
1600	2000	0	-200	250	250	150	-	150	220			
2000	2250	0	-250	310	310	190	-	190	250			

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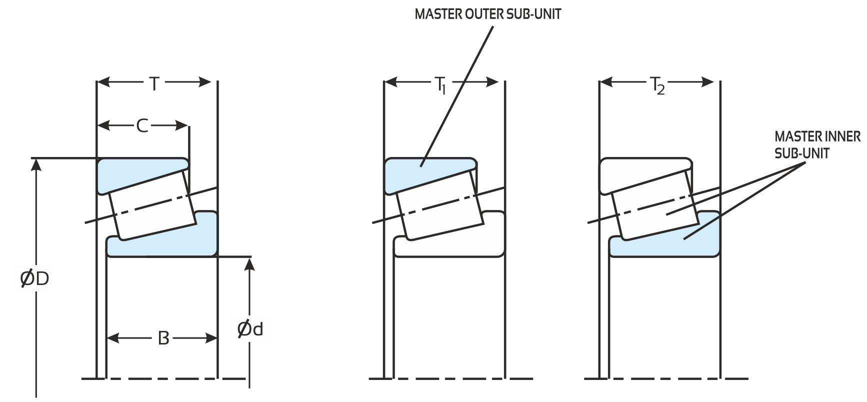
5.4 Tolerances for Tapered Roller Bearings (Metric Series)

Normal tolerance class

Symbols (Applicable for metric and inch series)

d = bearing bore diameter, nominal
△ds = deviation of a single bore diameter
△dmp = single plane mean bore diameter deviation
(for a basically tapered bore dmp refers only to the theoretical small end of bore)
Vdp = borediameter variation in single radial plane
Vdmp = mean bore diameter variation
(this applies only to a basically cylindrical bore)
D = bearing outside diameter, nominal
D1 = outer ring flange outside diameter, nominal
Ds = deviation of a single outside diameter
Dmp = single plane mean outside diameter deviation
VDp = outside diameter variation in a single radial plane
VDmp = mean outside diameter variation
B = inner ring width, nominal
T = bearing width, nominal
△Ts = deviation of theactual bearing width
T1 = effective width of inner sub-unit, nominal
△Bs = deviation of single inner ring width x outer ring width, nominal
C = deviation of single outer ring width
△Cs = radial run out or assembled bearing inner ring
Kia = radial run out or assembled bearing outer ring
Kea = inner ring reference face
Sd (back face, where applicable) run out with bore
SD = variation of bearing outside surface generatix inclination with outer ring reference face (back face)
Sia = assemble bearing inner ring face (back face) run out with raceway
Sea = assembled bearing outer ringface (back face) run out with raceway
△T1S = deviation of the actual effective width of inner subunit
T2 = effective width of outer sub-unit, nominal
T2s = deviation of the actual effective width or outer sub-unit



SYMBOLS FOR TAPERED ROLLER BEARINGS

Metric Series (ISO 492 / IS 7460)

Table 5.4.1 Bore-inner Ring

Tolerance value in microns

d (mm)		△ dmp		Vdp	Kia	Vdmp
Over	Including	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
400	500	0	-45	45	34	80
500	630	0	-50	50	38	90
630	800	0	-75	75	56	105
800	1000	0	-100	100	75	120
1000	1250	0	-125	125	94	140
1250	1600	0	-160	160	120	160

Table 5.4.2 - Outer diameter

Tolerance value in microns

D (mm)		△ Dmp		VDp	VDmp	Kea
Over	Including	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
500	360	0	-50	50	38	100
630	800	0	-75	75	56	120
800	1000	0	-100	100	75	140
1000	1250	0	-125	125	84	165
1250	1600	0	-160	160	120	190
1600	2000	0	-200	200	150	230

Table 5.4.3 Width - Inner and outer ring, single row bearing and single row subunits

Tolerance value in microns

d mm		Δ Bs		Δ Cs		Δ Ts		Δ T1s		Δ T2s	
Over	Including	High	Low	High	Low	High	Low	High	Low	High	Low
10	18	0	-120	0	-120	+200	0	+100	0	+100	0
18	30	0	-120	0	-120	+200	0	+100	0	+100	0
30	50	0	-120	0	-120	+200	0	+100	0	+100	0
50	80	0	-150	0	-150	+200	0	+100	0	+100	0
80	120	0	-200	0	-200	+200	-200	+100	-100	+100	-100
120	180	0	-250	0	-250	+350	-250	+150	-150	+200	-100
180	250	0	-300	0	-300	+350	-250	+150	-150	+200	-100
250	315	0	-350	0	-350	+350	-250	+150	-150	+200	-100
315	400	0	-400	0	-400	+400	-400	+200	-200	+200	-200
400	500	0	-450	0	-450	-	-	-	-	-	-
500	630	0	-500	0	-500	-	-	-	-	-	-
630	800	0	-750	0	-750	-	-	-	-	-	-
800	1000	0	-1000	0	-1000	-	-	-	-	-	-
1000	1250	0	-1200	0	-1200	-	-	-	-	-	-
1250	1600	0	-1500	0	-1500	-	-	-	-	-	-

Table 5.4.4 Width deviations of assembled double row and four row tapered roller bearings

Tolerance value in microns

d (mm)		Overall width/height deviations of assembled double rows tapered roller bearings		Overall width/height deviations of assembled four rows tapered roller bearings	
Over	Including	High	Low	High	Low
10	18	-	-	-	-
18	30	-	-	-	-
30	50	+240	-240	-	-
50	80	+300	-300	-	-
80	120	+400	-400	+500	-500
120	180	+500	-500	+600	-600
180	250	+600	-600	+750	-750
250	315	+700	-700	+900	-900
315	400	+800	-800	+1000	-1000
400	900	+900	-900	+1700	-1700
500	630	+1000	-1000	+1200	-1200
630	800	+1500	-1500	+1500	-1500
800	1000	+1500	-1500	+1500	-1500

5.5 Tolerance for Tapered roller bearings - Inch Series (ISO 578)

5.5.1 Tolerance for inner ring bore diameter

Unit : microns

Nominal bore diameter (d)				Single bore diameter deviation(Δds)					
mm (inch)				Class 4,2		Class 3,0		Class 00	
Over		Incl.		high	low	high	low	high	low
-		76.2	(3.0)	+13	0	+13	0	+8	0
76.2	(3.0)	266.7	(10.5)	+25	0	+13	0	+8	0
266.7	(10.5)	304.8	(12.0)	+25	0	+13	0	—	—
304.8	(12.0)	609.6	(24.0)	+51	0	+25	0	—	—
609.6	(24.0)	914.4	(36.0)	+76	0	+38	0	—	—
914.4	(36.0)	1219.2	(48.0)	+102	0	+51	0	—	—
1219.2	(48.0)	-		+127	0	+76	0	—	—

5.5.2 Tolerance for Outer ring Outside diameter

Units : microns

Nominal outside diameter (D)				Single outside diameter deviation(ΔDs)					
mm (inch)				Class 4,2		Class 3,0		Class 00	
Over		Incl.		high	low	high	low	high	low
-		266.7	(10.5)	+25	0	+13	0	+8	0
266.7	(10.5)	304.8	(12.0)	+25	0	+13	0	—	—
304.8	(12.0)	609.6	(24.0)	+51	0	+25	0	—	—
609.6	(24.0)	914.4	(36.0)	+76	0	+38	0	—	—
914.4	(36.0)	1219.2	(48.0)	+102	0	+51	0	—	—
1219.2	(48.0)	-		+127	0	+76	0	—	—

5.5.3 Tolerance for overall width or combined width

Units : microns

Nominal bore diameter (d)		Overall width tolerancefor single row tapered roller bearing (ΔTs)								Overall width tolerance for double row taper roller bearing (ΔT2s)				Overall width tolerance for 4 row taper roller bearing (ΔT4s)	
mm (inch)		Class 4		Class 2		Class 3		Class 0,00		Class 4		Class 2		Class 4,2,3	
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low
—	101.6 (4)	+203	0	+203	0	+203	-203	+203	-203	+406	0	+406	0	+1 524	-1 524
101.6 (4)	304.8 (12)	+356	-254	+203	0	+203	-203	+203	-203	+711	-508	+406	-203	+1 524	-1 524
304.8 (12)	609.6 (24)	+381	-381	+381	-381	+203	-203	—	—	+762	-762	+762	-762	+1 524	-1 524
609.6 (24)	—	+381	-381	—	—	+381	-381	—	—	+762	-762	—	—	+1 524	-1 524

5.5.4 Radial runout of of inner and outer rings

Units : microns

Nominal outside diameter (D)		Inner ring radial runout K ia Outer ring radial runout K ea				
mm (inch)		Class 4	Class 2	Class 3	Class 0	Class 00
over	incl.	max				
—	304.8 (14)	51	38	8	4	2
304.8 (14)	609.6 (24)	51	38	18	—	—
609.6 (24)	914.4 (36)	76	51	51	—	—
914.4 (36)	—	76	—	76	—	—

Basic Symbole for Dimension & Accuracy

Radial bearings - inner ring (cylindrical and tapered bore)	
d	Nominal cylindrical bore diameter. Nominal tapered bore diameter at the theoretical small end
B	Nominal inner ring width
Kia	Circular radial run-out of inner ring bore surface of assembled bearing
Sd	Circular axial run-out of inner ring face
Sia	Circular axial run-out of inner ring face of assembled bearing
Radial bearings - inner ring (tapered bore)	
d_1	Nominal bore diameter at the theoretical large end of a tapered bore
SL	Difference between nominal diameters at the theoretical large end and small end of a tapered bore (d1-d)
Radial bearings - Outer ring	
D	Nominal outside diameter
C	Nominal outer ring width
Kea	Radial run-out of outer ring outside surface of assembled bearing
SD	Perpendicularity of o/r outside surface axis w.r.t the outer ring face
Sea	Axial run-out of o/r face of assembled bearing w.r.t inner ring bore surface
Chamfer limits	
r_s	Single chamfer dimension
$r_{s\,min}$	Smallest single chamfer dimension of rs, r1, r2, r3....
r_1, r_3	Radial direction chamfer dimensions
r_2, r_4	Axial direction chamfer dimensions
Tapered roller bearings	
T	Nominal assembled bearing width
T_1	Nominal width of cone assembly assembled with a master cup
T_2	Nominal effective width of cup assembled with a master cone
Thrust bearings – shaft washer	
d	Nominal bore diameter of shaft washer, single direction bearing
d_2	Nominal bore diameter of central shaft washer, double direction bearing
Thrust bearings – housing washer	
D	Nominal outside diameter of housing washer
Thrust bearings – assembled bearing height	
T	Nominal assembled bearing height, single direction thrust
T_1	Nominal-assembled bearing height, double direction thrust bearing-
T_4	Spherical roller thrust bearing nominal assembled bearing height.

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5.6 Tolerance for Thrust Ball and Roller Bearings

(As per ISO 199) Symbols

d	= bore diameter of shaft washer,single-direction bearing
d2	= bore diameter of shaft washer, double-direction bearing
△dmp	= deviation of mean bore diameter in a single plan ofshaft, single-direction bearing
△d2mp	= deviation of mean bore diameter in a single plan ofshaft, double-direction bearing
D	= outside dianneter of housing washer
△dmp	= deviation of mean outside diameter in a single of plan of housing washer
Se	= variation in thichness between housing washer raceway and face (Note: Applies only to ball thrust bearings and cylindrical roller thrust bearings with 90°contact angle)
Si	= variation in thichness between shaft washer raceway and bach face (Note: Applies only to ball thrust bearings and cylindrical roller thrust bearings with 90°contact angle)
T1	= bearing height, single-direction bearing
T2	= bearing height, double direction bearing
△Ts	= deviation of the actual bearing height, single-direction bearing
△T1s	= deviation of the actual bearing height, double-direction bearing
Vdp	= variation of bore diameter in a single plane ofshaft washer, single-direction bearing
Vd2p	= variation ofbore diameter in a single plane ofshaft washer, double-direction bearing
Vdp	= variation ofoutside diameter in a single radial plane of housing washer

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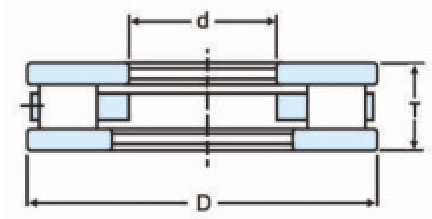
Single Direction Thrust bearing



Double Direction Thrust bearing

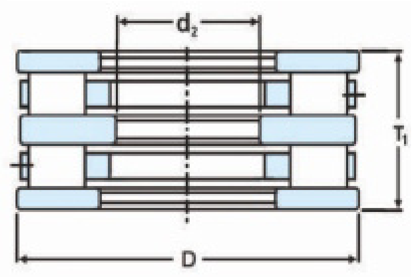


Table 5.6.1 Shaft washer and bearing height (As per ISO:199/ Normal tolerance class)

Tolerance value in microns

d and d2 (mm)		Δ dmp, Δ d2mp		Vdp, Vd2p	Si	Δ Ts		ΔT1s	
Over	Incl.	High	Low	Max.	Max.	High	Low	High	Low
-	18	0	-8	6	10	+20	-250	+150	-400
18	30	0	-10	8	10	+20	250	+150	-400
30	50	0	-12	9	10	+20	-250	+150	-400
50	80	0	-15	11	10	+20	-300	+150	-500
80	120	0	-20	15	15	+25	-300	+150	-500
120	180	0	-25	19	15	+25	-400	+200	-600
180	250	0	-30	23	20	+30	-400	+250	-600
250	315	0	-35	26	25	+40	-400	-	-
315	400	0	-40	30	30	+40	-500	-	-
400	500	0	-45	34	30	+50	-500	-	-
500	630	0	-50	38	35	+60	-600	-	-
630	800	0	-75	55	40	+70	-750	-	-
800	1000	0	-100	75	45	+80	-1000	-	-
1000	1250	0	-125	95	50	+100	-1400	-	-
1250	1600	0	-160	120	60	+120	-1600	-	-
1600	2000	0	-200	150	75	+140	-1900	-	-
2000	2500	0	-250	190	90	+160	-2300	-	-

NOTE : for double-direction bearings the values apply only up to and including d2 = 190mm.

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Table 5.6.2 housing washer and bearing height (As per ISO199/ Normal tolerance class)

Tolerance value in microns

D (mm)		Δ Dmp		VDp	Se
Over	Including	high	low	max.	max.
10	18	0	-11	8	Identical to Si of shaft washer of same bearing
18	30	0	-13	10	
30	50	0	-16	12	
50	80	0	-19	14	
80	120	0	-22	17	
120	180	0	-25	19	
180	250	0	-30	23	
250	315	0	-35	26	
315	400	0	-40	30	
400	500	0	-45	34	
500	630	0	-50	38	
630	800	0	-75	55	
800	1000	0	-100	75	
1000	1250	0	-125	95	
1250	1600	0	-160	120	
1600	2000	0	-200	150	
2000	2500	0	-250	190	
2500	2800	0	-300	225	

NOTE : for double-direction bearings the values apply only up to and including D = 360mm.

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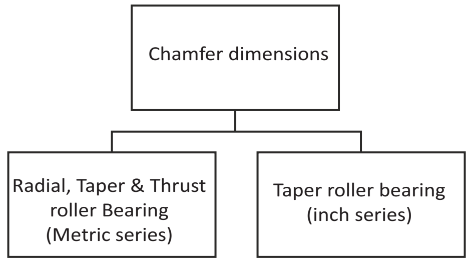
5.7 Chamfer Dimensions Limits For Rolling Bearings



Chamfer limits for Radial bearings and Taper roller bearings of metric series (ISO:582/IS:5934)

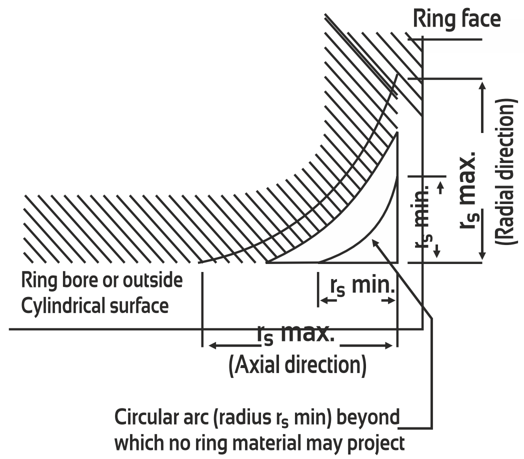
d = bearing bore diameter, nominal

D = bearing outside diameter, nominal

$r_{s\,min}$ = smallest permissible single chamfer dimension (minimum limit)

$r_{s\,max}$ = largest permissible single chamfer dimension (maximum limit)

$r_{as\,max}$ = largest permissible single shaft housing fillet radius



Note: Inner ring is in accordance with 'd' and outer ring with 'D'
'rs' is the smallest permissible chamfer dimension mentioned in data tables.

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Table 5.7.1 Tapered Roller Bearings (Metrric Series)

Dimensions in mm

Cone (d) or Cup (D) back face chamfer				
r_s min	d or D		r_s max	
	>	<	Radial directions	Axial direction
0.3	-	40	0.7	1.4
	40	-	0.9	1.6
0.6	-	40	1.1	1.7
	40	-	1.3	2
1.0	-	50	1.6	2.5
	50	-	1.9	3
1.5	-	120	2.3	3
	120	250	2.8	3.5
	250	-	3.5	4
2	-	120	2.8	4
	120	250	3.5	4.5
	250	-	4	5
2.5	-	120	3.5	5
	120	250	4	5.5
	250	-	4.5	6
3	-	120	4	5.5
	120	250	4.5	6.5
	250	400	5	7
	400	-	5.5	7.5
4	-	120	5	7
	120	250	5.5	7.5
	250	400	6	8
	400	-	6.5	8.5
5	-	180	6.5	8
	180	-	7.5	9
6	-	180	7.5	10
	180	-	9	11

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Table 5.7.2 Radial Bearings Expect Tapered Roller Bearings

Dimensions in mm

r_s min	d or D		r_s max	
	>	≤	radial directions	axial direction
0.3	-	40	0.6	1
	40	-	0.8	1
0.6	-	40	1	2
	40	-	1.3	2
1	-	50	1.5	3
	50	-	1.9	3
1.1	-	120	2	3.5
	120	-	2.5	4
1.5	-	120	2.3	4
	120	-	3	5
2	-	80	3	4.5
	80	220	3.5	5
	220	-	3.8	6
2.1	-	280	4	6.5
	280	-	4.5	7
2.5	-	100	3.8	6
	100	280	4.5	6
	280	-	5	7
3	-	280	5	8
	280	-	5.5	8
4	-	-	6.5	9

Table 5.7.3 Thrust bearings

Dimensions in mm

r_s min	r_s max radial and axial direction
0.05	0.1
0.08	0.16
0.1	0.2
0.15	0.3
0.2	0.5
0.3	0.8
0.6	1.5
1	2.2
1.1	2.7
1.5	3.5
2	4
2.1	4.5
3	5.5
4	6.5
5	8
6	10

Comparison between nominal chamfer dimension & minimum chamfer limits

Table 5.7.4 Radial bearings except tapered roller bearings and thrust bearings

Dimensions in millimeter

r_s nom	r_s min
0.1	0.05
0.15	0.08
0.2	0.1
0.3	0.15
0.4	0.2
0.5	0.3
1	0.6
1.5	1
2	1.1*
2.5	1.5
3	2
3.5	2.1*
4	3
5	4
6	5
8	6
10	7.5
12	9.5
15	12
18	15
22	19

* In ISO :582-1972 the rs min values were 1 and 2 mm respectively.

Comparison between nominal chamfer dimension & minimum chamfer limits

Table 5.7.5 tapered roller bearings

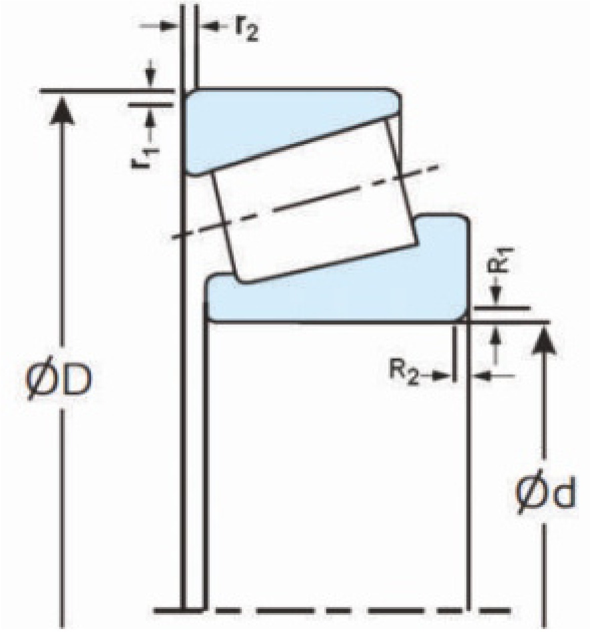
Dimensions in millimeter

r nom	Cup back face chamfer		Cup back face chamfer	
	rs min	rs min (ISO 582-1972)	rs min	rs min* (ISO 582-1972)
0.5	0.3	0.3	0.3	0.3
1	0.6	0.6	0.6	0.6
1.5	1	1	1	1
2	1.5	1	1.5	1
2.5	2	1.5	1.5	1.5
3	2.5	2	2	2
3.5	3	2	2.5	2
4	4	3	3	3
5	5	4	4	4
6	6	5	5	5

Chamfer dimensions limits for Tapered roller bearings

(inch series as per ISO : 1123)

d = inner ring bore diameter
D = outer ring outside diameter
R = nominal dimension of inner ring back face chamfer
R1 = height of inner ring back face chamfer
R2 = width of inner ring back face chamfer
r = nominal dimension of outer ring back face chamfer
r1 = height of outer ring back face chamfer
r2 = width of outer ring back face chamfer



Chamfer dimensions limits for Tapered roller bearings (inch series)

Table 5.7.6 Inner ring chamfer dimensions limits

Bore diameter d nominal		Chamfer height R1		Chamfer Width R2	
Over	Incl.	min.	max.	min.	max.
Values in inches					
-	2	R	R + 0.015	R	R + 0.035
2	4	R	R + 0.020	R	R + 0.050
4	10	R	R + 0.025	R	R + 0.070
Values in millimeters					
-	50.8	R	R + 0.38	R	R + 0.89
50.8	101.6	R	R + 0.51	R	R + 1.27
101.8	254	R	R + 0.64	R	R + 1.78

Table 5.7.7 Outer ring chamfer dimensions limits

Outside diameter D nominal		Chamfer height r1		Chamfer Width r2	
Over	Incl.	Min	max.	r	max.
Values in inches					
-	4	r	r + 0.023	r	r + 0.042
4	6.625	r	r + 0.025	r	r + 0.042
6.625	10.5	r	r + 0.033	r	r + 0.053
10.5	14	r	r + 0.067	r	r + 0.067
Values in millimeters					
-	101.61	r	r + 0.58	r	r + 1.07
101.61	168.275	r	r + 0.64	r	r + 1.07
168.275	266.7	r	r + 0.84	r	r + 1.35
266. 7	355.6	r	r + 1.70	r	r + 1.07

The value of r is identical with that r_{min} in ISO/R 355, Part I.

5.8 Basic Tolerance for Tapered Bore

d-Nominal bore diameter
d1- Basic diameter at the theoretical large end of a tapered bore
B-Nominal bearing inner ring width

- In case of taper 1/12: The basic diameter at the theoretical large end of the bore: d=d+1/12B
- In case of taper 1/30: The basic diameter at the theoretical large end of the bore: d=d+1/30B

The tolerances for a tapered bore, taper 1:12comprise

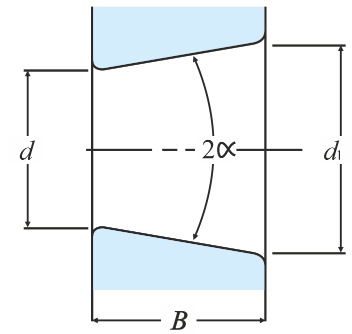
a). Mean diameter tolerance, given by limits for the actual mean diameter deviation at the theoretical small end of the bore, △dmp

b). Taper tolerance diameter, given by limits for the difference between the actual mean diameter deviations at the two ends of the bore, Ad1mp-Admp

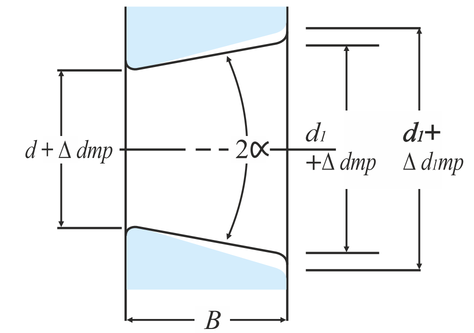
c). Tolerance for the diameter variation, Vdp' is given by a maximum value applying in any radial plane of the bore.

For taper 1/12, normal taper angle (half the cone angle):
a=2°23'9.4"
=2.38594
=0.041643 rad

For taper 1/30, normal taper angle (half the cone angle):
a=0° 57' 17.4"
=0.95484
=0.016665 rad



Theoretical tapered hole



Tapered hole having dimensional Difference of the average bore Diameter within the flat surface

Table 5.6 Tolerance and allowable values (Class 0) of tapered hole of radial bearings (standard tapper ratio 1:12)

Unit : µm

d (mm)		Δ dmp		Δ d1mp - Δ dmp		Vdp
Over	Including	High	Low	High	Low	Max.
-	10	+22	0	+15	0	9
10	18	+27	0	+18	0	11
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	1000	+140	0	+90	0	-
1 000	1250	+165	0	+105	0	-
1250	1600	+195	0	+125	0	-

Table 5.8: Tolerance and allowable value (Class 0) for tapered bore (1: 30) of Radial bearing Unit : µm						
d (mm)		Δ dmp		Δ d1mp - Δ dmp		Vdp
Over	Including	High	Low	High	Low	Max.
80	120	+ 20	0	+ 35	0	22
120	180	+ 25	0	+ 40	0	40
180	250	+ 30	0	+ 46	0	46
250	315	+ 35	0	+ 52	0	52
315	400	+ 40	0	+ 57	0	57
400	500	+ 45	0	+ 63	0	63
500	630	+ 50	0	+ 70	0	70

5.9 Selection of accuracy class for specific applications

For all types of general application normal class tolerances are applicable. But in some cases as required it can be changed. But for few applications listed below the bearings can have a tolerance class of 5,4 or higher.

Required performance	Specific applications examples	Tolerance class
High accuracy is required during operation	Computers, magnetic disc spindles	P5, P4, P2
	Radar/ parabola antenna slewing shafts	P4
	Machine tool spindles	P5, P4, P2
	VTR drum spindle	P5, P4
	Printing press roll bearing	P5
	Aluminum foil roll necks	P5
	Roll neck mill backing bearings	P4
Very high speed	LNG pumps	P5
	Gyroscope	P4
	High frequency machine spindle	P4
	Superchargers	P5, P4
	Jet engine spindles and accessories	P5, P4
	Centrifugal separators	P5, P4
	Dental drill	P2
	Turbo molecular pump spindles and touch-down	P5, P4
Low tirque & low variation is required	Control equipment (synchronous motors, servomotors)	P4
	Measuring instruments	P5
	Machine tool spindles	P5, P4, P2

06 Bearing Internal Clearance

6.1 Types of Clearance During Operation

Internal clearance of a bearing is an important factor affecting not only the bearing performance but also the proper functioning of a machine. Bearing internal clearance is defined as the relative movement of either rings in radial or axial direction, when one ring is fixed. Movement in the diametrical direction is radial clearance, while movement in the shaft's direction is axial clearance. Internal clearance is critical to bearing performance for many reasons. The amount of clearance influences the load distribution in a bearing, which in turn affects smooth operation. It also influences bearing noise and vibration. There are three types of clearance present in the bearing during operation.

Initial clearance: The clearance present inside the bearing before it is mounted on a shaft or housing.

Mounted clearance: The clearance in the bearing after mounting but before the bearing comes into operation.

Operating clearance: The clearance remaining in the bearing after temperature affect and mounting.

For satisfactorily performance bearings must have the appropriate operating clearance. If sufficient amount of clearance is not present in the bearing it may fail. For calculating clearance, effect of fits and temperature is considered. The selection of the clearance is dependent upon the application. In some cases negative clearance (preload) is required when stiffness or bearing positioning is important. Bearing internal clearances changes due to:

- Thermal expansion or contraction of shaft or housing.
- Elastic deformation of rings under load
- Axial clamping can influence clearance or preload.
- Misalignment during running
- Improper mounting of bearing

To get the accurate measurement of internal clearance a certain 'measured load' has to be applied on the raceways. However, under this 'measured load' a slight elastic deformation of the bearing occurs due to which the measured internal clearance value will be slight greater than the true clearance value. This difference between the bearing's true clearance and the measured clearance under the load must be compensated. These compensation values are given in Table 6.1. (Table Below)

Nominal Bore Diameter *d* mm over	incl.	Measuring Load N	{Kgf}	Adjustment of internal clearance (Unit µm) C2	CN	C3	C4	C5
10 [1]	18	24.5	{2.5}	3 ~ 4	4	4	4	4
18	50	49	{5}	4 ~ 5	5	6	6	6
50	200	147	{15}	6 ~ 8	8	9	9	9

Note: For roller bearings the amount of elastic deformation is small enough, to be ignored.

Radial clearance of the bearing is built up for following reasons:

1. Accommodate the reduction of clearance in a bearing due to interference for inner ring on the shaft or outer ring in the housing.
2. Accommodate the minor changes in the dimensions of parts without affecting the bearing performance.
3. Compensate for the differential expansion of the two rings when the inner ring of a bearing operates at a higher temperature than the outer ring.
4. It allows a slight misalignment between the shaft and the housing and thereby prevents the premature failure of the bearing.
5. It affects the end play of radial ball bearing, and also affects their capacity for carrying axial loads, the greater the radial clearance the greater the capacity for supporting axial load.

Important: Once ball and roller bearings are mounted and running, a small amount of radial internal or running clearance is normally desirable. In the case of bearings under radial load, quieter running is generally obtained when this clearance is minimum.

6.2 Types of Radial Internal Clearance:

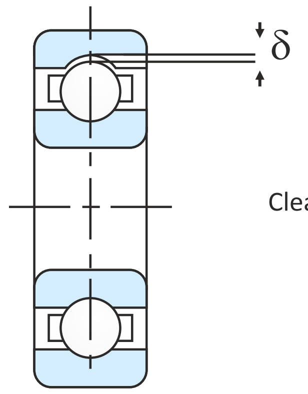
Radial bearings are made with following different ranges of radial internal clearance- C2, Normal, C3 and C4

C2: These bearings have the smallest amount of radial internal clearance. They should only be used where freedom is required in the assembled bearings and there is no possibility of the initial radial internal clearances being eliminated by external causes. Therefore, special attention must be given to the seating dimensions as the expansion of the inner ring or contraction of the outer ring may cause tight bearings. In this respect a C2 bearing should not be used unless recommended.

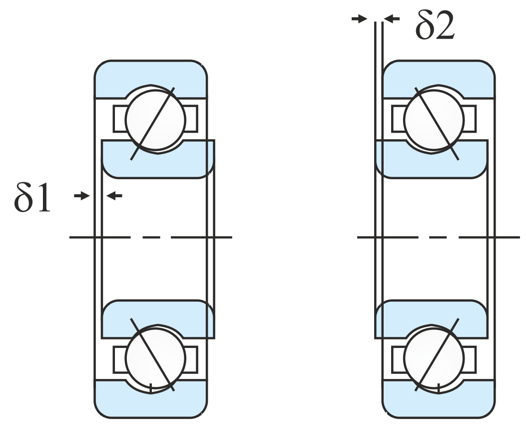
CN: This grade of radial internal clearance is intended for use where only when one ring is made an interference fit and there is no appreciable loss of clearance due to temperature difference. ball and roller bearings for general engineering applications are usually of this clearance.

C3: This grade of radial internal clearance should be used when both rings of a bearing are made an interference fit or when only one ring is an interference fit but there is likely to be some loss of clearance due to temperature differences. It is the grade normally used for radial ball bearings that take axial loading but for some purposes even bearings with C4 clearance may be required.

C4: Where there will be some loss of clearance due to temperature differences and both rings are interference fit, this grade of radial internal clearance is employed. One example of its use is in bearings for traction motors. Customers should always consult us before ordering bearings with this grade of radial internal clearance.



Radial Clearance = δ



Axial Clearance = δ1+δ2

6.3 Criteria For Selection of Internal Clearance

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

Effective Internal Clearance:

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

$\delta eff = \delta o - (\delta f + \delta t)$

Where

δeff: Effective internal clearance, mm

δo: Bearing internal clearance, mm

δf: Reduced amount of clearance due to interference, mm

Reduced clearance due to interference:

After installation of bearings with interference fit on shaft and housing, the inner ring will expand and the outer ring will contract; thus reducing the bearings' internal clearance. The amount of expansion or contraction will depend on the shape of the bearing, the shape of the shaft or housing, dimensions of the respective parts, and the type of materials used. The differential can range from approximately 70% to 90% of the effective interference.

$\delta f = (0.70 \sim 0.90)\, \Delta deff$

Where,

δf: Reduced amount of clearance due to interference, mm

$\Delta deff$: Effective interference, mm

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

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

$\delta t = \alpha . \Delta T . Do$

Where,

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

α : Bearing material expansion coefficient 12.5 x 10-6/°C

ΔT: Inner/outer ring temperature differential, "C

Do: Outer ring raceway diameter, mm

Outer ring raceway diameter, Do, values can be approximated by using formula

For ball bearings and spherical roller bearings,

Do=0.20 (d+4.0D)

For roller bearings (except spherical roller bearing),

Do=0.25 (d+3.0D)

Where,

d: Bearing bore diameter, mm

D: Bearing outside diameter, mm

6.4 Radial Internal clearance value

Bearing Internal Clearance Values As Per ISO: 5753/IS: 5935
6.4.1Deep Groove Ball Bearings (Cylindrical bore)

Table 6.2 Radial internal clearance for Deep groove ball bearing with cylindrical bore.

Clearance values in microns

Bore diameter d (mm)		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2.5	6	0	7	2	13	8	23	-	-	-	-
6	10	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
800	900	20	160	140	320	300	500	480	700	670	940
900	1000	20	170	150	350	330	550	530	770	740	1040
1000	1120	20	180	160	380	360	600	580	850	820	1150
1120	1250	20	190	170	410	390	650	630	920	890	1260

6.4.2(A) Cylindrical Roller Bearing (Interchangeable)

Table 6.3 Radial internal clearance for cylindrical roller bearing (interchangeable) with cylindrical bore.

Clearance values in microns

Bore diameter d (mm)		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
-	10	0	25	20	45	35	60	50	75	-	-
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735

6.4.2(B.1) Cylindrical Roller Bearings (Non-interchangeable)

Table 6.4 Radial internal clearance for Cylindrical roller bearing (non-interchangeable) with cylindrical bore.

Clearance values in microns

Nominal Bore diameter d (mm)		C1NA		C2NA		NA		C3NA		C4NA		C5NA	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
-	10	5	10	10	20	20	30	35	45	45	55	-	-
10	18	5	10	10	20	20	30	35	45	45	55	65	75
18	24	5	10	10	20	20	30	35	45	45	55	65	75
24	30	5	10	10	25	25	35	40	50	50	60	70	80
30	40	5	12	12	25	25	40	45	55	55	70	80	95
40	50	5	15	15	30	30	45	50	65	65	80	95	110
50	65	5	15	15	35	35	50	55	75	75	90	110	130
65	80	10	20	20	40	40	60	70	90	90	110	130	150
80	100	10	25	25	45	45	70	80	105	105	125	155	180
100	120	10	25	25	50	50	80	95	120	120	145	180	205
120	140	15	30	30	60	60	90	105	135	135	160	200	230
140	160	15	35	35	65	65	100	115	150	150	180	225	260
160	180	15	35	35	75	75	110	125	165	165	200	250	285
180	200	20	40	40	80	80	120	140	180	180	220	275	315
200	225	20	45	45	90	90	135	155	200	200	240	305	350
225	250	25	50	50	100	100	150	170	215	215	265	330	380
250	280	25	55	55	110	110	165	185	240	240	295	370	420
280	315	30	60	60	120	120	180	205	265	265	325	410	470
315	355	30	65	65	135	135	200	225	295	295	360	455	520
355	400	35	75	75	150	150	225	255	330	330	405	510	585
400	450	45	85	85	170	170	255	285	370	370	455	565	650

Note: For bearing with normal clearance, NA is added to bearing number, Ex. NU305NA

6.4.2(B.2) Cylindrical Roller Bearing (Non-Interchangeable)

Table 6.5 Radial internal clearance for Cylindrical roller bearing (non-interchangeable) with tapered bore.

Clearance values in microns

Nominal Bore diameter d (mm)		C9NA[2]		CONA[2]		C1NA		C2NA		NA[1]		C3NA	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
-	10	5	5	7	17	10	20	20	30	35	45	45	55
10	18	5	10	7	17	10	20	20	30	35	45	45	55
18	24	5	10	7	17	10	20	20	30	35	45	45	55
24	30	5	10	10	20	10	25	25	35	40	50	50	60
30	40	5	12	10	20	12	25	25	40	45	55	55	70
40	50	5	15	10	20	15	30	30	45	50	65	65	80
50	65	5	15	10	20	15	35	35	50	55	75	75	90
65	80	10	20	15	30	20	40	40	60	70	90	90	110
80	100	10	25	20	35	25	45	45	70	80	105	105	125
100	120	10	25	20	35	25	50	50	80	95	120	120	145
120	140	15	30	25	40	30	60	60	90	105	135	135	160
140	160	15	35	30	45	35	65	65	100	115	150	150	180
160	180	15	35	30	45	35	75	75	110	120	165	165	200
180	200	20	40	30	50	40	80	80	120	140	180	180	220
200	225	20	45	35	55	45	90	90	105	155	200	200	240
225	250	25	50	40	65	50	10	100	150	170	210	215	265
250	280	25	55	40	65	55	110	110	165	185	240	240	295
280	315	30	60	45	75	60	120	120	180	205	265	265	325
315	355	30	65	45	75	65	135	135	200	225	295	295	360
355	400	35	75	50	90	75	150	150	225	255	330	330	405
400	450	45	85	60	10	85	170	170	255	285	370	370	455
450	500	50	95	70	115	95	190	190	285	315	410	410	505

Note: C9NA, CONA and CINA are applied only to precision bearing of class 5 or higher

Over Incl. Min. Max. Min. Max. Min. Max. Min. Max. Min. Max.

6.4.3 Double Row Self Aligning Ball Bearing

Table 6.6(A) Radial internal clearance for Double row self-aligning ball bearing with cylindrical bore.

Clearance values in microns

Bore diameter d (mm)		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2.5	6	1	8	5	15	10	20	15	25	21	33
6	10	2	9	6	17	12	25	19	33	27	42
10	14	2	10	6	19	13	26	21	35	30	48
14	18	3	12	8	21	15	28	23	37	32	50
18	24	4	14	10	23	17	30	25	39	34	52
24	30	5	16	11	24	19	35	29	46	40	58
30	40	6	18	13	29	23	40	34	53	46	66
40	50	6	19	14	31	25	44	37	57	50	71
50	65	7	21	16	36	30	50	45	69	62	88
65	80	8	24	18	40	35	60	54	83	76	108
80	100	9	27	22	48	42	70	64	96	89	124
100	120	10	31	25	56	50	83	75	114	105	145
120	140	10	38	30	68	60	100	90	135	125	175
140	160	15	44	35	80	70	120	110	161	150	210

Table 6.6(B) Radial internal clearance for Double Row Self Aligning Ball Bearing with tapered bore.

Clearance values in microns

Bore diameter d (mm)		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
18	24	7	17	13	26	20	33	28	42	37	55
24	30	9	20	15	28	23	39	33	50	44	62
30	40	12	24	19	35	29	46	40	59	52	72
40	50	14	27	22	39	33	52	45	65	58	79
50	65	18	32	27	47	41	61	56	80	73	99
65	80	23	39	35	57	50	75	69	98	91	123
80	100	29	47	42	68	62	90	84	116	109	144
100	120	35	56	50	81	75	108	100	139	130	170
120	140	40	68	60	98	90	130	120	165	155	205
140	160	45	74	65	110	100	150	140	191	180	240

6.4.4 Spherical Roller Bearing

Table 6.7(A) Radial internal clearance for Spherical roller bearing with cylindrical bore.

Clearance values in microns

Nominal Bore diameter d (mm)		Bearing with cylindrical bore									
		C2		CN		C3		C4		C5	
Over	Incl.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
14	18	10	20	20	35	35	45	45	60	60	75
18	24	10	20	20	35	35	45	45	60	60	75
24	30	15	25	25	40	40	55	55	75	75	95
30	40	15	30	30	45	45	60	60	80	80	100
40	50	20	35	35	55	55	75	75	100	100	125
50	65	20	40	40	65	65	90	90	120	120	150
65	80	30	50	50	80	80	110	110	145	145	180
80	100	35	60	60	100	100	135	135	180	180	225
100	120	40	75	75	120	120	160	160	210	210	26
120	140	50	95	95	145	145	190	190	240	240	300
140	160	60	110	110	170	170	220	220	280	280	350
160	180	65	120	120	180	180	240	240	310	310	390
180	200	70	130	130	200	200	260	260	340	340	430
200	225	80	140	140	220	220	290	290	380	380	470
225	250	90	150	150	240	240	320	320	420	420	520
250	280	100	170	170	260	260	350	350	460	460	570
280	315	110	190	190	280	280	370	370	500	500	630
315	355	120	200	200	310	310	410	410	550	550	690
355	400	130	220	220	340	340	450	450	600	600	750
400	450	140	240	240	370	370	500	500	660	660	820
450	500	140	260	260	410	410	550	550	720	720	900
500	560	150	280	280	440	440	600	600	780	780	1,000
560	630	170	310	310	480	480	650	650	850	850	1,100
630	710	190	350	350	530	530	700	700	920	920	1,190
710	800	210	390	390	580	580	770	770	1,010	1,010	1,300
800	900	230	430	430	650	650	860	860	1,120	1,120	1,440
900	1,000	260	480	480	710	710	930	930	1,220	1,220	1,570
1,000	1,120	290	530	530	780	780	1,020	1.020	1,330	1,330	1,720
1,120	1,250	320	580	580	860	860	1,120	1,120	1,460	1,460	1,870
1,250	1,400	350	640	640	950	950	1,240	1,240	1,620	1,620	2,080

Table 6.7(B) Radial internal clearance for Spherical roller bearing with tapered bore.

Clearance values in microns

Bore diameter d (mm)		Group 2 (C2)		Group N (CN)		Group 3 (C3)		Group 4 (C4)		Group 5 (C5)	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
18	24	15	25	25	35	35	45	45	60	60	75
24	30	20	30	30	40	40	55	55	75	75	95
30	40	25	35	35	50	50	65	65	85	85	105
40	50	30	45	45	60	60	80	80	100	100	130
50	65	40	55	55	75	75	95	95	120	120	160
65	80	50	70	70	95	95	120	120	150	150	200
80	100	55	80	80	110	110	140	140	180	180	230
100	120	65	100	100	135	135	170	170	220	220	280
120	140	80	120	120	160	160	200	200	260	260	330
140	160	90	130	130	180	180	230	230	300	300	380
160	180	100	140	140	200	200	260	260	340	340	430
180	200	110	160	160	220	220	290	290	370	370	470
200	225	120	180	180	250	250	320	320	410	410	520
225	250	140	200	200	270	270	350	350	450	450	570
250	280	150	220	220	300	300	390	390	490	490	620
280	315	170	240	240	330	330	430	430	540	540	680
315	355	190	270	270	360	360	470	470	590	590	740
355	400	210	300	300	400	400	520	520	650	650	820
400	450	230	330	330	450	450	570	570	720	720	910
450	500	260	270	270	490	490	630	630	790	790	1000
500	560	290	410	410	540	540	680	680	870	870	1100
560	630	320	460	460	600	600	760	760	980	980	1230
630	710	350	510	510	670	670	850	850	1090	1090	1360
710	800	390	370	370	750	750	960	960	1220	1220	1500
800	900	440	640	640	840	840	1070	1070	1370	1370	1690
900	1000	490	710	710	930	930	1190	1190	1520	1520	1860

6.5 Preload

Bearing Preload is the process of applying an axial load, independent of external loads, to a bearing. An axial preload ensures constant contact between the rolling element and raceways reducing or eliminating play inside bearing.

Bearings are preloaded to increase rigidity and thereby to reduce unwanted bearing's displacement. This means that the bearings' internal clearance is negative before operation. This is called "preload" and is commonly applied to angular ball bearings and tapered roller bearings.

The amount of preload applied is important. It must be sufficient to reduce the excess play, but care must be taken not to apply too much preload. Proper preload allows the rolling elements to freely rotate in the bearing races, while excessive preload could lead to skidding. This will increase friction and heat generation, which can ultimately lead to premature bearing failure.

Purpose of preload

(1) Bearing's rigidity increases, internal clearance tends not to be produced even when heavy load is applied.

(2) The particular frequency of the bearing increases and is becomes suitable for high-speed rotation.

(3) Shaft run-out is suppressed; rotation and position precision are enhanced.

(4) Vibration and noise are controlled.

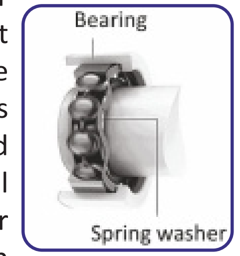
(5) Sliding of rolling elements by turning, spinning, or pivoting, is controlled and smearing is reduced.

(6) Fretting produced by external vibration is prevented.

Preloading different types of bearings

1. Deep groove ball bearings

Deep groove ball bearings requiring a preload must be loaded axially. Axial load can be applied to the outer ring or inner ring. The race comes in contact with the ball and translates this load to the raceway of the outer or inner ring. This creates a contact angle, between the race, the ball and the outer race. Preloading of deep groove ball bearings is optional but preloading of angular contact bearings is mandatory. Preloading can be done using a constant-force adjustable spacer (spring washer). Spring preloading reduces noise and is widely used in electric motors



Preload on deep groove ball bearing is done in rare cases and is optional. In Deep Groove Ball Bearing, for applying preloading minimum two bearings will be needed i.e., matched pair bearings.

One very important point for preloading deep groove ball bearing is the selection of clearance. Higher Radial clearances (C3, C4) are required so that same contact angle is maintained between ball and both the races (inner and outer). Whenever inner ring is axially displaced (sa) with respect to the outer ring, thereby preload (few microns) is induced .

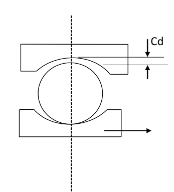


Fig.1

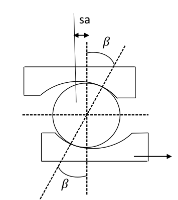


Fig.2

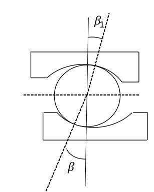


Fig.3

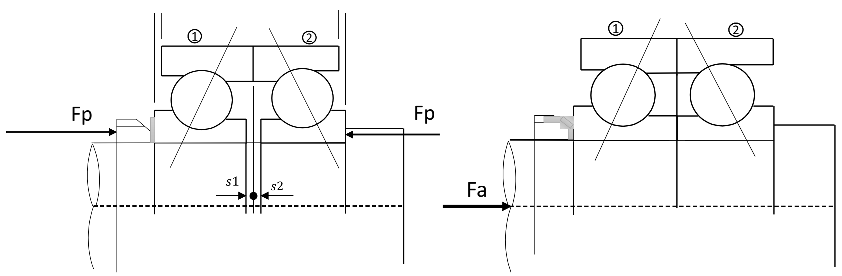
Note: Unequal Angles between ball and inner /outer race of will generate gyroscopic motion on ball (Fig.3)

In case of Deep groove ball bearings preloading is done in case of motors and encoders etc.

2. Angular contact bearing

Angular contact bearings have large contact angles typically 15°, 25°, 30° or 40°. Angular contact bearings which are manufactured in matched pairs are referred to as duplex bearings. Duplex bearings are manufactured with the bearing faces adjacent to each other in face to face or back-to-back arrangement. The raceways of duplex bearings are slightly offset but come together when the proper preload is applied during assembly.

Axial displacement of inner rings of bearing 1 & 2 while applying preload Force (Fp)



Where,

Fp is Preload applied during mounting

Fa is operational axial load

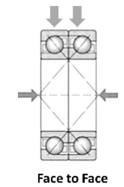
Preload force is applied on bearings from both sides as shown in figure,inside faces of inner ring will move towards each other reducing or eliminatinge the gap (s1 & s2)

Under Operation For Bearing 1

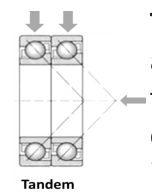
Total axial load = Fa + Fp

For bearing 2

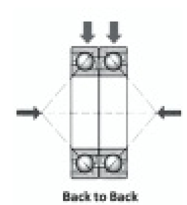
Axial Load = Fa- Fp



In Face-to-face bearings assembly, there is a clearance between the outer rings. After preloading, the outer ring faces and inner ring faces are clamped together, bringing the faces flush with each other, and resulting in contact angles that converge towards the centerline.



Tandem assembly two or more bearings are arranged in the same orientation. During assembly, the inner rings are clamped together, resulting in contact angles that are parallel to each other and increases the thrust capacity in one direction only.



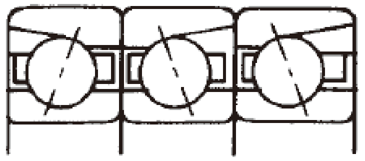
In Back to Back bearing assembly, bearing has clearance between inner ring faces. After preloading inner rings are clamped together, bringing the inner and outer ring faces flush with each other and resulting in contact angles that diverge towards centerline.

Universally Matched Single Row Angular Contact Ball Bearings with high ndm factor, preloading is done in applications such as:

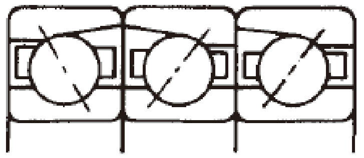
- End Suctions Pumps
- High speed Motors
- Input shaft (Bevel and Spiral Bevel Input Drives)

It is important to select optimum Preload with the help of calculations and experience. Aiming for higher stiffness will increase the operating temperature and can lead to early bearing failure.

Triplex Bearing Arrangement should be chosen in case of high stiffness and axial forces.



DBD

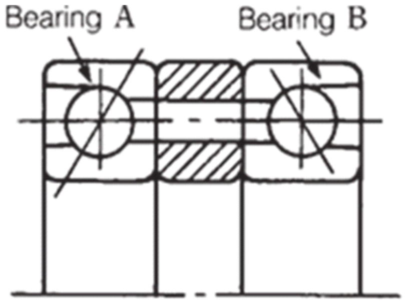


DFD

Preload methods

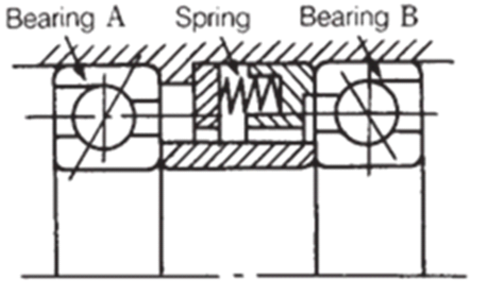
Rigid preloading

It provides the higher radial and axial rigidity. The preload is obtained by applying a bad with a precision locknut or clamping element and a spacers is used between the two bearings. The nut applies an axial load to the inner or outer bearing ring and thus preloads bearings. Shims may also be used to obtain the proper preload.



Spring preload

It provides the higher radial and axial rigidity. The preload is obtained by applying a load with a precision locknut or clamping element and a spacers is used between the two bearings. The nut applies an axial load to the inner or outer bearing ring and thus preloads bearings. Shims may also be used to obtain the proper preload.



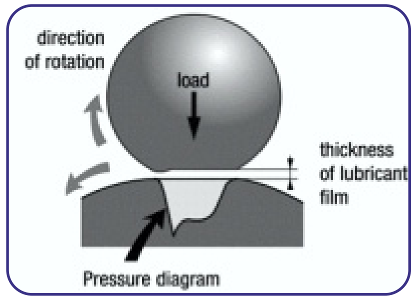
07 Lubrication

7.1 Function of the Lubrication

The main function of lubricant is to provide a lubricating film between the rolling elements and the raceway of the bearing in order to prevent wear and allow smooth rotation of the contact surfaces to prolong the service life of the bearings.

The characteristics of lubricants are as follows:

(1) Reduction of Friction and Wear
Preventing direct metal to metal contact between the bearing elements and rings by providing a thin film. This film reduces the friction and wear in the contact areas.
(2) Extension of Fatigue Life
Lubricants improve the rolling fatigue life of bearings greatly by providing a thin film between the rolling contact surfaces.
(3) Dissipation of Frictional Heat
Lubricant acts as a coolant to carry away frictional heat from contact surfaces prevent the bearing from overheating.
(4) Others
Lubricants also helps to prevent foreign material from entering the bearings and protect against rusting.



The first step in the lubrication selection is to consider whether to.. use Oil lubrication or Grease lubrication for the particular application and should be decided in the design process.

7.2 Selection of the type of lubrication

The guideline is allowing the selection of the proper lubricant for the wide range of bearing types and operating conditions. The first consideration is method of lubrication is best for the particular application. Bearing lubrication method is broadly classified into three categories: Oil lubrication, Grease lubrication and solid lubrication. Satisfactory bearing performance can be achieved by adopting the most suitable for the application and operating condition. First two methods are being used in most of the applications. A comparison of grease and oil lubrication is given in Table 7.1&7.2.

Table 7.1 Comparison of grease and oil lubrication characteristics

Method	Grease Lubrication	Oil Lubrication
Handling	□	△
Reliability	o	□
Cooling Effect	x	o
Seal Structure	o	△
Power Loss	o	o
Environment Contamination	o	△
High speed rotation	x	o

□ : Very Good o : Good △ : Fair x : Poor

Table 7.1 Comparison of grease lubrication and oil lubrication

	Oil lubrication	Grease lubrication
Advantages	•Good coverage in the bearing • Dissipating heat • Easy monitoring of the lubricant • Good physical and chemical stability	•Cleanliness of the system •Sealing easier •Assembly simplicity •Reduction or elimination of relubrication •Possibility of using pre-greased bearings
Disadvantages	• Necessary of a lubrication system • Poor protection against oxidation and moisture in case of long stops • Starting delay when circulation of oil is necessary prior to rotation	•Cost effectiveness •Higher friction coefficient than for oil •Poorer dissipation of heat •Replenishment (if necessary) difficulty •Grease leakage, contamination or ageing

7.3 Grease lubrication

Thanks to its ability to dispense the lubricating film over time, grease lubricants offer an additional advantage when being used in maintenance-free applications. Most of NBC bearings are grease-lubricated, with different greases.

The following section will give broad guideline in selecting the appropriate lubricating grease. Before that let us discuss the characteristics of greases.

7.3.1 Characteristics of greases

Grease is a semi-fluid to solid and in which liquid lubricant is dispersing in a thickening agent called soap. Additives may also add to bring certain specific properties. The concept of fill for life in most of the applications has made grease as an integral component of the bearing. The service life of the bearing and its behaviour in diverse environments are largely determined by the properties of the grease.

7.3.1.1 Speed factor $n \cdot d_m$

The dm. N factor is the first step for choosing a bearing lubricant that will perform well under a given set of conditions. The factor is obtained by multiplying the bearing speed in rpms by the average of the outer diameter and bore diameter of the bearing in millimetres. DN factor of a bearing is critical to preventing lubricant starvation, which is characterized by decreasing lubricant film thickness. In case outer ring rotation consider only outer diameter to calculate DN factor.

7.3.1.2 Base Oil Viscosity

The base oil of the grease provides the separation between two surfaces of mating parts. Therefore, selecting the correct viscosity is very important. Knowing the speed factor value and operating temperature, the minimum viscosity requirement can be selected.

Grease made with low viscosity base oils is more suitable for high speeds and low to medium load application, while greases made with high viscosity base oils are more suited for low speed 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.

7.3.1.3 Operating temperature range

Due to friction between the rolling elements and ring raceways, the operating temperature of a bearing is likely to increase; however, in some application, external process-related temperature can influence the bearing such that its final operating temperature may be much higher. Therefore, make sure that the operating temperature range of the grease must be within the range of operating temperatures as per grease manufacturers. Grease temperature ranges are defined by both the dropping point of the grease thickener and composition of the base oil. If the operating temperature range is wide, synthetic greases offer advantages. The high temperature limit for lubricating greases is a function of the oxidation stability. Starting torque in a grease-lubricated bearing at low temperatures can also be critical. It is recommended that greases are not used below 20°C than the lower operating temperature of the grease as stated by the grease manufacturer

7.3.1.4 Base oil Type

Once the viscosity has been determined, it's time to consider additives and base oil types. Most greases are produced using API Group II and III mineral oil base stocks for most applications. Synthetic oils such as Polyalphaolefin (PAO), diester or silicone oil are mainly used as the base oil for grease. Demanding applications like high or low operating temperatures, a wide ambient temperature range, or any application where extended relubrication intervals are desired, then synthetic base oil can be used

7.3.1.5 Additives

Additives are primarily include enhancing the existing desirable properties, suppressing the existing undesirable properties, and imparting new properties. The most common additives are oxidation and rust inhibitors, extreme pressure, antiwear, and friction-reducing agents.

It is recommended that extreme pressure additives be used in heavy load applications. For long use without replenishment, an antioxidant should be added.

7.3.1.6 Thickener Type

Thickeners are a fibrous matrix that contains the base oil. Under load, oil is released into the contact surfaces to provide lubrication. When the load is released, the oil is drawn back into the thickener matrix. The thickener in a grease is the component that sets grease apart from fluid lubricants. Thickener consist of two types, metallic soaps and non-soaps. Metallic soap thickeners include lithium, sodium, calcium, etc. Non-soap base thickeners are divided into two groups; inorganic (silica gel, bentonite, etc.) and organic (polyurea, fluorocarbon, etc.).

Poly-urea and other non-metallic soaps are generally superior in high temperature properties. However, this type of grease does not have a high working temperature unless the base oil also must have heat resistant. The highest possible working temperature for grease should be determined considering the heat resistance of the base oil.

Lithium-complex and urea thickeners are commonly being used in wheel bearing applications. However, grease for EV wheel application required lower torque, hence, more shear-stable di-urea thickeners could perform better.

7.3.1.7 Grease Consistency

The consistency of the grease is determined by the thickener concentration, thickener type and the viscosity of the base oil. In simple terms consistency expresses a measure of the relative hardness of a grease. The NLGI has established guidelines scale to indicate grease consistency as per Table 7.3. The consistency generally chosen for bearings is grade 2 & 3. Speed factor and operating temperature determine the best consistency for a given application.

Higher speed factors require higher consistency greases.

A common mistake when selecting a grease is to confuse between consistency and the base oil viscosity. The NLGI number relates to the consistency of the grease. It is possible to create NLGI #2 grease using ISO VG 10 base oil or ISO VG 1000 base oil. One would never use ISO VG 10 oil in an application that demands ISO VG 1000.

Table 7.3 Relationship between consistency and application of grease

NLGI Consistency No.	Worked Penetration	Working conditions
0	355~385	☐ For centralised greasing use ☐ When fretting is likely to occur
1	310~340	☐ For centralised greasing use ☐ When fretting is likely to occur ☐ For low temperature
2	265~295	☐ For general use ☐ For selected use
3	220~250	☐ For high temperature ☐ For selected ball bearings
4	175~205	☐ For high temperature ☐ For special use

Table 7.4 Relationship between consistency and application of grease

Working condition	Suitable Grease
Smooth running (Low noise level)	Grease with NLGI 2
Vertical mount	Good adhesion property with NLGI 3 or 4
Outer ring rotation or centrifugal force on bearing	NLGI between 2 to 4
High temperature	Synthetic base oil with NLGI 2 or 3
Low temperature	Low viscous base oil with NLGI 1 or 2
Contaminated environment	NLGI 3 grease

NBC supply pre-greased with sealed and shielded bearing that is appropriate for the application. Contact NBC team for assistance in choosing the grease for your application. The following page will help to make an initial choice.

Standard greases and their characteristics are listed in Table 7.5. As performance characteristics of even the same type of grease will vary widely from brand to brand.

E-mobility has brought new challenge into the bearing design and lubrication. One of the challenges is grease with little electrical conductivity could extend the life of the bearing against serious bearing damage. To choose lubricant for electric vehicle application, contact NEI technical cell.

Table 7.5 Grease varieties and characteristics

CHARACTERISTICS	GREASE NAME				
	Lithium grease			Calcium grease (cup grease)	Sodium grease (fiber grease)
Thickener	Lithium Soap			Calcium Soap	Sodium Soap
Base Oil	Mineral oil	Synthetic oil (diester oil)	Synthetic oil (Silicon oil)	Mineral oil	Mineral oil
Dropping point (°c)	170 to 190	170 to 230	220 to 260	80 to 100	160 to 180
Operating temp. Range (°c)	-30 to +120	-50 to +130	-50 to +180	-10 to +70	0 to +110
Rotational range	Medium to high	High	Low to medium	Low to medium	Low to high
Mechanical stability	Excellent	Good to excellent	Good	Fair to good	Good to excellent
Water resistance	Good	Good	Good	Good	Bad
Pressure resistance	Good	Fair	Bad to fair	Fair	Good to excellent
Remarks	Most widely usable for various rolling bearings	Superior Low, Temperature & friction characteristics. Suitable for bearings for measuring instruments & extra small ball bearings for small electric motors.	Superior, High & low temperature characteristics.	Suitable for application at Low rotation speed & under light load. Not applicable at high temperature	Liable to emulsify in the presence of water. Used at relatively high temperature.

Table 7.5 Grease varieties and characteristics (contd.)

CHARACTERISTICS	GREASE NAME				
	Complex Base Grease		Non- Soap Base Grease		
Thickener	Lithium Complex Soap	Calcium Complex Soap	Bentone	Urea Compounds	Fluorine Compunds
Base Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil/Synthetic Oil	Synthetic Oil
Dropping point (°c)	250 or Higher	200 to 280	-	240 or higher	250 or Higher
Operating temp. Range (°c)	-30 to +150	-10 to +130	-10 to +150	-30 to +150	-40 to +250
Rotational range	Low to High	Low to Medium	Medium to High	Low to High	Low to Medium
Mechanical stability	Good to Excellent	Good	Good	Good to Excellent	Good
Water resistance	Good to Excellent	Good	Good	Good to Excellent	Good
Pressure resistance	Good	Good	Good	Good to Excellent	Good
Remarks	Superior mechanical stability and heat resistance. Used at relatively high temperature.	Superior pressure resistance when extreme pressure agents is added. Used In bearings for rolling mills.	Suitable for application at high temperature & under relatively heavy load	Superior water resistance, oxidation stability, and heat stability. Suitable for application at high temperature & high rotation speed.	Superior chemical resistance and solvent resistance. Usable upto 250 °C.

7.3.2 Relubrication intervals

Grease replenishment or exchange is required if the grease service life is shorter than the anticipated bearing life. In this case grease deteriorates with the passage of time, fresh grease must be re-supplied at proper intervals. The replenishment time interval depends on the type of bearing, dimensions, bearing's rotating speed, bearing temperature, and type of grease.

The bearings are re-lubricated by means of grease guns through lubricating nipples. If frequent re-lubrication is required, grease pumps and volumetric metering units must be used. It is essential that the fresh grease displace the spent grease, so that the grease get exchanged, but over greasing should be prevented.

1.Grease quantities for weekly to yearly relubrication[g]:
m1 =D.B.X

Table: 7.6 Reduction factor

Relubrication	X
weekly	0.002
monthly	0.003
yearly	0.004

2. Quantity for extremely short relubrication intervals [g]:

m2 (0.5~20).V[Kg/h]

3. Relubrication quantity m3 prior to restarting after several years of standstill [g]:

m3 =D. B. 0.01

Where

V = free space in the bearing
D= Outer dia of the bearing (mm)
B = Width of the bearing (mm)

Grease replenishment intervals can also be calculated by using following graph. This chart indicates the replenishment interval for standard rolling bearing grease when used under normal operating conditions.

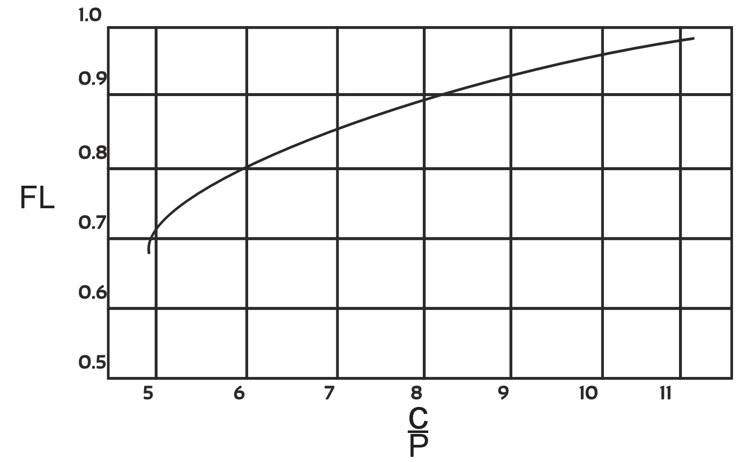


Fig. 7.1 Value of adjustment factor FL depends on bearing load

Example:
Find the grease lubrication interval for ball bearing 6205 with a radial load 1.4 kN operating at 4800 r/min

From the bearing tables the allowable speed for bearing 6205 is 13000 r/min

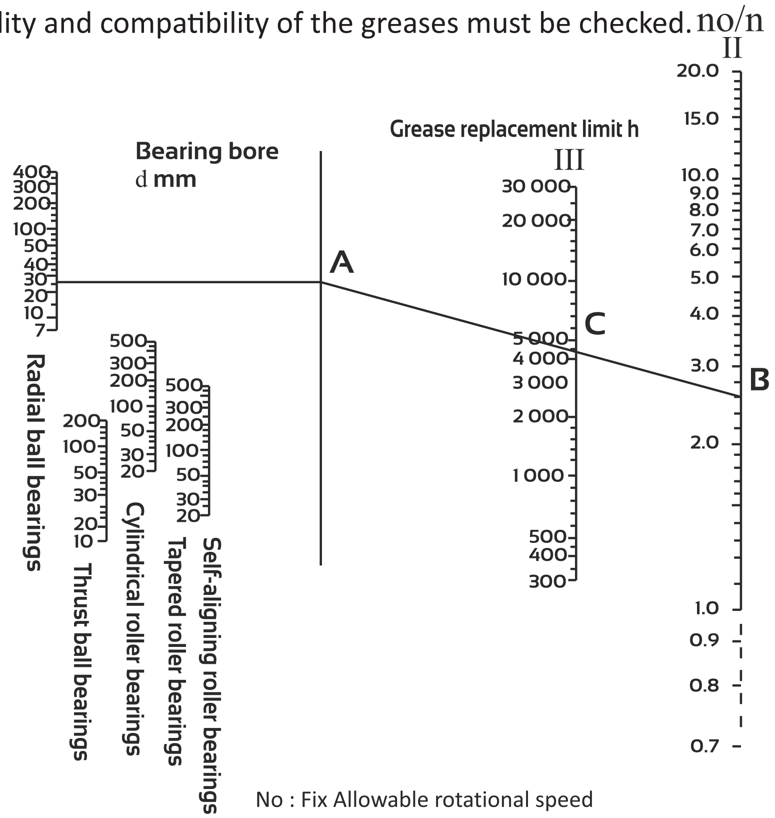
Cr/Pr=14/1.4 kN = 10
From fig.7.1 adjusted load (FL) is 0.98
n0=0.98x13000=12740 r/min
therefore n/n0=12740/4800=2.6

Using the chart in fig.7.2 locate the point corresponding to bore diameter d=25 mm on the vertical line for radial batt bearings. Draw a straight-horizontal line to vertical line.

nbc
CKA Birla Group

After that draw a staright-line from that point(A in example) to a point on the line II which corresponds to the no /n value (2.6 in example). Point C, where this line intersects vertical line indicates the lubrication interval 'h' which is approx. 4500 hours.

Relubrication should be done to avoid grease deterioration having an adverse effect on the bearing life. However, High performance greases can extend relubrication intervals and grease life. The grease used for relubrication must be the same as that used in initial greasing. If other greases are used, the miscibility and compatibility of the greases must be checked.



No : Fix Allowable rotational speed (dimensions table)
n : Operating rotational speed

Fig. 7.2 Diagram for grease interval

7.3.6 Grease quantity for initial fill and relubrication

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

The quantity of grease for ordinary bearings is determined as follows. Enough 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:

Speed	Speed factor	Grease fill
very slow	<50 000	60-80 %
slow to normal	50 000 to 200 000	25-60 %
high	200 000 to 600 000	15-30 %
very high	>600 000	15-20 %

It must be in mind that excessive grease will generate heat when churned and will consequently cause temperature rise which in turn causes the grease to soften and may allow leakage. With excessive grease fills oxidation and deterioration may cause lubricating efficiency to be lowered. Where speeds are high and temperature rises need to be kept to a minimum, a reduced amount of grease should be used.

The standard bearing space can be found by below formula

V=K.W

where,

V:Quantity of bearing space open type (approx.)cm3

K: Bearing space factor (Table 7.7)

W: Mass of bearing kg

Table 7.7 Bearing space ratio (K)

Bearing Type	Retainer Type	K
Ball Bearings [1]	Pressed Retainer	61
NU-cylindrical Roller Bearings [2]	Pressed Retainer Machined Retainer	50 36
N-cylindrical Roller Bearings [3]	Pressed Retainer Machined Retainer	55 37
Tapered Roller Bearings	Machined Retainer	46
Spherical Roller Bearings	Pressed Retainer Machined Retainer	35 28

Notes:

1 Remove 160 Series

2 Remove NU4 Series

3 Remove N4 Series

In general, the permissible working temperature is limited by the degree of mechanical agitation to which the grease is subjected, and we shall be pleased to recommend suitable lubricants for varying conditions on receipt of necessary particulars, before the bearings are set to work, they should be thoroughly charged with grease in such a manner as to ensure the efficient coverage of all working surfaces. The housing should also be lightly packed with grease, it being important that a reserve supply of lubricant should be maintained in actual contact with the bearing to promote satisfactory and continuous lubrication. if two bearings are mounted in the same housing, they, for this reason, should be separated by distance pieces. If correctly applied, one charge of grease will last for a very long period, varying with the condition of working. 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.

7.3.7 Mixing Different Types of Grease

In general, 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. Different brands of grease must not be mixed even same physical properties as the additives may differ. In cases where change of the grease used becomes necessary, all remaining old grease must be removed. Also, the remaining lubricant in housing cavities, lubrication pipes or grooves must be carefully removed. Especially in the changer over period, special attention should be paid to the lubrication situation in the bearing arrangement. If required, the defined relubrication intervals should be shortened during such a conversion period

.

7.3.8 Compatibility

Grease formulated with base oil, the additives and the thickener. For higher performance from grease Lubricants must always be checked for their compatibility with other lubricants, Seal and the environment.

7.4 Oil lubrication

Oil lubrication is generally used when the bearing is adapted in a mechanism that is already lubricated (gear reducer, gearbox) or else when it can benefit from a central lubrication system.

- Oil is a better lubricant for high speeds or high temperatures. It can be cooled to help reduce bearing temperature.
- It is easier to handle and control the amount of lubricant reaching the bearing.
- Oil can be introduced to the bearing in many ways, such as drip-feed, pressurized circulating systems, oil bath or air-oil mist. Each is suited for certain types of applications

.

In this section, the properties and characteristics of lubricants for typical roller bearing applications are listed. These general characteristics have resulted from long, successful performance in these applications

Types of oils

Lubricating oils are commercially available in many. Oils are classified Animal & Vegetable oils, Mineral oil and Synthetic oil.

7.4.1 Mineral oil

Oils are refined from crude petroleum oil, with additives to improve certain properties. Petroleum oils mostly used for oil-lubricated applications of bearings.

7.4.2 Synthetic oils

Synthetic oils cover a broad range of categories and include polyalphaolefins (PAO), Silicon oil, Fluorinated oil, Polyglycols and various esters. In general, synthetic oils are less prone to oxidation and can operate at extreme temperatures.
The polyalphaolefins (PAO) have a long, straight hydrocarbon chain chemistry provide superior performance. Therefore, PAO oil

is mostly used in the oil-lubricated applications of bearings when severe temperature or when extended lubricant life is required.

Selection of the proper type of oils depends on bearing speed, load, operating temperature and lubrication method.

7.4.3 Additives

Additives are substances formulated for improvement of chemical and physical properties of base oil, which results in enhancing the lubricant performance and extending the equipment life. The most commonly used additives are the Friction modifiers, Anti-wear additives, Extreme pressure (EP) additives, Rust and corrosion inhibitors, Anti-oxidants, Detergents, Dispersants, Pour point depressants and Viscosity index improvers. Great care must be used in choosing an additive. One must check with the lubricant manufacturer to check the influence of the additive on the bearing performance

.

- Extreme pressure
  Protects metal surfaces against micro-welding and necessary when the bearing is highly loaded.
- Anti-wear
  Reduces the wear of the metal surfaces by forming a protective surface layer.
- Anti-corrosion
  Protects metal surfaces against corrosive attacks.

7.4.4 Viscosity

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.

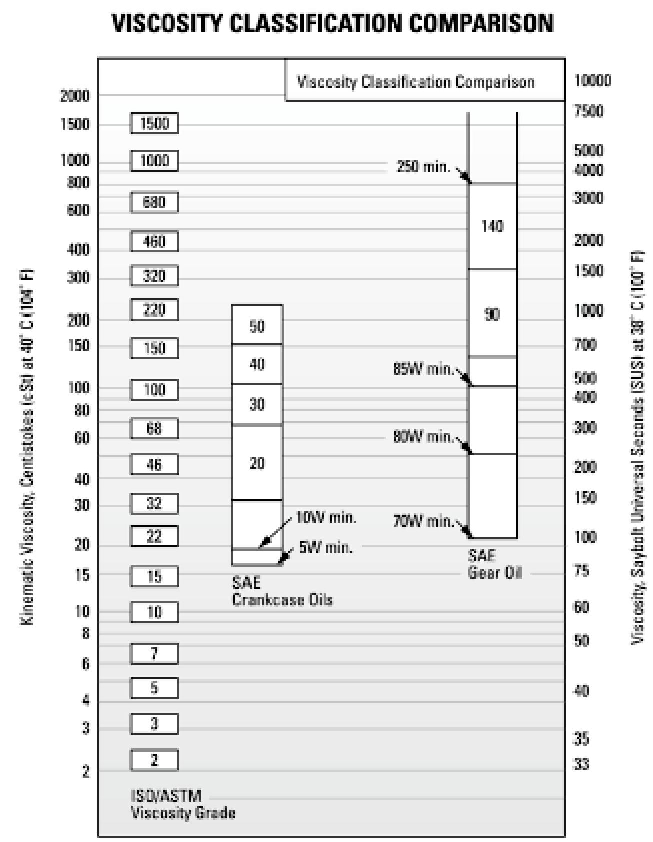
In regard to operating temperature and lubrication, Table 7.8 lists the required oil viscosity for different types of rolling bearings under normal operating conditions. Fig. 7.4 is an oil viscosity operating temperature comparison chart for the purpose of selecting a lubrication oil with viscosity characteristics appropriate to an application.

Table 7.8 Bearing Types and Proper Viscosity of Lubricating Oils

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

Remark 1mm2=1cSt (centistokes)

Since oil viscosity varies inversely with temperature, a viscosity value must always be stated with the temperature at which it was determined. There are several classifications of oils based on viscosity grades. The most familiar are the Society of Automotive Engineers (SAE) classifications for automotive engine and gear oils.



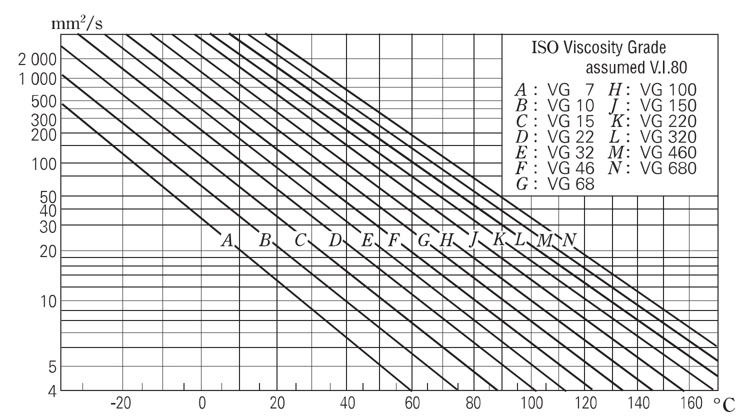


Fig.115 Relation between lubricating oil viscosity and temperature

Table 7.9 Selection standard for lubricaating oils (Reference)

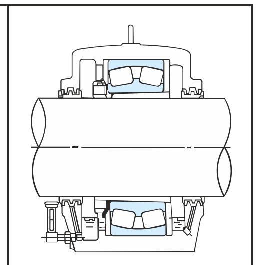
Bearing operating temperature	Speed factor	Lubricating oil ISO viscosity grade (VG)		Suitable bearing
		Normal load	Heavy load or shock load	
−30 to 0	Up to allowable revolutions	22, 32	46	All types
0 to 60	15,000 Up to	46, 68	100	All types
	15,000 to 80,000	32, 46	68	All types
	80,000 to150,000	22, 32	32	All types but thrust ball bearings
	150,000 to 500,000	22, 32	10	Single row radial ball bearings, cylindrical roller bearings
60 to100	15,000 Up to	220	150	All types
	15,000 to 80,000	150	100	All types
	80,000 to 150,000	100, 150	68	All types but thrust ball bearings
	150,000 to 500,000	68	32	Single row radial ball bearings, cylindrical roller bearings
100 to 150	Up to allowable revolutions	320		All types
0 to 60	Up to allowable revolutions	46, 68		Self-aligning roller bearings
60 to 100	Up to allowable revolutions	150		-

Please consult NEI technical cell in cases where operating conditions fall outside the range covered by this table.

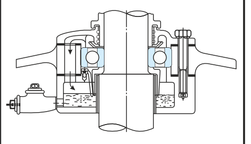
Method of oil lubrication
- Oil bath
- Splash
- Drop feed
- Forced oil
- Disc Lubrication
- Spray
- Oil Jet

Table 7.4.5 Method of oil Lubrication

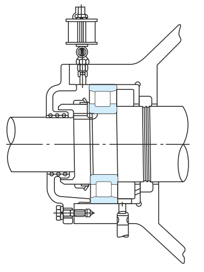
Oil bath lubrication
- This method is mostly used for slow and intermediate speed operation.
- The bearing operates in an oil bath made by filling the housing with oil.
- Too much oil causes excessive temperature rise (through agitation) while too little oil may cause seizing.
- It is desirable to install an oil gauge so that the oil level can easily be checked.
- In the case of a vertical shaft, 50-80% of the ball /roller bearing should be submerged when the bearing is idle.



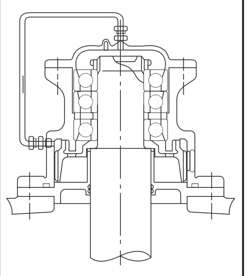
Splash lubrication
- In this method oil is splashed by impellers attached to a shaft without direct submersion
- This method is effective for high speeds.
- One example, bearings and gears in a gear box. Where the gears may splash the oil.
- A magnet should be placed at the bottom to prevent worn particles entering the bearings.



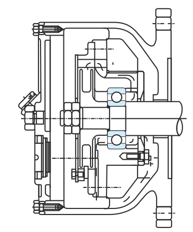
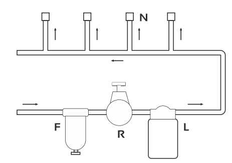
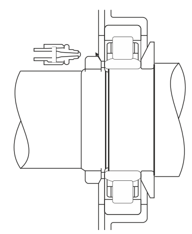
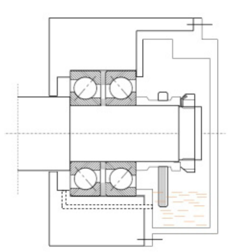
Drop-Feed lubrication
- This is a lubrication method where an oil pot (called "oiler") is installed at the upper portion of housing and oil drips from the oiler through a tiny hole.
- The dripping oil is converted to fog or mist on collisions with the rotating shaft/bearing parts.
- This method is more effective for comparatively high speeds and light loads rather than medium loads.
- Although application capability is great irrespective of shaft mounting (vertical or horizontal)
- Always remember to top off the oiler before it runs dry.

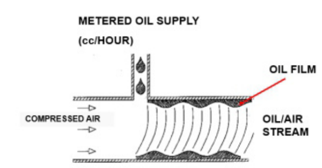


Forced oil circulation
- This method is commonly used for high speed operation requiring bearing cooling and for high temperatures environment.
- Oil is travelled through the bearing and drains out through the pipe on the left.
- After being cooled in a reservoir, it returns to the bearing through a 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



Methods of Oil Lubrication (contd.)

Disc Lubrication • In this method, a partially submerged rotating disc rotates and picks up ail from the casing then drains down through the bearing, lubricating it .	
Spray lubrication (oil-mist lubrication) • Filtered oil is blown through a lubrication sprayer (using dry compressed air), emerging in an atomized form. •This lubrication method is high effectiveness of cooling and prevention of bearings from dust or water invasion due to high internal pressure associated. •This method has often been used for bearings with high speed main spindle bearings or grinding machines. • Also it recently has become popular for bearings mounted on metal rolling mills.	
Oil Jet lubrication • This method lubricates by injecting oil under high pressure directly into the side of the bearing. • This is a reliable system for high speed, high temperature or otherwise severe conditions. • Used for lubricating the bearings in jet engines, gas turbines and other high-speed equipment. • Machine tools is one example of this type of lubrication.	
Oil Ring Lubrication Oil rings are made of brass, steel, and elastomeric material and suspended from horizontal shafts. The ring Rotates with the Shaft and Flings the oil on the Housing and shaft and is directed onwards due to the housing design inside the bearing. The oil level and sump allow high-speed operation due to better cooling: lower viscosity oil can be used. The disadvantage is the wear of the slinger parts, High speed Pumps, Reets compressors Non-Brive-side-- Input shaft of Gear Box. Etc. For size Bearings	

Air-Oil Lubrication (Metered Lubrication Technique) ▪ The oil is mixed in the Air Current at the Throat of Venturi producing braking of Oil Drop into Multiple Drop lets equally distributed across the C/s of delivery Line. ▪ The Air Acts as Carrier of Oil. ▪ The bearing receives Continuously supply of Fresh oil and the oil Leaves the Bearing Housing at the seal, labyrinth seal, acting additional barrier to outside contamination and taking some Bearing Heat along with it.	

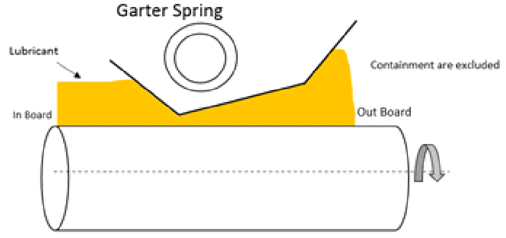
7.4.6 External Sealing

Rotary Seals for Rolling Bearings

- Contact Type
- Non-Contact type
- Internal Bearing Seals

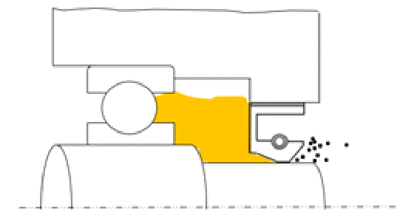
The main Function of any seal is to retain bearing lubricant both oil or grease and to exclude outside material that can contaminate lubricant and damage bearing, the contaminants include moisture in the form steam or water, dry contaminants in particulate sizes like, dust, dirt.

Primary Contact Type seal is Radial Lip seal.
Lip seal can be found in high speed, under water, steel mills, paper, refineries etc. almost anywhere which has rotating shaft.

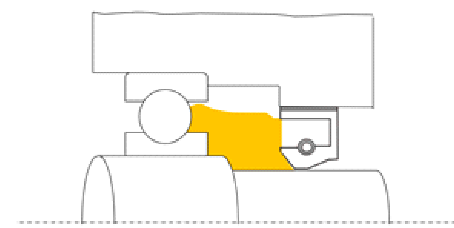


Rotary lip seal is preferred where the pressure differential between inboard side of machine to outboard side is null or minimum. It occupies less space and is easy to install. The sealing action of lip seal lies by managing the thin oil film between the sealing lip and smooth shaft surface and with shaft rotating relative to seal lip creates pumping action due to the design of seal lip. Two Jobs are accomplished with the design of the seal lip, the thin lubricant film at interface reduces the heat generated with rotating shaft and pumping action apart from enhancing the sealing action.--

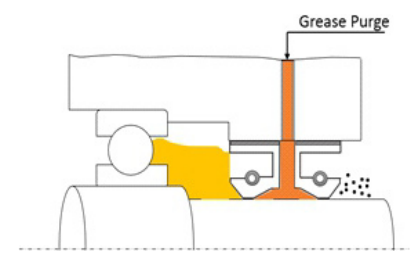
If the primary function of the seal is to exclude, the steep angle needs to face the contaminant



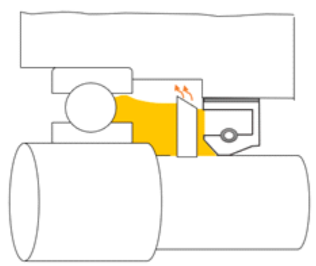
If the primary function is retention, the seal should be installed with a steep lip angle facing the lubricant



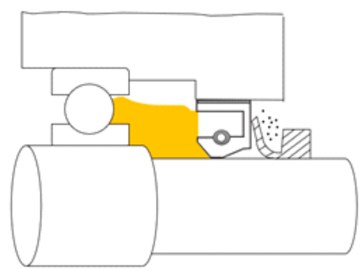
Seals in back-to-back with grease purge in the middle to retain oil and expel contamination



Standard lip seal attached with internal oil slinger to protect lip from oil pressure surge



Lip Seal with V-ring seal for excessive contamination



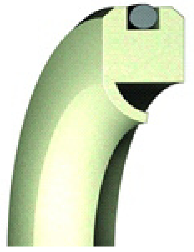
Shaft surface finish and peripheral speed at shaft, seal lip interface:
Proper surface finish is critical to ensure positive sealing and achieve the longest seal life possible in rotating applications. Surface finish, Ra 0.8 to 1.6 for automotive and industrial application. For Cryogenic & Aerospace applications the surface finish Ra Value is 0.4

The optimum surface roughness allows a film of the fluid being sealed to flow between the seal and the mating surface, which effectively lubricates and extends the life of the seal

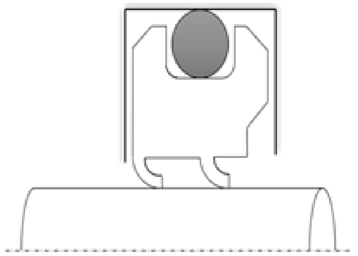
The Peripheral shaft speed For Nitrile rubber Lip Seal is 15 m/s.

PTFE lip seals are preferred over elastomeric lip seals when conditions are severe.

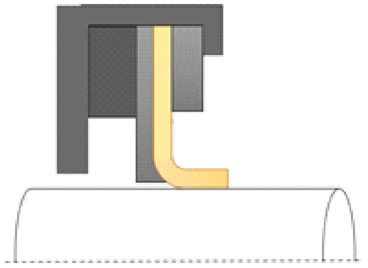
Common reasons for upgrading to a PTFE seal:
.Poor lubrication at the lip.
.High pressure differential.
.High speed or high temperature.
(Speed up to 30m/sand temperature 200°C)
.Chemical compatibility like refrigerant.
.Higher contact area with shaft.
.Low coefficient of Friction at higher speeds



PTFE seal with Single flexi-lip



PTFE seal with dual flex lips for higher differential pressure of 20 bar plus as in utilities in chillers and AC compressors.

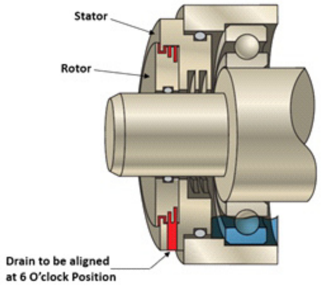


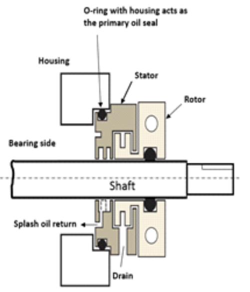
For even higher differential pressure 30 to 35 bar for higher retention PTFE seal with metal case is utilized

Bearing isolators uses contact O-rings on shaft and housing

Bearing Isolators is improved sealing solution over lip seal, as there is no relative motion between the shaft and seal. Close tolerance labyrinth design to expel the dirt, dust, moisture, and lot of air borne contamination. Lubrication oil retention is far superior to lip seals. Fits in lip seal cavity, with grooving of the shafts. The contact with the shaft and housing is with static O-rings which maintains press fit with the housing and shaft. Graphite filled PTFE is widely used common material for bearing isolators. It provides low coefficient of friction and excellent thermal stability. Bronze is the other material commonly used as it has good hardness and wear resistance properties

The Bearing Isolators are made in two parts-Rotor and Stator. O-ring are to hold both Stator and Rotor in place. The expansion of shaft is allowed easily without displacing either Stator or Rotor as O ring on shaft permits the relative expansion of shaft.





The Improved features are:

- Almost 0 % oil leakage and 100 % resistance to contamination.
- No grooving of shaft or other damages
- No restriction to axial shaft expansion
- Resists water splash
- High peripheral shaft velocity about 25 m/s

While mounting following to be checked and ensured:

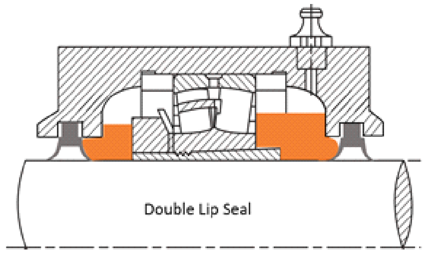
- Surface finish of shaft around 1.6 microns is acceptable with bearing isolators on shaft and housing bore.
- O-rings to be lubricated during installation and ensure they don't get twisted during mounting.
- Ensures the Isolator is fitted at right angles to shaft axis.
- Check machinery vent for bearing housings to prevent vacuum or pressure built-up.

Isolators are ideal for Electrical Motors, Pumps, Gearboxes and Blowers against heavy water spray and dry containments.

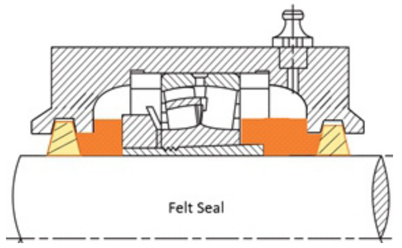
Seals for Plummer Block

Contact type seal for Horizontally Split Housings

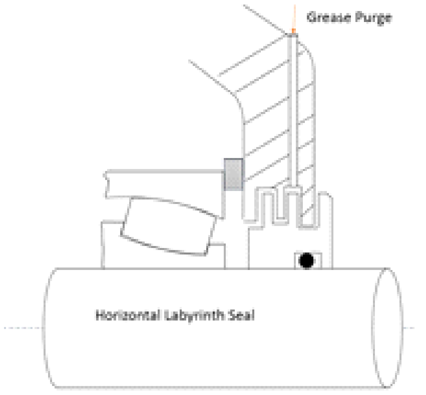
- NBR rubber seal is often used with grease lubrication.
- Positive contact with shaft provides effective sealing in contaminated dry atmosphere.
- The sliding velocity is limited to 5m/s and temperature application..
- The misalignment of shaft up to 1^0 with no possible restriction to shaft.



- Felt seal are made of wool or rayon.
- Excellent for grease and poor performance for oil.
- Felt is fist soaked with grease or oil before putting in place.
- Sliding velocity at shaft seal interface is 5m/s with temperature application
- Ideal for dusty contamination.



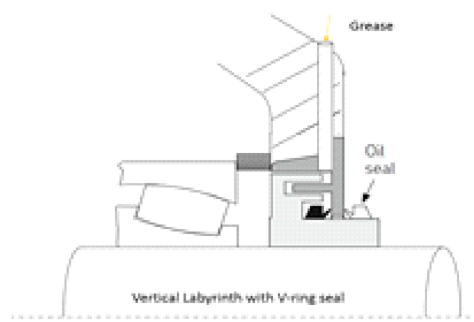
Horizontal labyrinth non-contacting seal for split plummer block housings.



- Horizontal labyrinth are non-contacting seal for split plummer housings.
- Labyrinth with extra convulsion is preferred for high contamination and retention. Grease purged between the convulsion spaces improves the sealing. Held with statico-ring which is press fitted on the shaft.
- The speed is same as shafts, but misalignment of shaft is Limited to 0.3°
- The axial expansion of shaft is marginally permitted.

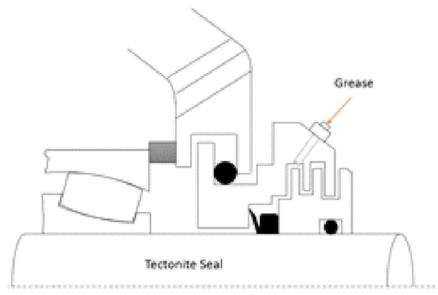
Vertical labyrinth non-contacting seal for split block housing

In Vertical Labyrinth, the convulsion is arranged parallel to shaft axis. Additional improvements in sealing are provided by V-ring seal and grease purge. The circumferential speed is good around 12m/s and higher shaft axial expansion than Horizontal Aligned Labyrinth.



Tectonite seal for split Plummer Block Housing

Tectonite seal has highest sealing of lubricant and exclusion of contaminants for all the seal in split Plummer block housings. Excellent sliding speed around 12m/s with misalignment of shaft higher than conventional labyrinth. Uses v-ring seal to seal lubricant (oil or grease). With grease filled in convulsion excludes the outside contamination



7.4.7 Compatibility

Performance of the lubricating oil also depends on compatibility with contact parts. Their behaviour must be checked in relation to plastics, seal materials (elastomers) at operating temperature. Though Synthetic oils enhance performance must always be checked for their compatibility.

7.5 Solid and Dry Lubrication

Solid lubricants are materials, which in solid phase reduce friction between surfaces sliding against each other, without the need for a liquid medium. Generally, these lubricants are applied on the contact surfaces by different coating process are adopted to use Molybdenum disulphide (MoS2) and tungsten disulphide (Ws2).

7.6 Oil impregnated ball bearing

Oil impregnated ball bearing is a type of polymer lubricant composed lubricating oil in the matrix. The special solution works similar to grease but by applying a special treatment process, the polymer solidifies retaining a large proportion of the lubricant within the bearing. Unlike grease, the OIBB is solid polymer matrix can prevent dirt or foreign particles entering into the contact. For more details, please contact NBC team.

08 Friction and Temperature

8.1 Friction

Frictional resistance to motion in a rolling bearing arises from various sources; the following commonly predominate:

1. Rolling friction: Elastic hysteresis and deformation at raceway contacts.
2. Sliding friction: Sliding from unequal curvatures in contact areas, sliding contact of the cage with rolling elements and guiding surfaces, sliding between the ends of rollers and ring flanges, and seal friction;
3. Lubricant friction: Viscous shearing on rolling element, cage, and raceway surfaces; churning and working of lubricant dispersed within the bearing cavity.

For most normal operating conditions, the total frictional moment can be estimated with sufficient accuracy as load dependent using a constant coefficient of friction

M=0.5xHxPxd
Where,
M = bearing frictional moment, calculated at the bearing bore radius (N mm)
H = coefficient of friction for the bearing (Table 8.1)
P = bearing load (N)
d-bearing bore diameter (mm)

The starting coefficient of friction can generally be taken as being about 60% higher than the running values given in Table 8.1. More accurate calculations of bearing friction are available which account for variations in the coefficient of friction with relative bearing load, bearing size, and cross section series.

Table 8.1 Co-efficient of friction for rolling element bearing

Bearing Types	Approximate values of µ
Deep Groove Ball Bearings	0.0015[a]
Cylindrical Roller Bearings with cage	0.0011[b]
Cylindrical Roller Bearings full complement	0.002 [a,b]
Spherical Roller Bearings	0.0018
Tapered Roller Bearings	0.0018

Note: "Apply to unsealed bearing
No appreciable axial load (Fa=0)

8.2 Bearing opration temperature

Operating temperature bears important relations to bearing and seal friction, design of the bearing assembly, and especially lubrication considerations

Generally, all friction loss in a bearing is transformed into heat within the bearing itself and causes the temperature of the bearing to rise. The amount of thermal generation caused by friction moment can be calculated using the below equation.

Q=0.105x10xMxn
where,
Q: Thermal value, kW
M: Friction moment, N.mm
n Rotational speed, rpm

Bearing operating temperature is determined by the equilibrium or balance between the amount of heat generated by the bearing and the amount of heat conducted away from the bearing. In most cases the temperature rises sharply during initial operation, then increases slowly until it reaches a stable condition and then remains constant. The time it takes to reach this stable state

depends on the amount of heat produced, heat capacity/diffusion of the shaft and bearing housing, amount of lubricant and method of lubrication. If the temperature continues to rise and does not become constant, it must be assumed that there is some improper function.

Possible causes of abnormal temperature increase may be due: .

- Bearing misalignment
- Moment load
- Incorrect installation
- Insufficient internal clearance
- Excessive pre-load, too much or too little lubricant

09 Limiting Speed

As bearing rotational speed increases, the temperature of the bearing also increases due to friction heat generated in the bearing interior. If the temperature continues to rise and exceeds certain limits, the efficiency of the lubricant drastically decreases, this causes damage to the bearing such as seizure and the bearing can no longer continue to operate in a stable manner.

Therefore, the maximum speed at which it is possible for the bearing to continuously operate without the generation of excessive heat beyond specified limits is called the **limiting speed or allowable speed** (r/min). The limiting speed is derived from ISO 15312 standard.

The factors that can affect the maximum allowable bearing speed include:

(1) Bearing type
(2) Bearing dimension and accuracies
(3) Lubrication system (grease lubrication, air-oil lubrication, jet lubrication, etc.)
(4) Internal clearance or preload on the bearing
(5) Bearing arrangement (2-row, 3-row, 4-row)
(6) Bearing load (C/P ratio)
(7) Accuracies of shaft, housing, etc.
(8) Type of Cage & design
(9) Centrifugal forces, gyroscopic moments etc. (10) Loss of fits
(11) Temperature increase results in heat generation, viscosity loss and reduces clearance

Besides the precision of the bearing itself, the magnitude and direction of the load, the type of cage, the type of lubricant and lubrication system, the rate of heat dissipation, the alignment, the mounting practice, and the balance of the rotating components all play a significant role in deciding limiting speed of bearing. Since each application must be evaluated on its own merits, it is recommended to consult NBC application engineering when the speed approaches the limiting value.

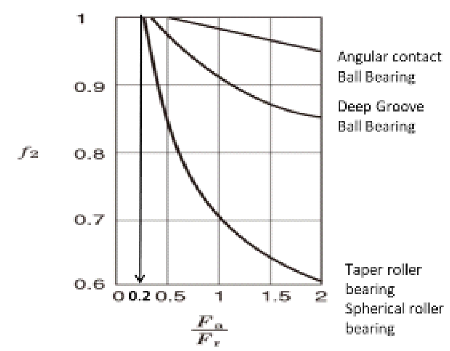
The maximum allowable speeds listed in the bearing dimensions tables are reference values and are applicable only to individual bearings that are adequately lubricated and correctly preloaded under a condition where the heat is reliably removed from the bearing arrangement. The limiting speeds listed in the bearing tables for grease and oil lubrication are for standard NBC bearings under normal operating conditions, correctly installed, using the suitable lubricants with adequate supply and proper maintenance. Consult NEI engineering for limiting speed for bearings with polyamide cage, contact type sealed bearings and higher requiring higher accuracy class.

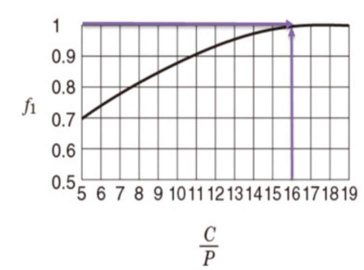
In the case of grease lubrication, these speeds are attainable only when the bearing is filled with an adequate amount of high-quality grease, the bearing is sufficiently run in, and heat is removed by an arrangement such as a cooling jacket. The maximum allowable speed of a particular bearing can vary depending on the relation between heat generation and heat dissipation in the bearing as well as how well the bearing is lubricated.
The bearing dimensions table gives approximate Allowable/limiting rotational speeds for grease and oil lubrication. The values are based on the following:

- The bearing must have the proper internal clearance prescribed in the NBC Engineering standard design specifications and must be properly installed.
- A quality lubricant must be used.
- The lubricant must be Replenished and changed when necessary.
- The bearing must be operated at normal operating temperature under ordinary load conditions (P≤0.09 C, & F/F 50.3).
- If load is P≤0.04 C., the rolling elements may not turn smoothly. If so, please contact NBC Engineering for more information.
- Allowable rotational speed for deep groove ball bearings with contact seal (LLU type) or low-torque seal (LLH type) is determined according to the circumferential speed of the seal.
- For bearings to be used other than standard mentioned conditions please consult NBC engineering for limiting speed.
- Always limit the speed of Bearing-80% less_than_Limiting speed

Correction of Limiting speed
During operation when the load condition are C/P 16 and the limiting speed must be corrected by multiplying the limiting speed given in the bearing catalogue using the formula and the values of f,& f2 from the graphs

Where,
f,- Limiting speed correction factor for Dynamic Load (C) to equivalent Load ratio
f2- Limiting speed factor for Combined Load Ratio B/w Axial (Fa) and Radial Loads (Fr)
N-Limiting speed given in bearing tables.





From both graphs f1, f2 are equal to 1 for the condition C/P= 16 and Fa=0.2 Fr. For other condition like C/P and Fa 0.2 Fr, corresponding values of f,, f, to be multiplied for correcting the limiting speed.

10 Fits

10.1 The Necessity of a Proper Fit

In some cases improper fit may lead to damage and shorten bearing life. Therefore, it is necessary to make a careful analysis while selecting a proper fit.

Some of the negative conditions caused by improper fit are listed below:

- Raceway cracking, early pitting and displacement of raceways
- Raceway & shaft or housing abrasion caused by creeping in fretting corrosion
- Seizing caused by loss of internal clearance
- Increased noise & lowered rotational accuracy due to raceway groove deformation.

Selection of fits: Selection of proper fit depended upon thorough analysis of bearing operating conditions, including consideration of following factors:

(1) Condition of Rotation

This condition refer to the rotation of bearing ring being considered in relation to the direction of load. There are 3 different conditions:

- Rotating load
- Stationery load
- Direction of load indeterminate

(2) Magnitude of the load

The interference fit of a bearing's inner ring on its seating will be loosened with the increasing load, as the ring will expand under the influence of rotating load, & ring may begin co creep. If it is of shock character, greater interference is required.

The loss of interference due to increasing load can be estimated using the following equation:

When Frs: 0.3Cor

Adp=0.08 d.Fr
B

When Fr 20.3 Cor

Adp=0.02 (Fr/B)

where,

Adp=Interference decrease of inner ring (um)

Fr=Radial load (N)

B = Inner width (mm)

Cor=Basic static load (N)

(3) Bearing Internal Clearance

An interference fit of a bearing on the shaft or in housing means that ring is elastically deformed (expanded or compressed) and bearing's internal clearance reduced.

The internal clearance and permissible reduction depend on the type and size of the bearing.

- The reduction in clearance due to interference fit can be so large that bearings with an internal clearance which is greater than normal have to be used.

The expansion of the inner ring and contraction of outer ring can be assumed to be approximately 60-80% of the interference, depending on the material of shaft and housing.

(4) Temperature Condition

Interference between inner ring & steel shalt is reduced as a result of temperature increase (difference between bearing temperature and ambient temperature). This can result in an easing of fit of the inner ring on its seating. While outer ring expansion may result in increase in clearance.

The decrease of the interference of the inner ring due to this

temperature difference may be calculated using following equation: Adt=0.0015xdxAT

Where Adt= effective interference for temperature difference (µm)

AT=Temperature difference between bearing temperature ambient temperature (deg. C).

d = Bearing bore diameter (mm)

(5) Running Accuracy Requirement

To reduce resilience and vibration, clearance fit should generally not be used for bearings, where high demands are placed on running accuracy.

(6) Design& Material of Shaft & Housing

The fit of a bearing ring on its seating must not lead to uneven distortion of the ring (out of roundness).This can be caused by discontinuity in the housing surface. Split housings are therefore not suitable where outer rings are to have an interference fit.

(7) Ease of Mounting & Dismounting

Bearings with clearance fit are usually easier to mount or dismount than those having interference fit. Where operating condition necessitate interference fit and it is essential that mounting &dismounting can be done easily, separable bearings or bearings with taper bore and adaptor or withdrawal sleeve may be used.

(8) Displacement of Non-Locating bearings

If non-separable bearings are used as floating bearings, if the ring is under stationary load, so that axial displacement has to take place in the housing bore, a hardened intermediate bushing is often fitted to the outer ring.

(9) Effective Interference and finish of shaft &housing

--Roughness of the fitted surface is reduced-since the roughness of the fitted surface is reduced during fitting, the effective interference becomes less than the apparent interference.

The amount of this interference decrease varies depending on roughness of the surfaces.
Normally, manufacturers assume the following interference reductions:
For ground shaft: 1-2.5 Micron
Machined Shaft: 5-7 Micron

(10) Fitting stress & ring expansion and contraction

While calculating the minimum required amount of interference, following factors should be factors should be taken into consideration:

- Interference is reduced by radial load
- Interference is reduced by difference between bearing temperature and ambient temperature
- Interference is reduced by variation of fitted surfaces

Important details on fits: Maximum interference should not exceed the ratio of 1:1000 of shaft or outside diameter.

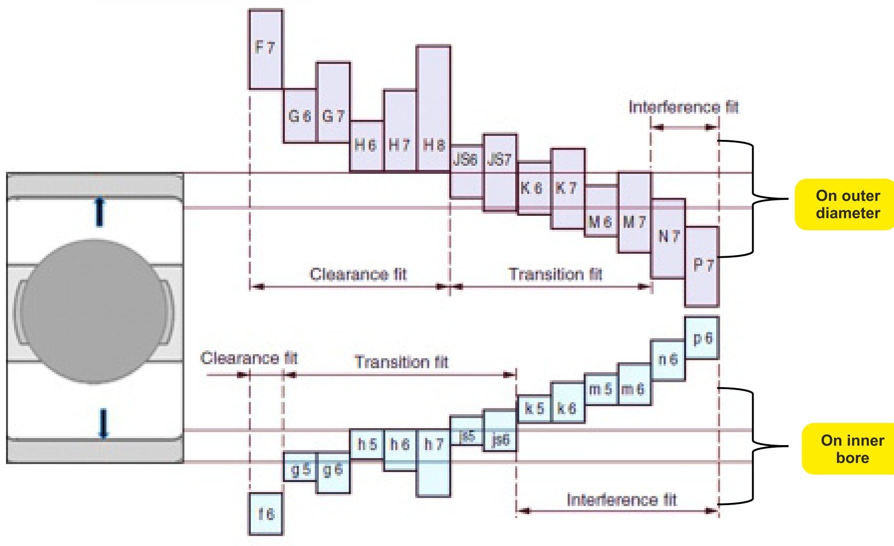
Tight interference fits are recommended for:
(a) Operating conditions with large vibrations or shock loads
(b) Application using hollow shaft of housing with thin walls
(c) Application using housing made of light alloys or plastic.
Loose interferences are recommended for:
(a) Application requiring high running accuracy
(b) Application using small size bearings or thin walled bearings.
Shaft and housing material, geometry, hardness and surface finish must be carefully controlled.

- Ground shafts should be finished to 1.3 micron Ra or better,
- For turned shafts a finish of 2.5 micron Ra or better; and
- Housing bores should be finished to 4 micron Ra or better.

To avoid shearing of aluminum and magnesium housing during bearing installation, steel inserts should be used; alternatively special lubricants may be used for Freezing and heating to facilitate assembly. A minimum interference fit of 0.0015" and 0.001" per inch of diameter is required for magnesium and aluminum housing respectively.
Where bearings are to be pressed onto a hollow shaft, allowance must be made for contraction of the hollow shaft in order to maintain the desired radial pressure.

10.2 Housing & Shaft Tolerance Class

NEI engineering department should be consulted for proper fitting practices on all special applications. For normal class bearing shaft and housing tolerances are given in table below. The tolerances are for solid steel shaft & housing of cast iron and steel.



Shaft & Housing tolerances

Shaft tolerance class generally for radial bearings (classes 0, 6X and 6)

Type of load	Condition	Example	Shaft diameters: Ball bearings	Shaft diameters: Cylindrical, neddle and tapered roller bearings	Shaft diameters: Spherical roller bearings	Shaft diameters: Tolerance class symbol
Rotating inner ring load	Light and variable loads (P<0,06C)	Conveyers lightly loaded mechanisms, bearings	18...100 >100...140	≤40 >40...100	- -	j6 k6
	Normal and heavy loads (P>0, 06C)	General mechanical engineering electric motors, turbines, pups, gearboxes,	≤18 >18...100 >100..140 >140...200 >200...280 - -	- ≤40 >40...100 >100..140 >140...200 >200...400 - -	- ≤ 40 > 40...65 > 65..100 > 100...140 > 140...280 > 280...500 > 500	j5 K5(k6) m5(m6) m6 n6 p6 r6 r7
	Heavy loads and shock loads, ardous working conditions (P>0, 12C)	Heavy duty railway vehicles axle bearings, traction motors, rolling mills	- - -	>50...140 >140...200 200	>50...100 >100...200 > 200	n6 p6 r6
	High running accuracy, light loads (P<0,06C)	Machine tools	≤ 18 > 18...100 > 100...200 -	- ≤ 40 > 40...100 > 140...200	- - - -	h5 j5 k5 m5
Stationary inner ring load	Radial bearings with cylindrical core		All diameters			
	Easy axial displacement of inner ring on shaft desirable	Wheels on non-roating shafts (free wheels)				g6(f6)
	Axial displacement of inner ring on shaft not necessary	Tension pullyes, sheaves				h6
Axial load	Common to all shaft diameter. Shaft & inner is not fixed		≤250 >250	≤250 >250	<250 >250	j6 js6

Fits for shaft for Tapered bore bearing (normal class) with adapter / withdrawal sleeve

All loads	**For all sizes general applications**	**All shaft diameters**	**h9**

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Housing tolerance class generally for radial bearings (classes 0, 6X and 6)

Split or Single (Housing rotating outer ring load)

Load type	Conditions	Example	Tolerance class	Outer ring axial displacement in non - separable bearing
Rotating outer ring load	Light and variable loads (P≤0,06C)	Roller bearing wheel hubs, connecting rod bearing	M7	Outer ring cannot move axially
	Normal and heavy loads (P>0,06C)	Ball bearing wheel hubs, connecting rod bearings, crane traveling wheels	N7	
	Rotating outer ring load Heavy loads on bearings in thin walled housings, heavy shock loads (P>0,12C)	Conveyer rollers, rope sheaves, belt tension pulleys	P7	
Direction of load indeterminate	Normal and heavy loads (P > 0,06C). Outer ring displacement is not necessary	Crank shaft main bearing	K7	Outer ring cannot move axially
		Electric motors, pumps crankshaft main bearing		
	Heavy shock loads	Traction motors	M7	

Split or Single Housing (Stationary outer load)

Load type	Conditions	Example	Tolerance class	Outer ring axial displacement in non- separable bearing
Stationary outer load	Loads of all kinds	General mechanical engineering, railway axle boxes	H7	Outer ring can move axially
	Light and normal loads Desirable outer ring displacement (P≤0,12 C)		H8	Outer ring cannot move axially
	Quiet operation	Electric motor	H6	
	Heat conduction through shaft	Drying cylinders, large electrical machines with spherical roller bearings	G7	
Direction of load indeterminate	Light and normal loads Desirable outer ring displacement (P≤0,12 C)	medium-sized electric motors, pumps, crankshaft main bearings	J7	Outer ring can move axially

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Numeric value table of fitting for radial bearing of 'Normal class' for metric size

Table for fit on shaft — Unit um

Nominal shaft diameter in mm

	over incl.	3 6		6 10		10 18		18 30		30 50		50 65		65 80		80 100		100 120		120 140		140 160		160 180	
Deviations of bearing bore diameter in m (tolerance class Normal)																									
	tdmp	0 -8		0 -8		0 -8		0 -10		0 -12		0 -15		0 -15		0 -20		0 -20		0 -25		0 -25		0 -25	
Shaft deviation, fit interference or fit clearance in m																									
Clearance fit	f6	-10 -18	2 7 18	-13 -22	5 11 22	-16 -27	8 15 27	-20 -33	10 17 33	-25 -41	13 22 41	-30 -49	15 26 49	-30 -49	15 26 49	-36 -58	16 50 58	-36 -58	16 50 58	-43 -68	18 34 68	-43 -68	18 34 68	-43 -68	18 34 68
Transition fit	g5	-4 -9	4 0 9	-5 -11	3 2 11	-6 -14	2 3 14	-6 -16	3 3 16	-9 -20	3 5 20	-10 -23	5 4 23	-10 -23	5 4 23	-12 -27	8 4 27	-12 -27	8 4 27	-14 -32	11 3 32	-14 -32	11 3 32	-14 -32	11 3 32
	g6	-4 -12	4 1 12	-5 -14	3 3 14	-6 -17	2 4 17	-7 -20	3 5 20	-9 -25	3 6 25	-10 -29	5 6 29	-10 -29	5 6 29	-12 -34	8 6 34	-12 -34	8 6 34	-14 -39	11 6 39	-14 -39	11 6 39	-14 -39	11 6 39
	h5	0 -5	8 4 5	0 -6	8 3 6	0 -8	8 3 8	0 -9	10 4 9	0 -11	12 4 11	0 -13	15 6 13	0 -13	15 6 13	0 -15	20 8 15	0 -15	20 8 15	0 -18	25 11 18	0 -18	25 11 18	0 -18	25 11 18
	h6	0 -8	8 3 8	0 -9	8 2 9	0 -11	8 2 11	0 -13	10 2 13	0 -16	12 3 16	0 -19	15 4 19	0 -19	15 4 19	0 -22	20 6 22	0 -22	20 6 22	0 -25	25 8 25	0 -25	25 8 25	0 -25	25 8 25
	j5	3 -2	11 7 2	4 -2	12 7 2	5 -3	13 8 3	5 -4	15 9 4	6 -5	18 10 5	6 -7	21 12 7	6 -7	21 12 7	6 -9	26 14 9	6 -9	26 14 9	7 -11	32 18 11	7 -11	32 18 11	7 -11	32 18 11
	j6	6 -2	14 8 2	7 -2	15 9 2	8 -3	16 10 3	9 -4	19 11 4	11 -5	23 14 5	12 -7	27 16 7	12 -7	27 16 7	13 -9	33 19 9	13 -9	33 19 9	14 -11	39 22 11	14 -11	39 22 11	14 -11	39 22 11
	js5	2.5 -2.5	11 6 3	3 -3	11 6 3	4 -4	12 6 4	4.5 -4.5	15 9 5	5.5 -5.5	18 10 6	6.5 -6.5	22 13 7	6.5 -6.5	22 13 7	7.5 -7.5	28 16 8	7.5 -7.5	28 16 8	9 -9	34 20 9	9 -9	34 20 9	9 -9	34 20 9
	js6	4 -4	12 7 4	4.5 -4.5	13 7 5	5.5 -5.5	14 8 6	6.5 -6.5	17 9 7	8 -8	20 11 8	9.5 -9.5	25 13 10	9.5 -9.5	25 13 10	11 -11	31 17 11	11 -11	31 17 11	12.5 -12.5	38 21 13	12.5 -12.5	38 21 13	12.5 -12.5	38 21 13
	k5	6 1	14 9 1	7 1	15 10 1	9 1	17 12 1	11 2	21 15 2	13 2	25 17 2	15 2	30 21 2	15 2	30 21 2	18 3	38 26 3	18 3	38 26 3	21 3	46 32 3	21 3	46 32 3	21 3	46 32 3
	k6	9 1	17 11 1	10 1	18 12 1	12 1	20 14 1	15 2	25 17 2	18 2	30 21 2	21 2	36 25 2	21 2	36 25 2	25 3	45 31 3	25 3	45 31 3	28 3	53 36 3	28 3	53 36 3	28 3	53 36 3
	m5	9 4	17 13 4	12 6	20 15 6	15 7	23 18 7	17 8	27 21 8	20 9	32 24 9	24 11	39 30 11	24 11	39 30 11	28 13	48 36 13	28 13	48 36 13	33 15	58 44 15	33 15	58 44 15	33 15	58 44 15
	m6	12 4	20 15 4	15 6	23 17 6	18 7	26 20 7	21 8	31 23 8	25 9	37 27 9	30 11	45 34 11	30 11	45 34 11	35 13	55 42 13	35 13	55 42 13	40 15	65 48 15	40 15	65 48 15	40 15	65 48 15
	n5	13 8	21 17 8	16 10	24 19 10	20 12	28 23 12	24 15	34 28 15	28 17	40 32 17	33 20	48 39 20	33 20	48 39 20	38 23	58 46 23	38 23	58 46 23	45 27	70 56 27	45 27	70 56 27	45 27	70 56 27
	n6	16 8	24 19 8	19 10	27 21 10	23 12	31 25 12	28 15	38 30 15	33 17	45 36 17	39 20	54 43 20	39 20	54 43 20	45 23	65 51 23	45 23	65 51 23	52 27	77 60 27	52 27	77 60 27	52 27	77 60 27
	p6	20 12	28 23 12	24 15	32 26 15	29 18	37 21 18	35 22	45 37 22	42 26	54 45 26	51 32	66 55 32	51 32	66 55 32	59 37	79 65 37	59 37	79 65 37	68 43	93 76 43	68 43	93 76 43	68 43	93 76 43
	p7	24 12	32 25 15	30 15	38 30 15	36 18	44 35 18	43 22	53 43 22	51 26	63 51 26	62 32	77 62 32	62 32	77 62 32	72 37	92 73 37	72 37	92 73 37	83 43	108 87 43	83 43	108 87 43	83 43	108 87 43

Table for fit on shaft — Unit um

200 220		220 250		250 280		280 315		315 355		355 400		400 450		450 500		500 560		560 630		630 710		710 800		800 900	
0 -30		0 -30		0 -35		0 -35		0 -40		0 -40		0 -45		0 -45		0 -50		0 -50		0 -75		0 -75		0 -100	
-50 -79	20 40 79	-50 -79	20 40 79	-56 -88	21 44 88	-56 -88	21 44 88	-62 -98	22 47 98	-62 -98	22 47 98	-68 -108	23 51 108	-68 -108	23 51 108	-76 120	26 58 120	-76 120	26 58 120	-80 -130	5 47 130	-80 -130	5 47 130	-86 -146	14 39 146
-15 -35	15 2 35	-15 -35	15 2 35	-17 -40	18 1 40	-17 -40	18 1 40	-18 -43	22 0 43	-18 -43	22 0 43	-20 -47	25 1 47	-20 -47	25 1 47	-	-	-	-	-	-	-	-	-	-
-15 -44	15 5 44	-15 -44	15 5 44	-17 49	18 4 49	-17 49	18 4 49	-18 -54	22 3 54	-18 -54	22 3 54	-20 -60	25 3 60	-20 -60	25 3 60	-22 -66	28 4 66	-22 -66	28 4 66	-24 -74	51 9 74	-24 -74	51 9 74	-26 -82	74 24 82
0 -20	30 13 20	0 -20	30 13 20	0 -23	35 16 23	0 -23	35 16 23	0 -25	40 18 25	0 -25	40 18 25	0 -27	45 21 27	0 -27	45 21 27	0 -32	50 23 32	0 -32	50 23 32	0 -36	75 38 36	0 -36	75 38 36	0 -40	100 53 40
0 -29	30 10 29	0 -29	30 10 29	0 -32	35 13 32	0 -32	35 13 32	0 -36	40 15 36	0 -36	40 15 36	0 -40	45 17 40	0 -40	45 17 40	0 -44	50 18 44	0 -44	50 18 44	0 -50	75 33 50	0 -50	75 33 50	0 -56	100 48 56
7 -13	37 20 13	7 -13	37 20 13	7 -16	42 23 16	7 -16	42 23 16	7 -18	47 25 18	7 -18	47 25 18	7 -20	52 28 20	7 -20	52 28 20	-	-	-	-	-	-	-	-	-	-
16 -13	46 26 13	16 -13	46 26 13	16 -16	51 29 16	16 -16	51 29 16	18 -18	58 33 18	18 -18	58 33 18	20 -20	65 37 20	20 -20	65 37 20	-	-	-	-	-	-	-	-	-	-
10 -10	40 23 10	10 -10	40 23 10	11.5 -11.5	47 27 12	11.5 -11.5	47 27 12	12.5 -12.5	53 32 13	12.5 -12.5	53 32 13	13.5 -13.5	59 35 14	13.5 -13.5	59 35 14	16 -16	65 38 16	16 -16	65 38 16	18 -18	91 55 18	18 -18	91 55 18	20 -20	118 72 20
14.5 -14.5	45 25 15	14.5 -14.5	45 25 15	16 -16	51 29 16	16 -16	51 29 16	18 -18	58 33 18	18 -18	58 33 18	20 -20	65 37 20	20 -20	65 37 20	22 -22	72 40 22	22 -22	72 40 22	25 -25	100 58 25	25 -25	100 58 25	28 -28	128 76 28
24 4	54 37 4	24 4	54 37 4	27 4	62 43 4	27 4	62 43 4	29 4	69 47 4	29 4	69 47 4	32 5	77 53 5	32 5	77 53 5	-	-	-	-	-	-	-	-	-	-
33 4	63 43 4	33 4	63 43 4	36 4	71 49 4	36 4	71 49 4	40 4	80 55 4	40 4	80 55 4	45 5	90 62 5	45 5	90 62 5	44 0	94 62 0	44 0	94 62 0	50 0	125 83 0	50 0	125 83 0	56 0	156 104 0
37 17	67 50 17	37 17	67 50 17	43 20	78 59 20	43 20	78 59 20	46 21	86 64 21	46 21	86 64 21	50 23	95 71 23	50 23	95 71 23	-	-	-	-	-	-	-	-	-	-
46 17	76 56 17	46 17	76 56 17	52 20	57 65 20	52 20	57 65 20	57 21	97 72 21	57 21	97 72 21	63 23	108 80 23	63 23	108 80 23	70 26	120 88 26	70 26	120 88 26	80 30	155 113 30	80 30	155 113 30	90 34	190 138 34
51 31	81 64 31	51 31	81 64 31	57 34	92 73 34	57 34	92 73 34	62 37	102 80 37	62 37	102 80 37	67 40	112 88 40	67 40	112 88 40	-	-	-	-	-	-	-	-	-	-
60 31	90 70 31	60 31	90 70 31	66 34	101 79 34	66 34	101 79 34	73 37	113 88 37	73 37	113 88 37	80 40	125 97 40	80 40	125 97 40	88 44	138 106 44	88 44	138 106 44	100 50	175 133 50	100 50	175 133 50	112 56	212 160 56
79 50	109 89 50	79 50	109 89 50	88 56	123 101 56	88 56	123 101 56	98 62	138 113 62	98 62	138 113 62	108 68	153 125 68	108 68	153 125 68	122 78	172 140 78	122 78	172 140 78	138 88	213 171 88	138 88	213 171 88	156 100	256 204 100
96 50	126 101 50	96 50	126 101 50	108 56	143 114 56	108 56	143 114 56	119 62	159 127 62	119 62	159 127 62	131 68	176 139 68	131 68	176 139 68	148 78	198 158 78	148 78	198 158 78	168 88	243 199 88	168 88	243 199 88	190 100	290 227 100

Numeric value table of fitting for radial bearing of 'Normal class' for metric size

Nominal housing bore diameter in mm																	
	over incl.	6 10		10 18		18 30		30 50		50 80		80 120		120 150		150 180	
Deviations of bearing outside diameter in m (tolerance class Normal)																	
	tdmp	0 -8		0 -8		0 -9		0 -11		0 -13		0 -15		0 -18		0 -25	
Housing deviation, fit interference or fit clearance in m																	
Clearance Fit	E8	47 25	25 35 55	59 32	32 44 67	73 40	40 54 82	89 50	50 67 100	106 60	60 79 119	126 72	72 85 141	148 85	85 112 166	148 85	85 114 173
Clearance Fit	F7	28 13	13 21 36	34 16	16 25 42	41 20	20 30 50	50 25	25 37 61	60 30	30 44 73	71 36	36 53 86	83 43	43 62 101	83 43	43 64 108
Clearance Fit	G6	14 5	5 11 22	17 6	6 12 25	20 7	7 14 29	25 9	9 18 36	29 10	10 21 42	34 12	12 24 49	39 14	14 28 57	39 14	14 31 64
Clearance Fit	G7	20 5	5 13 28	24 6	6 15 32	28 7	7 17 37	34 9	9 21 45	40 10	10 24 53	47 12	12 29 62	54 14	14 33 72	54 14	14 36 79
Clearance Fit	H6	9 0	0 6 17	11 0	0 6 19	13 0	0 7 22	16 0	0 9 27	19 0	0 11 32	22 0	0 12 37	25 0	0 14 43	25 0	0 17 50
Clearance Fit	H7	15 0	0 8 23	18 0	0 9 26	21 0	0 10 30	25 0	0 12 36	30 0	0 14 43	35 0	0 17 50	40 0	0 19 58	40 0	0 22 65
Clearance Fit	H8	22 0	0 10 30	27 0	0 12 35	33 0	0 14 42	39 0	0 17 50	46 0	0 20 59	54 0	0 23 69	63 0	0 27 81	63 0	0 29 88
	J6	5 −4	4 2 13	6 −5	5 1 14	8 −5	5 2 17	10 −6	6 3 21	13 −6	6 5 26	16 −6	6 6 31	18 −7	7 7 36	18 −7	7 10 43

	over incl.	180 250		250 315		315 400		400 500		500 630		630 800		800 1000		1000 1250	
	tdmp	0 -30		0 -35		0 -40		0 -45		0 -50		0 -75		0 -100		0 -125	
Clearance Fit	E8	172 100	100 134 202	191 110	110 149 226	214 125	125 168 254	232 135	135 182 277	255 145	145 199 305	285 160	160 227 360	310 170	170 250 410	360 195	195 292 485
Clearance Fit	F7	96 50	50 75 126	108 56	56 85 143	119 62	62 94 159	131 68	68 104 176	146 76	76 116 196	160 80	80 132 235	176 86	86 149 276	203 98	98 175 328
Clearance Fit	G6	44 15	15 35 74	49 17	17 39 84	54 18	18 43 94	60 20	20 48 105	66 22	22 54 116	74 24	24 66 149	82 26	26 78 182	94 28	28 93 219
Clearance Fit	G7	61 15	15 40 91	69 17	17 46 104	75 18	18 50 115	83 20	20 56 128	92 22	22 62 142	104 24	24 76 179	116 26	26 89 216	133 28	28 105 258
Clearance Fit	H6	29 0	0 20 59	32 0	0 22 67	36 0	0 25 76	40 0	0 28 85	44 0	0 32 94	50 0	0 42 125	56 0	0 52 156	66 0	0 64 191
Clearance Fit	H7	46 0	0 25 76	52 0	0 29 87	57 0	0 32 97	63 0	0 36 108	70 0	0 40 120	80 0	0 52 155	90 0	0 63 190	105 0	0 77 230
Clearance Fit	H8	72 0	0 34 102	81 0	0 39 116	89 0	0 43 129	97 0	0 47 142	110 0	0 54 160	125 0	0 67 200	140 0	0 80 240	165 0	0 97 290
	J6	22 −7	7 13 52	25 −7	7 15 60	29 −7	7 18 69	33 −7	7 21 78	-	-	-	-	-	-	-	-

Numeric value table of fitting for radial bearing of 'Normal class' for metric size

Housing Fits Unit µm

Transition fit	J7	8 −7	7 1 16	10 −8	8 1 18	12 −9	9 1 21	14 −11	11 1 25	18 −12	12 2 31	22 −13	13 4 37	26 −14	14 5 44	26 −14	14 8 51
	JS6	4.5 −4.5	4.5 2 12.5	5.5 −5.5	5.5 1 13.5	6.5 −6.5	6.5 0 15.5	8 −8	8 1 19	9.5 −9.5	9.5 0 22.5	11 −11	11 1 26	12.5 −12.5	12.5 1 30.5	12.5 −12.5	12.5 3 37.5
	JS7	7.5 −7.5	7,5 1 15.5	9 −9	9 0 17	10.5 −10.5	10.5 1 19.5	12.5 −12.5	12.5 1 23.5	15 −15	15 1 28	17.5 −17.5	17.5 1 32.5	20 −20	20 1 38	20 −20	20 1 45
	K6	2 −7	7 1 10	2 −9	9 3 10	9 3 10	11 4 11	3 −13	13 4 14	4 −15	15 4 17	4 −18	18 6 19	4 −21	21 7 22	4 −21	21 4 29
	K7	5 −10	10 2 13	6 −12	12 3 14	6 −15	15 5 15	7 −18	18 6 18	9 −21	21 7 22	10 −25	25 8 25	12 −28	28 9 30	12 −28	28 6 37
	M6	−3 −12	12 6 5	−4 −15	15 9 4	−4 −17	17 10 5	−4 −20	20 11 7	−5 −24	24 13 8	−6 −28	28 16 9	−8 −33	33 19 10	−8 −33	33 16 17
	M7	0 −15	15 7 8	0 −18	18 9 8	0 −21	21 11 9	0 −25	25 13 11	0 −30	30 16 13	0 −35	35 18 15	0 −40	40 21 18	0 −40	40 18 25
	N6	−7 −16	16 10 1	−9 −20	20 14 1	−11 −24	24 17 2	−12 −28	28 19 1	−14 −33	33 22 1	−16 −38	38 26 1	−20 −45	45 31 2	−20 −45	45 28 5
Interference Fit	N7	−4 −19	19 11 4	−5 −23	23 14 3	−7 −28	28 18 2	−8 −33	33 21 3	−9 −39	39 25 4	−10 −45	45 28 5	−12 −52	52 33 3	−12 −52	52 30 13
	P6	−12 −21	21 15 4	−15 −26	26 20 7	−18 −31	31 24 9	−21 −37	37 28 10	−26 −45	45 34 13	−30 −52	52 40 15	−36 −61	61 47 18	−36 −61	61 44 11
	P7	−9 −24	24 16 1	−11 −29	29 20 3	−14 −35	35 25 5	−17 −42	42 30 6	−21 −51	51 37 8	−24 −59	59 42 9	−28 −68	68 49 10	−28 −68	68 46 3

Housing Fits Unit µm

30 −16	16 9 60	36 −16	16 13 71	39 −18	18 14 79	43 −20	20 16 88	-	-	-	-	-	-	-	-
14.5 −14.5	14.5 5 44.5	16 −16	16 7 51	18 −18	18 6 58	20 −20	20 8 65	22 −22	22 10 72	25 −25	25 17 100	28 −28	28 24 128	33 −33	33 31 158
23 −23	23 2 53	26 −26	26 3 61	28.5 −28.5	28.5 3 68.5	31.5 −31.5	31.5 4 76.5	35 −35	35 5 85	40 −40	40 12 115	45 −45	45 18 145	52.5 −52.5	52 24 177
5 −24	24 4 35	5 −27	27 5 40	7 −29	29 4 47	8 −32	32 4 53	0 −44	44 12 50	0 −50	50 8 75	0 −56	56 4 100	0 −66	66 2 125
13 −33	33 8 43	16 −36	36 7 51	17 −40	40 8 57	18 −45	45 9 63	0 −70	70 30 50	0 −80	80 28 75	0 −90	90 27 100	0 −105	105 28 125
−8 −37	37 17 22	−9 −41	41 19 26	−10 −46	46 21 30	−10 −50	50 22 35	−26 −70	70 38 24	−30 −80	80 38 45	−34 −90	90 38 66	−40 −106	106 45 85
0 −46	46 21 30	0 −52	52 23 35	0 −57	57 25 40	0 −63	63 27 45	−26 −96	96 56 24	−30 −110	110 58 45	−34 −124	124 61 66	−40 −145	145 68 85
−22 −51	51 31 8	−25 −57	57 35 10	−26 −62	62 37 14	−27 −67	67 39 18	−44 −88	88 56 6	−50 −100	100 58 25	−56 −112	112 60 44	−66 −132	132 67 59
−14 −60	60 35 16	−14 −66	66 37 21	−16 −73	73 41 24	−17 −80	80 44 28	−44 −114	114 74 6	−50 −130	130 78 25	−56 −146	146 83 44	−66 −171	171 94 59
−41 −70	70 50 11	−47 −79	79 57 12	−51 −87	87 62 11	−55 −95	95 67 10	−78 −122	122 90 28	−88 −138	138 96 13	−100 −156	156 104 0	−120 −186	186 121 5
−33 −79	79 54 3	−36 −88	88 59 1	−41 −98	98 66 1	−45 −108	108 72 0	−78 −148	148 108 28	−88 −168	168 126 13	−100 −190	190 127 0	−120 −225	225 148 5

Limits and Fits Guideline TAPERED ROLLER BEARINGS
ABMA RECOMMENDED FITTING PRACTICE

Shaft and housing material, geometry, hardness and surface finish must be carefully controlled. Ground shafts should be finished to 1.3 micron Ra or better; for turned shafts a finish of 2.5pm Ra or better; and housing bores should be finished to 4 micron Ra or better.

To avoid shearing aluminum and magnesium housing during bearing installation, steel inserts should be used; alternatively special lubricants may be used for freezing and heating to facilitate assembly.
A minimum interference fit is required for aluminum of 0.0010* per inch of diameter, for magnesium of 0.0015" per inch of diameter.

Where bearings are to be pressed onto a hollow shaft, allowance must be made for contraction of the hollow shaft in order to maintain the desired radial pressure.

AFBMA AUTOMOTIVE TAPERED CONE FITTING PRACTICE.

Use	Application	Fit Type	Cone Bore B*	Shaft Diameter B*	Fit	Cone Bore B*	Shaft Diameter B*	Fit
			Upto 3" bore			Above 3" bore		
Automotive Rotating Shafts	Pinion, transmission rear wheels, crossshaft, transfer case	Adjustable cones	+0.0005 -0.0000	+0.0005 +0.0000	0.0005T 0.0005L	+0.0010 -0.0000	+0.0015 +0.0005	0.0015T 0.0005L
		Non-Adjustable cones	+0.0005 -0.0000	+0.0015 +0.0010	0.0015T 0.0005T	+0.0010 -0.0000	+0.0025 +0.0015	0.0025T 0.0005T
	Differential	Non-Adjustable cones	+0.0005 -0.0000	+0.0025 +0.0015	0.0025T 0.0010T	+0.0010 -0.0000	+0.0035 +0.0025	0.0035T 0.0015T
Automotive Stationary Shafts	Front wheels, full floating rear wheels trailer wheels	Adjustable cones	+0.0005 -0.0000	-0.0002 -0.0007	0.0002L 0.0012L	+0.0010 -0.0000	-0.0002 -0.0012	0.0002L 0.0022L

AFBMA AUTOMOTIVE TAPERED CUP FITTING PRACTICE.

Use	Application	Fit Type	Cup O.D. D*	Housing Bore D*	Fit	Cup O.D. D*	Housing Bore D*	Fit	Cup O.D. D*	Housing Bore D*	Fit
			Less 3" O.D.			3" to 5"O.D.			Above 5" O.D.		
Auto-motive	Front wheels, full floating rear wheels pinion, differntial	Non-Adjustable cups	+0.0010 -0.0000	-0.0015 -0.0005	0.0025T 0.0005T	+0.0010 -0.0000	-0.0020 -0.0010	0.0030T 0.0010T	+0.0010 -0.0000	-0.0030 -0.0010	0.0040T 0.0010T
	Differential	Non-Adjustable cups	+0.0010 -0.0000	+0.0010 +0.0020	0.0000L 0.0020L	+0.0010 -0.0000	+0.0010 +0.0020	0.0000L 0.0020L	+0.0010 -0.0000	-0.0000 +0.0020	0.0010T 0.0020L
	Rear wheels, trans-mission, cross shaft & other application	Adjustable cups	+0.0010 -0.0000	-0.0000 +0.0010	0.0010T 0.0010L	-0.0010 -0.0000	+0.0000 +0.0010	0.0010T 0.0010L	-0.0010 -0.0000	-0.0000 +0.0020	0.0010T -0.0020L

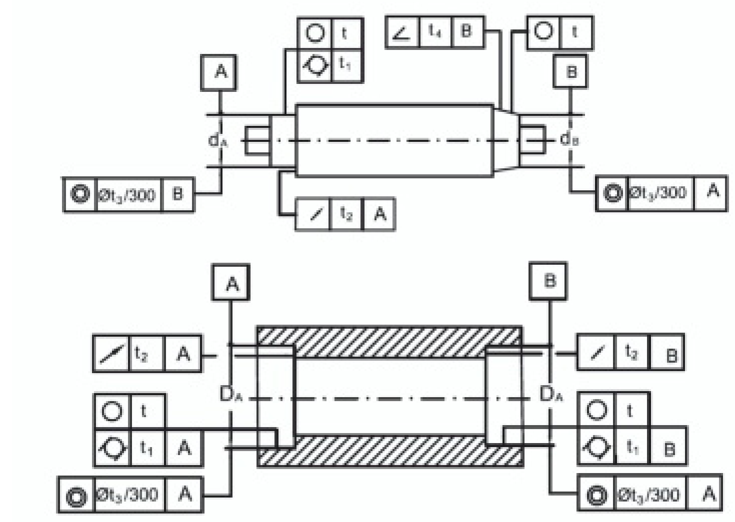
*D - Normal cup O.D., L - Loose, T - Tight

THE NBC PRODUCT ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR PROPER FITTING PRACTICE ON ALL SPECIAL APPLICATIONS. AFBMA AUTOMOTIVE TAPERED CONE FITTING PRACTICE

Table: ISO Tolerance grade for dimensions

over	incl.	IT0	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12
mm		µm												
1	3	0,5	0,8	1,2	2	3	4	6	10	14	25	40	60	100
3	6	0,6	1	1,5	2,5	4	5	8	12	18	30	48	75	120
6	10	0,6	1	1,5	2,5	4	6	9	15	22	36	58	90	150
10	18	0,8	1,2	2	3	5	8	11	18	27	43	70	110	180
18	30	1	1,5	2,5	4	6	9	13	21	33	52	84	130	210
30	50	1	1,5	2,5	4	7	11	16	25	39	62	100	160	250
50	80	1,2	2	3	5	8	13	19	30	46	74	120	190	300
80	120	1,5	2,5	4	6	10	15	22	35	54	87	140	220	350
120	180	2	3,5	5	8	12	18	25	40	63	100	160	250	400
180	250	3	4,5	7	10	14	20	29	46	72	115	185	290	460
250	315	4	6	8	12	16	23	32	52	81	130	210	320	520
315	400	5	7	9	13	18	25	36	57	89	140	230	360	570
400	500	6	8	10	15	20	27	40	63	97	155	250	400	630
500	630	–	–	–	–	–	28	44	70	110	175	280	440	700
630	800	–	–	–	–	–	35	50	80	125	200	320	500	800
800	1 000	–	–	–	–	–	36	56	90	140	230	360	560	900
1 000	1 250	–	–	–	–	–	42	66	105	165	260	420	660	1 050
1 250	1 600	–	–	–	–	–	50	78	125	195	310	500	780	1 250
1 600	2 000	–	–	–	–	–	60	92	150	230	370	600	920	1 500
2 000	2 500	–	–	–	–	–	70	110	175	280	440	700	1 100	1 750

10.4 Shaft and housing accuracies



Tolerance name	Fit	Symbol of deviation		Permissible deviation depending on the tolerance class				
				P0 P6X	P6	P5	P4(SP)	P2(UP)
Tolerance of dimension	shaft	-	-	IT6(IT5)	IT5	IT4	IT4	IT3
	housing			IT7(IT6)	IT6	IT5	IT4	IT4
Tolerance of roundness and cylindricity	shaft	○ ⌭	t, t_1	$\frac{IT4}{2}\left(\frac{IT3}{2}\right)$	$\frac{IT3}{2}\left(\frac{IT2}{2}\right)$	$\frac{IT2}{2}$	$\frac{IT1}{2}$	$\frac{IT0}{2}$
	housing		t, t_1	$\frac{IT5}{2}\left(\frac{IT4}{2}\right)$	$\frac{IT4}{2}\left(\frac{IT2}{2}\right)$	$\frac{IT3}{2}$	$\frac{IT2}{2}$	$\frac{IT1}{2}$
Tolerance of face runout	shaft	↗	t_2	IT4 (IT3)	IT3 (IT2)	IT2	IT1	IT0
	housing			IT5 (IT4)	IT4 (IT3)	IT2	IT2	IT1
Tolerance of concentricity	shaft	◎	t_3	IT5	IT4	IT4	IT3	IT3
	housing			IT6	IT5	IT5	IT4	IT3
Tolerance of angularity	shaft	<	t_4	$\frac{IT7}{2}$	$\frac{IT6}{2}$	$\frac{IT4}{2}$	$\frac{IT3}{2}$	$\frac{IT2}{2}$

For IT grade value refer table for ISO tolerance grade

11 Special Process

11.1 Black Oxide Conversion Treated Bearings

Key Features

The Black oxide chemical conversion treatment was originally developed to improve the corrosion resistance of the base material. Overtime, this process was introduced on tribological components.

NBC has expanded its solution to the most challenging condition to meet application needs. Bearings are processed with proprietary black oxide conversion process. This helps prevent mild adhesive wear resistance. In addition, helps retain lubricant and increases smear-resistance especially during run-in periods.

Black oxide is a conversion oxide formed on the metal surface because of a chemical reaction in alkaline solution conforming to standard DIN 50938.
Black oxide also performs well in starved lubrication condition 3 times than standard bearings.

Benefits

- Moisture corrosion resistance
- Improved running-in behaviour
- Resistance against Peeling

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- Better performance in low lubrication conditions
- Increased oil and grease adhesion
- Repels chemical attack from aggressive oil additives on the bearing steel
- Reduced hydrogen permeation
- Decrease of fretting corrosion risk in the fits
- Reduced friction and wear

APPLICATIONS/INDUSTRIES

- Automotive alternator Pulley bearings
- Wheel bearing
- Wind Turbines
- Traction motor bearing

11.2 Isofinishing

The proprietary special super finishing removes surface irregularities whilst maintaining the valleys of machined finish for vital lubricant retention. Improvements in surface finish reducing friction, lubricant temperature and ultimately resulting in reduced power loss.

The controlled reduction of surface asperities using oxalic acids and non-abrasive finishing stones are achieved. The specially formulated chemical solution does not deteriorate the material.

The super finishing process has proved effective in improving resistance to micro-pitting.

KEY FEATURES

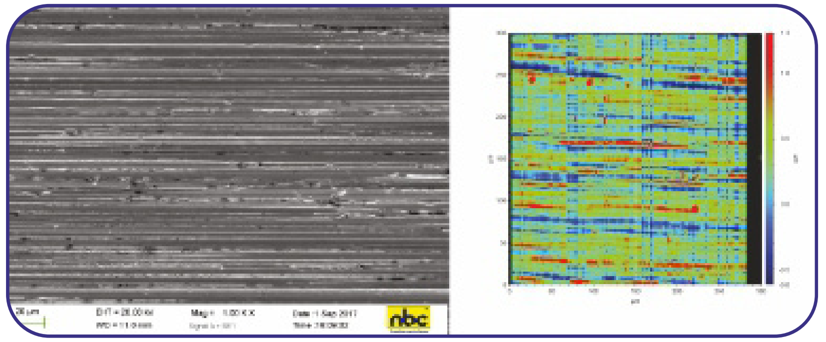
- Surface reduction to mirror like finishes
- Optimum surface roughness
- Increased lubrication retention and heat transfer

- Reduction in lubricant temperature
- Reduced noise

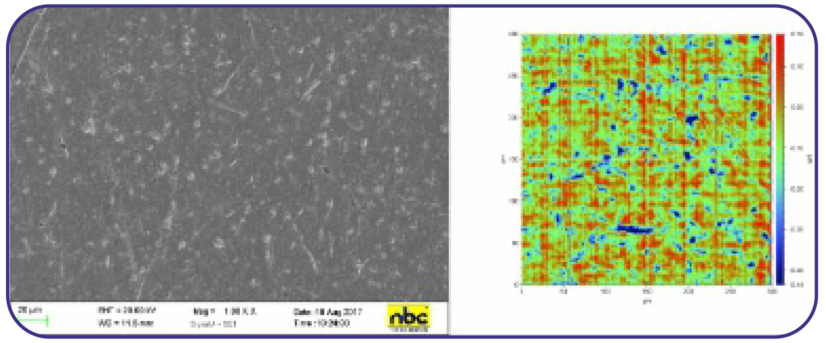
APPLICATIONS/INDUSTRIES

- Transmission bearings

Honing



Isofinishing



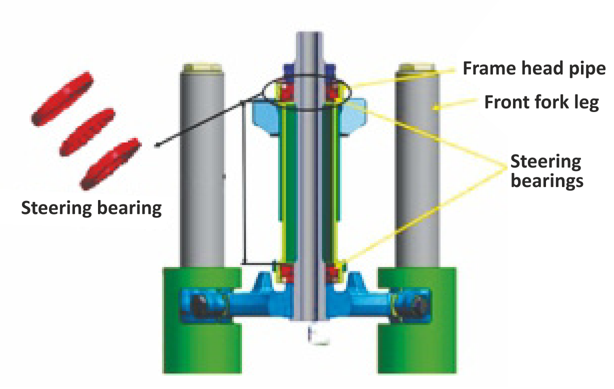
11.3 Oil Impregnated Bearing Solutions

Key features
It is a new class of lubricant for bearings in comparison with oil and greased lubricated bearing.

In this type of lubrication oil is mixed with the polymer (a type of polyethylene) and molded to form a casing which acts as an oil reservoir throughout bearing life
.

Benefits:

- More quantity of lubricant in the same bearing pocket
- Resistant to contaminants and dust particles
- No Re-lubrication needed
- Less torque as compared to greased bearing as it is fixed in the bearing pocket as compared to greases which changes its position during rotation (churning in cage pockets and seal pocket)
- Increase in load carrying capacity in case of oil impregnated ball cage assembly.
- No leakage from the bearing due to solidification process



Applications/industries

- 2 & 3 wheeler steering column bearing
- Other Automotive and Industrial application for oil impregnated bearings.

Oil impregnated ball cage assembly

Oil impregnated sealed ball bearing

Handling precautions:

- Oil Impregnated bearings should not be heated beyond 100°C
- Don't use any kind of organic solvents with oil impregnated bearings.
- Slight load is required to rotate the bearings properly.
- Nitrile gloves should be used for handling --
- Slight discoloration can observed

11.4 Bearings for Electric Vehicle (EMB)

These bearings are used for high-speed applications. Each principal component of an Electric Vehicle (EV) has several technologies currently in use or can become prominent in the future. Among all the components, bearings play a vital role to consider when determining the reliability of Evs.

In the near future, electric vehicles and transmission are going to be significant drivers of this automobile industry. To improve the efficiency, reliability, and durability of these upcoming technology, NBC offers to customers the system and components that would withstand their demands and expectations.
Typical expectations are lightweight, low friction, high transient ramp capability, high speed, and low noise. In a typical electric vehicle, an extra 1% of mileage can be gained using a set of optimized bearings and seals on the electric traction motor and gearbox compared to conventional alternatives.

In order to have higher efficiency of electric motors, the motor runs at a higher speed (around ~20000 RPM) compared to an IC engine (~5000 RPM), which poses a significant challenge in terms of friction and temperature coupled with low noise on bearing design parameters.

Application:

. High-Speed Electric Motors & Transmission
. Planetary gearboxes
. Insulated and conductive bearings for Induction Motors

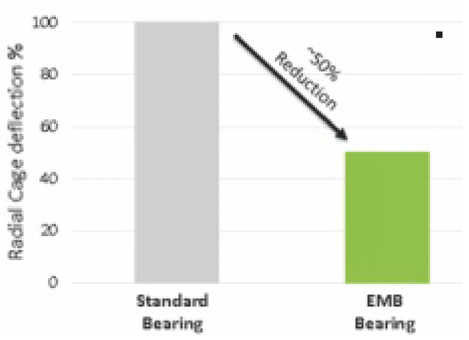
Benefits:

- High-Speed Stability
- Fulfill the Low Noise requirements
- Energy Efficient Bearings
- Solutions for Current Leakage issues

Product Features:

- Deflection reduced by 50% of conventional cage
- Lightweight Cage Design
- Optimized internal design
- Grease with Current Conductive Properties Noise
- suppression properties of grease

Patented Cage Technology



11.5 Sensor Integrated Bearings (SIB)

Sensor Integrated Bearings (SIB) are mechatronic machine components that feature a bearing and a sensor packaged together

Parameter	Purpose of Measurement
Speed, Direction, Acceleration	Signature of the driving shaft of application (e.g., EV, wheel, control, etc.)
Temperature	Bearing & vicinity measurement for criticality, Maintenance,etc
Vibration	Condition monitoring, prognostic, Maintenance, etc.
Load	Actual operating condition and design validation

Application:

- Critical rotating applications like AC motors and Industrial machinery
- On-board Condition Monitoring, Control algorithms & Fault Diagnosis

Benefits:

- Compact & Integrated solutions resulting in space and cost-saving
- Facilitates Accurate & reliable data acquisition in real time environment
- Durable & rugged for dynamic service requirements

12 Condition Monitoring

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Condition Monitoring Services

Condition Monitoring is the potential technique of predicting the failures and improving assets reliability. Today's competitive market demands qualitative products, with zero defects. Therefore optimal productivity and smooth processes are only possible when machines operates within vibration tolerances.

Uncontrolled vibrations creates undesirable behavior in machineries leads to catastrophic failures. Condition monitoring leads to predict remaining useful life of assets and improves its reliability. It allows to use exact permissible life of assets.

To maintain healthy conditions of machine and predicting its failure is our business. We provide intelligent solutions of condition monitoring in order to improve assets reliability. Our expertise in various streams of condition monitoring helps industries to maintain their assets failure free.

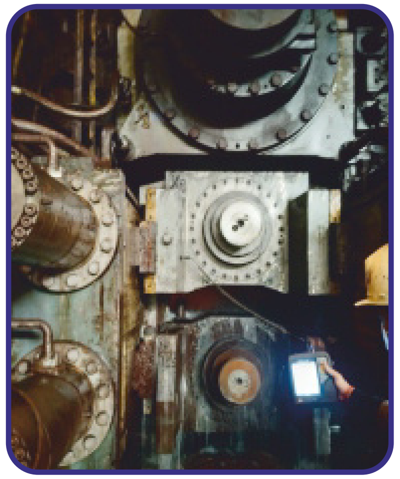
We provide smart solutions to industries through

- Vibration Analysis & Fault Diagnosis
- Laser Alignment
- In-Situ Dynamic Balancing
- Thermography

Vibration Analysis & Fault Diagnosis

Vibration Signature analysis is the process by which intelligent information is extracted about machinery condition from vibration data during machine operation. We Perform fault diagnosis based upon vibration signature and predicts various machinery faults.

Our expertise in vibration analysis and fault diagnosis provides intelligent solutions for protecting machinery from catastrophic failures.

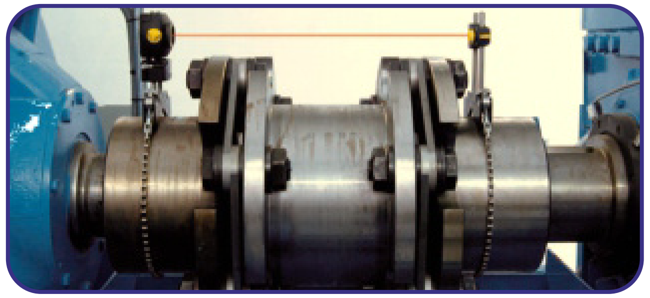


Laser Alignment

Alignment practices are often required to protect equipment's from premature failures. Misaligned condition of assets often leads to more power consumption, severe vibration levels, and premature bearing failures.

Our expertise in laser alignment offers alignment solution to industries. We offer field laser alignment, which makes alignment process fast and accurate by avoiding trail & error method.

We perform laser alignment for shaft in coupled & Un-coupled condition, torsion shaft alignment, ID&FD fan alignment, cooling tower fan shaft alignment, wind mill alignment, cardon shaft alignment, soft foot correction and thermal growth compensation.

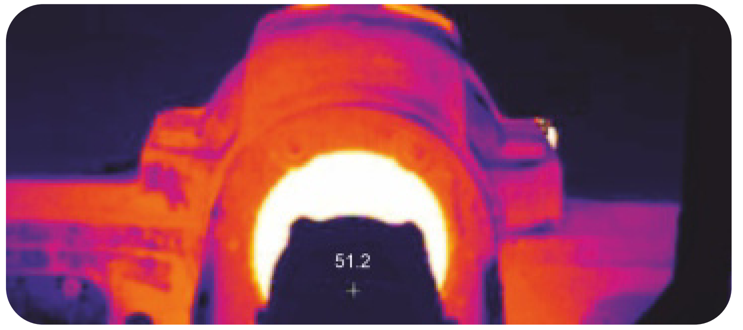


In-Situ Dynamic Balancing
Unbalance Condition of machine is one of the most common contributors to vibrations in rotating machines. If unbalance remains uncorrected, it may lead to severe vibration problems, premature bearing failures, low performance of machines than expected, and more power consumptions.

We offer highest balancing grade by measuring phase very precisely using latest FFT data collector and laser based optical phase reference.

Thermography

Infrared thermography is a technique that produces a visible graph or a thermographic image of thermal energy radiated by objects.



Thermography often required to detect hot and cold spot, condition monitoring of insulation lining of boiler, steam pipeline and hot air ducts. Detection of thermal abnormalities are also performed using thermography.

We offer thermography services for all critical equipment's

A complete smart solution to protect critical assets from failures through condition monitoring is our prime objective. High end equipment's with advanced method of analysis is the key differentiating element of our service.

13 Bearing Fitment and Handling

13.1 Fitment

Rolling bearing is a very precise product and its mounting deserves careful attention. Mounting is an important function as it:

• Ensures safety of the equipment and the operator
• Minimizes breakdown and reduces downtime
• Bearing can perform to its maximum load carrying capacity
• Enhance the bearing life
• Prevent creeping of rings on shaft under load

The characteristics and assembly of the bearing should be thoroughly studied before mounting. The sequence of mounting must be established and verified. Mounting process is an important factor that affect the service life of bearing. Few basic rules should be obeyed while mounting such as:

 keeping the mounting area absolutely clean
• Protection of all bearing parts from contamination and corrosion
• Proper cleaning of bearing component
• Checking bearing fitment dimensions
• Using proper tools for mounting
.• Follow mounting sequence
• Post mounting checks
• Exact quantity of Lubricant must be filled in the bearing
• After assembly check correctness of bearing functioning

Tips for bearing maintenance to help ensure a longer life span.

Handle with care

Bearings are delicate enough to get damaged quickly. As such, it is very important that they are stored horizontally in a clean and dry environment with their packaging intact. Do not expose them to any airborne contaminants, as even a tiny speck of dirt can cause premature failure. Never hammer or pound them, or apply a direct force on it or its outer ring, which can cause damage to the rolling elements, resulting in misalignment. The most important thing to remember is to never remove bearings from their packaging until ready for use.

Absolute cleanliness is essential when handling bearings. They should not be removed from their wrappings until required for fitting. All tools, shaft, housings and other components must be perfectly clean. If fitting operations are delayed or interrupted the assembly should be wrapped with grease proof paper to exclude dirt and dust.

Check the bearing housing and shaft

Whenever a bearing is used for mounting, it is crucial that the housing and shaft are inspected for any sort of physical condition or damage. Always use a soft cloth to wipe the surfaces clean and make sure any nicks and burrs are removed.

Mount the bearings correctly

The method used to mount the bearings depends on the type of bearing. For example, bearings with cylindrical bores are generally mounted through a press fit method. Bearings with tapered bores can be mounted directly on tapered or cylindrical shafts with the use of tapered sleeves. The fits of the rings with shaft and housing on bearing seating are very important Therefore ensure that the shaft and housing seating are of correct size and of good shape.

All shoulders must be smooth and square with the axis of retation.- drive one ring on its seating by blows on the other. Such blows would irretrievably damage the balls or rollers and raceways.

Where the ring of a bearing is against an abutment, make sure it is tight fit. For heavy interference fits, inner rings may be shrunk on to the seating after heating in clean mineral oil at a temperature of approximately 100°C. Be sure that the bearing is in contact with the abutment shoulder after it has cooled.

Avoid preheating or overheating

The maximum heating allowed on the bearings depends on the heat treatment of the material. If they are heated above the permitted limit, they can permanently deform or soften the bearing steel, lowering load carrying capacity and resulting in a failure. Always heat the bearings using induction heaters, and never with an open flame.

Always use the proper tools

Specialized tools like bearing pullers, bearing fitting tool kits, oil injector kits, hydraulic nuts, or induction heaters should be used in the mounting and dismounting processes. These tools ensure the smooth process of mounting or dismounting, in order to minimize the risk of damage. Apply pressure evenly around the rings. "A press is better than a hammer."

Should a hammer be used, mild steel or brass tube of suitable size, faced up square, should be interposed between it and the bearing. This will distribute the force of the blows (or rather taps), which should be given progressively around the ring.

When the parts are separable, roller bearings are brought together the inner ring, the outer ring and the rollers must all be square with the other. If not square, then the rollers would not slide freely, and force would have to be used to bring the parts together. Such force would result in the rollers and raceways becoming scored and this, in addition to causing noisy running could cause early failure of the bearing.

Avoid corrosion

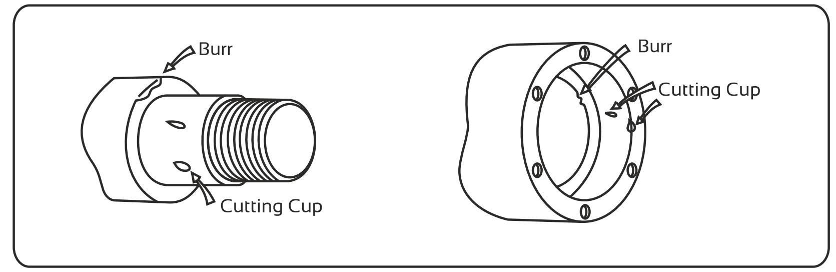
It is crucial that you should not expose bearings to the presence of water for a long time, as it will lead to rust and corrosion. It will also cause the premature failure of the bearings, which can affect the machine performance and productivity. As a result, it will increase your operating costs. Also, make sure to wear gloves when handling bearings. Perspiration can also lead to rust and corrosion.

Proper lubrication

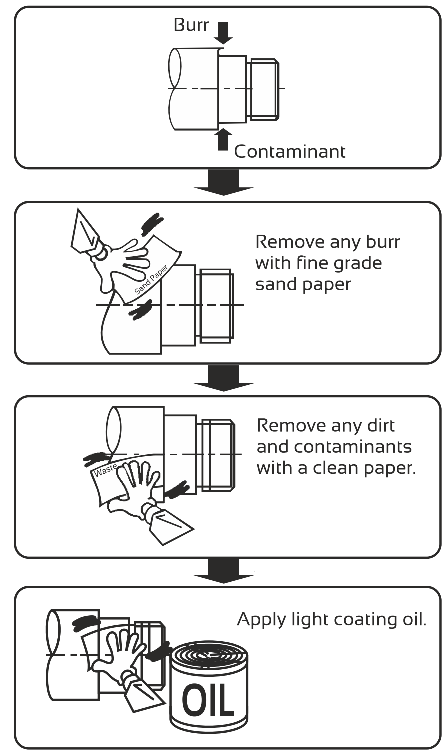
If you want to have a prolonged life of your bearings, it is crucial that they should be properly lubricated. The correct lubricant depends on the environmental conditions, temperature, speed and load. In this case, it is advisable that you should follow your manufacturer's recommendations.

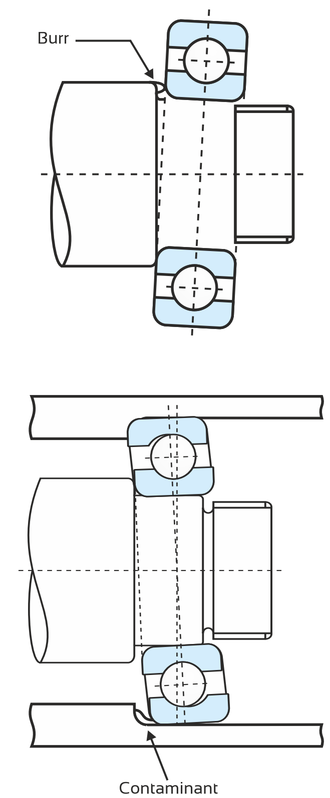
13.2 Preparations Before Mounting

- Do not remove the bearings from their packaging until just before use.
- The bearings are covered with anti-corrosion oil. The oil should not be wiped out from bearing surfaces until bearing is not used. At the time of mounting wipe out oil from bearing outer surface and bore only. Sealed /shield bearings must never be washed before mounting.
- Clean shaft and housing. Any burrs, cutting chips, rust or dirt should be removed from the bearing mounting surfaces by using fine grade sand papers/ file. Installation can then be simplified if the clean surfaces are lubricated with spindle oil. Ensure that lubricating holes and threaded holes are clean.

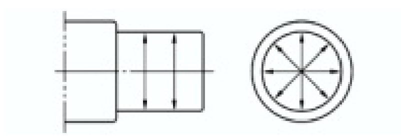


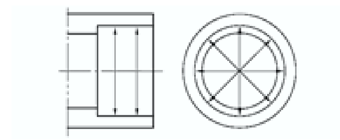
9.1.2 Preparation Procedure



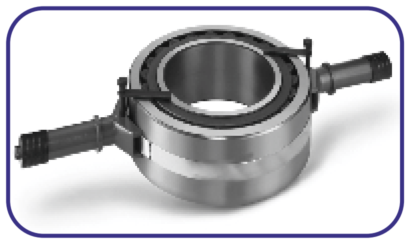


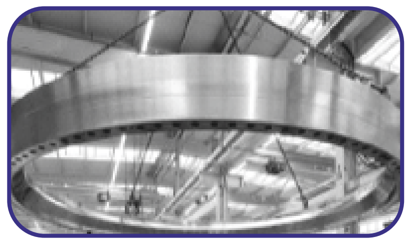
• Check dimensions, shoulder and finishing of shaft and the housing as per the drawing. The shaft diameter and housing bore diameter should be measured at the several points. Tapered shaft must be checked with ring gauge and sine bar. The diameter of straight shaft and housing is usually checked with micrometer and internal gaiuge. Check the size at two different positions and at four locations


Shaft


Housing

• Check dimensions, shoulder and finishing of shaft and the housing as per the drawing.The shaft diameter and housing bore





13.3 Mounting

Bearing mounting depends upon the type of bearing, application, size of bearing. Avoid direct hammer blows on the bearings while mounting. Make sure that cage and seals are not hit directly. Mounting can be done in the following ways.

- **Mechanical Mounting**
  - Hammer & mounting sleeve
  - Fitting tools/ Spanner
  - Press
- **Temperature mounting (hot & cold)**
  - Induction heating
  - Oil bath heating
  - Using dry ice or liquid nitrogen
- **Other mounting methods**
  - Oil injection
  - Hydraulic push up

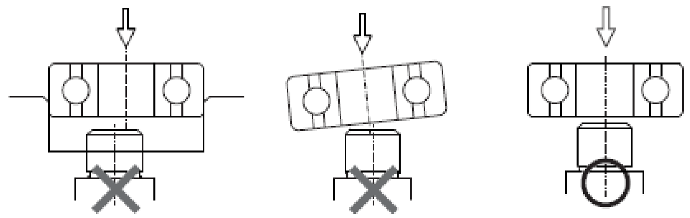
13.3.1 Mechanical method

The method used to mount the bearings depends on the type of bearing. The bearings are with cylindrical bore and tapered bore.

• Non-separable bearing, the component which is tight fit is mounted first in housing or shaft.
• Separable bearing, inner can be mounted independently of outer. During assembly, care must be taken to align the shaft properly with housing.

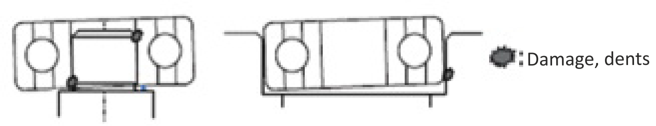
Alignment

Ensure proper alignment of shaft or housing with the inner or outer. If either of the component is misaligned, it will get stuck.



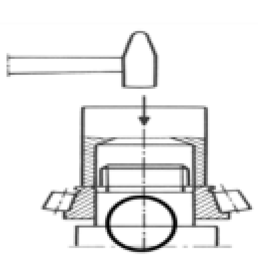
Off center　　Tilted　　Good

Misalignment Due to Contamination and Damage

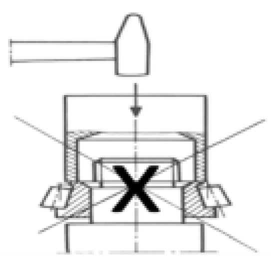


Inner mounting on shaft

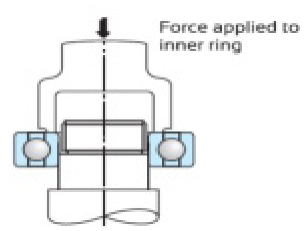
While pressing on the shaft apply force on the inner ring face.



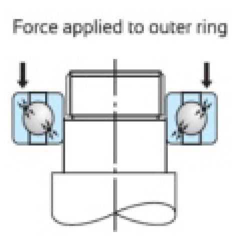
Correct method
As fitting tool face is
Resting on the bearing face



Not ok as fitting tool
is touching the cage



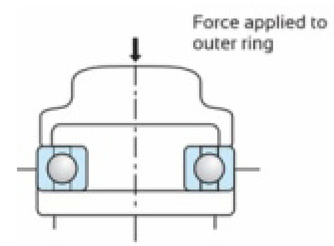
Right Method



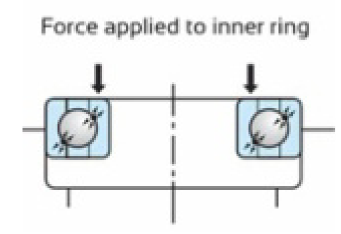
Wrong Method

Outer ring mounting in housing

During pressing in the housing apply force on the outer ring face.



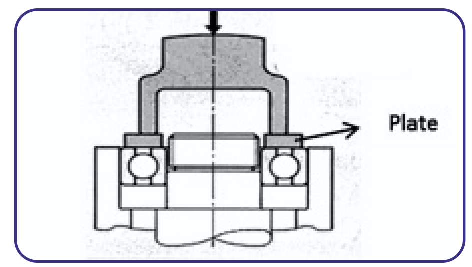
Loads on outer ring
(Right Method)



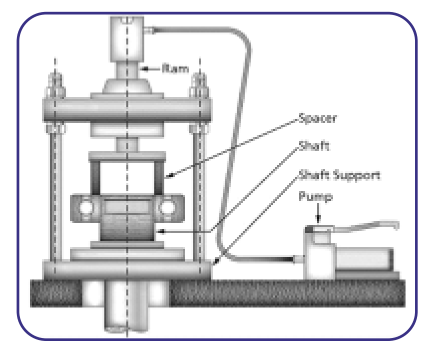
Loads on inner ring
(Wrong Method)

Mounting both housing and shaft together

When both inner and outer are mounted together, than force is applied by a fitting tool on the plate that is placed on the face of the bearing as shown.



Mounting by hydraulic press



13.3.2 Temperature Mounting

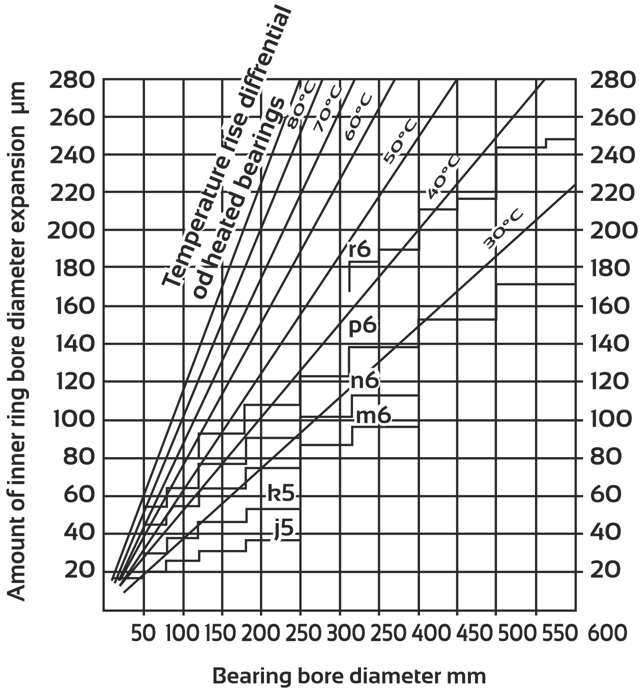
(Heat expansion of inner ring to ease installation)

Oil bath method

Commonly used for large bearings and bearings with a heavy interference fit.

1. Immersion of the bearing in heated oil is the most common method. Use clean oil and suspend the bearing in the oil with a wire or support it underneath using a metal screen in order to avoid uneven heating of bearing elements.

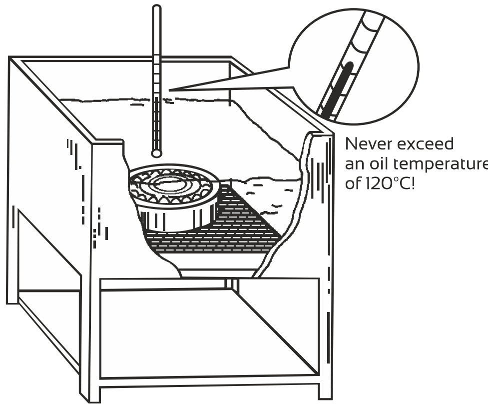
2. The temperature to which the inner ring should be heated depends upon the amount of interference fit i.e. the diameter of the interference fit surfaces. Refer to the following graph to determine the proper temperature.



3. To prevent gaps from occurring between the inner ring and shaft shoulder, bearings which have been heated and mounted on the shaft should be held in place until they have cooled completely.

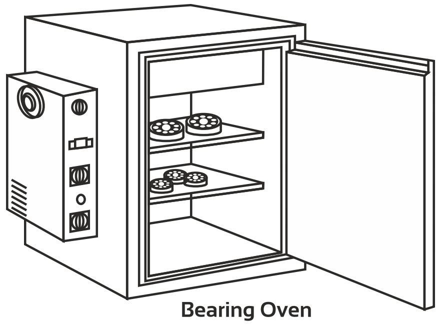
Precautions: Bearings should never be heated over 120°C.

For higher operating consult NBC. Temperature mounting cannot be used for pre-greased and sealed or shield bearings.



Bearing Oven

This method can also be used for heating pre-greased bearings. Bearings must not be heated above 80-85°C. The seals on the bearing must never touch the plate of oven. Always keep a ring between bearing and oven plate.



Bearing Oven

induction Heating

This method can also be used for the inner rings of roller bearings. Bearings are dry and can be heated up in a short period of time. After using this method, administer a de-magnetizing treatment to the bearing.

13.4 Mounting Bearings on Tapered Bore

Tapered bore bearings are always mounted with interference fit and this will depend upon how far the bearing is driven on the tapered shaft. During mounting the radial clearance decreases. Hence it is important to check the clearance as the bearing is pushed up the shaft.

Bearings with tapered bores can be mounted directly on tapered or cylindrical shafts with the use of tapered sleeves. However, pressure should be applied only with a press fit because without it the raceways can be damaged.

In case of tapered sleeve and nut bearings, the clamping nut must not be over-tightened, for this could expand the inner ring and eliminate all clearance within the bearing, or even fracture the inner ring. We recommend that after the nut has been tightened by hand pressure, use a pin hammer. Give one or two light hammer blows to the handle of the spanner. This should tighten the nut just sufficiently.

If possible, check that the sleeve is still clamped firmly to the shaft after a few days of running. As an additional precaution we recommend that whenever the bearings are fitted, check the rotation of the shaft as it tends to tighten the nut on the sleeve. To assist customers who use torque spanners we recommend that the following torque be applied to the clamping nut for light series bearings.

Shaft Diameter	Torque on Nut
1" (25mm)	7.6 Kg.m
1.5" (38 mm)	12.4 Kg.m
2" (50mm)	17.25 Kg.m
3" (75mm)	30.3 Kg.m

For medium series bearing we recommend that the above values be increased by approximately 50 percent.

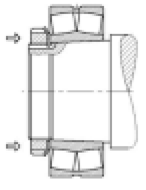
Mounting can be done in the following ways.

For shaft diameter up to 75 mm.

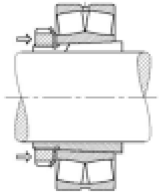
- By pushing the bearing directly on the shaft by a fitting tool or a lock nut.
- Using adaptor sleeve and sleeve locking nut.

For shaft diameter more than 75 mm.

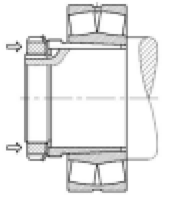
- Oil injection method. Shaft and sleeve with duct. Duct is used to feed oil under pressure to bearing seating. As the bearing expand radially, the sleeve is inserted axially with adjusting bolts.
- Hydraulic nut cum dial pressure gauge arrangement



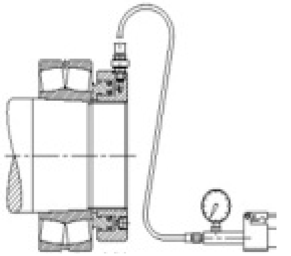
Mounting bearing Directly over shaft with lock nut
Lock nut is clamped against the face of bearing



Bearing mounted on adaptor sleeve with adaptor sleeve lock nut



Bearing mounted on withdrawal sleeve with lock nut



Hydraulic nut & dial cum pressure gauge arrangement

13.5 Measuring of Radial Clearance Reduction for Bearings with Tapered Bore

While mounting large bearings on tapered shaft it is important to measure radial clearance otherwise due to reduction of clearance there is possibility of bearings getting jammed during mounting. Follow the steps:

1. Measure the initial clearance before mounting.

2. Rotate the bearing 4-5 times before measuring the clearance in mounted bearing
3. Measure the clearance between the rolling element and outer ring

(Note: measurement may be affected due to weight of bearing or if the shape of the outer gets deformed after mounting. Also if the feeler gauge positioning is not ok).

Feeler gauge

Checking clearance with feeler gauge

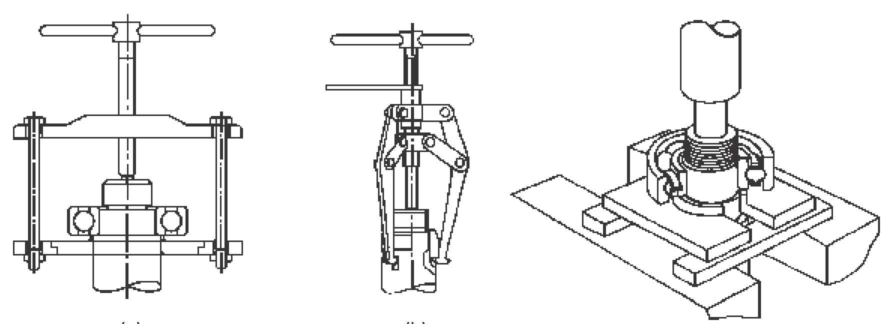
While Mounting spherical roller bearing on the tapered shaft, radial clearance must be checked and for Permissible residual clearance refer table below.

Table for permissible residual clearance

Bearing Bore Diameter d		Reduction in Radial Clearance		Push-in amount in axial direction				Minimum Permissible Residual Clearance	
				Taper 1:12		Taper 1:30			
over	incl	min.	max.	min.	max.	min.	max.	CN	C3
30	40	0.025	0.03	0.4	0.45	-	-	0.01	0.025
40	50	0.03	0.035	0.45	0.55	-	-	0.015	0.03
50	65	0.03	0.035	0.45	0.55	-	-	0.025	0.035
65	80	0.04	0.045	0.6	0.7	-	-	0.03	0.04
80	100	0.045	0.055	0.7	0.85	1.75	2.15	0.035	0.05
100	120	0.05	0.06	0.75	0.9	1.9	2.25	0.045	0.065
120	140	0.06	0.07	0.9	1.1	2.25	2.75	0.055	0.08
140	160	0.065	0.08	1	1.3	2.5	3.25	0.06	0.1
160	160	0.07	0.09	1.1	1.4	2.75	3.5	0.07	0.11
160	200	0.08	0.1	1.3	1.6	3.25	4	0.07	0.11
200	225	0.09	0.11	1.4	1.7	3.5	4.25	0.08	0.13
225	250	0.1	0.12	1.6	1.9	4	4.75	0.09	0.14
250	280	0.11	0.14	1.7	2.2	4.25	5.5	0.1	0.15
280	315	0.12	0.15	1.9	2.4	4.75	6	0.11	0.16
315	355	0.14	0.17	2.2	2.7	5.5	6.75	0.12	0.18
355	400	0.15	0.19	2.4	3	6	7.5	0.13	0.2
400	450	0.17	0.21	2.7	3.3	6.75	8.25	0.14	0.22
450	500	0.19	0.24	3	3.7	7.5	9.25	0.16	0.24
500	560	0.21	0.27	3.4	4.3	8.5	11	0.17	0.27
560	630	0.23	0.3	3.7	4.8	9.25	12	0.2	0.31
630	710	0.26	0.33	4.2	5.3	10.5	13	0.22	0.33
710	800	0.28	0.37	4.5	5.9	11.5	15	0.24	0.39
800	900	0.31	0.41	5	6.6	12.5	16.5	0.28	0.43
900	1000	0.34	0.46	5.5	7.4	14	18.5	0.31	0.74
1000	1120	0.37	0.5	5.9	8	15	20	0.36	0.53

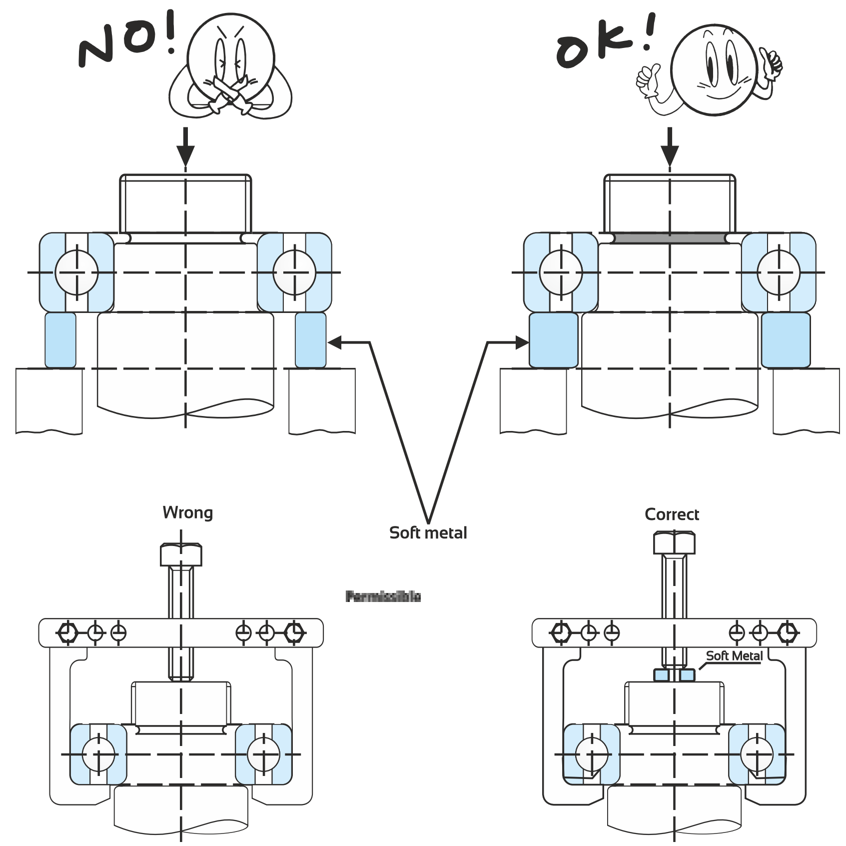
13.6 Dismounting

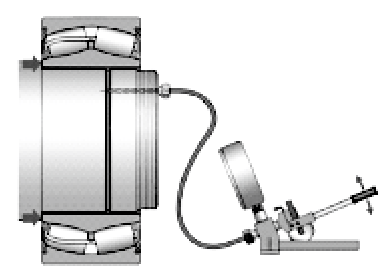
A bearing may be removed for periodic inspection. If the removed bearing is to be used again or it is removed only for inspection, it should be dismounted as carefully as when it was mounted. If the bearing has a tight fit, its removal may be difficult. The means for removal should be considered in the 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. In case of non-separable bearing, the ring having loose fit must be withdrawn first. For separable bearing the rings can be dismounted independent of each other.
Small size bearings can be dismounted using press or mechanical puller. In case of large size bearings (bore>75 mm) it is recommended to use oil injection method and puller both.



(a) (b)
Removal Using a Bearing puller

Removal Using a spacer





Removal by hydraulic pressure

13.7 Bearing Cleaning

It is seldom necessary to clean bearings with the sole object of removing the rust preventive oil, which they are coated before being packed. Rust preventives with a petroleum jelly base have certain lubrication qualities and in any case since the amount used for the protection of bearings is small, no harm is done with the grease or oil used for lubrication.

As a rule washing shall only be done when bearings have become dirty or when the mechanism in which they are used is so sensitive that even slight irregular resistance to rotation is not permissible. When bearings are inspected, the appearance of the bearings should first be recorded and the amount and condition of the lubricant should be checked. After the lubricant has been sampled for examination, the bearings should be cleaned.
Cleaning media most commonly employed for used bearing are:
(a) Benzene
(b) White Spirit (Low flash point)
(c) Turpentine
(d) Paraffin Oil
(e) Light Spindle Oil
(f) Trichloro Ethylene
(g) Carbon Tetra Chloride
(h) Petroleum Ether

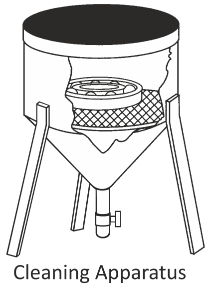
Method of cleaning

Rough cleaning

In Rough cleaning a separate container should be used and to support the bearing. A screen is provided in the container. All the cleaning media as mentioned above can be used for cleaning bearing, if bearing is very dirty, Gasoline should be used. Care should be taken to prevent igniting and to prevent rusting after cleaning.
In rough cleaning, each bearing is moved about vigorously without rotating it, since any trapped foreign matter can scratch the rolling elements & trace. If the oil is heated it cleans the bearing effectively. However, never heat the oil above 100°C. After as much as possible of the dirt has been removed this way, the bearing is transferred to the final cleaning.

Final cleaning

Now bearing is submerged in clean oil & rotated gently the inner ring or outer ring so that inside of the bearing will also be cleaned. After that, rotate the bearing faster until all trace of dirt has been removed. Now remove the bearing from bath and wipe it with a clean cloth, apply a coat of rust preventive oil to the bearing and wrap it is not going to be used immediately. It is necessary to always keep rinsing oil clean.
After any cleaning process it is necessary to protect the bearing by dipping it in hot petroleum jelly or oil, or by applying the grease to be used that it reaches every part of the surface. In the latter case rotation of bearings is necessary while grease is being applied.



Cleaning Apparatus

13.8 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–

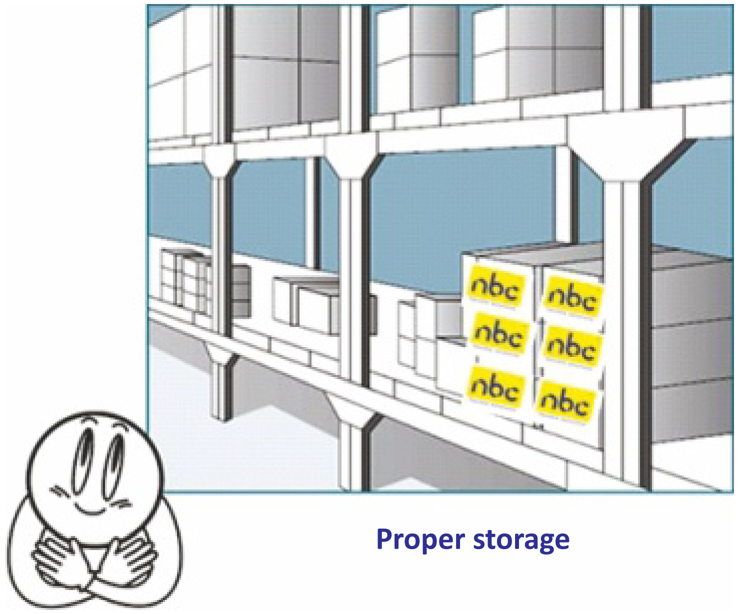
(e) When there is rust or scoring on the raceway surfaces or rolling elements.
(f) When there are any significant impact or brinell traces on the raceway surfaces or rolling elements.
(g) When there is significant evidence of creep on the bore or the periphery of the outer ring.
(h) When discoloration by heat is evident.
(i) When significant damage to the seals or shields of grease sealed bearings has occurred

13.9 Bearing Handling & Storage

13.9.1 Storage

Importance of proper bearing storage

- Store the bearings in their original packing to avoid any contamination or corrosion
- Place large and heavier bearings on a flat surface with complete support at the bottom.
- Never store the bearings in upright position
- Store bearings in cool and dry rooms away from direct sunlight
- Avoid contact with aggressive media like chemicals, gases, acidic fumes etc. during storage
- Open bearings (without seal or shield) can be stored up to five years. Sealed and Shielded (Greased) bearings needs regular attention



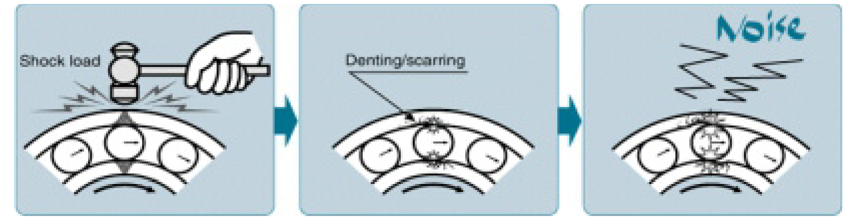
Proper storage

13.9.2 Bearing Handling

Bearings carry their loads along an extremely narrow contact surface between the rolling elements and the inner and outer raceway surfaces.

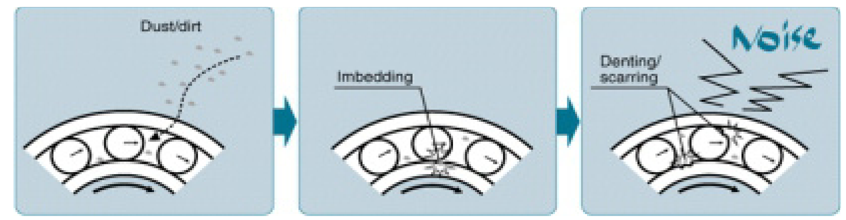
If an excessive load or impact is applied to this narrow area of contact, brinelling and/or scarring will occur. This damage leads to objectionable noise and vibration levels and rough bearing rotation. (Even dropping bearings on the floor will cause this type of damage.)

Bearings are very susceptible to impacts and shock loads!



Bearings are very susceptible to foreign particle contamination!

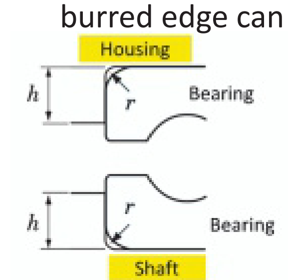
If foreign particles infiltrate the bearing during rotation, denting and/or scarring will occur and this will lead to poor bearing rotation and excess noise.



13.10 Abutments for Bearings

1.Shaft and housing abutments for a ball or roller bearing must be flat and square with the axis of rotation.

2. An abutment must be deep enough to clear the unground corner radius of a bearing ring and contact its ground face.
3. The radius at the root of an abutment must be smaller than the corner radius of the ring located against that abutment, alternatively the root may be undercut.
4. The edge of an abutment must be reduced or chamfered, as a burred edge can so easily dent or distort a bearing ring.



The fillet radius (r) of shaft / housing, should be smaller than the chamfer dimensions of the bearing.

Ball Bearings, Angular Contact and Duplex Bearings

When a bearing carries heavy axial load, abutments must be deeper i.e. it should not extend beyond the inner ring outside diameter or below the outer ring bore. A deep abutment can cause difficulties when a bearing is removed from its seating and, therefore, it is advantageous to provide grooves or holes on such an abutment so that a suitable extraction tool can be used.

Roller Bearings

Bearings not carrying axial loads

The maximum abutment depth is more important for these bearings than for ball bearings. The maximum inner abutment diameter and minimum outer ring abutment diameter are recommended accordingly. Broadly these coincide with the diameter of the inner and outer ring raceways respectively.

Bearings carrying axial load

Abutments for these bearings should extend beyond the raceways to avoid shear stresses in the lips. Every possible care is necessary to ensure that the abutments are flat and square with the axis of rotation.

Thrust Bearings

Abutments for Thrust bearings should extend beyond the pitch circle diameter of the balls to prevent the washers moving under load.

For standard Thrust bearings with one small bore washer and one large bore washer, the approximate pitch circle diameter

$$= \frac{\text{Small bore diameter + Large outside diameter}}{2}$$

In case of bearings with two bore washers, use the pitch circle diameter for the same basic bearing size with one large-bore washer and one small bore washer.

14 Bearing Failure

14.1 Bearing Failure

Rolling bearing consists of Inner ring, outer ring, rolling elements and cage/retainer to hold the rolling elements (ball/roller) at their respective position. Application of rolling bearing can be seen almost everywhere e.g. aerospace, railways, automotive and industrial segment.

In general, if rolling bearings are used properly they will continue to run till their predicted fatigue life. In the rolling bearing, failure can happen due to a number of reasons. Most common are:

- Fatigue failure
- Lubrication problem
- Contamination

But the type of failure varies depending upon the industry and application.

Proper investigation of the root cause of a bearing failure is necessary to make suitable recommendations for eliminating the cause of failure. However, sometimes it becomes difficult or even impossible to ascertain the exact root cause of a bearing failure when bearing subjected to advance stage or catastrophic mode failure. In such cases, finding out primary cause may become a tricky task as the evidence is likely to be lost. If all the variables and conditions are known at the time of failure occurrence or prior to the time of failure including the application and operating conditions then, by understanding the traces of failure and defining its probable causes, the possibility of similar type of failure in the future can be avoided. Moreover, two or more failure patterns can occur simultaneously and reduce the bearing life exponentially. Proper examination of contact traces, seating of bearing and running path pattern on the raceways for given application can help us in conducting proper root cause analysis of a bearing failure. Failure in bearing can take place due to human error and fatigue failure.

In contrast to fatigue life, bearings premature failure due to human error include:

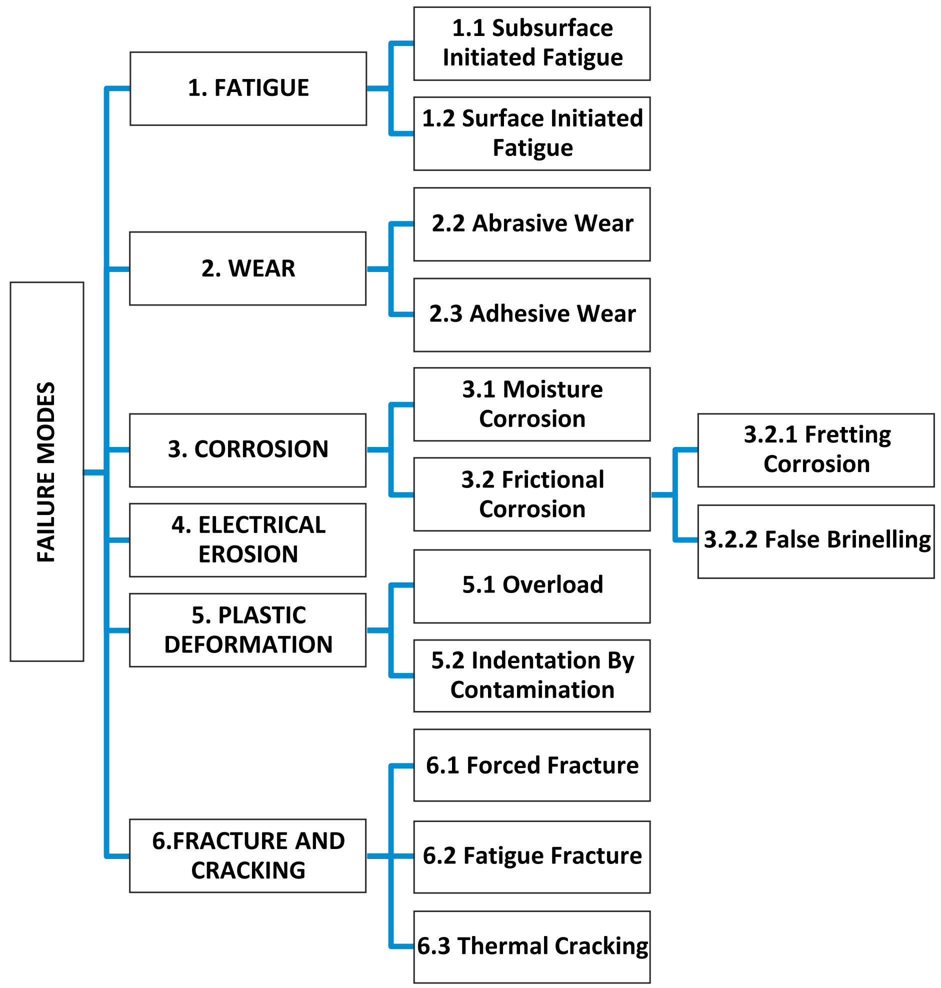
1. Improper mounting/handling practice
2. Wrong bearing selection
3. Inappropriate operating condition
4. Insufficient lubrication
5. Solid or liquid contamination
6. Wrong lubrication selection
7. Material fault/inclusion
8. Deviation/abnormality in manufacturing process

14.2 Classification of Failure Modes in Rolling Bearing

While performing bearing failure analysis, it is first and foremost important to understand the basic classification of different types of failures modes and what causes them. Rolling bearing failures are classified strictly according to their primary causes which constitutes of wear, indentation, surface distress, corrosion and electric current damage. Each of the different causes of bearing failure produces its own characteristic damage. Such damages are known as primary damage which gives rise to secondary or advance mode of failure which constitutes of flaking, cracks and cage damage. This will result in scrapping of the bearing due to excessive internal clearance, noise, vibration etc. A failed bearing can frequently display a combination of primary & secondary damages. The classification of bearing failure is based on ISO 15243: 2004. The failure modes are divided into 6 main modes and sub-modes based on the appearances and features that are visible on the bearing components surfaces.

(Note: Bearing manufacturers can classify bearing failures in their own way and use different terminology)

Failure modes classification as per ISO 15243:2004
(Rolling Bearing Damage and Failures)



1. Fatigue

Fatigue is visible as flaking of particles from the surface. During service bearing surface undergoes repetitive loading from rolling elements. Due to repteated stress there is change in the microstructure between the rolling elements and the raceways. This results into material removal from bearing components surface(s).This is called bearing fatigue failure or flaking.

Flaking occurs when small chips of bearing material gets tear off from the smooth surface of the raceway or rolling elements due to rolling fatigue, thereby creating regions having rough and coarse texture.Flaking may be caused at initial stage of bearing life by

- over-load during operation
- excessive load due to improper handling,
- poor shaft or housing accuracy,
- installation error,
- ingress of foreign objects
- rusting, etc.

If the flaking is noticed at its initial stage then it is possible to identify its cause and the appropriate action can be taken to prevent its recurrence. When flaking propagates further, it makes its presence known in the form of noise and vibrations which indicates it is time to change the bearing.

Fatigue failures are:

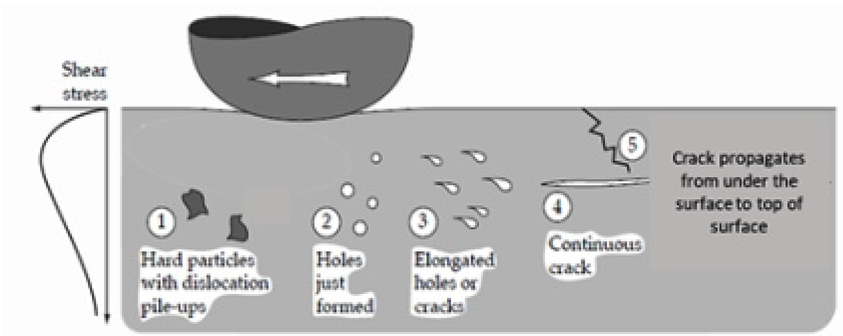
- Subsurface initiated
- Surface initiated

Subsurface Initiated fatigue

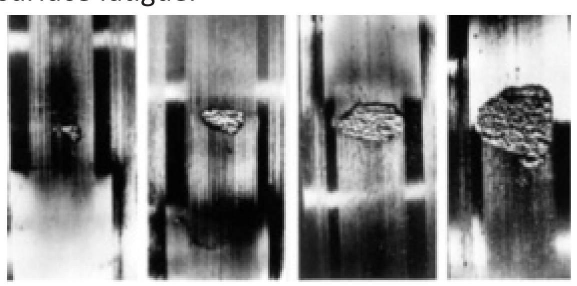
During operation, there are repeated cyclic stress in the rotating part and constant stresses in the stationary part. Under load zone the-rolling elements are compressed due to maximum-load-and as they move out of load zone they expand due to minimum load

Depending upon the operating condition (i.e load, operating clearance and temperature) and number of stress cycles over a period of time, there is a build-up of residual stresses that will cause micro cracks to be initiated at a certain depth under the surface i.e. subsurface. These cracks will propagate from under the component surface to top of the surface.

Illustration of a process of subsurface crack formation.



In another case, presence of higher nonmetallic inclusion in bearing material may lead to sub-surface initiated fatigue. During operation, beneath the bearing surface which undergoes repetitive loading condition these nonmetallic inclusion acts like stress riser and create micro cracks which finally may lead flaking. Initially fatigue is visible as flaking which propagates to spalling (pitting) and then peeling as shown in figure below-progression of subsurface fatigue.



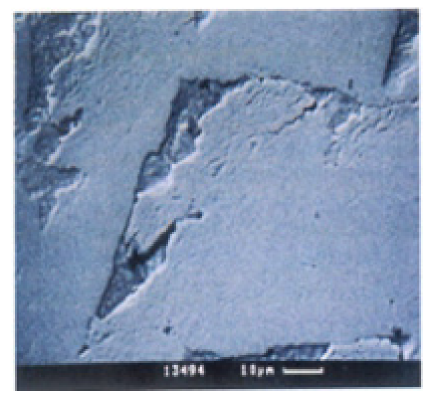
Stage 1 Stage 2 Stage 3 Stage 4

Surface Initiated fatigue

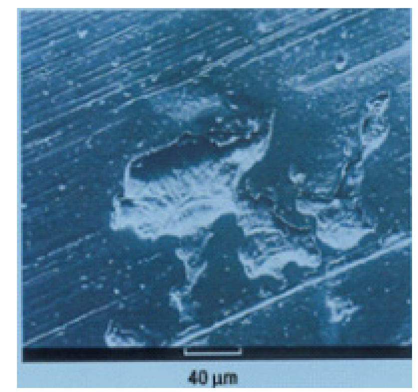
Fatigue initiated from the surface is mainly caused due to surface distress. Surface distress is the damage to the rolling contact surface roughness under the reduced lubrication or wrong lubricant selection.It may also occur when lubrication is contaminated with foreign particles due to poor sealing of bearing which may result into high stress concentration on bearing surfaces. This in turn will give metal to metal contact, together with a certain percentage of sliding motion causing the formation of

- Surface microcracks
- Surface microspalls

Micro-cracks can start in the asperties, followed by micro spalls, finally leading to micro flaking



Micro Cracks



Micro Spalling

Causes	Countermeasures
• Insufficient lubrication • Inadequate lubrication • Contamination • Improper mounting	• Lubricant quantity and filling method should be proper to avoid metal to metal contact • Lubricant properties should satisfy bearing operating conditions ex. EP additive grease can be used in extreme pressure conditions. • Lubricant should be free from any dust or contamination • Follow standard mounting practices.

Localized flaking on the Inner ring of DRAC due to improper lubrication.

Localized flaking on the bearing raceway corresponding to rolling element pitch, due to faulty assembly of the bearing (misalignment or less clearance) in application.

Localized flaking on cup of taper roller bearing caused due to impact loading

Flaking in the load zone on the outer ring of taper roller bearing caused by excessive loading

Axially displaced flaking pattern of uniform width and in opposite direction of Inner & outer raceway due to high axial load in application.

2. Wear

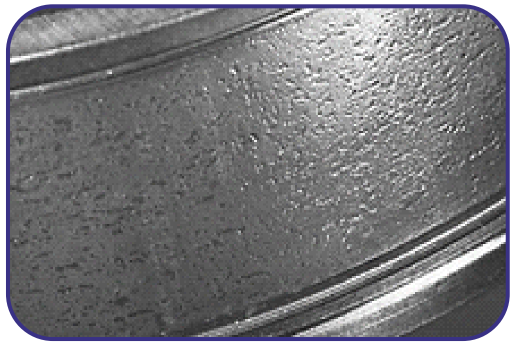
Wear is the progressive removal of the material resulting from interaction of the asperities of two sliding or rolling/sliding contacting surfaces during application. There are two basic mechanism of wear in rolling element bearings:

- Abrasive wear
- Adhesive wear.

2.1 Abrasive wear (particle wear; three body wear)

Abrasive wear is the result of inadequate lubrication or fine foreign particles entry in the bearing.

Sand, fine metal particles from grinding/machining and fine metal/carbides from gears will wear or lap the rolling elements and races. The surfaces become dull to a degree, which varies according to the coarseness and nature of the abrasive particles. These particles increase in numbers as the material is worn away from the running surfaces and the cage. Finally, wear progresses with time which ultimately results in flaking and thus failure of the bearing.

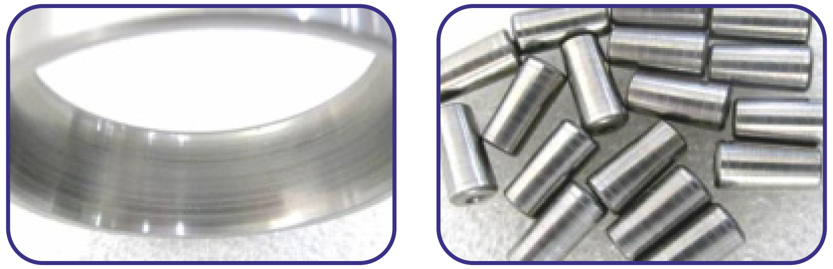


Abrasive wear on the inner ring raceways of a double-row cylindrical roller bearing with central rib

In tapered bearings, the roller head surface and cone flange/rib face will have more wear comparatively to the raceways due to both sliding and rolling contact at flange surface. This wear will result in increased end play or internal clearance which will result in misalignment in the bearing and thus reduces fatigue life. Abrasive wear can also affect other parts of the machine where bearings are used.

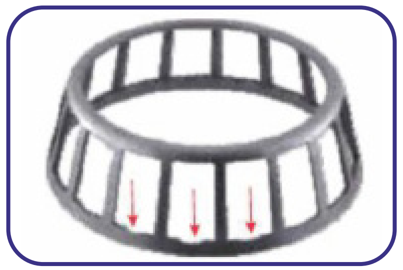
Excessive wear of rollers head either due to excessive preloading or heavy contamination

Causes	Countermeasures
• Sealing ineffective • Contaminated lubricant due to worn out particles from bearing/adjacent components . • Improper cleaning before and during mounting operation.	• Check/ improve the sealing effectiveness. • Always use fresh/clean lubricant. Change oil at specified intervals of mileage covered. • Unpack the bearing at the time of mounting only. Use clean tools and keep the area cleaned where bearing is mounted.



Grooving on cup raceway and rollers outer diameter surface of Taper roller bearing due to fine size hard contaminants

Excessive wear of cage pocket as a result of flaking on single ball



Heavy wear on retainer pockets of taper roller bearing due to over rolling of hard contaminants between rollers head surface and retainer pockets

Wear caused by inadequate lubricant

Causes	Countermeasures
• Lubricant has gradually... been used up/lost its.	• Check that the lubricant.. reaches the bearing/ frequent lubrication.

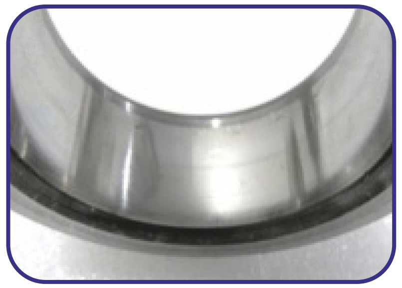
Inner ring of taper roller bearing plastically deformed and discolored due to lack of lubrication or loss of lubricating properties in high temperature application

2.2 Adhesive wear (smearing, skidding, galling)

Adhesive wear is a transfer of material from one surface to another with frictional heating and sometimes, tempering or re-hardening of the surface. This produces localized stress concentrations with the potential for cracking or flaking of the contact areas.
Smearing (skidding) - Occurrence of surface roughness due to inadequate lubrication between the surfaces which results in sliding/slipping of rolling elements and transfer of material between

Creep-When there is a small clearance between the bearing ring and its seating surface the rolling motion of the ring against its seating with a minute difference in the rotational speeds is termed as Creep.

When creep occurs, the asperities in the ring /seating surface contact region are over rolled, which can cause the surface of the ring to take a shiny appearance.



Mirror like/shiny appearance on bore & OD surface due to creeping caused by micro-motion

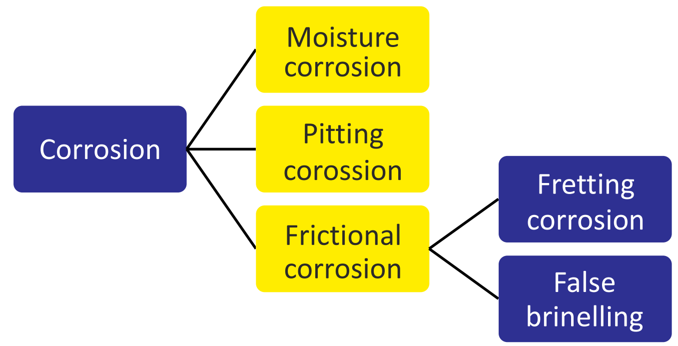
Seizing marks on Inner & outer ring - Rotary motion between rings and shaft/housing with loose fits under circumferential /static load or insufficient axial support of rings can cause cold welding at the fitting surfaces (inner ring bore, outer ring outside diameter) and axial mating surfaces or shiny appearance of contact areas where surface roughness is good. Wear of fitting surface and face perhaps causes reduction in preload or clearance enlargement.

Seizing marks on inner ring bore surface due to loose fits

3. Corrosion

It is the gradual destruction of materials (usually metals) by chemical and/or electrochemical reaction with their environment.

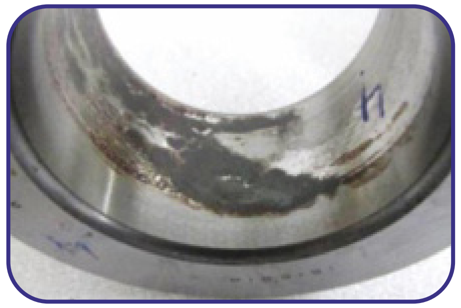
In case bearing is handled or stored improperly which resulted into removal of rust preventive oil film or when water enter through defective or inadequate seals or sometimes from condensation under certain conditions, black oxide commonly called "water etch" will form at respective rolling positions.



3.1 Moisture corrosion (oxidation, rust)

When steel, used for rolling bearing components comes in contact with moisture e.g. water or acid, oxidation of surfaces takes place. Subsequently the formation of corrosion pits occurs & finally leads to flaking of the surface and could initiate cracking. It is most often caused by condensate collecting in the bearing housing due to temperature changes. Rust will form if water or corrosive agents reach the inside of the bearing.

Causes	Countermeasures
• Improper lubricant used • Damaged, worn or inadequate sealing can lead to entry of water, moisture or corrosive substance in the bearing • High temperature & high humidity environment while stationary • Poor packaging or storing conditions • Bearing handling with bare hands	• Study of lubrication suitability as per the application • Improve sealing mechanism • Anti-rust treatment for periods of non-running • Follow best practices for storage and handling • Improve handling methods i.e. usage of gloves



Moisture corrosion on Inner race bore of Taper Roller Bearing

Moisture corrosion on outer ring of Spherical Roller Bearing

Contact corrosion on cone raceway of Taper Roller Bearing at roller pitch distance

3.2 Pitting Corrosion

Pitting corrosion is a localized form of corrosion by which cavities or "holes" are produced in the material. Pitting is considered to be more dangerous than uniform corrosion damage because it is more difficult to detect, predict and design against. Corrosion products often cover the pits.

- Factors influencing pitting: Cl- content, pH value, temperature, presence of oxidizing agent

Pitting corrosion on balls of deep groove ball bearing

3.3 Frictional Corrosion

Frictional corrosion is a chemical reaction caused by relative micro movements between mating surfaces under certain frictional conditions. These micro-movements lead to oxidation of the surface and the material becomes visible as powdery rust and/or loss of material from one or both mating surfaces.

3.3.1 Fretting Corrosion

Fretting corrosion occurs when there is relative movement between bearing ring and shaft or housing, on account of the fit being too loose. The relative movement may also cause small particles of material to become detach from the surface. These particles oxidize quickly when exposed to the oxygen in the atmosphere; powdery rust develops (iron oxide). The bearing surface becomes shinny or a discolored blackish red.

Causes	Countermeasures
• Vibrations with small amplitude • Insufficient interference • Poor lubrication • Form disturbance of fitting surfaces • Shaft deflection or housing deformation	• Maintain desired preload in the bearing • Improve fits • Use of proper lubricant/ lubricant film at fitting surfaces • Shaft or housing rigidness to bending

Fretting corrosion on cone bore of Taper Roller Bearing due to micro movement between cone and shaft

3.3.2 False Brinelling

When bearing is stationary, lubrication film between the rolling elements and the raceways is very thin; gives metal to metal contact and the vibration produce small relative movements of rolling elements and rings. As a result of these relative movements, small particles break away from the surfaces and thus would lead to the formation of depressions on the raceways with a combination of corrosion & wear depending on the intensity of the vibrations, the lubrication conditions and load.

In the case of stationary bearings, the depression appears at rolling pitch and can often be discolored reddish or shinny. For the case of bearings in running condition (while rotation) false brinelling caused by vibration are visible in the form of closely spaced flutes.

Causes	Countermeasures
• Oscillation or vibration while bearing is stationary e.g. while transportation • Oscillations with small amplitude • Poor lubrication	• Secure shaft & housing while transportation • Radially preload the bearing or provide a vibration damping base • Use oil or high consistency grease when bearings are used for oscillation motion • Use of proper lubricant

Brinelling mark on cup raceway due to vibrations

False brinelling marks along with roller dents near large face of Taper Roller Bearing due to vibrations

False brinelling and contact corrosion marks on cup raceway of Taper Roller Bearing due to water/moisture entry and vibrations

4. Electrical Erosion

Electrical erosion is the removal of material from the contact surfaces caused by the passage of electric current. When electric current passes through a bearing, arcing and burning occur through the thin oil film at points of contact between the races and rolling elements. The material is heated to temperatures ranging from tempering to melting levels. This leads to the appearance of discolored areas, varying in size, where the material has been tempered, re-hardened or melted. Small craters also form where the metal has melted.

Craters formed by current leakage resulting in fluting

Fluting on inner ring raceway with dark colored balls

5. Plastic Deformation

Permanent deformation occurs whenever the yield strength of the material is exceeded. This can occur in two different ways:

- On a macro scale, where the contact load between a rolling element and the raceway causes yielding over a substantial portion of the contact footprint.
- On micro scale, where a foreign object is over-rolled between a rolling element and the raceway and yielding

occurs only a small part of contact point.

5.1 True Brinelling

Overloading of a stationary bearing by static load or shock load leads to plastic deformation at the rolling element/raceway contacts. Overloading can occur by excessive preloading or due to incorrect handling during mounting.

Ball bearings are subjected to indentations if the pressure is applied to the wrong race such that it passes through the balls during the mounting or dismounting operations or if it is subjected to abnormal loading in stationary condition.

Causes	Countermeasures
• Excessive load/ mounting pressure • Shock during transport or due to improper mounting/careless handling • Mounting pressure applied to wrong race	• Improvement in mounting and handling practices. • Apply mounting pressure to the ring with interference fit.

True brinelling mark on inner race shoulder of Ball Bearing due to improper mounting/dismounting

5.2 Indentation

5.2.1 Indentation from foreign particles

When foreign particles get trapped and over-rolled between the rolling surfaces, indentations are formed on raceways and rolling elements. The size and shape of the indentation depends on the nature of the particles. It can be caused by-

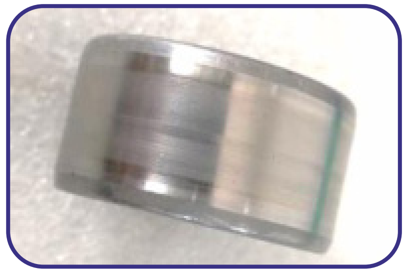
i. Soft particles e.g. fibers or wood

ii.Hardened steel particles e.g. from gears or bearing itself.

iii. Hard mineral particles e.g. grinding wheels

Causes	Countermeasures
• Ingress of solid foreign particles into the bearing • Trapping of flaked particles	• Lubrication oil change at defined service interval • Improve sealing • Cleanliness to be maintained while bearing mounting operation • Check for the involved & other bearings/components for flaking/damage

Wear and indentation on cup raceway soft foreign particle contamination



Wear and indentation on inner ring raceway of Cylindrical Roller Bearing due to soft foreign particle contamination

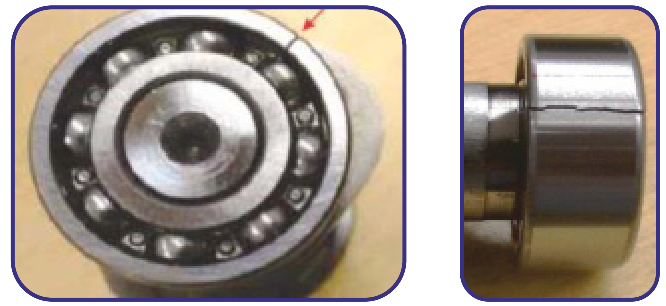
Wear and indentation on inner ring raceway of Double Row Spherical Roller Bearing due to soft foreign particle contamination

6. fracture

Crack initiates and propagates when the ultimate tensile strength of the material is locally exceeded. Fracture is the result of a crack propagating to the point of complete separation of the component.

6.1 Forced fracture

Forced fracture is due to stress concentration in excess of the material tensile strength and is caused by local over-stressing, e.g. from impact, or by over-stressing due to an excessive interference fit.



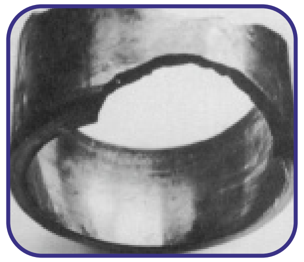
Forced fracture of Outer ring caused by a direct impact blow

Forced fracture due to excessive interference fit

6.2 Fatigue fracture

Frequent exceeding of the fatigue strength limit under bending, tension or torsion conditions results in fatigue cracking. A crack is initiated at a stress raiser and propagates in steps over a part of the component cross section, ultimately resulting in a forced fracture.

Fatigue fracture is sometimes caused by insufficient support of the bearing ring in the housing or on the shaft

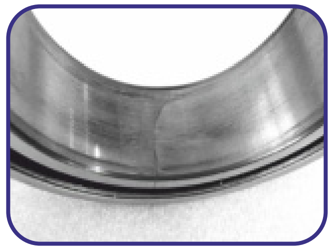


Fatigue fracture of Outer ring caused by insufficient support in the housing

Fatigue fracture of an outer ring from snap ring groove in Double Row Angular Contact Ball Bearing caused by axial loading

6.3 Thermal cracking (heat cracking)

Thermal cracking is caused by high frictional heating due to sliding motion. Crack usually propagates at right angle to the direction of sliding. Hardened steel components are sensitive to thermal cracking due to re-hardening of the surfaces in combination with the development of high residual tensile stress.



Thermal cracking on cone bore of taper roller bearing

Technical Data Rolling Bearing

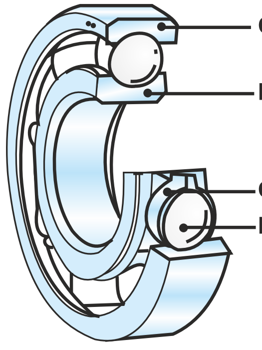
15 Technical Data - Ball Bearing

15.1 Deep Groove Ball Bearing

The deep groove ball bearing are non-separable bearings. These bearings can take radial & axial load and can run at high speed. They are available as plain or sealed bearings. The bearings are economically priced and hence most widely used. The bearings are available in metric and inch series. Angular misalignment capability of these bearings are very limited, hence while mounting bearing positioned must be perfectly aligned in housing and shaft.

Minimum load of P/Cr >0.01 is required for these bearings for smooth and slippage free operation.

The ball bearing consists of inner, outer ball, cage & seals.



Equivalent load rating

For bearings under dynamic load, use following condition and formula

Load ratio	Equivalent dynamic load
$\frac{F_a}{F_r} \leq e$	$P = F_r$
$\frac{F_a}{F_r} > e$	$P = XF_r + YF_a$

Where

P = Equivalent dynamic bearing load for combined load (N)

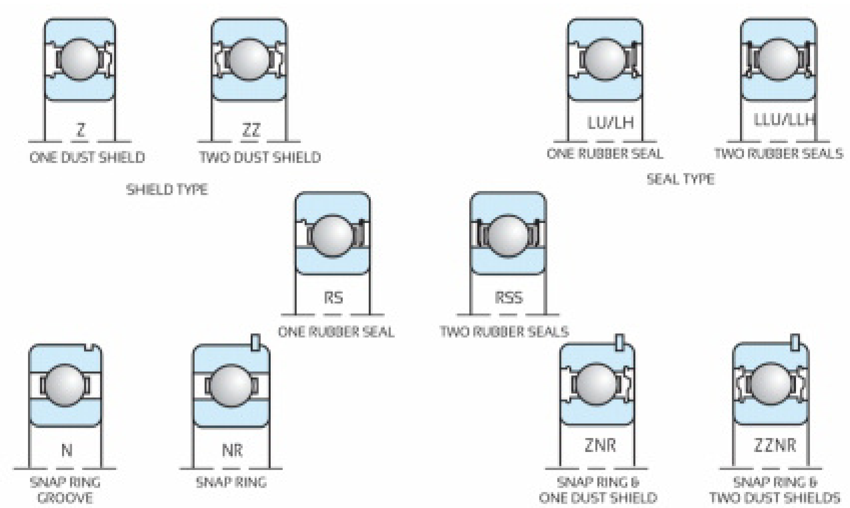
F,= Axial dynamic bearing load (N)

F,= Axial dynamic bearing load (N)

Single row deep groove ball bearing with shield/seal

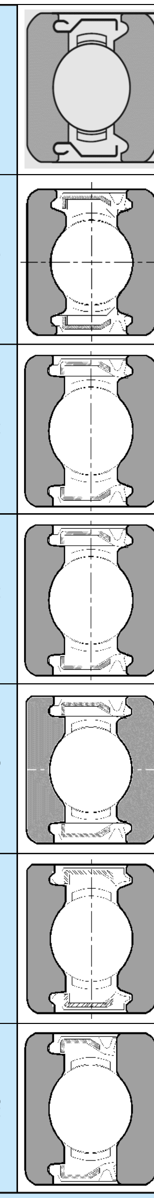
The bearings are with non- contact shield (Z) and contact type of rubbler seals (RS, LU, LH). These are most commanly used rubber seals. Apart from these seals new design rubber seals were developed sepecific to applications. Depending upon the application requirment seals/shield is fixed on one side or both side. The bearings are also available with groove (N) on outer diameter and snap ring ® for axial lacating.

Different variants are shown below



Note: Design variants & seals option are available for all types of bearings. For more information contact NEI sales/technical cell.

Guidelines are given below for selection of seals based on operating conditions

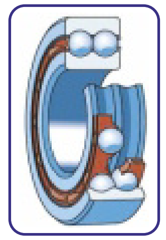


	Sealed Type						Shielded Type
	RS	LB	LU	LH	LH1	LV	Z
Construction	Rubber seal is affixed in outer ring seal groove & seal lip is in contact with inner ring outer diameter.	Rubber seal is affixed in outer ring seal groove & seal lip is aligned with V-groove of inner ring surface with labyrinth clearance	Rubber seal is affixed in outer ring seal groove & seal lip is in contact with inner ring v-groove.	Basic construction same as LU type, but specialy designed lip on edge of seal prevents penetration by foreign matter, low torque construction.	Basic construction same as LH type, Additionaly vent hole provided to evacuate vaccum from bearing.	3 - Lip design,Rubber seal is affixed in outer ring seal groove & seal lip is in contact with inner ring v-groove, 3rd lip is in contact with inner ring outer diameter.	Metal shield plate is affixed to outside ring, normally Inner ring incorporates a V-groove and labyrinth clearance.
	Contact Type	Non Contact Type	Contact Type	Contact Type	Contact Type	Contact Type	Non Contact Type
Torque	Medium	Low	High	Medium	Medium	High	Low
Dust Proofing	Good	Better than Z Type	Very Good	Good	Good	Excellent	Good
Water Proofing	Very Good	Poor	Very Good	Very Good	Very Good	Excellent	Poor

Note : Seal's material will be selected based on operating temprature.

Note: For other detailed information on seals/shield contact NEI Technical Cell.

Double row deep groove ball bearing



Double row ball bearings are available in 62 & 63 series.

The load carrying Capacity of these bearings are more than single row. The bore and outer diameter dimensions are same. Width is slightly bigger than single row.

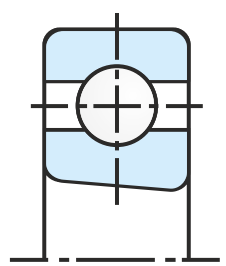
TMB Ball Bearing

TMB ball bearings have the same boundary dimensions as standard deep groove ball bearings, but have undergone a special heat treatment that considerably extends wear life. These bearings were especially effective in countering reduced wear life due to the effects of infiltration of dust and other foreign matter.

TMB 62 series bearings can be used in place of standard. 63 series serings enabling lighter weight, more compact designs. For dimensional specifications and other detailed information about TMB ball bearings contact engineering.

Single row deep groove Radial ball Bearings With Tapered Bore

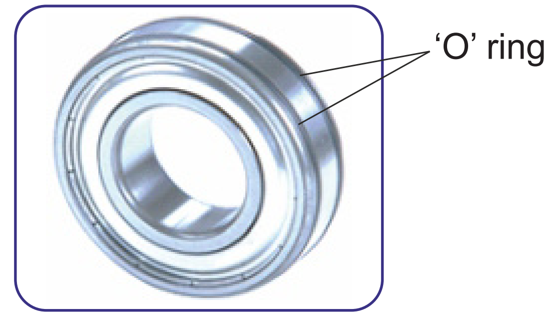
The single row radial ball bearings with tapered bore are identical to single row radial ball bearings except that these have tapered bore which is used for easier mounting and for the adjustment of radial clearance. Dimensions of tapered bore diameter refer to small bore.



SINGLE ROW RADIAL
BALL BEARING WITH
TAPER BORE

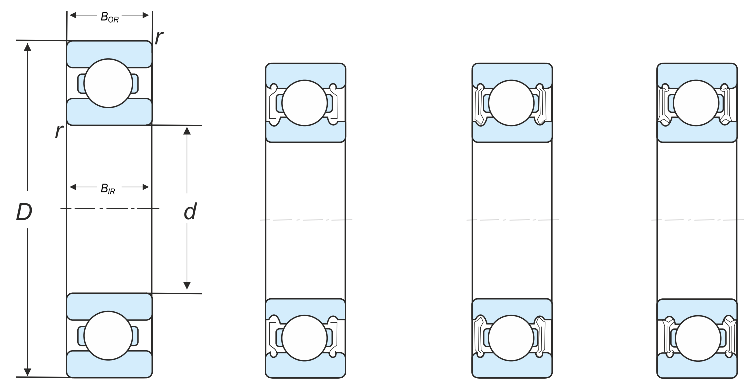
Creep prevention deep groove ball bearing

The dimensional boundary are the same as plain bearings. In the circumference of outside diameter there is groove in which the 'O' rings are placed. The 'O ring' is in contact with the inside of the housing inner diameter. This contact prevent rotation of bearing inside housing. It is used in assemblies where tight fit between bearing OD and housing inner diameter is not possible.

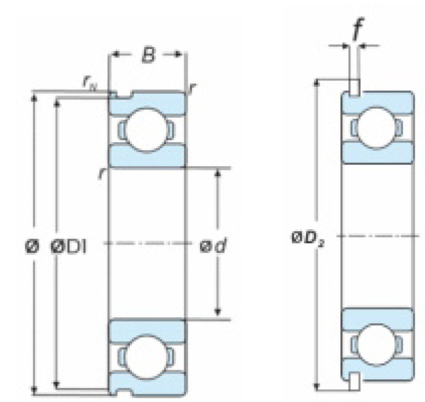


Note: The limiting speeds for Deep Grove Ball Bearing mentioned in data table are valid for open type, shield (Z, ZZ) and non contact rubber seal (LB, LLB) bearings in application using grease/oil.
Limiting speed for grease includes open type, Z, ZZ, LB, LLB bearings.
Limiting speed for oil includes open type, Z , LB bearings
For contact type sealed bearings contact NEI engineering.

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$F\frac{F_a}{F_r} < e$ X	$F\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

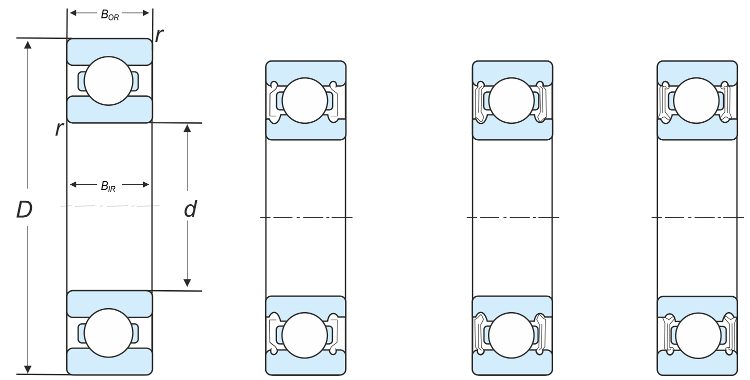
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

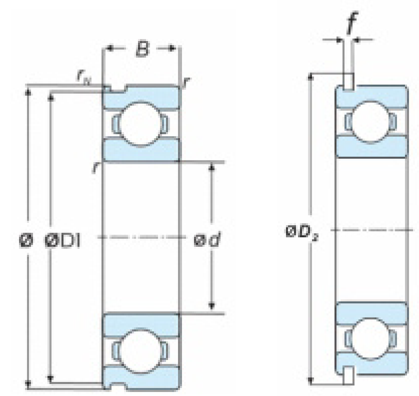
Boundry Dimensions (mm) d	D	B_{IR}	B_{OR}	r_{smin}	Basic Load Rating Dynamic (KN) C_r	Static (KN) C_{or}	Dynamic (Kgf) C_r	Static (Kgf) C_{or}	Fatigue Load Limit (KN) C_u	Limiting Speed (rpm) Grease	Oil	Bearing Numbers Open type	Shield Type		Sealed Bearings* Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	Mass (Kg) (Approx)
10	26	8	8	0.3	5.05	1.96	515	200	0.17	29000	34000	**6000**	Z	ZZ	-	-	RS	RSS	-	-	0.019
10	30	9	9	0.6	6.64	2.64	677	269	0.22	25000	30000	**6200**	Z	ZZ	-	LH	RS	RSS	N	NR	0.032
10	28	8	8	0.3	5.65	2.39	576	244	0.19	24000	29000	**N1566**	-	-	-	-	-	RSS	-	-	0.026
12	35	11	11	0.3	7.53	3.32	767	339	0.26	23000	27000	**6300**	Z	ZZ	-	LH	LU	LLU	-	-	0.053
12	24	6	6	0.3	3.20	1.46	326	149	0.10	27000	32000	**6901**	-	-	-	-	RS	RSS	-	-	0.011
12	28	8	8	0.3	5.65	2.39	576	244	0.19	26000	30000	**6001**	Z	ZZ	-	-	RSA/LUAX2	-	-	-	0.021
12	28	8	8	0.3	5.85	2.39	597	244	0.19	26000	30000	**AST6001**	-	-	-	-	RS	-	-	-	0.021
12	32	10	10	0.6	7.66	3.1	781	316	0.26	22000	26000	**6201**	Z	ZZ	-	LH	RS/LU/LUAX2	RSS/RSSA1	N1	NR	0.038
12	32	10	10	0.6	7.66	3.1	781	316	0.26	22000	26000	**TM6201**	-	-	-	-	LU	-	-	-	0.038
12	32	10	10	0.6	7.94	3.1	809	316	0.26	22000	26000	**AST6201**	-	-	-	-	-	-	-	-	0.038
12	32	14	14	0.6	6.7	3.0	683	306	0.26	22000	26000	**62201**	Z	-	-	-	-	RSS	-	-	0.05
12	37	12	12	1	10.80	4.2	1101	428	0.35	20000	24000	**6301**	Z	ZZ	-	LH	LU	LLU	-	-	0.061
12	37	12	12	1	12.45	4.2	1270	428	0.35	20000	24000	**ML6301**	-	-	-	-	-	-	-	-	0.061
12	40	12	12	1	12.65	5	1290	510	0.42	18000	21000	**613963**	-	-	-	-	-	-	-	-	0.072

Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

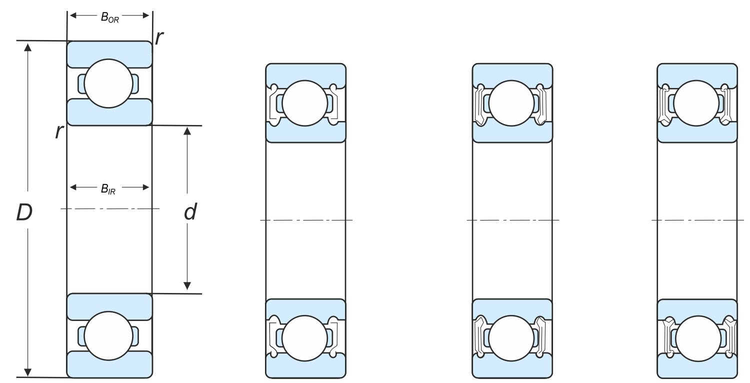
Static equivalent radial load

Por =0.6Fr+0.5Fa

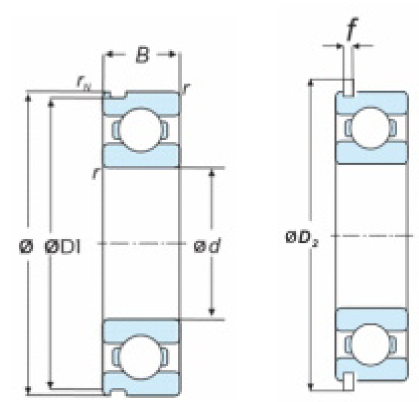
when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
mm					KN		Kgf		KN	rpm					Sealed Bearings*						
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	
15	28	7	7	0.3	4.10	2.06	418	210	0.13	24000	28000	**6902**	Z	-	-	-	RS	RSS	-	-	0.018
15	32	9	9	0.3	6.20	2.84	632	290	0.20	22000	26000	**6002**	Z	ZZ	-	LLH	LU/LUA	LLU	-	-	0.035
15	32	9	9	0.3	6.20	2.84	632	290	0.20	22000	26000	**TMB6002**	Z	-	-	-	-	-	-	-	0.035
15	32	8	8	0.3	5.60	2.84	571	290	0.20	22000	26000	**16002**	-	-	-	-	-	-	-	-	0.025
15	35	11	11	0.6	8.60	3.6	877	367	0.30	19000	23000	**6202**	Z	ZZ	-	-	LU/LUAX2	LLU/LLUA/LLVA	-	-	0.052
15	35	11	11	0.6	8.60	3.6	877	367	0.30	19000	23000	**TM6202**	-	-	-	-	-	-	-	-	0.052
15	35	14	14	0.6	7.70	3.7	785	377	0.30	22000	25000	**62202**	-	-	-	-	-	RSS	-	-	0.06
15	35	11	11	0.6	8.48	3.72	865	379	0.29	24000	27000	**6202C**	-	-	-	-	-	LLWA	-	-	0.044
15	42	13	13	1	12.70	5.54	1295	565	0.45	17000	21000	**6302**	Z	ZZ	-	-	RS	RSS	-	-	0.084
15	42	13	13	1	14.65	5.54	1493	565	0.45	17000	21000	**ML6302**	-	-	-	-	-	-	-	-	0.084
16	42	13	13	1	10.66	4.55	1087	464	0.37	17000	21000	**BB1002**	-	-	-	-	-	-	-	-	0.084
17	30	7	7	0.3	5.15	2.58	525	263	0.17	20000	24000	**6903**	-	-	-	-	-	-	-	-	0.016
17	35	8	8	0.3	7.55	3.35	770	342	0.25	20000	24000	**16003**	-	-	-	-	-	-	-	-	0.032
17	35	10	10	0.3	7.55	3.35	770	342	0.25	20000	24000	**6003**	Z	ZZ	-	LLHA	LU	LLU	-	-	0.039

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

Por =0.6Fr+0.5Fa

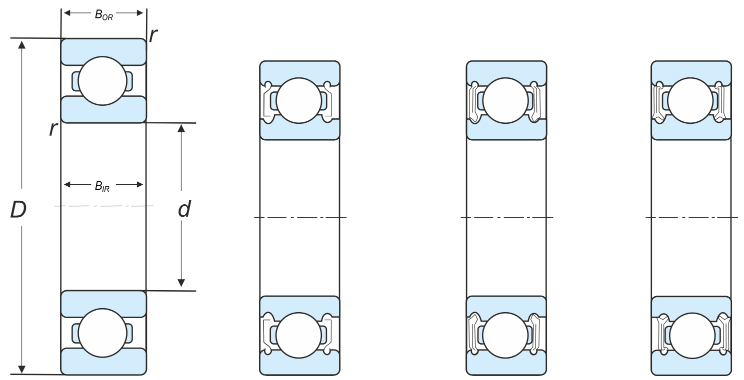
when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
mm					KN		Kgf		KN	rpm											
												Open type	Shield Type		Sealed Bearings*				Snap Ring Groove	Snap Ring	
															Non Contact Type	Low Torque Type	Contact Type				
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil										
17	35	10	10	0.3	7.55	3.35	770	342	0.25	20000	24000	**TM6003**	-	-	-	-	-	-	-	-	0.039
17	40	12	12	0.6	10.60	4.6	1081	469	0.38	18000	21000	**6203**	Z	ZZ	-	LLH/LLHA	LU/LUAX2	LLU	-	-	0.065
17	40	12	12	0.6	10.60	4.6	1081	469	0.38	18000	21000	**TM6203**	-	-	-	-	-	-	-	-	0.065
17	40	12	12	0.6	10.60	4.6	1081	469	0.38	18000	21000	**TMB6203**	-	-	-	-	-	LLU	-	-	0.065
17	40	12	12	0.6	12.22	4.6	1246	469	0.38	18000	21000	**ML6203**	-	-	-	-	-	-	-	-	0.065
17	40	12	12	0.6	11.66	5.2	1188	530	0.43	18000	21000	**6203C**	-	-	-	LLHA	LU	LLVA	N1	-	0.061
17	40	12	12	0.6	13.44	5.2	1371	530	0.43	18000	21000	**ML6203C**	-	-	-	-	-	-	-	-	0.061
17	40	16	16	0.6	9.60	4.6	979	469	0.43	16000	18000	**62203**	-	-	-	-	-	RSS	-	-	0.09
17	42	12	12	0.6	12.88	5.7	1313	581	0.43	18000	21000	**6203A/42**	-	-	-	LH	LU	-	-	-	0.078
17	42	12	12	0.6	12.88	5.7	1313	581	0.43	18000	21000	**TMB6203A/42**	-	-	-	-	LU	-	-	-	0.078
17	47	14	14	1	15.00	6.55	1530	668	0.55	16000	19000	**6303**	Z	ZZ	-	LLHA	LU	LLU/LLWA/LLVA	-	-	0.116
17	47	14	14	1	17.30	6.55	1764	668	0.55	16000	19000	**ML6303**	-	-	-	-	LUA	-	-	-	0.116
17	40	12	12	0.6	10.60	4.6	1081	469	0.38	18000	21000	**6203SPL**	-	-	-	-	-	LLV	-	-	0.068
17	47	14	14	1	15.00	6.55	1530	668	0.55	19000	21000	**6303A**	-	-	-	-	-	LLWA	-	-	0.105

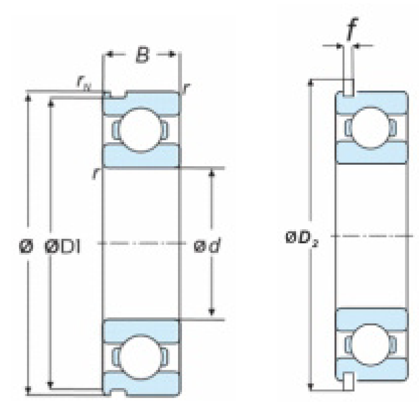
Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

CKA Birla Group | nbc

Single Row Deep Groove Ball Bearing (Metric series)



Open type Shielded type (ZZ) Sealed type (contact & non contact) Low torque seal



With snap ring groove With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

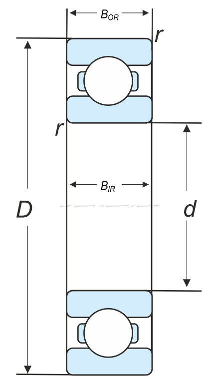
Static equivalent radial load

Por =0.6Fr+0.5Fa

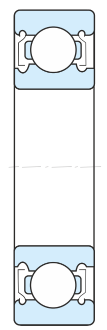
when Por<Fr use Por=Fr

Boundry Dimensions (mm)					Basic Load Rating Dynamic (KN)	Basic Load Rating Static (KN)	Basic Load Rating Dynamic (Kgf)	Basic Load Rating Static (Kgf)	Fatigue Load Limit (KN)	Limiting Speed (rpm)		Bearing Numbers							Mass (Kg) (Approx)
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Sealed Bearings* Non Contact Type	Sealed Bearings* Low Torque Type	Sealed Bearings* Contact Type	Snap Ring Groove	Snap Ring	
18	56	16	16	1.1	22.98	10.4	2343	1061	0.84	13000	15000	**63/18**	- -	-	-	- LLU	-	-	0.196
18	56	16	16	1.1	26.50	10.4	2702	1061	0.84	13000	15000	**ML63/18**	- -	-	-	- LLU	-	-	0.196
20	32	9	9	0.3	4.44	2.47	453	252	0.15	21000	23000	**6904/32**	- -	-	LLH	- RSS	-	-	0.026
20	37	9	9	0.3	7.05	3.7	719	377	0.12	18000	20000	**6904**	- -	-	-	-	-	-	0.036
20	42	8	8	0.3	7.40	4	755	408	0.21	16000	18000	**16004**	- -	-	-	-	-	-	0.049
20	42	9	9	0.6	8.65	4.5	882	459	0.32	15000	18000	**98204**	- -	-	-	-	-	-	0.052
20	42	12	12	0.6	10.40	5.05	1061	515	0.36	18000	21000	**6004**	Z ZZ	-	LH/LLH	LU LLU	-	-	0.069
20	42	12	12	0.6	10.77	5.05	1099	515	0.36	18000	21000	**AST6004**	- -	-	-	- -	-	-	0.069
20	47	14	14	1	15.21	6.7	1551	683	0.56	16000	18000	**6204**	Z ZZ	-	LLHA	LU/LUA LLU/RSS	N	-	0.114
20	47	14	14	1	15.21	6.7	1551	683	0.56	16000	18000	**TM6204**	- -	-	LLHA	- -	-	-	0.114
20	47	14	14	1	15.21	6.7	1551	683	0.56	16000	18000	**TMB6204**	- -	-	-	- LLU	-	-	0.114
20	47	14	14	1	15.76	6.7	1607	683	0.56	16000	18000	**AST6204**	- -	-	-	- -	-	-	0.114
20	47	14	14	1	15.76	6.7	1607	683	0.56	16000	18000	**ASTB6204**	- -	-	-	- -	-	-	0.114
20	47	14	14	1	14.21	6.5	1449	663	0.44	16000	18000	**6204M**	- -	-	-	- -	N	-	0.105

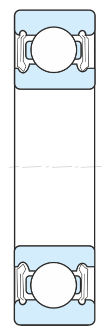
Single Row Deep Groove Ball Bearing (Metric series)



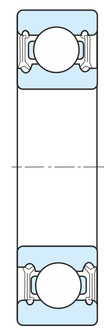
Open type



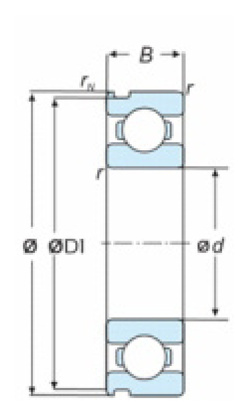
Shielded type (ZZ)



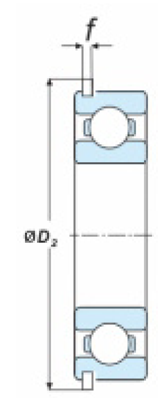
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$F\frac{F_a}{F_r} < e$ X	$F\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

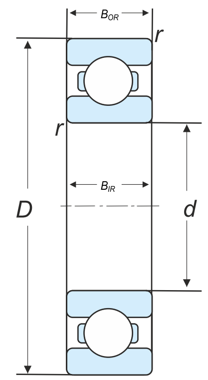
Static equivalent radial load

Por =0.6Fr+0.5Fa
when Por<Fr use Por=Fr

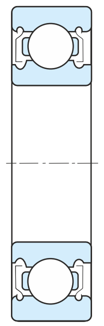
Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
mm					KN		Kgf		KN	rpm											
															Sealed Bearings*						
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	
20	47	16	16	1	15.21	6.7	1551	683	0.56	16000	18000	**TMB6204/2B**	-	-	-	-	-	LLU	-	-	0.11
20	47	15.88	15.88	0.6	15.21	6.7	1551	683	0.56	16000	18000	**BB1003**	-	-	-	-	-	-	-	-	0.12
20	47	18	18	1	12.80	6.7	1305	683	0.56	11000	16000	**62204**	-	-	-	-	-	-	-	-	0.14
20	50	14	14	1	15.21	6.7	1551	683	0.56	16000	18000	**1838002**	-	-	-	-	-	-	-	-	0.125
20	52	15	15	1.1	17.65	7.85	1800	800	0.66	14000	17000	**6304**	Z	ZZ	-	-	RS	RSS	N	-	0.147
20	52	15	15	1.1	18.29	7.85	1865	800	0.66	14000	17000	**AST6304**	-	-	-	-	-	-	-	-	0.147
20	52	15	15	1.1	20.09	9	2049	918	0.75	14000	17000	**6304M**	-	-	-	-	-	-	-	-	0.142
20	55	11	11	1.1	17.65	7.85	1800	800	0.55	14000	17500	**20x55x11**	-	-	-	-	-	-	-	-	0.136
20	56	17	17	1.1	22.76	10.2	2320	1040	0.86	13000	15000	**20x56x17**	-	-	-	-	-	-	N	-	0.19
20	62	16	16	1	25.97	12.2	2649	1244	1.02	10000	12000	**BB1063**	-	ZZ	-	-	-	-	-	-	0.254
20	42	12	12	0.6	10.40	5.05	1061	515	0.36	18000	21000	**N1344**	-	-	-	-	-		-	-	0.067
20	47	16	16	1	16.29	7.16	1662	730	0.60	16000	18000	**N1389X19**	-	-	-	-	-	LLUA	-	-	0.112
20	47	16	16	1	16.88	7.16	1721	730	0.60	16000	18000	**ASTBN1389X19**	-	-	-	LLH1A	-	LLUA	-	-	0.112
20	52	14	14	1	20.09	9	2049	918	0.75	14000	17000	**SP6304M**	-	-	-	-	-		-	-	0.138

Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

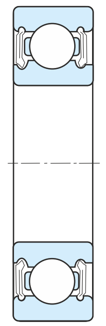
Single Row Deep Groove Ball Bearing (Metric series)



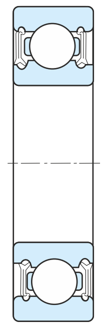
Open type



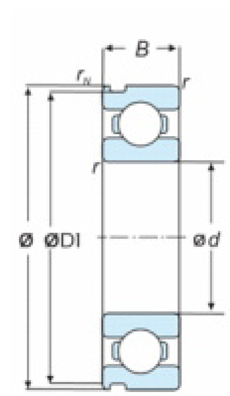
Shielded type (ZZ)



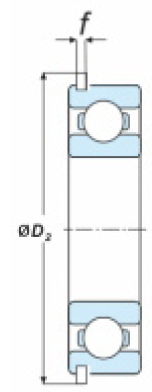
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

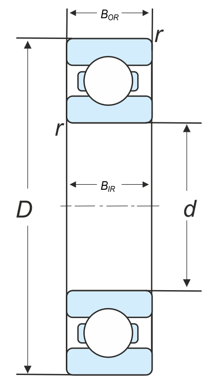
Static equivalent radial load

Por =0.6Fr+0.5Fa

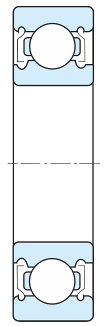
when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static						Sealed Bearings*					
mm					KN		Kgf		KN	rpm									
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	
20	52	15	15	1.1	20.09	9	2049	918	0.75	14000	17000	**G1361**	- -	-	-	- LLUA	-	-	0.153
20	52	15	15	1.1	20.82	9	2123	918	0.75	14000	17000	**ASTBG1361**	- -	-	-	- LLUA	-	-	0.153
20	52	15	15	1.1	20.09	9	2049	918	0.75	14000	17000	**N1426**	- -	-	-	- -	-	-	0.142
20	52	15	15	1.1	23.17	9	2362	918	0.75	14000	17000	**MLN1426**	- -	-	-	- -	N	-	0.142
20	52	15	15	1.1	20.09	9	2049	918	0.75	16000	18000	**6304MA**	- -	-	-	- LLUA	-	-	0.11
22	52	15	15	1	17.65	7.85	1800	800	0.76	19000	21000	**6304/22**	- -	-	-	- -	-	-	0.13
22	52	15	15	1	20.15	9	2054	921	0.75	18000	20000	**6304/22M**	- -	-	-	- LLU	-	-	0.141
22	52	15	15	1	20.87	9	2128	921	0.75	18000	20000	**AST6304/22M**	- -	-	-	- LLUA	-	-	0.141
22	56	16	16	1.1	22.98	10.4	2343	1061	0.87	13000	15000	**63/22**	- -	-	-	- -	-	-	0.164
22	56	16	16	1.1	22.98	10.4	2343	1061	0.87	13000	15000	**TM63/22**	- -	-	LLHA	- -	N	-	0.164
22	56	16	16	1.1	23.81	10.4	2427	1061	0.87	13000	15000	**AST63/22.PX10**	- -	-	-	- -	-	-	0.164
22	44	12	12	0.6	10.43	5.15	1064	525	0.36	17000	20000	**60/22**	- -	-	-	- LLV	-	-	0.074
22	50	14	14	1	16.85	7.95	1718	811	0.51	14000	17000	**62/22**	- -	-	-	-	-	-	0.114
22	52	15	15	1.1	20.09	9	2049	918	0.76	18000	20000	**G1360**	- -	-	-	- LLUA	-	-	0.142

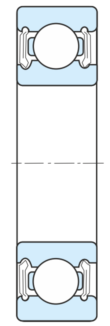
Single Row Deep Groove Ball Bearing (Metric series)



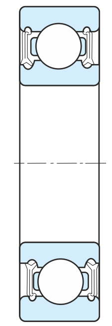
Open type



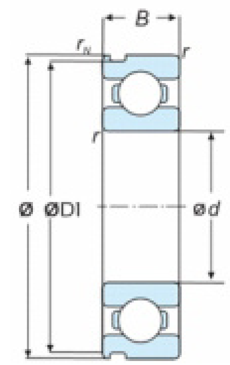
Shielded type (ZZ)



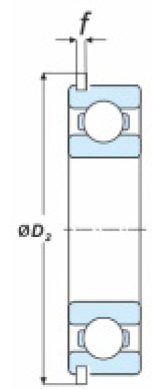
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

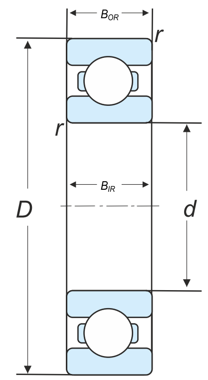
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

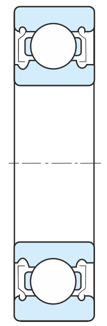
d (mm)	D (mm)	B_{IR} (mm)	B_{OR} (mm)	r_{smin} (mm)	Basic Load Rating Dynamic C_r (KN)	Basic Load Rating Static C_{or} (KN)	Basic Load Rating Dynamic C_r (Kgf)	Basic Load Rating Static C_{or} (Kgf)	Fatigue Load Limit C_u (KN)	Limiting Speed Grease (rpm)	Limiting Speed Oil (rpm)	Open type	Shield Type		Sealed Bearings* Non Contact Type	Sealed Bearings* Low Torque Type	Sealed Bearings* Contact Type		Snap Ring Groove	Snap Ring	Mass (Kg) (Approx)
22	52	15	15	1.1	20.82	9	2123	918	0.76	18000	20000	**ASTG1360**	-	-	-	-	-	LLUA	-	-	0.142
22	52	15	15	1.1	20.09	9	2049	918	0.76	18000	20000	**N1360**	-	-	-	-	-	-	-	-	0.136
22	52	15	15	1.1	23.17	9	2362	918	0.76	18000	20000	**MLN1360**	-	-	-	-	-	-	-	-	0.136
22	56	11.5	11.5	1.5/1	18.43	9.5	1879	969	0.70	13000	15000	**N1422**	-	-	-	-	-	-	-	-	0.135
25	42	9	9	0.3	7.80	4.55	795	464	0.28	16000	19000	**6905**	-	-	-	-	-	-	N	NR	0.042
25	47	8	8	0.3	8.35	5.1	851	520	0.32	15000	18000	**16005**	-	-	-	-	-	-	-	-	0.06
25	47	12	12	0.6	11.20	5.85	1142	597	0.39	15000	18000	**6005**	Z	ZZ	-	LLH	-	RSS/LLUA1	-	-	0.088
25	47	12	12	0.6	11.20	5.85	1142	597	0.39	15000	18000	**TMB6005**	-	-	-	-	-	-	N	NR	0.088
25	52	9	9	0.6	11.60	6.5	1183	663	0.45	14000	17000	**98205**	-	-	-	-	-	-	-	-	0.085
25	52	15	15	1	15.50	7.85	1581	800	0.57	13000	15000	**6205**	Z	ZZ	-	-	LU	LLU/LLUA	-	-	0.129
25	52	15	15	1	15.50	7.85	1581	800	0.57	13000	15000	**TM6205**	Z	-	-	-	-	-	-	-	0.129
25	52	15	15	1	15.50	7.85	1581	800	0.57	13000	15000	**TMB6205**	-	-	-	-	-	-	-	-	0.129
25	52	15	15	1	17.87	7.85	1823	800	0.57	13000	15000	**ML6205**	-	-	-	-	-	-			0.129
25	52	18	18	1	14.10	7.8	1438	795	0.57	13000	15000	**62205**	-	-	-	-	-	-			

Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

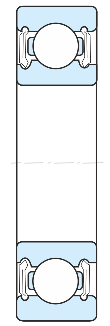
Single Row Deep Groove Ball Bearing (Metric series)



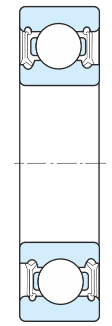
Open type



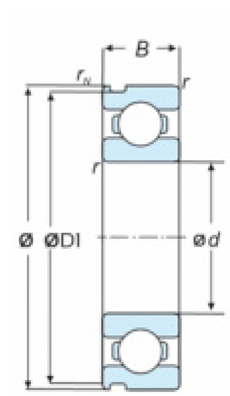
Shielded type (ZZ)



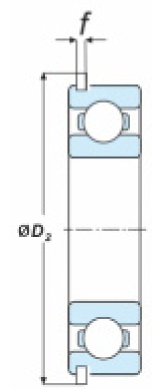
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$F\frac{F_a}{F_r} < e$ X	$F\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

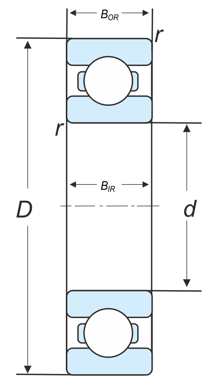
Static equivalent radial load

Por =0.6Fr+0.5Fa

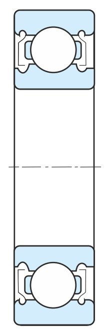
when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
mm					KN		Kgf		KN	rpm											
															Sealed Bearings*						
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	
25	52	12	12	0.6	15.20	18.05	1550	1841	0.63	9000	15000	**420205**	-	-	-	-	-	-	-	-	0.1
25	52	15	15	1	19.54	9.3	1992	948	0.76	13000	15000	**6205C**	Z	-	-	-	-	LLU/LLUA	N	-	0.128
25	52	15	15	1	19.54	9.3	1992	948	0.76	13000	15000	**TM6205C**	-	-	-	-	-	LLU	N	-	0.128
25	52	15	15	1	20.24	9.3	2064	948	0.76	13000	15000	**AST6205C**	-	-	-	-	-	LLU	N	-	0.128
25	52	15	15	1	20.24	9.3	2064	948	0.76	13000	15000	**ASTB6205C**	-	-	-	-	-	-	-	-	0.128
25	56	15	15	1.1	19.65	9.5	2003	969	0.75	16000	18000	**25X56X15**	Z	-	-	-	-	-	-	-	0.162
25	62	12	12	0.6	21.65	11.3	2207	1152	0.83	13500	16000	**1838001**	-	-	-	-	-	-	-	-	0.176
25	62	17	17	1.1	23.50	10.9	2396	1111	0.91	12000	14000	**6305**	Z	ZZ	-	-	LU	LLU	N	NR	0.225
25	62	17	17	1.1	23.50	10.9	2396	1111	0.91	12000	14000	**TMB6305**	-	-	-	-	-	LLU	-	NR	0.225
25	62	17	17	1.1	27.10	10.9	2763	1111	0.91	12000	14000	**ML6305**	-	-	-	-	-	-	-	-	0.225
25	62	14	14	0.2	17.70	10.3	1805	1050	0.68	6700	11400	**6007/25**	-	-	-	-	-	-	-	-	0.211
25	62	17	17	1.5	26.20	12.1	2671	1234	1.02	16000	18000	**6305CS**	Z	-	-	-	-	LLU/LLUA	NX	-	0.225
25	62	17	17	1.5	27.14	12.1	2768	1234	1.02	16000	18000	**AST6305CS**	-	-	-	-	-	-	-	-	0.225
25	68	12	12	0.6	22.64	11.1	2309	1132	0.89	14000	15000	**N1287**	-	-	-	-	-	-	-	-	

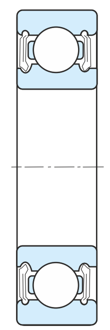
Single Row Deep Groove Ball Bearing (Metric series)



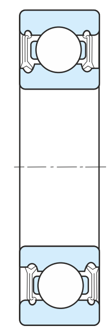
Open type



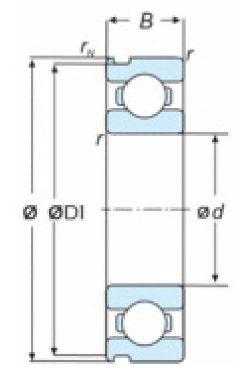
Shielded type (ZZ)



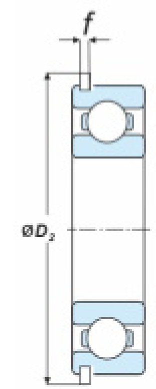
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

F_a / C_{or}	e	$\frac{F_a}{F_r} < e$ X	Y	$\frac{F_a}{F_r} > e$ X	Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

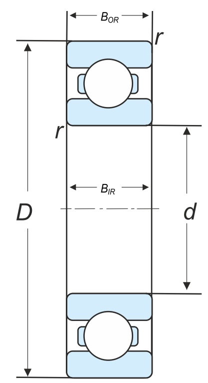
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

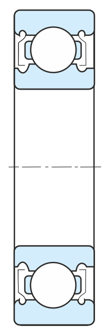
Boundry Dimensions (mm)					Basic Load Rating Dynamic (KN)	Static (KN)	Dynamic (Kgf)	Static (Kgf)	Fatigue Load Limit (KN)	Limiting Speed (rpm)		Bearing Numbers									Mass (Kg) (Approx)
															Sealed Bearings*						
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	
25	72	17	17	1.1	23.50	10.9	2396	1111	0.89	12000	14000	**SP72X25Xl7**	-	-	-	-	-	-	-	-	0.37
25	72	19	19	2	30.08	14.5	3067	1479	1.19	7700	13100	**6306/25**	-	-	-	-	LU	LLU	N	-	0.365
25	72	19	19	2	30.08	14.5	3067	1479	1.19	7700	13100	**TM6306/25**	-	-	-	-	-	LLU	N	-	0.365
25	72	19	19	2	31.17	14.5	3178	1479	1.19	7700	13100	**AST6306/25**	-	-	-	-	LU	-	-	-	0.365
25	52	15	15	1	20.09	9	2049	918	0.76	13000	15000	**G1362**	-	-	-	-	-	-	-	-	0.128
25	56	15	15	1	19.76	9.5	2015	969	0.75	12500	14500	**N1468**	-	-	-	-	-	-	-	-	0.152
25	62	17	17	0.3	26.20	12.1	2671	1234	1.02	12000	14000	**G1332**	-	-	-	-	-	-	-	-	0.229
25	62	17	17	1.1	29.19	13.5	2977	1377	1.12	12000	14000	**N1366**	-	-	-	-	-	-	-	-	0.224
25	62	17	17	1.8	26.20	12.1	2671	1234	1.02	12000	14000	**N1332**	-	-	-	LH1A	-	LLH1/LLH1A	NX	-	0.229
25	62	17	17	1.8	30.21	12.1	3080	1234	1.02	12000	14000	**MLN1332**	-	-	-	LH1A	-	LLH1A	NX	-	0.229
25	62	17	17	1.8	30.21	12.1	3080	1234	1.02	12000	14000	**MLBN1332**	-	-	-	-	-	-	-	-	0.229
25	62	19	19	0.4	26.20	12.1	2671	1234	1.02	12000	14000	**N1415**	-	-	-	-	-	LLU	NX	-	0.253
25	62	19	19	0.4	30.21	12.1	3080	1234	1.02	12000	14000	**MLBN1415**	-	-	-	-	-	LLU	N	-	0.253
25	64	17	17	0.5	24.75	11.5	2524	1173	0.98	11500	13500	**N1464**	-	-	-	-	-	-	-	-	

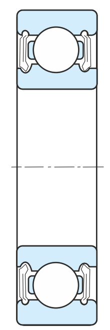
Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

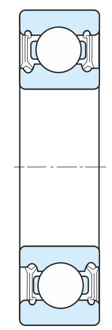
Single Row Deep Groove Ball Bearing (Metric series)

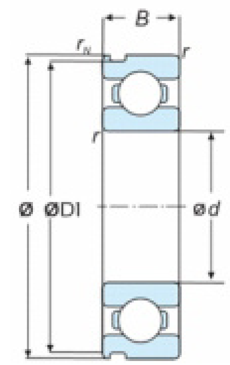


Open type

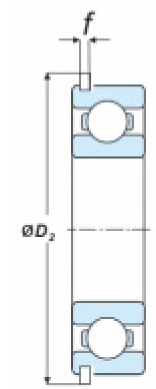

Shielded type (ZZ)


Sealed type (contact & non contact)


Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

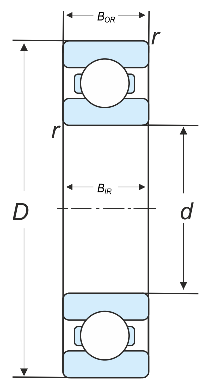
Static equivalent radial load

Por =0.6Fr+0.5Fa

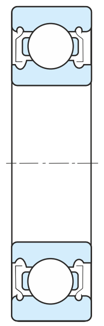
when Por<Fr use Por=Fr

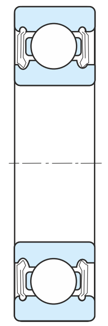
Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass
					Dynamic	Static	Dynamic	Static						Sealed Bearings*					
mm					KN		Kgf		KN	rpm									(Kg)
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	(Approx)
25	64	17	17	0.5	28.54	11.5	2911	1173	0.98	11500	13500	**MLN1464**	- -	-	RLLA	- -	-	N2R	0.26
25	68	18	18	0.3	29.60	14	3018	1428	1.16	11000	13000	**G1335**	- -	-	-	- -	-	-	0.312
25	68	18	18	0.3	29.60	14	3018	1428	1.16	11000	13000	**63/25LLUNX**	- -	-	-	- LLU	NX	-	0.302
25	80	21	21	1.5	38.50	17.6	3926	1795	1.47	10000	12000	**6405**	- -	-	-	LU -	-	-	0.536
25.5	72	19	19	1.1	27.10	14.5	2763	1479	1.19	10000	12000	**872489**	- -	-	-	- -	-	-	0.363
28	58	16	16	1	19.80	9.75	2019	994	0.74	12000	14000	**62/28**	- -	-	LLH/LLHA	- LLU	N	NR	0.171
28	58	16	16	1	19.80	9.75	2019	994	0.74	12000	14000	**TM62/28**	- -	-	LLHA	- -	-	-	0.171
28	68	18	18	1.1	29.60	14	3018	1428	1.18	11000	13000	**63/28**	- -	-	-	LU LLU	N	NR	0.293
28	68	18	18	1.1	30.67	14	3127	1428	1.18	11000	13000	**AST63/28**	- -	-	-	- -	-	-	0.293
28	68	17	17	1.1	29.60	14	3018	1428	1.18	11000	13000	**SP63/28**	- -	-	-	- -	-	-	0.254
28	72	18	18	1.5	28.53	15.4	2909	1570	1.13	9800	11000	**72x28x18**	- -	-	-	- -	-	-	0.35
28	72	18	18		24.64	14.6	2513	1489	0.98	9800	11000	**BB1087**	- -	-	-	- -	-	-	0.36
28	72	18	18		24.64	14.6	2513	1489	0.98	9800	11000	**TMBB1087**	- -	-	-	- -	-	-	0.36
30	47	9	9	0.3	8.00	4.9	816	500	0.29	14000	17000	**6906**	- -	-	-	- -	-	-	0.05

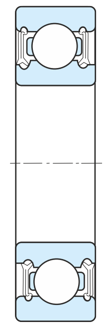
Single Row Deep Groove Ball Bearing (Metric series)

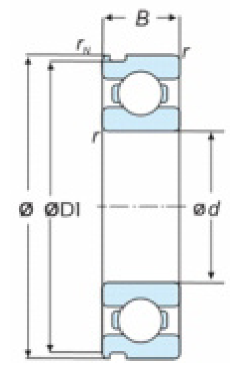


Open type

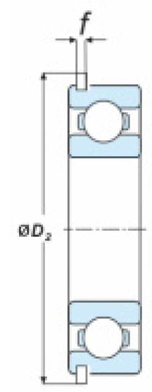

Shielded type (ZZ)


Sealed type (contact & non contact)


Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

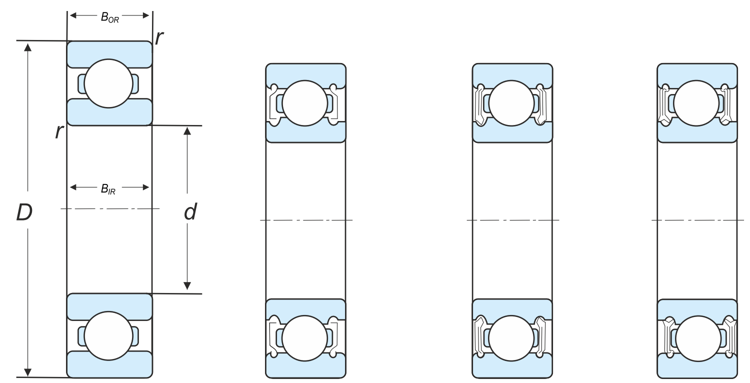
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

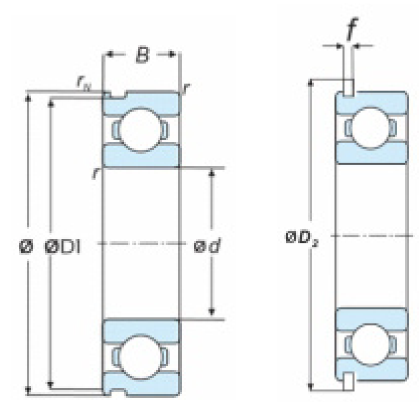
Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers										Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static														
mm					KN		Kgf		KN	rpm					Sealed Bearings*							
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	
30	55	13	13	1	14.70	8.3	1499	846	0.54	13000	15000	**6006**	Z	ZZ	LBRA	LLHA	LU	LLU	N	NR	0.116
30	55	13	13	1	16.95	8.3	1729	846	0.54	13000	15000	**MLB6006**	-	-	-	-	-	-	-	-	0.116
30	55	11	11	1	14.70	8.3	1499	846	0.54	13000	15000	**SP6006**	-	-	-	-	-	-	-	-	0.1
30	55	9	9	0.3	11.20	7.35	1142	749	0.37	13000	15000	**16006**	-	-	-	-	-	-	-	-	0.091
30	62	16	16	1	21.60	11.3	2203	1152	0.82	11000	13000	**6206**	Z	ZZ	-	LLH	RS	RSS	N	NR	0.201
30	62	16	16	1	25.97	12.8	2649	1305	1.03	11000	13000	**6206C**	-	-	-	-	LU	-	-	-	0.195
30	62	16	16	1	26.91	12.8	2744	1305	1.03	11000	13000	**AST6206C**	-	-	-	-	LU	-	-	-	0.195
30	62	16	16	1	26.91	12.8	2744	1305	1.03	11000	13000	**ASTB6206C**	-	-	-	-	-	-	-	-	0.195
30	62	20	20	1	19.50	11.3	1988	1152	1.03	7500	13000	**62206**	-	-	-	-	-	-	-	-	0.25
30	62	14	14	1	20.60	11.3	2101	1152	0.87	7500	13000	**420206**	-	-	-	-	-	-	-	-	0.18
30	72	19	19	1.1	30.08	14.5	3067	1479	1.19	10000	12000	**6306**	Z	ZZ	LLBR	LLH	LU	LLU	N	NR	0.334
30	72	19	19	1.1	30.08	14.5	3067	1479	1.19	10000	12000	**TM6306**	-	-	-	-	-	LLU	N	NR	0.334
30	72	19	19	1.1	31.17	14.5	3178	1479	1.19	10000	12000	**AST6306**	-	-	-	-	-	-	-	-	0.334
30	72	19	19	1.1	36.15	17.28	3687	1762	1.45	10000	12000	**6306C**	-	-	-	-	-	-	-		

Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

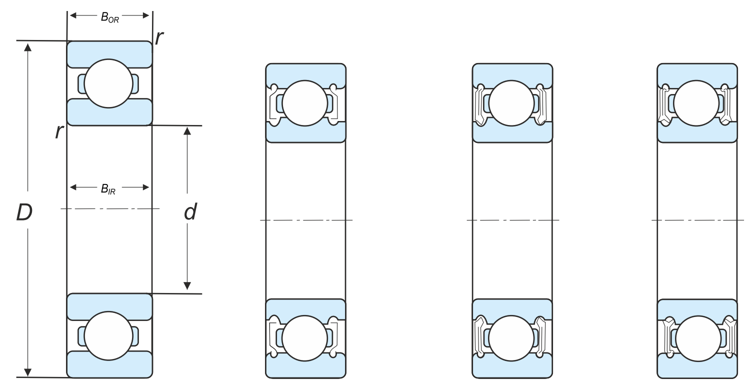
Static equivalent radial load

Por =0.6Fr+0.5Fa

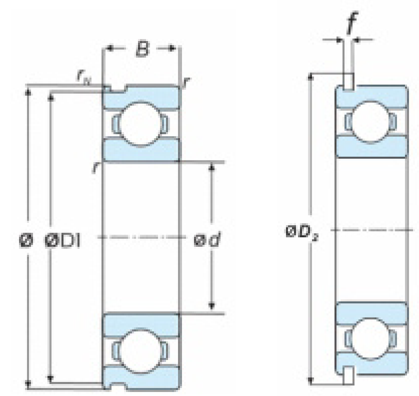
when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass
					Dynamic	Static	Dynamic	Static						Sealed Bearings*					(Kg)
mm					KN		Kgf		KN	rpm									(Approx)
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	
30	72	17	17	1.1	29.70	16.7	3029	1703	1.36	12000	14000	**420306**	-	- -	-	- -	-	-	0.3
30	72	21	21	1.1	36.15	17.28	3687	1762	1.45	15000	16000	**N1345**	-	- -	-	- LLU	N	-	0.35
30	72	21	21	1.1	37.46	17.28	3819	1762	1.45	15000	16000	**ASTN1345**	-	- -	LLH1	- LLU	N	-	0.35
30	90	23	23	1.5	45.07	22.8	4595	2325	1.84	7800	9200	**6406**	-	- -	-	- -	N	NR	0.698
30	90	23	23	1.5	51.97	22.8	5299	2325	1.84	7800	9200	**ML6406**	-	- -	-	- -	-	-	0.698
30	56	12	12	1.5/1.0	18.43	9.5	1879	969	0.69	13000	15000	**N1530**	-	- -	-	- -	-	-	0.108
30	56	12	12	1.5/1.0	19.09	9.5	1947	969	0.69	13000	15000	**ASTN1530**	-	- -	-	- -	-	-	0.108
30	56	13.5	13.5	1.5/1.0	18.43	9.5	1879	969	0.69	13000	15000	**N1626**	-	- -	-	- -	-	-	0.12
30	56	13.5	13.5	1.5/1.0	19.09	9.5	1947	969	0.69	13000	15000	**ASTN1626**	-	- -	-	- -	-	-	0.12
30	62	15	15	1.5/1.0	19.76	11	2015	1122	0.75	11000	13000	**N1424**	-	- -	-	- -	-	-	0.186
30	62	15	15	1.5/1.0	22.78	11	2323	1122	0.75	11000	13000	**MLN1424**	Z	- -	-	- -	-	-	0.189
30	62	16	16	1	21.60	11.3	2203	1152	0.82	11000	13000	**N1624**	-	- -	-	- LLH1	N	-	0.198
30	62	16	16	1	22.38	11.3	2282	1152	0.82	11000	13000	**ASTN1624**	-	- -	-	- LLH1	N	-	0.198
30	72	19	19	1.1	36.15	17.28	3687	1762	1.45	10000	12000	**N1392**	-	- -	-	- LLU	N	-	

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

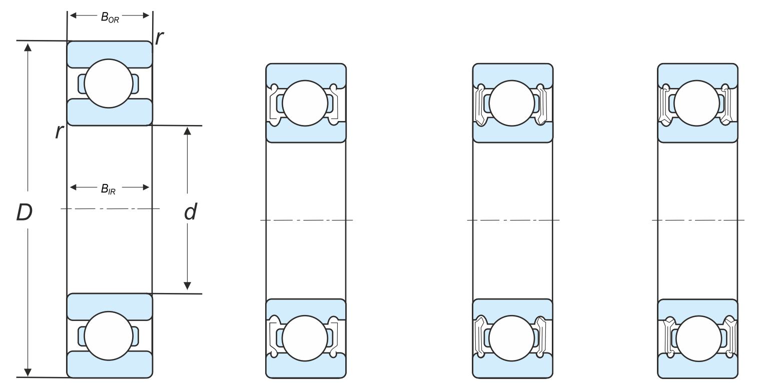
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

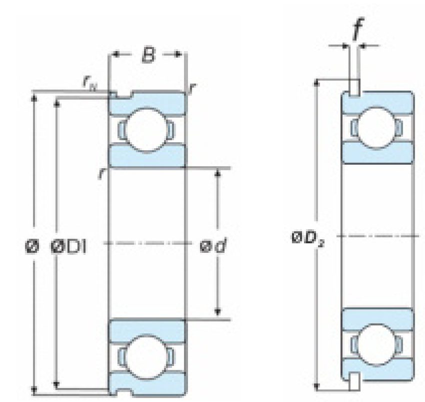
Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static							Sealed Bearings*						
mm					KN		Kgf		KN	rpm											
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	
34.991	72	15	18.5	1.5	28.40	15.3	2896	1560	1.12	9800	11000	**BB1103**	-	-	-	-	-	-	-	-	0.3
35	62	9	9	0.3	11.70	8.2	1193	836	0.42	12000	14000	**16007**	-	-	-	-	-	-	-	-	0.11
35	62	14	14	0.5	17.70	10.3	1805	1050	0.66	12000	14000	**6007**	Z	ZZ	-	-	RS	RSS	N	NR	0.154
35	62	14	14	0.5	17.70	10.3	1805	1050	0.66	12000	14000	**TM6007**	-	-	-	-	-	-	-	NR	0.154
35	62	14	14	0.5	17.70	10.3	1805	1050	0.66	12000	14000	**TMB6007**	-	-	-	-	-	-	-	-	0.154
35	62	14	14	0.5	20.41	10.3	2081	1050	0.66	12000	14000	**MLB6007**	-	-	-	-	-	-	-	-	0.154
35	62	14	14	0.5	17.70	10.3	1805	1050	0.66	12000	14000	**6007SPL**	-	-	-	-	-	RSS	-	-	0.154
35	72	17	17	1.1	28.40	15.3	2896	1560	1.12	9800	11000	**6207**	Z	ZZ	-	-	LU	LLU	N	NR	0.28
35	72	17	17	1.1	28.40	15.3	2896	1560	1.12	9800	11000	**TM6207.PX1**	-	-	-	-	-	-	-	-	0.28
35	72	17	17	1.5	28.40	15.3	2896	1560	1.12	9800	11000	**TMB6207X19**	-	-	-	-	-	LLU	-	-	0.28
35	72	17	17	1.1	32.75	15.3	3340	1560	1.12	9800	11000	**ML6207**	-	ZZ	-	-	-	LLU/LLH1	N	NR	0.28
35	72	17	17	1.5	28.40	15.3	2896	1560	1.12	9800	11000	**6207RO**	-	-	-	-	-	-	-	-	0.286
35	72	23	23	1.1	25.50	15.2	2600	1550	1.12	6300	11000	**62207**	-	-	-	-	-	-	-	-	0.39
35	80	21	21	1.5	37.00	19.2	3773	1958	1.51	8800	10000	**6307**	Z	ZZ	LLBR	LLH/LLH1	LU	LLU	N	NR	

Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

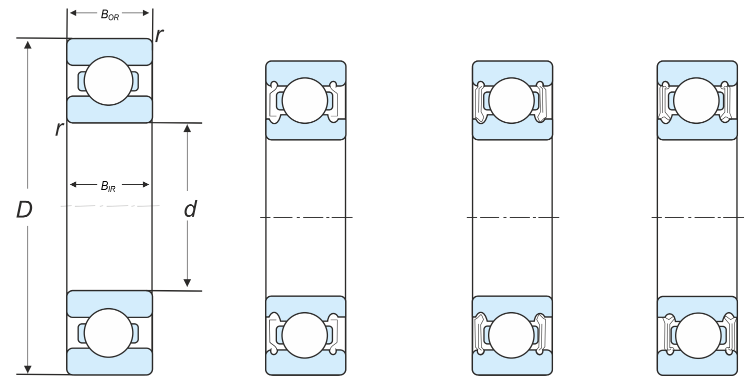
Static equivalent radial load

Por =0.6Fr+0.5Fa

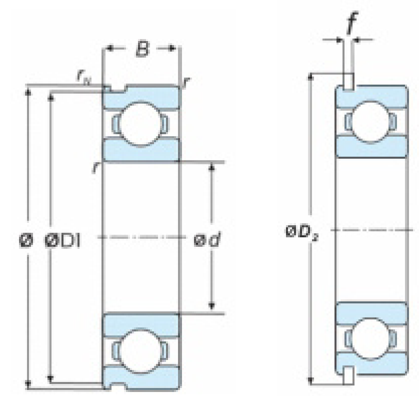
when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass
					Dynamic	Static	Dynamic	Static						Sealed Bearings*					(Kg)
mm					KN		Kgf		KN	rpm									(Approx)
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	
35	80	21	21	1.5	42.67	19.2	4351	1958	1.51	8800	10000	**ML6307**	- -	-	-	- LLU	NX	-	0.459
35	80	26	21	1.5	37.00	19.2	3773	1958	1.51	8800	10000	**SP6307**	- -	-	-	- LLU	-	-	0.483
35	80	21	21	1.5	37.00	19.2	3773	1958	1.51	8800	10000	**CR-6307**	- -	-	-	- LLU	-	-	0.445
35	80	21	21	1.5	38.33	19.2	3909	1958	1.51	8800	10000	**ASTBCR-6307**-	-	-	-	- LLU	-	-	0.445
35	100	25	25	1.5	53.61	27.8	5467	2835	2.25	7800	9100	**6407**	- -	-	-	- -	-	-	0.925
35	72	15	15	1.5	22.20	13.8	2264	1407	0.88	9800	11000	**N1201**	- -	-	-	- -	-	-	0.277
35	72	15	15	1.5	22.20	13.8	2264	1407	0.88	9800	11000	**TMN1201**	- -	-	-	- -	-	-	0.277
35	72	15	15	1.5	25.60	13.8	2610	1407	0.88	9800	11000	**MLN1201.PX1**-	-	-	-	- -	-	-	0.277
35	72	21	21	1.1	31.41	16	3203	1632	1.25	9800	11000	**N1485**	- -	-	-	- LLH1A	N	-	0.335
35	85	23	23	1.5	40.88	21.3	4169	2172	1.70	8500	9800	**N1206LLU**	- -	-	-	- LLU	-	-	0.623
35	90	25	25	1.5	49.40	26.2	5037	2672	2.13	8300	9500	**N1412**	- -	-	-	- LLU	-	-	0.697
35	90	25	25	1.5	56.96	26.2	5808	2672	2.13	8300	9500	**MLBN1412**	- -	-	-	- LLU	-	-	0.697
36	64	12	12	1.5/1.0	19.87	11.1	2026	1132	0.74	12000	14000	**N1506**	- -	-	-	- -	-	-	0.133
36	64	12	12	1.5/1.0	22.91	11.1	2336	1132	0.74	12000	14000	**MLN1506**	- -	-	-	- -	-		

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

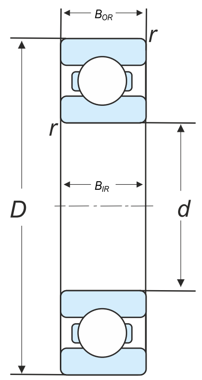
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

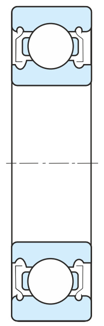
Boundry Dimensions (mm) d	D	B_{IR}	B_{OR}	r_{smin}	Basic Load Rating Dynamic (KN) C_r	Static (KN) C_{or}	Dynamic (Kgf) C_r	Static (Kgf) C_{or}	Fatigue Load Limit (KN) C_u	Limiting Speed (rpm) Grease	Oil	Bearing Numbers Open type	Shield Type		Sealed Bearings* Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	Mass (Kg) (Approx)
40	58	12	12	0.6	11.42	7.91	1165	807	0.45	11000	13000	**N1305**	-	-	-	-	-	-	-	-	0.084
40	62	12	12	0.6	15.21	10	1551	1020	0.59	10000	12000	**6908**	-	-	-	-	-	-	-	-	0.11
40	68	9	9	0.3	11.10	8.55	1132	872	4.60	10000	12000	**16008**	-	-	-	-	-	-	-	-	0.13
40	68	15	15	1	18.60	11.5	1897	1173	0.71	10000	12000	**6008**	-	ZZ	-	-	-	LLU	N	NR	0.195
40	68	15	15	1	21.45	11.5	2187	1173	0.71	10000	12000	**ML6008**	-	ZZ	-	-	-	-	-	-	0.195
40	80	18	18	1.1	32.50	18	3314	1835	1.27	8700	10000	**6208**	Z	ZZ	-	LLHA	LU	LLU	N	NR	0.357
40	80	18	18	1.1	32.50	18	3314	1835	1.27	8700	10000	**TM6208**	-	-	-	LLHA	-	-	N	-	0.357
40	80	18	18	1.1	32.50	18	3314	1835	1.27	8700	10000	**TMB6208**	-	-	-	-	-	LLU	N	-	0.357
40	80	18	18	1.1	33.67	18	3434	1835	1.27	8700	10000	**AST6208**	-	-	-	-	-	-	-	-	0.357
40	80	18	18	1.1	37.48	18	3822	1835	1.27	8700	10000	**ML6208**	-	-	-	-	-	-	-	-	0.357
40	80	18	18	1.1	29.10	18	2967	1835	1.27	8700	10000	**6208K**	-	-	-	-	-	-	-	-	0.363
40	85	18	18	1.1	32.50	18	3314	1835	1.26	11000	12000	**40X85X18**	-	-	-	-	-	-	NX	NXR	0.467
40	90	23	23	1.5	45.07	22.9	4595	2335	1.84	7800	9200	**6308**	Z	ZZ	-	LLH	RSS/LU	LLU	N	NR	0.599

Note: 1.* All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell

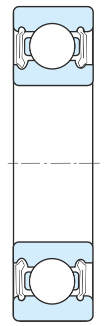
Single Row Deep Groove Ball Bearing (Metric series)



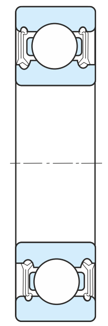
Open type



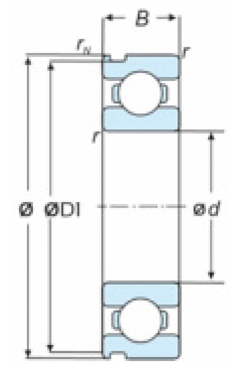
Shielded type (ZZ)



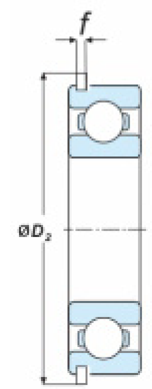
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

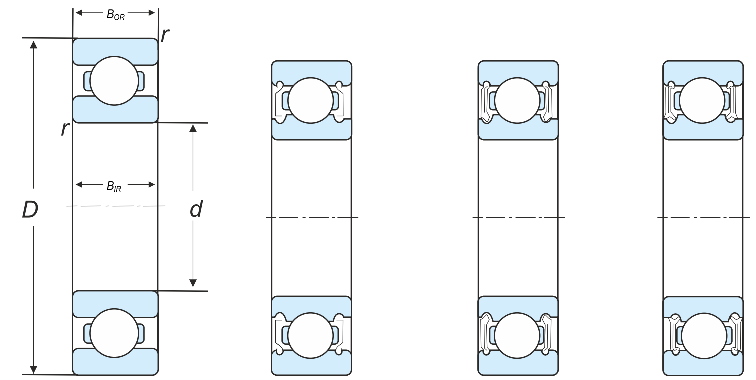
Static equivalent radial load

Por =0.6Fr+0.5Fa

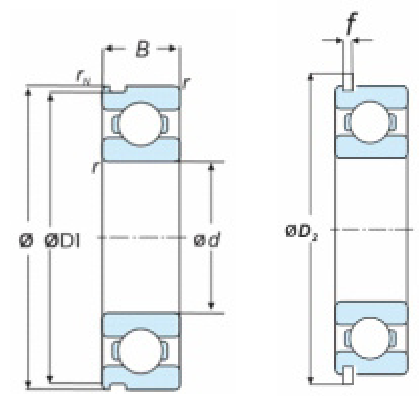
when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
mm					KN		Kgf		KN	rpm					Sealed Bearings*						
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Non Contact Type	Low Torque Type	Contact Type		Snap Ring Groove	Snap Ring	
40	90	23	23	1.5	51.97	22.9	5299	2335	1.84	7800	9200	**ML6308**	-	-	-	-	-	-	-	-	0.599
40	90	23	23	1.5	49.17	26	5014	2651	2.11	7800	9200	**6308C**	-	-	-	-	-	LLU	-	-	0.62
40	90	23	23	1.5	56.70	26	5782	2651	2.11	7800	9200	**ML6308C**	-	-	-	-	-	-	-	-	0.62
40	90	23	23	1.5	45.07	22.9	4595	2335	2.11	7800	9200	**6308RO**	-		-	-	-		-	-	0.665
40	90	23	23	1.5	56.61	28	5773	2855	2.37	11000	13000	**N1334**	-	-	-	-	-	-	N	-	0.538
40	90	23	23	1.5	58.65	28	5981	2855	2.37	11000	13000	**ASTBN1334**	-	-	-	-	-	-	N	-	0.538
40	110	27	27	2	61.90	38	6312	3875	3.07	7000	8200	**6408**	-	-	-	-	-	-	N	NR	1.21
40	100	25	25	1.5	58.50	32	5965	3263	2.57	7400	8400	**N1451**	-	-	-	-	-	-	-	-	0.897
42.025	90	23	23	0.6/1.5	45.18	24	4607	2447	1.87	7800	9200	**N1270**	-	-	-	RSS	-	-	N	-	0.548
45	75	16	16	1	23.20	15.1	2366	1540	0.93	9200	11000	**6009**	Z	ZZ	-	-	-	LLU/LLUA	N	NR	0.237
45	75	16	16	1	26.75	15.1	2728	1540	0.93	9200	11000	**ML6009**	-	-	-	-	-	-	-	-	0.237
45	75	12	12	1	23.20	15.1	2366	1540	0.93	9200	11000	**SP6009**	-	-	-	-	-	-	-	-	0.2
45	85	19	19	1.1	36.00	20.5	3671	2090	1.44	7800	9200	**6209**	Z	ZZ	-	-	LU	LLU	N	NR	0.4
45	85	19	19	1.1	36.00	20.5	3671	2090	1.44	7800	9200	**TM6209**	-	-	-	-	-	-	N	-	0.4

Single Row Deep Groove Ball Bearing (Metric series)



Open type | Shielded type (ZZ) | Sealed type (contact & non contact) | Low torque seal



With snap ring groove | With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

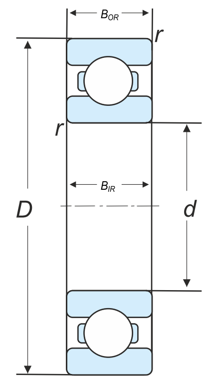
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

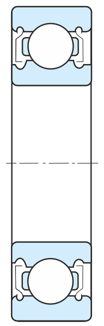
Boundry Dimensions (mm)					Basic Load Rating Dynamic (KN)	Basic Load Rating Static (KN)	Basic Load Rating Dynamic (Kgf)	Basic Load Rating Static (Kgf)	Fatigue Load Limit (KN)	Limiting Speed (rpm)		Bearing Numbers									Mass (Kg) (Approx)
d	D	B IR	B OR	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Sealed Bearings* Non Contact Type	Sealed Bearings* Low Torque Type	Sealed Bearings* Contact Type		Snap Ring Groove	Snap Ring	
45	85	19	19	1.1	32.70	20.5	3334	2090	1.44	7800	9200	**6209K**	-	-	-	-		-	-	-	0.41
45	100	25	25	1.5	58.50	32	5965	3263	2.54	7000	8200	**6309**	Z	ZZ	-	LLH/LLHA	-	LLU	N	NR	0.825
45	100	25	25	0.3	58.50	32	5965	3263	2.54	7000	8200	**TMB6309X19**	-	-	-	LLHA	-	-	-	-	0.825
45	100	25	25	1.5	67.46	32	6879	3263	2.54	7000	8200	**ML6309**	-	-	-	-	-	-	-	-	0.825
45	120	29	29	1.1	71.50	44.4	7291	4528	3.58	6300	7400	**6409**	-	-	-	-	-	-	-	-	1.55
45	68	12	12	0.6	14.50	10.86	1479	1107	0.62	4000	5500	**6909**	-	-	-	-	LUA	LLUA		-	0.126
50	80	10	10	0.6	14.70	11.3	1499	1152	0.61	8400	9800	**16010**	-	-	-	-	-	-	-	-	0.19
50	80	16	16	1	24.20	16.6	2468	1693	0.99	8400	9800	**6010**	Z	-	-	-	LU	LLU/LLUA	N	NR	0.262
50	80	16	16	1	27.91	16.6	2846	1693	0.99	8400	9800	**ML6010**	-	-	-	-	-	-	-	-	0.262
50	90	20	20	1.1	39.00	23.2	3977	2366	1.58	7100	8300	**6210**	Z	ZZ	-	LLHA	LU	LLU	N	NR	0.457
50	90	20	20	1.1	39.00	23.2	3977	2366	1.58	7100	8300	**TM6210**	-	-	-	-	LU	-	-	NR	0.457
50	90	20	20	1.1	39.00	23.2	3977	2366	1.58	7100	8300	**TMB6210**	-	-	-	-	LU	-	-	NR	0.457
50	90	20	20	1.1	35.00	23.2	3569	2366	1.58	7100	8300	**6210K**	-	-	-	-	-	-	-	-	0.46
50	110	27	27	2	68.50	38	6985	3875	3.02	6400	7500	**6310**	Z	-	LBRA	-	LU	LLU	N	NR	1.065

Note: 1. * All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell.

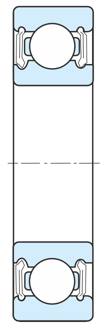
Single Row Deep Groove Ball Bearing (Metric series)



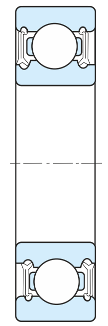
Open type



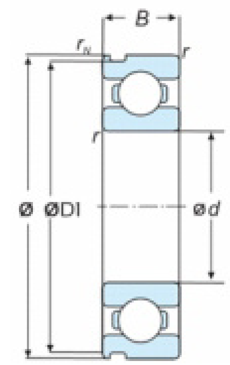
Shielded type (ZZ)



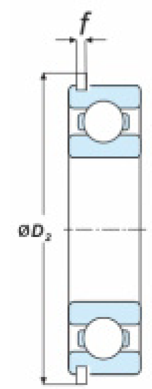
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

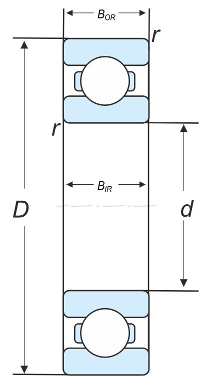
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

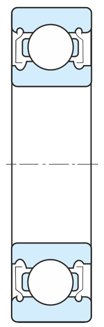
Boundry Dimensions (mm)					Basic Load Rating Dynamic (KN)	Basic Load Rating Static (KN)	Basic Load Rating Dynamic (Kgf)	Basic Load Rating Static (Kgf)	Fatigue Load Limit (KN)	Limiting Speed (rpm)		Bearing Numbers									Mass (Kg) (Approx)
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type		Sealed Bearings* Non Contact Type	Sealed Bearings* Low Torque Type	Sealed Bearings* Contact Type		Snap Ring Groove	Snap Ring	
50	130	31	31	2.1	92.28	55.13	9410	5622	3.40	5700	6700	**6410**	-	-	-	-	-	-	-	-	1.9
55	80	13	13	1	17.70	13.3	1805	1356	0.73	8200	9600	**6911**	-	ZZ	-	-	-	-	-	-	0.19
55	90	18	18	1.1	31.50	21.3	3212	2172	1.29	7700	9000	**6011**	-	-	-	-	-	LLU	-	-	0.39
55	100	21	21	1.5	48.00	29.3	4895	2988	2.00	6400	7600	**6211**	Z	ZZ	-	-	LU	LLU	N	NR	0.597
55	100	21	21	1.5	48.00	29.3	4895	2988	2.00	6400	7600	**6211RO**	-	-	-	-	-	-	-	-	0.607
55	100	21	21	1.5	43.40	29.3	4426	2988	2.00	6400	7600	**6211K**	-	ZZ	-	-	-	-	-	-	0.607
55	120	29	29	2	79.50	44.4	8107	4528	3.53	5800	6800	**6311**	Z	ZZ	-	-	LU	LLU	-	-	1.372
55	120	29	29	2	82.36	44.4	8399	4528	3.53	5800	6800	**AST6311**	-	-	-	-	-	-	-	NR	1.375
55	130	31	31	1.5	97.46	52.4	9938	5343	4.42	9000	10000	**N1336**	-	-	LLBA	-	-	-	-	-	1.79
55	130	31	31	1.5	100.97	52.4	10296	5343	4.42	9000	10000	**ASTN1336**	-	-	LLBA	-	-	-	-	-	1.79
55	140	33	33	2.1	93.55	56.5	9539	5761	3.90	5200	6100	**6411**	-		-	-	-	-	-	-	2.3
60	85	13	13	1	16.40	14.2	1672	1448	0.70	7600	8900	**6912**	-	-	-	-	-	RSS	-	-	0.19
60	95	18	18	1.1	35.14	24.22	3584	2470	1.19	7000	8300	**6012**	-	-	-	-	-	-	-	-	0.414
60	95	11	11	0.6	22.10	17.5	2254	1785	0.96	6000	7000	**16012**	-	-	-	-	-	-	-	-	0.285

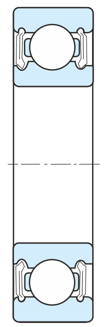
CKA Birla Group | nbc

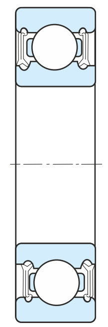
Single Row Deep Groove Ball Bearing (Metric series)

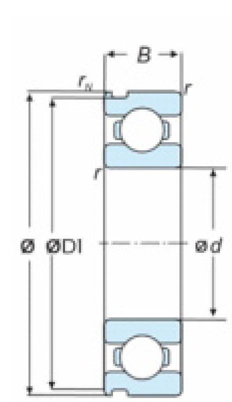


Open type

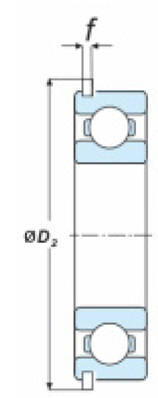

Shielded type (ZZ)


Sealed type (contact & non contact)


Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

Por =0.6Fr+0.5Fa

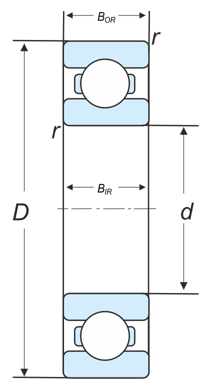
when Por<Fr use Por=Fr

Boundry Dimensions (mm)					Basic Load Rating: Dynamic (KN)	Static (KN)	Dynamic (Kgf)	Static (Kgf)	Fatigue Load Limit (KN)	Limiting Speed (rpm)		Bearing Numbers							Mass (Kg) (Approx)
d	D	B IR	B OR	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Sealed Bearings*: Non Contact Type	Sealed Bearings*: Low Torque Type	Sealed Bearings*: Contact Type	Snap Ring Groove	Snap Ring	
60	110	22	22	1.5	52.95	32.9	5399	3355	2.21	6000	7000	**6212**	Z ZZ	-	-	LU LLU	N	NR	0.769
60	110	22	22	1.5	61.06	32.9	6226	3355	2.21	6000	7000	**ML6212**	- -	-	-	- -	-	-	0.769
60	110	22	22	1.5	52.95	32.9	5399	3355	2.21	6000	7000	**6212RO**	- -	-	-	- -	-	-	0.769
60	110	22	22	1.5	47.70	32.9	4864	3355	2.21	6000	7000	**6212K**	- ZZ	-	-	- -	-	-	0.769
60	130	31	31	2.1	90.50	52	9228	5303	4.09	5400	6300	**6312**	Z ZZ	-	-	- -	-	-	1.689
60	150	35	35	2.1	109.20	70.3	11135	7169	4.43	4800	5700	**6412**	-	-	-	- -	-	-	2.8
65	90	13	13	1	22.20	17.5	2264	1785	0.95	5000	6000	**6913**	- -	-	-	- -	-	-	0.216
65	100	18	18	1.5	34.00	25.2	3467	2570	1.46	6500	7700	**6013**	Z -	-	LLH	- LLU/LLUA	-	NR	0.425
65	100	11	11	0.6	22.70	18.6	2315	1897	0.45	5000	6000	**16013**	- -	-	-	- -	-	-	0.297
65	120	23	23	1.5	63.50	40.1	6475	4089	2.71	5500	6500	**6213**	Z ZZ	-	-	- -	N	NR	0.98
65	125	23	23	1.5	63.50	40.1	6475	4089	2.69	5500	6500	**6213/125**	- ZZ	-	-	- RSS/LLU	-	-	1.17
65	125	23	23	1.5	63.50	40.1	6475	4089	2.69	5500	6500	**TMB6213/125**	- -	-	-	- RSS	-	-	1.17
65	140	33	33	2.1	103.00	59.8	10503	6098	4.68	4900	5800	**6313**	Z ZZ	-	-	LU LLU	-	NR	2.091

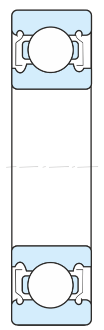
Note: 1. * All types of seals options can be made available, for more information contact us.

2. For snap groove & ring details contact NEI technical cell.

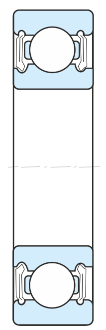
Single Row Deep Groove Ball Bearing (Metric series)



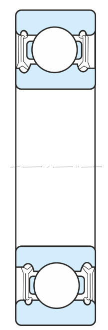
Open type



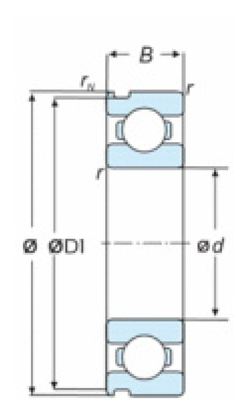
Shielded type (ZZ)



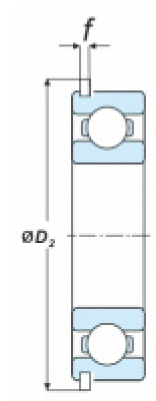
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$ X	$\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

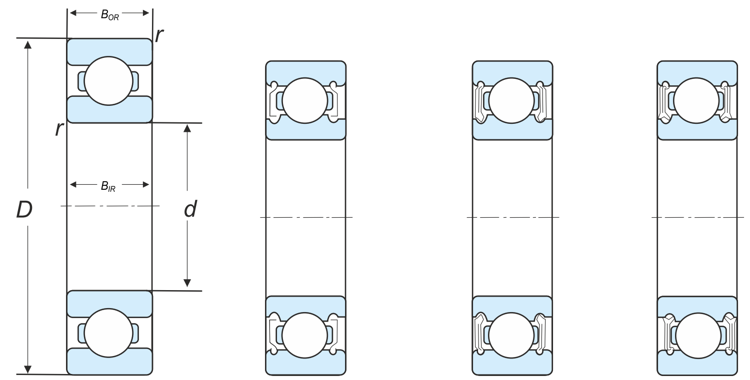
Static equivalent radial load

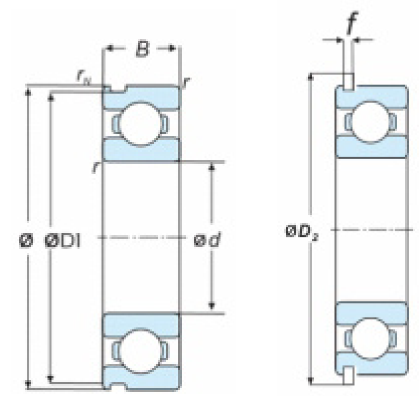
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static											
mm					KN		Kgf		KN	rpm				Sealed Bearings*					
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	
65	90	13	13	1.6	22.20	17.5	2264	1785	0.96	5000	6000	**N1364**	- -	-	-	- -	-	-	0.208
65	100	23.7	23.7	1.5	29.75	21.8	3033	2223	1.37	5000	6000	**N1264**	- -	-	RSSA1	- -	-	-	0.625
70	100	16	16	1	26.30	21.1	2682	2152	1.16	6500	7700	**6914**	- -	-	-	- -	-	-	0.334
70	110	20	20	1.1	42.00	30.8	4283	3141	1.83	6100	7100	**6014**	- -	-	-	- LLUA	N	NR	0.587
70	125	24	24	1.5	69.00	44.1	7036	4497	2.97	5100	6000	**6214**	- -	-	-	- -	-	-	1.056
70	150	35	35	2.1	115.00	68.04	11727	6938	5.32	4600	5400	**6314**	- ZZ	-	-	- -	-	-	2.61
70	110	13	13	0.6	27.89	25	2844	2551	1.38	6000	7000	**16014**	- -	-	-	- -	-	-	0.44
75	115	20	20	1.1	40.18	33.18	4097	3383	1.95	5700	6700	**6015**	- ZZ	-	-	- RSS	-	-	0.649
75	130	25	25	1.5	68.93	44.9	7029	4579	2.94	4800	5600	**6215**	- -	-	-	- -	-	-	1.139
75	130	25	25	1.5	66.10	49.5	6740	5048	2.94	4800	5600	**6215K**	- -	-	-	- -	-	-	1.2
75	160	37	37	2.1	126.00	76.97	12848	7849	6.00	4300	5000	**6315**	- -	-	-	- RSS	-	-	3.13
80	125	22	22	1.1	53.00	40	5405	4079	2.35	5200	6100	**6016**	- -	-	-	- LLU	-	-	0.861
80	140	26	26	2	71.55	54.3	7296	5537	3.84	4500	5300	**6216**	- -	-	-	- -	-	-	1.4
80	170	39	39	2.1	122.70	86.5	12512	8821	6.72	4000	4700	**6316**	- ZZ	-	-	- RSS	-	-	3.59

Single Row Deep Groove Ball Bearing (Metric series)





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$F\frac{F_a}{F_r} < e$ X	$F\frac{F_a}{F_r} < e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass
					Dynamic	Static	Dynamic	Static						Sealed Bearings*					(Kg)
mm					KN		Kgf		KN	rpm									(Approx)
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	
80	150	28	28	2	92.69	64	9451	6526	4.19	4200	5000	**N1390**	- -	-	-	- -	-	-	1.972
85	130	22	22	2	47.30	40.15	4823	4094	2.34	4200	5000	**6017**	- -	-	-	- -	-	-	0.92
85	150	28	28	2	83.20	64	8484	6526	4.17	4200	5000	**6217**	- -	-	-	- -	-	-	1.8
85	150	28	28	2	83.20	64	8484	6526	4.17	4200	5000	**6217K**	- -	-	-	- -	-	-	1.8
85	180	41	41	3	132.42	96.59	13503	9849	7.48	3800	4500	**6317**	- ZZ	-	-	- -	-	-	4.23
90	140	24	24	1.5	58.00	49.8	5914	5078	2.94	4700	5600	**6018**	- -	-	-	- -	-	-	1.02
90	160	30	30	2	95.98	71.46	9787	7287	4.81	4000	4700	**6218**	- -	-	-	- -	-	-	2.15
90	190	43	43	3	142.33	107.23	14514	10934	8.28	3600	4200	**6318**	- ZZ	-	-	- -	-	-	4.91
95	145	24	24	1.5	60.00	53.8	6118	5486	2.92	4500	5300	**60I9**	- -	-	-	- -	-	-	1.08
95	200	45	45	3	156.36	121.98	15944	12439	9.12	3300	3900	**6319**	- -	-	-	- -	-	-	5.67
100	150	24	24	1.5	64.46	56.13	6573	5724	3.11	4200	5000	**6020**	- ZZ	-	-	- -	-	-	1.15
100	180	34	34	2.1	122.14	92.72	12455	9455	6.30	3500	4200	**6220**	- -	-	-	- -	-	-	3.14
100	215	47	47	3	172.65	140.4	17605	14316	11.01	3200	3700	**6320**	- ZZ	-	-	- -	-	-	7
100	150	16	16	1	45.00	45	4589	4589	2.00	4000	5000	**16020M**	- -	-	-	- -	-	-	1

Note: 1. * All types of seals options can be made available, for more information contact us.

2. For snap groove & ring details contact NEI technical cell.

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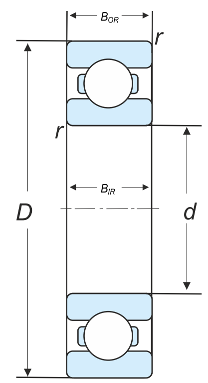
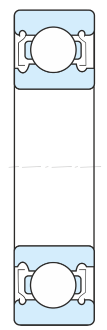
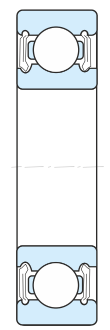
Single Row Deep Groove Ball Bearing (Metric series)



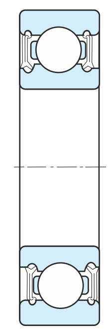
Open type



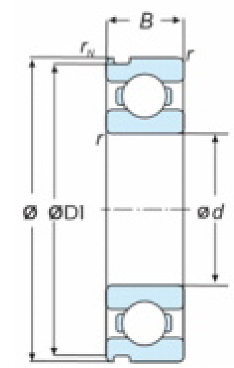
Shielded type (ZZ)



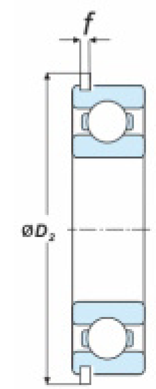
Sealed type (contact & non contact)



Low torque seal



With snap ring groove



With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$F\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

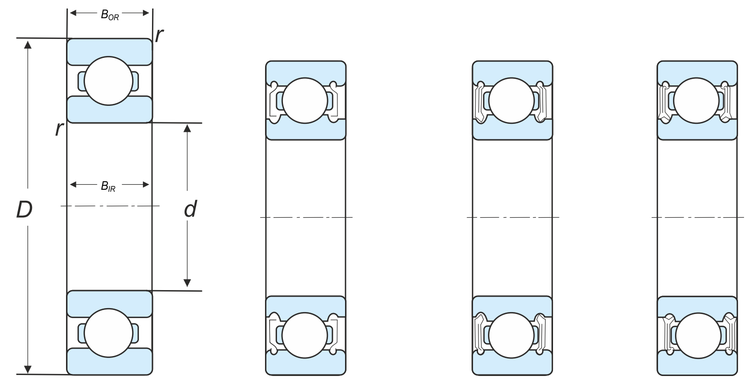
Static equivalent radial load

Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static											
mm					KN		Kgf		KN	rpm									
														Sealed Bearings*					
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	
105	160	26	26	2	71.90	63.36	7332	6461	3.57	4000	4700	**6021**	- -	-	-	- -	-	-	1..59
105	225	49	49	3	240.00	154	24473	15704	7.70	2900	3500	**6321**	- -	-	-	- -	-	-	8.05
110	170	28	28	2	81.80	72.8	8341	7424	4.30	3800	4500	**6022**	- -	-	-	- -	-	-	1.9
110	200	38	38	2.1	110.82	100.43	11301	10241	7.06	3200	3800	**6222**	- -	-	-	- -	-	-	4.36
110	240	50	50	3	204.90	178.3	20894	18182	14.13	2900	3400	**6322**	- -	-	-	- -	-	-	8
120	215	40	40	2.1	155.00	131	15806	13358	8.87	2900	3400	**6224**	- -	-	-	- -	-	-	5.3
120	260	55	55	3	207.00	185	21108	18865	16.35	2600	3100	**6324**	- -	-	-	- -	-	-	12.4
120	180	19	19	1	63.00	63.5	6424	6475	3.20	3500	4000	**16024M**	- -	-	-	- -	-	-	2
130	230	40	40	3	167.00	146	17029	14888	7.78	2700	3100	**6226**	- -	-	-	- -	-	-	5.82
130	280	58	58	4	229.00	214	23352	21822	9.80	2300	2700	**6326**	- -	-	-	- -	-	-	15.2
140	250	42	42	3	179.10	167	18263	17029	9.64	2500	2900	**6228**	- -	-	-	- -	-	-	7.68
150	320	65	65	4	278	284	28348	28960	13.1	2000	2300	**6330 C3**	- -	-	-	- -	-	-	21.4
150	225	35	35	2.1	132	125	13460	12747	5.50	2700	3200	**6030M**	- -	-	-	- -	-	-	5.5
150	270	45	45	3	182	205	18559	20904	7.90	2200	2600	**6230**	- -	-	-	- -	-	-	

Single Row Deep Groove Ball Bearing (Metric series)

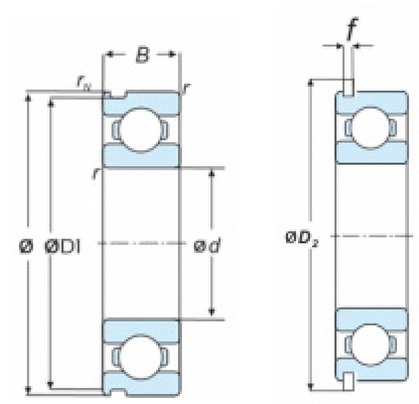


Open type

Shielded type (ZZ)

Sealed type (contact & non contact)

Low torque seal



With snap ring groove

With snap ring

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30	1	0	0.56	1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers							Mass
					Dynamic	Static	Dynamic	Static											
mm					KN		Kgf		KN	rpm									(Kg) (Approx)
														Sealed Bearings*					
d	D	B IR	B OR	r_{smin}	C_r	C_{or}	C_r	C_{or}	C_u	Grease	Oil	Open type	Shield Type	Non Contact Type	Low Torque Type	Contact Type	Snap Ring Groove	Snap Ring	
160	240	38	38	2.1	143.00	144	14582	14684	5.65	2500	3000	**6032M13**	- -	-	-	- -	-	-	6
160	240	25	25	1.5	95.00	105	9687	10707	4.68	2500	3000	**16032M**	- -	-	-	- -	-	-	4
170	310	52	52	4	228	239	23250	24371	9.60	2000	2300	**6234C3**	- -	-	-	- -	-	-	15.4
170	260	42	42	2.1	161	160	16417	16316	7.55	2300	2800	**6034**	- -	-	-	- -	-	-	7.8
180	280	46	46	2.1	189.00	199	19273	20292	8.31	2300	2700	**6036M**	- -	-	-	- -	-	-	10.5
200	250	24	24	1.5	76	100	7750	10197	3.37	2300		**61840**	- -	-	-	- -	-	-	2.75
200	360	58	58	4	250	300	25493	30592	12.6	1650	1900	**6240M**	- -	-	-	- -	-	-	27
220	400	65	65	4	275.00	340	28042	34670	13.67	1500	1800	**6244**	- -	-	-	- -	-	-	30.4
240	360	56	56	3	250	310	25493	31611	11.45	1700	1900	**6048MB**	- -	-	-	- -	-	-	21

Note: 1. * All types of seals options can be made available, for more information contact us.
2. For snap groove & ring details contact NEI technical cell.

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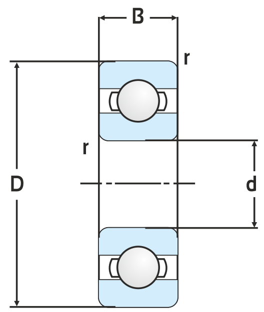
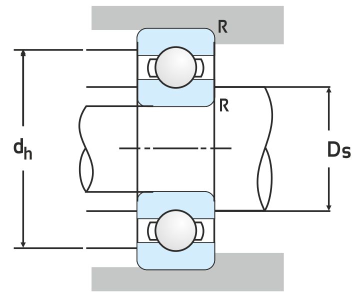
Single Row Deep Groove Ball Bearing (Inch series)





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \leq e$ X	$\frac{F_a}{F_r} \leq e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions				Basic Load Rating				Bearing Number	Fatigue Load Limit	Limiting Speed		Abutment and Fillet Dimension (mm)			Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static								
mm/inch				KN		Kgf			KN	rpm					
d	D	B	rmin	Cr	Cor	Cr	Cor		Cu	Grease	Oil	dh	Ds	R	
9.525	222.3	5.556	0.40	2.49	1.11	254	113	**S3**	0.11	32000	44000	12.7	18.3	0.3	0.01
0.3750	0.8750	0.2188	0.02												
12.7	28.56	6.35	0.40	4.03	2.01	411	205	**S5**	0.15	23500	27000	17.5	23.8	0.3	0.019
0.5000	1.1250	0.2500	0.02												
	33.33	9.525	0.80	6.1	2.75	622	280	**LS5**	0.16	20000	24000	17.5	29.5	0.5	0.037
	1.313	0.375	0.03												
15.88	34.93	7.145	0.80	5.55	2.86	566	292	**S7**	0.21	19000	23000	20.6	28.6	0.5	0.033
0.6250	1.3750	0.2813	0.03												
	39.68	11.11	0.80	9.6	4.55	979	464	**LS7**	0.25	19000	23000	21.1	34.8	0.5	0.059
	1.5625	0.4375	0.03												
	46.03	15.88	1.60	11.6	5.65	1183	576	**MS7**	0.12	16000	18000	23.1	39.6	1.1	0.12
	1.8125	0.6250	0.06												
19.05	41.26	7.938	0.80	7.38	4.0	753	408	**S8**	0.29	16000	18000	26.2	35.7	0.5	0.047
0.7500	1.6250	0.3125	0.03												
	47.61	14.29	1.60	13.7	6.65	1397	678	**LS8**	0.28	15000	18000	25.9	41.1	1.1	0.11
	1.8750	0.5625	0.06												
	50.78	17.46	1.60	15.9	7.85	1621	800	**MS8**	0.45	14500	17000	26.9	43.7	1.1	0.122
	2.0000	0.6875	0.06												

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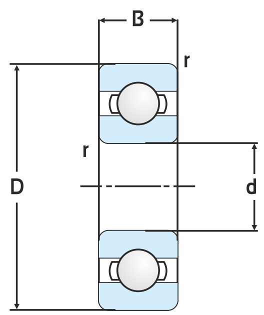
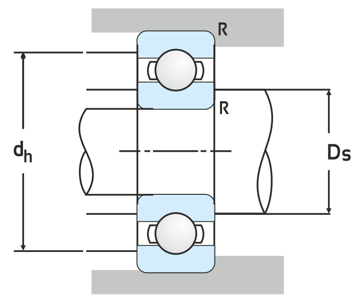
Single Row Deep Groove Ball Bearing (Inch series)





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$F\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

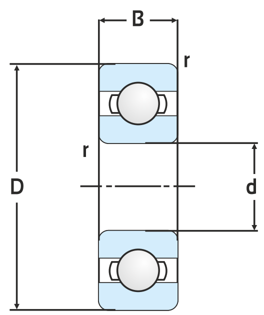
Static equivalent radial load

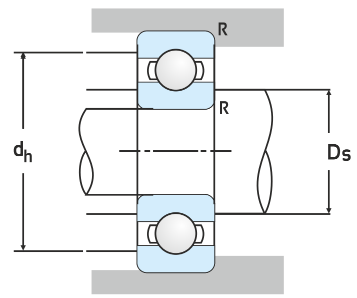
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions mm/inch				Basic Load Rating KN		Basic Load Rating Kgf		Bearing Number	Fatigue Load Limit KN	Limiting Speed rpm		Abutment and Fillet Dimension (mm)			Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static								
d	D	B	rmin	Cr	Cor	Cr	Cor		Cu	Grease	Oil	dh	Ds	R	
34.93	76.18	17.46	1.60	20.8	13.3	2121	1356	**LS12 1/2**	0.98	10000	12000	46	68.3	1.1	0.367
1.3750	3.0000	0.6875	0.06												
	88.88	22.23	2.40	37.2	22.05	3793	2248	**MSl2 1/2**	1.58	8600	10000	47.8	76.2	1.6	0.639
	3.2500	0.8750	0.09												
38.1	82.53	19.05	2.40	25.7	16	2621	1632	**LS13**	1.15	9000	10000	49.3	73.4	1.6	0.446
1.500	3.2500	0.7500	0.09												
	95.23	23.81	2.40	47.7	26.7	4864	2723	**MS13**	1.44	8000	9500	50.8	82.6	1.6	0.761
	3.7500	0.9375	0.09												
41.28	88.88	19.05	2.40	27.5	18.1	2804	1846	**LS13 1/2**	1.31	8500	10000	54.1	n.11	1.6	0.535
1.6250	3.5000	0.7500	0.09												
	101.6	23.81	2.40	48.3	277.5	4925	28297	**MS13 1/2**	1.49	7600	9000	56.6	88.1	1.6	0.862
	4.000	0.9375	0.09												
44.45	95250	20.64	2.40	35	23.2	3569	2366	**LS14**	2.20	8000	9500	572	87.1	1.6	0.654
1.7500	3.7500	0.8125	0.09												
	108	26.99	2.40	56.25	32.7	5736	3334	**MS14**	1.76	7000	8300	59.4	93.7	1.6	1.084
	4.2500	1.0625	0.09												

Single Row Deep Groove Ball Bearing (Inch series)





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

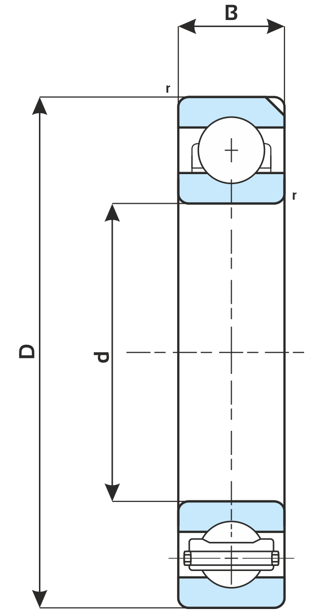
Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions				Basic Load Rating				Bearing Number	Fatigue Load Limit	Limiting Speed		Abutment and Fillet Dimension (mm)			Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static								
mm/inch				KN		Kgf			KN	rpm					
d	D	B	rmin	Cr	Cor	Cr	Cor		Cu	Grease	Oil	dh	Ds	R	
47.63	101.6	20.64	2.40	48.7	31.2	4966	3181	**LS14 1/2**	2.25	7800	9200	63.5	92.2	1.6	0.71
1.8750	4.0000	0.8125	0.09												
	114.3	26.99	2.40	62.1	38.5	6332	3926	**MS14 1/2**	2.08	6700	8000	65	100.1	1.6	1.24
	4.5000	1.0625	0.09												
50.8	101.6	20.64	2.40	48.7	31.2	4966	3181	**LS15**	2.26	7800	9200	63.5	92.2	1.6	0.671
2.0000	4.0000	0.8125	0.09												
	114.3	26.99	2.40	62.1	38.5	6332	3926	**MS15**	2.08	6700	8000	65	100.1	1.6	1.189
	4.5000	1.0625	0.09												

Special Bearing

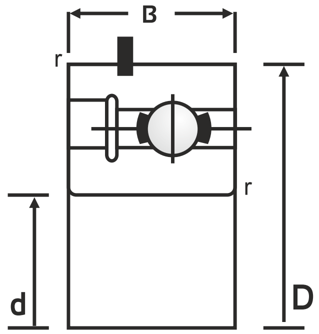
Notch (locating slot) on outer ring side face



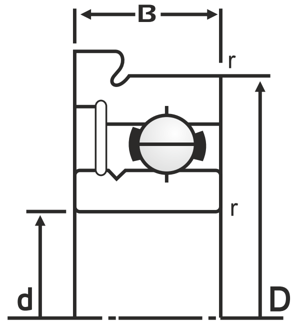
Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)	Refer figure
				Dynamic	Static	Dynamic	Static				
mm				KN		Kgf		KN			
d	D	B	r	Cr	Cor	Cr	Cor	Cu			
26.993	50.782	17.4625	1.6	-	-	-	-		L3782	0.660	1
35	62	17	1.1	46	38	4738	3823		RNU305	0.187	1
58.5	100	25	2.4	83	71	8426	7238		RNU309	0.660	1
66.5	100	21	1.1	65	63	6622	6371		RNU211	0.450	1
120	260	103	4.0	925	1452	94304	148012		N1081	31.850	1
25.4	53.962	28.575	1.1	67	62	6850	6300		LO64	0.263	2
680	742.5	300	8	-	-	-	-		N1065	161.83	3
820	903	400	10	-	-	-	-		N1084	348.02	3
31.75	79.35	22.225	1.1	64	54	6565	5464	6.5	N1004	0.510	4

Special Bearing

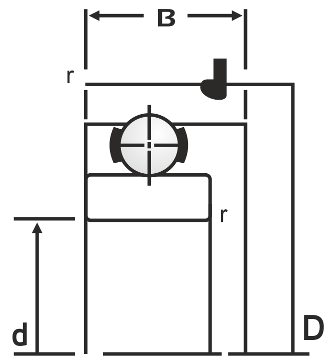
Insert Ball Bearings



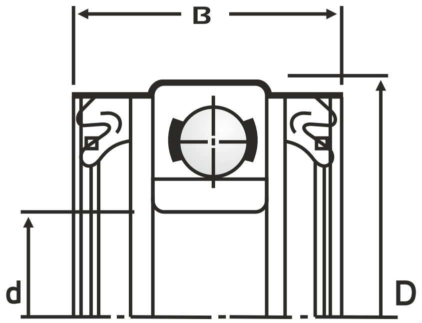
BB1004



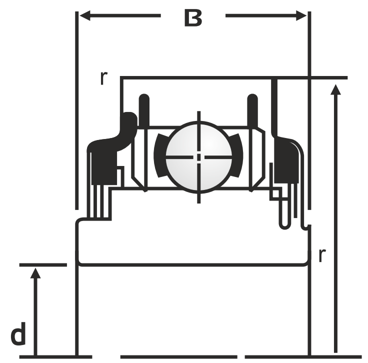
BB1016



BB1014



BB1019



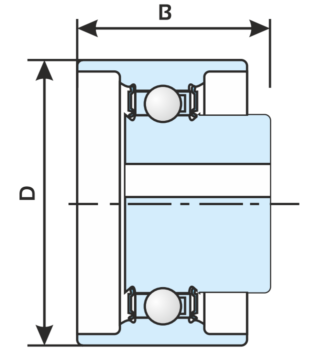
BB1005

Boundary Dimensions				Basic Load Rating				Limitlng Speed		Bearing Number
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		rpm		
d	D	B	r min	Cr	Co	Cr	Co	Grease	Oil	
25	52	18	1.5	11.5	6.2	1173	632	13000	15000	**BB1004**
25	52	18	1	11.5	6.2	1173	632	13000	15000	**BB1016**
25	65	21.5	2	21.3	9.8	2172	999	12000	14000	**BB1014**
40	82	50	-	29.1	17.2	2967	1754	700	10000	**BB1019**
45	85	27	1.6	32.5	19.8	3314	2019	7800	9200	**BB1005**

Special Bearing

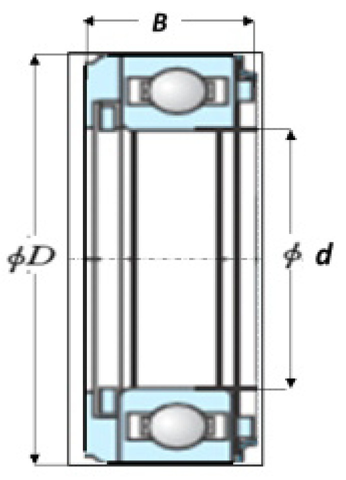
Belt Tensioners

Boundary Dimensions			Basic Load Rating				Fatigue Load Limit	Bearing Number
			Dynamic	Static	Dynamic	Static		
mm			KN		Kgf		KN	
d	D	B	Cr	Co	Cr	Co	Cu	
-	51	30.4	9.4	5.05	959	515	3.620	**JPU51-15**
-	51	32	10.1	5.85	1030	597	3.520	**BB1079**



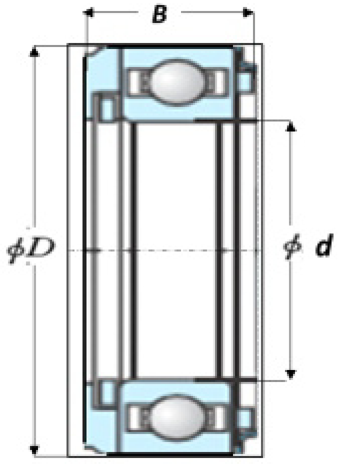
Clutch Release Bearing

Boundary Dimensions			Basic Load Rating				Bearing Number
			Dynamic	Static	Dynamic	Static	
mm			KN		Kgf		
d	D	B	Cr	Co	Cr	Co	
28.1	90	64	12.3	9.2	1254	938	H-34IGSC
28.2	55.6	32	-	-	-	-	FCR44-36
28.2	50	32	-	-	-	-	FCR44-36-1
30.4	54.6	24.5	8.8	6.1	897	622	CR-21SC
33	106.2	44.5	12.4	10	1264	1020	CR-10MB
33	61	22	11.77	8.68	1200	885	CR-48SC
34	76	44.8	12.7	9.9	1295	1010	CR-42TM
35.55	80	51	26.4	19.8	2692	2019	CR-45TM
37	76.9	43	26.5	19.8	2702	2019	CR-ME2710
38.1	66.6	16.35	13.3	9.1	1356	928	CR-41
39.9	130	61.5	27.8	20.23	2835	2063	CR-1035CBH
42	95	58	27.8	20	2835	2039	CR-5592



Clutch Release Bearing

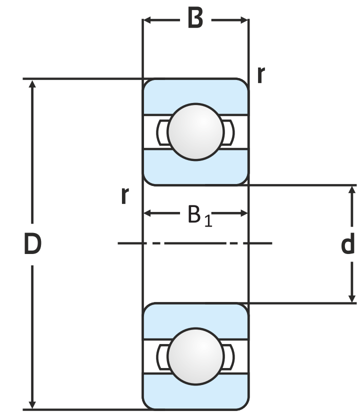
Boundary Dimensions			Basic Load Rating				Bearing Number
			Dynamic	Static	Dynamic	Static	
mm			KN		Kgf		
d	D	B	Cr	Co	Cr	Co	
44	95	56	27.8	20.6	2835	2101	CR-6544
45	86.6	28	32.7	20.5	3334	2090	1888451
47.6	104	59	29.65	24.5	3023	2498	CR-6695SC
50	91.6	29	35	23.2	3569	2366	1888180
50	81.6	25	21.8	16.6	2223	1693	306445C
50	81.6	21	21.8	16.6	2223	1693	SP306445C
50	91.8	25.5	27.8	20.23	2835	2063	CR-1035
50	91.8	29	37.1	23.2	3783	2366	CR-1888180
50.3	104	74	29.65	24.5	3023	2498	CR-6575SC
55	110	58	27.3	20.7	2784	2111	CR-55TPH
57	104	59	29.65	24.5	3023	2498	CR-6698SC
60.4	124	110.5	32.7	26.2	3334	2672	CR-7896SC
65	101.6	27	30.5	25.2	3110	2570	CR1002
65	100	23.7	26.8	21.8	2733	2223	N1264



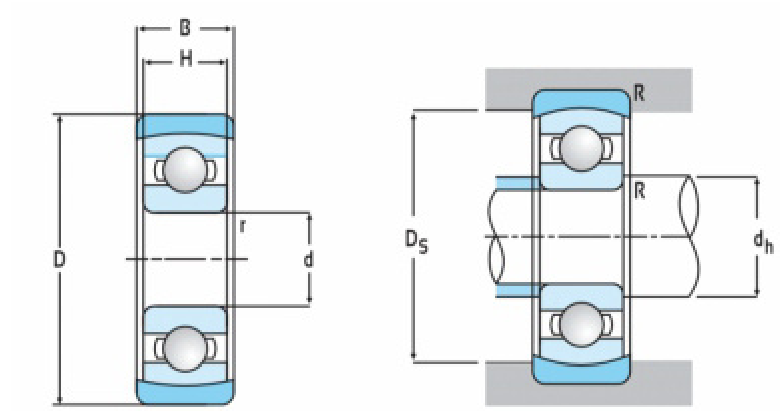
Special Bearing

Special DGBB with difference in width of Inner and Outer Ring

Boundary Dimensions					Basic Load Rating (KN)				Fatigue Load Limit	Limiting Speed		Bearing Number
					Dynamic	Static	Dynamic	Static				
mm					KN		Kgf		KN	rpm		
d	D	B	B_1	r min.	Cr	Co	Cr	Co	Cu	Grease	Oil	
35	72	18.5	15	-	25.7	15.4	2621	15703	1.12	9800	11000	BB1103
22	22	18.5	15	-	22.98	10.4	2343	10605	0.88	14000	17000	63/225PL



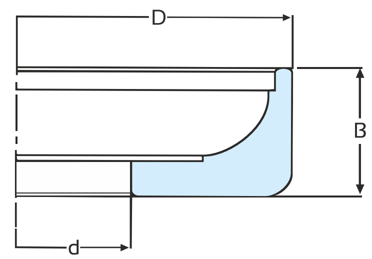
Single Row Externally Aligning Ball Bearing



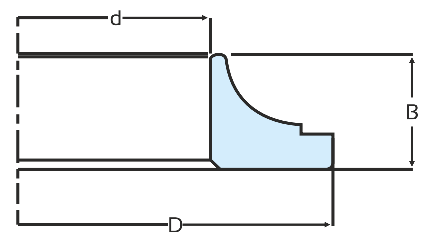
Boundary Dimensions					Basic Load Rating (KN)				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fitment			Mass Kg. (Approx.)
					Dynamic	Static	Dynamic	Static								
mm / inch					KN		Kgf		KN	rpm			mm/ inch			
d	D	B	H	r	Cr	Co	Cr	Co	Cu	Grease	Oil		D_s	d_h	R	
44.45	117.45	28.575	26.988	2.4	56.25	32.7	5735.81	3334.42	2.63	6500	900	MSN14	110	59.4	1.6	1.7
1.75	4.625	1.125	1.0625	0.09									4.33	2.34	0.06	

Special Bearing Races

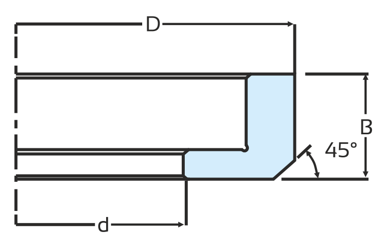
Bearing Races	d	D	B
BB1006	27	45	10.5
BB1030	27.8	46.2	8
BB1031	27.8	47.2	8



Bearing Races	d	D	B
BB1007	24.2	39	8.65
BB1058	25	48	5.5
BB1059	30	48	5.5

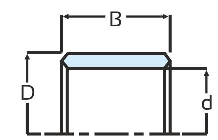


Bearing Races	d	D	B
BB1008	32	42.3	8

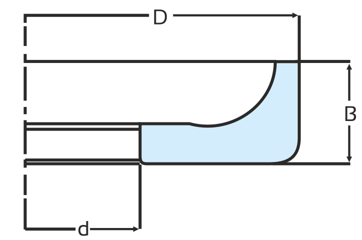


Special Bearing Races

Bearing Races	d	D	B
BB1009	17.04	20.05	14.1
RB5005	22.03	28.0	12
RB5003	23.29	31.79	9.63
RB5004	38.10	47.63	19.18



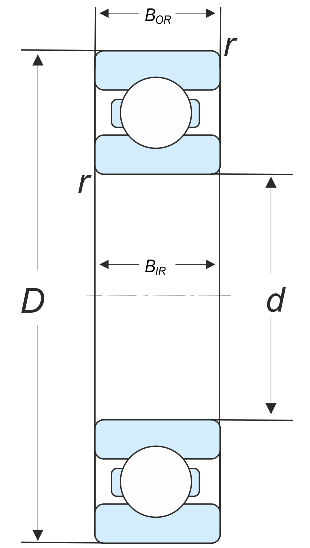
Bearing Races	d	D	B
BB1060	31	48	5.5
BB1061	26	48	5.5



Special Bearing

EMB Bearings for Electric Vehicle

Boundary Dimensions (mm)					Dynamic (KN)	Static (KN)	Dynamic (Kgf)	Static (Kgf)	Limiting Speed (rpm)	Bearing Number	Seals/ Shields	Mass KG
d	D	B_{IR}	B_{OR}	r_{smin}	C_r	C_{or}	C_r	C_{or}	Grease		Non-Contact Type	(Approx.)
30	62	16	16	1	21.60	11.3	2203	1152	14000	EMB 6206	ZZ	0.201
40	68	15	15	1	18.60	11.5	1897	1172	15000	EMB 6008	LLBRA	0.195
40	80	18	18	1.1	32.50	18	3314	1835	14000	EMB 6208	ZZ	0.357
45	75	16	16	1	23.20	15.1	2366	1539	15000	EMB 6009	LLBRA	0.237
45	100	25	25	1.5	58.50	32.0	5965	3263	19000	EMB 6309	LBRA	0.825
50	90	20	20	1.1	39.0	23.2	3977	2365	14000	EMB 6210	--	0.457
60	95	18	18	1.1	35.14	24.22	3584	2470	15000	EMB 6012	LLBRA	0.414

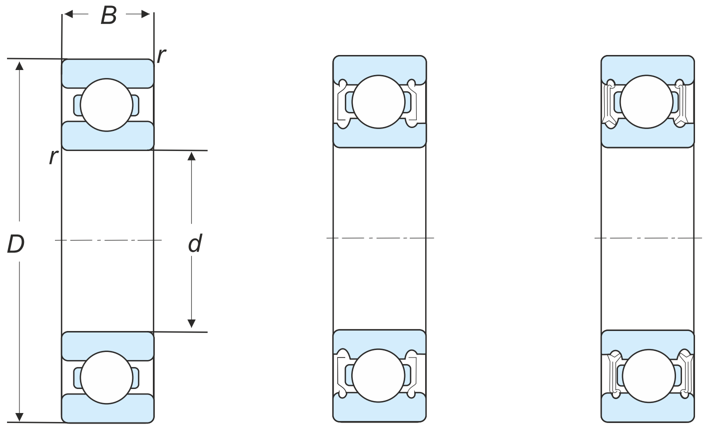


Open type

Sensor Integrated Bearings

Boundary Dimensions (mm)					Dynamic (KN)	Static (KN)	Dynamic (Kgf)	Static (Kgf)	Limiting Speed (rpm)	Bearing Number	Mass Kg	Feature
d	D	B_{IR}	B_{Total}	r_{smin}	C_r	C_{or}	C_r	C_{or}	Grease		(Approx.)	
30	62	16	25	1.0	21.60	11.3	2203	1152	14000	SIB 6206	0.201	Speed & Direction
25	62	17	26	1.1	23.50	10.9	2396	1111	12000	SIB 6305	0.225	Temprature Speed & Direction

Note: B (Total) : Width of bearing + sensor unit



Open type **Shielded type** **Contact sealed type**

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{C_{or}}$	e	$\frac{F_a}{F_r} \le e$ X	$\frac{F_a}{F_r} \le e$ Y	$\frac{F_a}{F_r} > e$ X	$\frac{F_a}{F_r} > e$ Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	034				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

Por =0.6Fr+0.5Fa

when Por<Fr use Por=Fr

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers					Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static		rpm							
mm				KN		Kgf		KN	Grease	Oil	Open Type	Shielded Type		Contact Type		
d	D	B	r	C_r	C_{or}	C_r	C_{or}	C_u								
4	13	5	0.3	1.30	0.49	133	49	0.024	42000	49000	**624**	-	ZZ	-	LLU	0.0032
	11	4	0.3	1.30	0.49	133	49	0.024	45000	52000	**694**	-	-	-	LLU	0.0032
5	16	5	0.4	1.73	0.67	177	68	0.027	37000	44000	**625**	-	ZZ	-	LLU	0.0047
6	19	6	0.4	2.33	0.89	238	91	0.052	34000	40000	**626**	-	ZZ	-	RSS	0.00805
7	19	6	0.4	2.24	0.91	228	93	0.053	34000	40000	**607**	-	ZZ	-	RSS	0.0075
	22	7	0.4	3.28	1.38	335	141	0.070	32000	37000	**627**	-	ZZ	-	RSS	0.0121
8	22	7	0.4	3.30	1.37	337	140	0.07	32000	37000	**608**	-	ZZ	-	RSS	0.0113
	24	8	0.4	3.33	1.42	340	145	0.079	31000	36000	**628**	-	ZZ	-	RSS	0.017
9	24	7	0.3	3.68	1.65	342	146	0.087	31000	36000	**609**	-	-	-	-	0.0147
	26	8	0.4	4.57	1.98	466	202	0.091	30000	35000	**629**	-	ZZ	-	RSS	0.019

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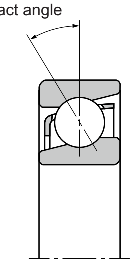
15.2 Angular Contact Ball Bearings

Angular contact ball bearings are non -separable bearings. The design of raceway curvature is such that balls makes contact with both the raceway at a particular angle oblique to the radial plane. The contact angle is defined as the angle between the line joining the point of contact between the raceway and ball at the radial plane. In addition to the radial loads, because of contact angle, these bearings can also support axial load. The axial load carrying capacity of these bearings increases as the contact angle increases. Due to lower shoulder, number balls can be accommodated in these bearings. This increases the radial load carrying capacity

Single row angular contact bearing can support axial load in one direction only. To counter axial load from other direction two single row bearings are adjusted depending upon the direction of axial force. To transfer load acting on the bearing, they are manufactured by different contact angles as given below.

Contact Angle	15°	30°	45°
Suffix Code	C	-	B



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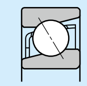
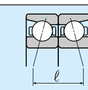
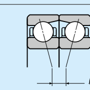
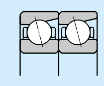
Single row Angular contact Braring arrangement (Duplex)

Bearing arrangement		Description
Standard		Available in series 70, 72, 72B, 73, 73B. Contact angles are with 30 & 40 deg. The bearings are available in nylon, brass and steel cage.

Bearing arrangement		Description
Back to back (DB)		In this arrangement load lines diverge form bearing axis. Along with radial load can accommodate axial load in both the directions. Can adjust tilting moments
Face to face (DF)		In this arrangement load lines converge towards bearing axis. Along with radial load can accommodate axial load in either directions. Can adjust tilting moments.
Tandem (DT)		In this arrangement load lines are parallel. Can accommodate radial load and single direction axial loads.

Double Row Angular

Double row angular contact ball bearings consists of inner, outer rings, ball and cage assemblies with sheet steel or polyamide cage. The bearings are available in open and sealed designs. Bearing can support radial and axial loads in both the directions due to the raceway geometry and the two rows of balls.

Double row angular contact bearing design is similar to single row. Design is based on back to back arrangement. They can support load in both the direction. Because of the second row the load carrying capacity is enhanced. The contact angle is 25°. The bearings are available in shield and rubber seals.

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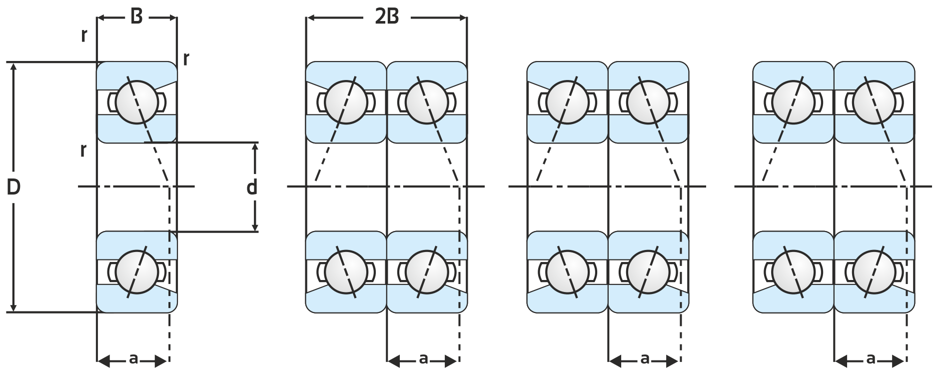
Single Row Angular Contact Ball Bearing (Metric Series)

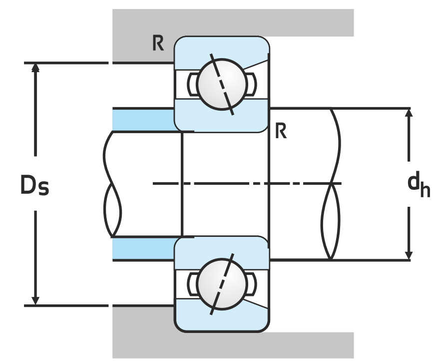


Single Row

Back-to-back arrangement (DB)

Face-to-back arrangement (DF)

Tandem arrangement (DT)



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

Contact angle		Single DT				DB, DF			
		$F_a / F_r \leqq e$		$F_a / F_r > e$		$F_a / F_r \leqq e$		$F_a / F_r > e$	
		X	Y	X	Y	X	Y	X	Y
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

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

Contact angle	Single DT		DB, DF	
	X_0	Y_0	X_0	Y_0
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single and DT arrangement
When $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions (mm)					Basic Load Rating Dynamic (KN)	Basic Load Rating Static (KN)	Basic Load Rating Dynamic (Kgf)	Basic Load Rating Static (Kgf)	Bearing Number	Fatigue Load Limit (KN)	Limiting Speed (rpm)		Abutment & Fitment details (mm)			Load Center (mm)	Mass (Kg) (Approx.)
d	D	B	2B	r min	Cr	Co	Cr	Co		Cu	Grease	Oil	Ds max.	dh min.	R max.	a	
10	30	9	18	0.3	5.0	2.52	510	257	**7200B**	0.171	25000	25000	23.5	12.5	0.3	9	0.023
12	32	10	20	0.6	7.0	3.65	714	372	**7201B**	0.242	22000	25000	27.5	14.5	0.6	14	0.036
15	35	11	22	0.6	7.94	4.29	810	438	**7202B**	0.287	18000	25000	30.5	19.5	0.6	16	0.05
17	40	12	24	0.6	1.00	5.5	102	561	**7203**	0.368	15000	21000	35	22	1	14.5	0.064
20	47	14	28	1	1.33	7.6	136	775	**7204**	0.51	14000	18000	41	26	1	17	0.1
25	52	15	30	1	14.8	9.4	1510	959	**7205B**	0.59	12000	16000	46.5	30.5	1	24	0.13
30	62	16	32	1	20.5	13.5	2091	1377	**7206B**	0.97	11000	14000	56.5	35.5	1	27.5	0.2
30	72	19	38	1.1	31.1	19.3	3172	1969	**7306B**	1.5	9600	13000	65	37	1	31.5	0.35
35	72	17	34	1.1	27.1	18.4	2764	1877	**7207**	1.3	8600	11000	65	42	1	24	281
35	80	21	42	1.5	38.3	24.4	3907	2489	**7307B**	1.73	8400	11000	71.5	43.5	1.5	34.5	0.47

Note:Bearing number with suffix 'B' is for angle 40 Deg. & without suffix is 30 Deg.
Load rating are given for single row, for DB,DF & DT consult NEI engineering

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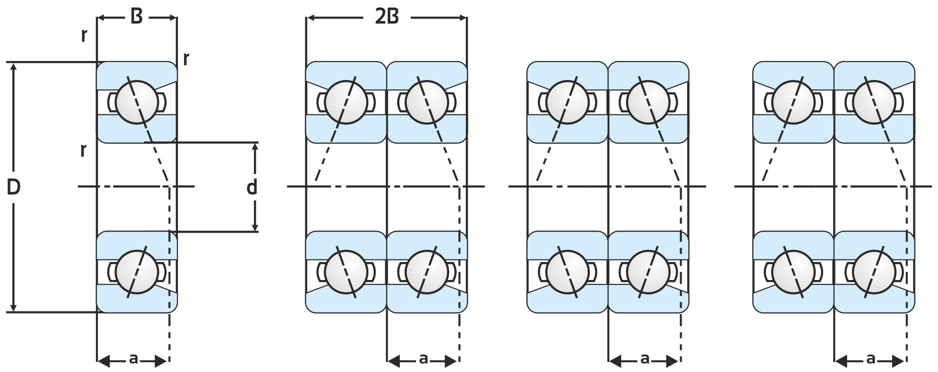
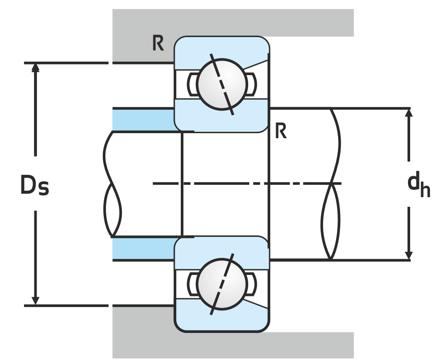
Single Row Angular Contact Ball Bearing (Metric Series)



Single Row | Back-to-back arrangement (DB) | Face-to-back arrangement (DF) | Tandem arrangement (DT)



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

Contact angle		Single DT				DB, DF			
		$F_a / F_r \leq e$		$F_a / F_r > e$		$F_a / F_r \leq e$		$F_a / F_r > e$	
		X	Y	X	Y	X	Y	X	Y
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

Static equivalent radial load

$P_{or} = X_0 F_r + Y_0 F_a$

Contact angle	Single DT		DB, DF	
	X_0	Y_0	X_0	Y_0
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single and DT arrangement

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

Boundry Dimensions					Basic Load Rating				Bearing Number	Fatigue Load Limit	Limiting Speed		Abutment & Fitment details			Load Center	Mass (Kg) (Approx.)
					Dynamic	Static	Dynamic	Static									
mm					KN		Kgf			KN	rpm		mm			mm	
d	D	B	2B	r min	Cr	Co	Cr	Co		Cu	Grease	Oil	Ds max.	dh min.	R max.	a	
40	90	23	46	1.5	46.5	29.5	4743	3009	**7308**	2.22	6900	9200	81.5	48.5	1	30.5	0.625
40	80	18	36	1.1	34.5	23.9	3519	2438	**7208B**	1.61	8300	11000	73	47	1	34	0.38
45	85	19	38	1.1	33.9	24.8	3458	2530	**7209B**	1.79	7400	9900	78	52	1	37	0.47
45	100	25	50	1.5	59.6	39.6	6079	4039	**7309B**	289	6600	8900	91.5	53.5	1.5	43	O.84
50	110	27	54	2	69.3	47.2	7069	4814	**7310**	36	5600	7500	100	60	1	36.5	1.09
50	90	20	40	1.1	37.4	28.6	3815	2917	**7210B**	1.94	6700	9000	83	57	1	39.5	0.5
55	100	21	42	1.5	46.3	36.1	4723	3682	**7211B**	2.54	6100	8200	91.5	63.5	1.5	43	0.61
60	110	22	44	1.5	56.1	44.4	5722	4529	**7212**	3.1	5300	7000	101.5	68.5	1	36	0.765
65	120	23	46	1.5	63.6	52.6	6487	5365	**7213B**	3.56	5200	7000	111.5	73.5	1.5	50.5	0.98

Note:Bearing number with suffix 'B' is for angle 40 Deg. & without suffix is 30 Deg.
Load rating are given for single row, for DB,DF & DT consult NEI engineering

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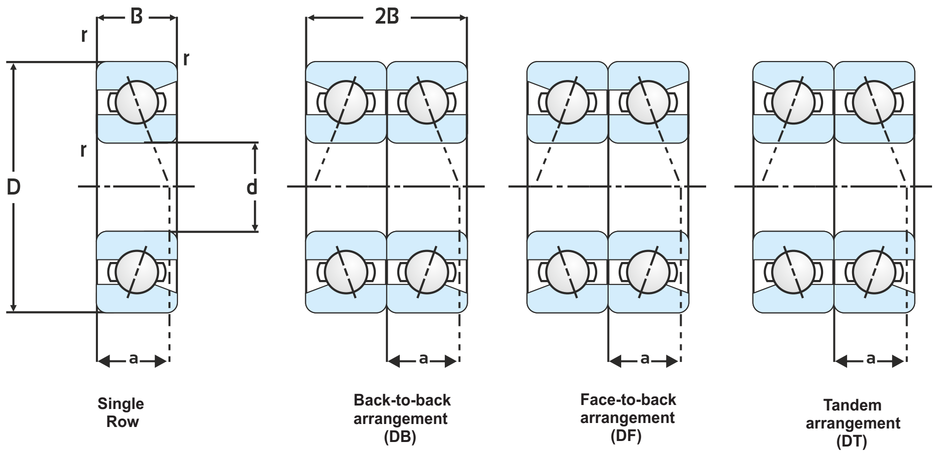
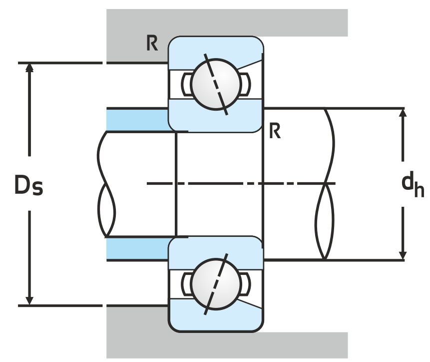
Single Row Angular Contact Ball Bearing (Metric Series)





Dynamic equivalent radial load

$P_r = XF_r + YF_a$

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

Static equivalent radial load

$P_{or} = X_0F_r + Y_0 F_a$

Contact angle	Single DT X_0	Single DT Y_0	DB, DF X_0	DB, DF Y_0
30^0	0.5	0.33	1	0.66
40^0	0.5	0.26	1	0.52

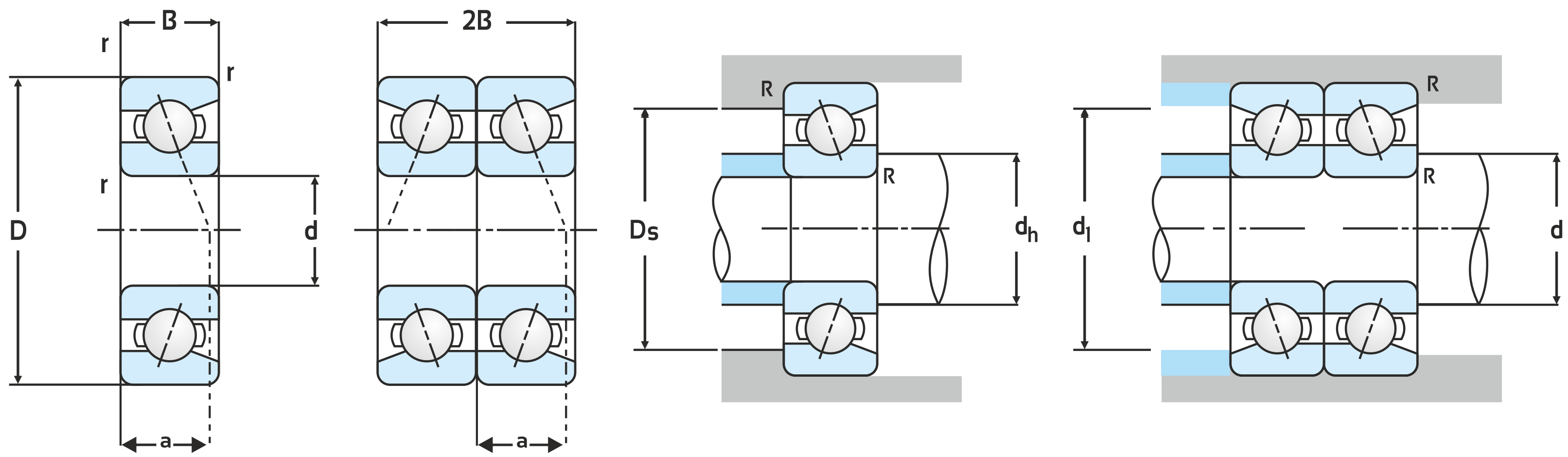
For single and DT arrangement

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

Boundry Dimensions					Basic Load Rating				Bearing Number	Fatigue Load Limit	Limiting Speed		Abutment & Fitment details			Load Center	Mass (Kg) (Approx.)
					Dynamic	Static	Dynamic	Static									
mm					KN		Kgf			KN	rpm		mm			mm	
d	D	B	2B	r min	Cr	Co	Cr	Co		Cu	Grease	Oil	D_s max.	d_h min.	R max.	a	
110	240	50	100	3	206	180	21006	18355	**7322BM**	12.2	3800	4400	226	117	2.5	99	9.9
170	310	52	104	4	267	325	27226	33140	**7234BM**	10.8	2450	2750	292	188	3	139	17.8
170	360	72	144	4	343	435	34976	44357	**7334BM**	17.8	2400	2700	343	188	3	147	37
180	320	52	104	4	325	328	27022	33446	**7236BM**	12	2400	2700	302	198	3	131	18.2
200	310	51	102	2.1	264	331	26920	33752	**7040BM**	14	1550	2200	298	212	2	99	14.9

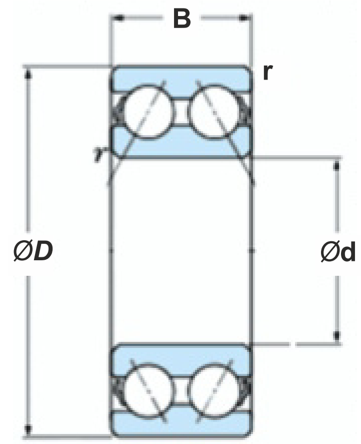
Note:Bearing number with suffix 'B' is for angle 40 Deg. & without suffix is 30 Deg.
Load rating are given for single row, for DB,DF & DT consult NEI engineering

Single Row Angular Contact Ball Bearing (Inch Series)



Boundry Dimensions				Basic Load Rating				Bearing Number	Fatigue Load Limit	Limiting Speed		Abutment & Fitment details			Load Center	Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static									
mm/inch				KN		Kgf			KN	rpm		mm			mm	
d	D	B	r min	Cr	Co	Cr	Co		Cu	Grease	Oil	D_s max.	d_h min.	R max.	a	
82.550 3.500	152.362 6.000	26.988 1.063	2.4 0.09	88.4	801	9014	81678	**LSI9 1/2 ACD**	33.6	2600	3500	134	100	2	73.6	2.27
82.550 3.500	152.362 6.000	53.975 2.125	2.4 0.09	176.8	155.8	18028	15736	**N4711C**	6.53	2600	3500	140	100	2	73.6	4.54

Double Row Angular Contact Bearing



r min

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
	X	Y	X	Y
0.68	1	0.92	0.67	1.41

Static equivalent
radial load

$P_{or} = F_r + 0.76F_a$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r min	Cr	Co	Cr	Co	Cu		
10	30	14	0.6	7.35	4.2	749	428	0.21	**3200**	0.05
12	32	15.9	0.6	10.1	5.6	1030	571	0.245	**3201**	0.06
	32	15.9	0.6	10.1	5.6	1030	571	0.245	**3201ZZ**	0.06
15	42	19	1	17.5	11.9	1784	1213	0.43	**3302**	0.13
	35	15.9	0.6	11.8	7.1	1203	724	0.31	**3202**	0.07
	35	15.9	0.6	11.8	7.1	1203	724	0.31	**3202ZZ**	0.07
17	47	222	1	21.7	17.1	2213	1744	0.52	**3303**	0.15
	40	17.5	0.6	14.9	92	1519	9381	0.39	**3203**	0.09
	40	17.5	0.6	14.9	92	1519	9381	0.39	**3203ZZ**	0.09
20	47	20.6	1	19.7	12.5	2009	1275	0.58	**3204**	0.16
	47	20.6	1	19.7	12.5	2009	1275	0.58	**3204ZZ**	0.16
	52	222	1	22.1	13.4	2254	1366	0.69	**3304**	0.22
25	52	20.6	1	20.5	13.4	2090	1366	0.71	**3205**	0.2

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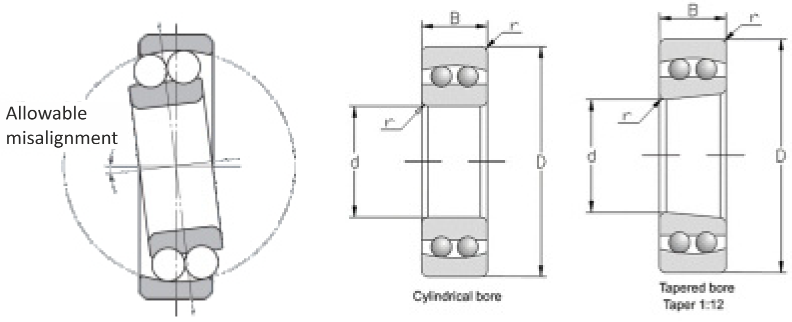
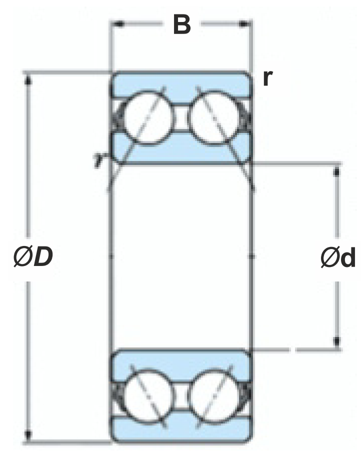
15.3 Self- Aligning Ball Bearing

In a self-aligning bearing, outer ring has a single spherical raceway with its center of curvature in line with the bearing axis and the inner ring has two raceways. The bearings support radial and limited axial loading. This allows the axis of the inner ring, balls and cage to deflect around the bearing center to correct misalignment caused between housing and shaft. In case of misalignment, the ball, cage and inner ring can swivel with respect to outer race. The bearings are available with stret bore and tapered bore. In some cases the ball slightly protrude from the bearing face. For more details contact NEI engineering.



Double Row Angular Contact Bearing



Equivalent radial load dynamic
$P_r = XF_r + YF_a$

e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
	X	Y	X	Y
0.68	1	0.92	0.67	1.41

Static equivalent radial load
$P_{or} = F_r + 0.76F_a$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D B	r min	r (min)	Cr	Cor	Cr	Cor	Cu		
30	62	23.8	1	29.4	21.5	2998	2192	0.93	**3206**	0.29
35	72	27	1.1	39.3	28.5	4007	2906	1.33	**3207**	0.44
40	80	30.2	1.1	44.9	33.5	4578	3416	1.84	**3208**	0.58
	90	36.5	1.5	59.2	43	6037	4385	2.1	**3308**	0.95
45	85	30.2	1.1	47.2	45.5	4813	4640	1.8	**3209**	0.7
	100	39.7	1.5	87.1	74.4	8882	7587	2.72	**3309**	1.37
50	90	30.2	1.1	53.2	43.5	5425	4436	2.11	**3210**	0.66
	110	44.4	2	88.5	67	9024	6832	3.41	**3310**	1.93
55	100	33.3	1.5	56.7	49.4	5782	5037	2.31	**3211**	0.14
60	110	36.5	1.5	74.4	63.2	7587	6445	3.42	**3212**	0.15
55	120	49.2	2	112	86	14421	8769	3.9	**3311**	2.7
60	130	54	2.1	135	98	13766	9993	4.5	**3312**	3.0
65	140	58.7	2.1	137	110	13970	11217	5.85	**3313**	4.1

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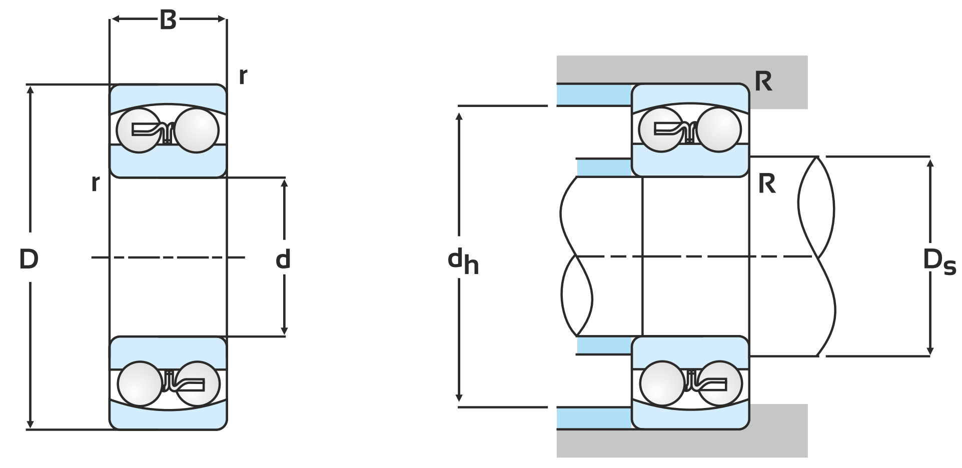
Self Aligning Ball Bearing



Boundary Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions			Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static								
mm				KN		Kgf		KN	rpm			mm			
d	D	B	r min	Cr	Co	Cr	Co	Cu	Grease	Oil		dh min.	Ds max.	R max.	
12	32	14	0.6	5.55	1.25	566	127	0.12	22000	26000	**2201**	16	28	0.6	0.052
17	40	12	0.6	8.1	7.3	826	744	0.12	14000	17000	**1203**	21	36	1	0.72
20	47	14	1	7.65	3.18	780	324	0.16	13000	15000	**1204**	25	42	1	0.114
20	52	15	1.1	9.6	4.02	979	410	0.20	11000	13000	**1304**	27	46	1	0.158
25	62	17	1.1	18.1	4.9	1846	500	0.30	9100	11000	**1305**	32	55	1	0.263
25	52	15	1	12.1	3.3	1234	337	0.20	11000	13000	**1205**	30	47	1	0.138
25	52	18	I	12.6	3.56	1288	363	0.20	12000	14000	**2205**	30	47	1	0.18
25	62	24	1.1	24.5	6.48	2498	661	0.40	9500	12000	**2305**	31.5	55.5	1	0.35
30	62	16	1	15.6	4.65	1591	474	0.28	9200	11000	**1206**	36	56	1	0.231
30	72	19	1.1	21.2	6.2	2162	632	0.38	7700	9100	**1306**	37	65	1	0.395
30	72	19	1.1	21.5	7.75	2192	790	0.38	8500	11000	**1306K**	36.5	65.5	I	0.39
30	62	20	1	15.3	4.55	1560	464	0.29	10000	12000	**2206**	35	57	1	0.66
30	72	27	1.1	31.5	8.68	3212	885	0.54	8000	10000	**2306**	36.5	65.5	1	0.5
35	80	21	1.5	25.49	7.94	2599	810	0.48	7500	9500	**1307**	43	72	1.5	0.53
35	72	23	1.1	21.8	6.65	2223	678	0.55	8500	10000	**2207**	41.5	65.5	1	0.4

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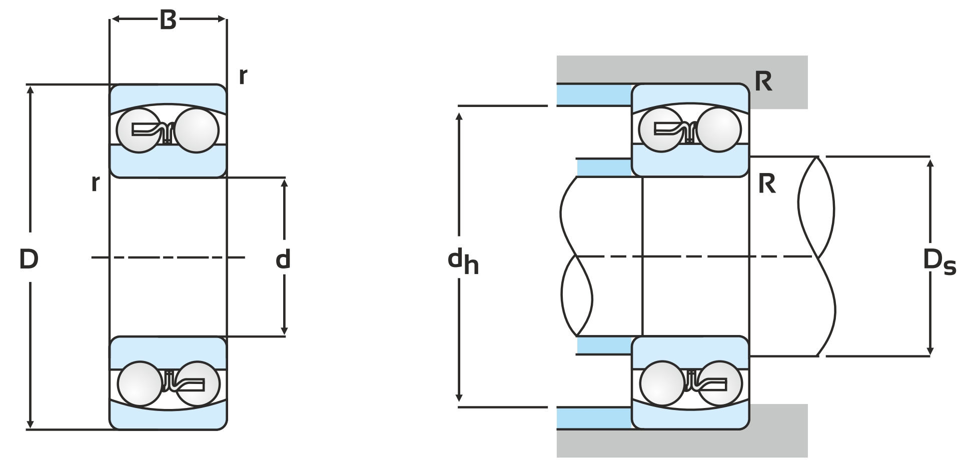
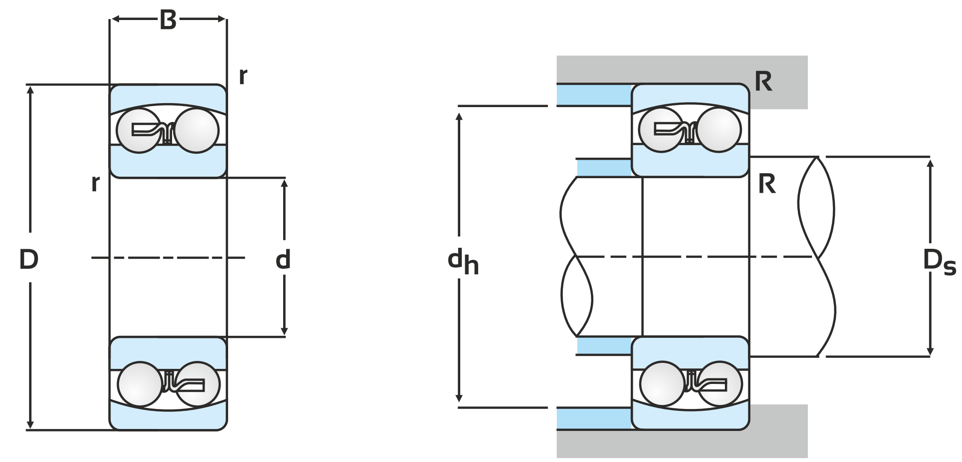
Self Aligning Ball Bearing



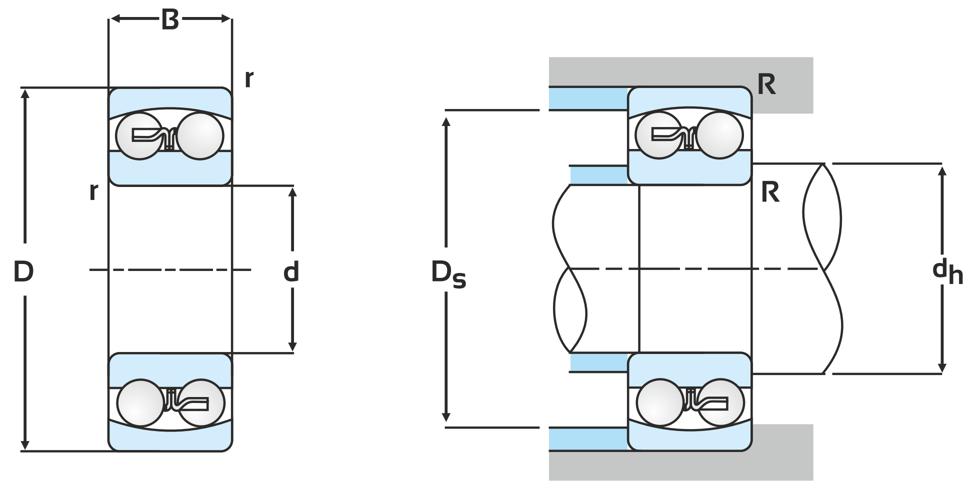
Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions			Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static								
mm				KN		Kgf		KN	rpm			mm			
d	D	B	r min	Cr	Co	Cr	Co	Cu	Grease	Oil		d_h min.	D_s max.	R max.	
40	80	18	1.1	19.7	6.7	2009	683	0.39	7100	8400	**1208**	47	73	1	0.417
40	90	23	1.5	29.5	9.5	3008	969	0.58	6700	8500	**1308K**	48	82	1.5	0.72
40	80	23	1.1	22.8	7.38	2325	753	0.39	7500	9000	**2208K**	46.5	73.5	1	0.53
40	90	33	1.5	45.2	13.2	4609	1346	0.80	6300	8000	**2308**	48	82	1.5	0.9
40	90	33	1.5	45.7	13.6	4660	1387	0.80	6300	8000	**2308K**	48	82	1.5	0.9
45	85	19	2	21.9	7.35	2233	749	0.45	6400	7500	**1209**	52	78	1	0.481
45	100	25	1.5	38	12.8	3875	1305	0.77	6000	7500	**1309K**	53	92	1.5	0.957
45	85	23	1.1	23.3	8.15	2376	831	0.39	7100	8500	**2209K**	51.5	78.5	I	0.52
45	100	36	1.5	55	16.2	5608	1652	1.01	5600	7100	**2309**	53	92	1.5	1.3
45	100	36	1.5	55	16.2	5608	1652	1.02	5600	7100	**2309K**	53	92	1.5	1.3
45	100	25	1.5	38.4	12.9	3916	1315	0.78	6000	7500	**1309**	53	92	1.5	0.96
50	110	40	2	64.5	19.8	6577	2019	1.23	5000	6300	**2310**	59	101	2	1.6
50	110	40	2	64.5	19.8	6577	2019	1.23	5000	6300	**2310K**	59	101	2	1.6
55	100	21	2	26.8	10	2733	1020	0.61	5300	6200	**1211**	63.5	91.5	1.5	0.703

Self Aligning Ball Bearing



Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions			Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static								
mm				KN		Kgf		KN	rpm			mm			
d	D	B	r min	Cr	Co	Cr	Co	Cu	Grease	Oil		d_h min.	D_s max.	R max.	
55	100	25	1.5	26.7	9.9	2723	1010	0.76	6000	7011	**2211K**	63	92	1.5	0.75
55	120	43	2	76.5	19.8	7801	2019	1.47	4800	6000	**2311K**	64	111	2	2.1
55	120	43	2	76.6	23.9	7811	2437	1.47	4800	6000	**2311**	64	111	*2*	2.1
60	110	22	1.5	30.5	11.5	3110	1173	0.71	5300	6300	**1212**	68	102	1.5	0.82
60	110	22	1.5	30.5	11.5	3110	1173	0.71	5300	6300	**1212K**	68	102	1.5	0.82
65	120	23	1.5	30.9	12.5	3151	1275	0.77	4800	6000	**1213K**	73	112	1.5	0.92
65	140	48	2	96.6	32.5	9850	3314	1.97	3800	4800	**2313**	76	129	2	3.2
65	140	48	2	96.6	32.5	9850	3314	1.97	3800	4800	**2313K**	76	129	2	3.2
70	150	51	2.1	110	37.5	11217	3824	2.20	3600	4500	**2314**	81	139	2	3.9
75	130	25	1.5	38.7	16	3946	1632	0.94	3900	4600	**1215**	83.5	121.5	1.5	1.46
75	130	31	1.5	44.2	18	4507	1835	1.06	4300	5300	**2215K**	83	122	1.5	1.72
80	140	26	2	39.7	17.1	4048	1744	0.98	4000	5000	**1216K**	89	131	2	1.7
80	170	58	2.1	137	48.5	13970	4946	2.69	3200	4000	**2316**	91	159	2	6.3
85	150	28	2	44.8	20.5	4568	2090	1.17	3800	4500	**1217K**	94	14	2	2.095
85	180	60	3	140	53.4	14276	5445	2.27	3000	3800	**2317**	98	167	2.5	7.3
100	180	34	2.1	69.3	29.9	7067	3049	1.54	3200	3800	**1220K**	111	169	2	3.8

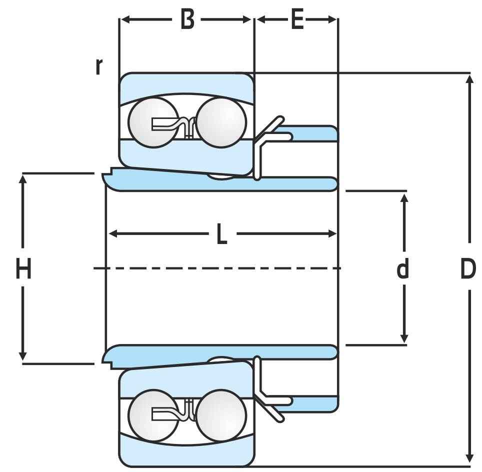
Self Aligning Ball Bearing (Inch series)

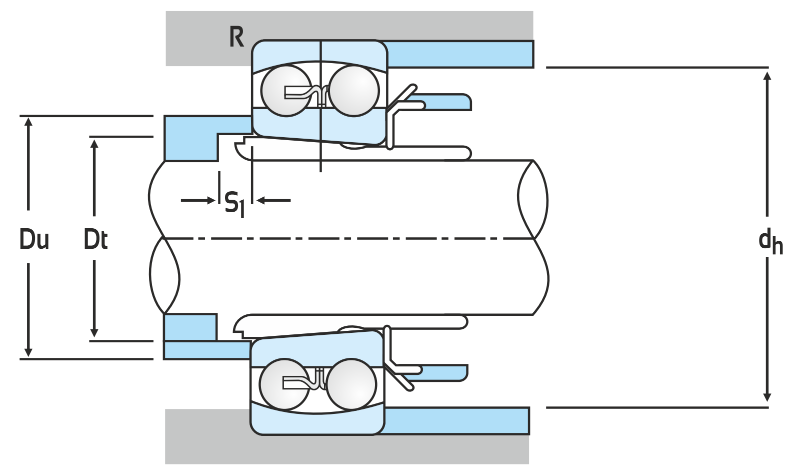


Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions			Mass (Kg) (Approx.)
				Dynamic	Static	Dynamic	Static								
mm				KN		Kgf		KN	rpm			mm			
d	D	B	r min	Cr	Co	Cr	Co	Cu	Grease	Oil		d_h min.	D_s max.	R max.	
31.750 (1.250)	69.850 (2.750)	17.460 (0.688)	1.6 (0.06)	19.15	5.750	1953	586	0.26	10700	14500	ULS12V	45 (1.77)	61.2 (2.41)	1.6 (0.06)	0.324

Self Aligning Ball Bearing With Sleeve

Double Row Self Aligning Ball Bearings with Taper Clamping Sleeve & Nut

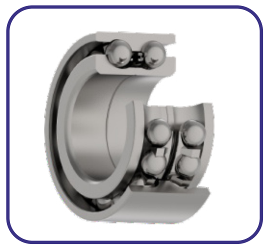




Boundry Dimensions							Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions					Mass (Kg) (Approx.)
							Dynamic	Static	Dynamic	Static										
mm							KN		Kgf		KN	rpm			mm					
d	D	B	L	E	H	r	C_r	C_{or}	C_r	C_o	Cu	Grease	Oil		Dt max.	Du max.	d_h min.	Si min.	R max.	
20	52	15	26	8	26	1	12.1	3.3	1234	337	0.20	11000	13000	**1205K**	28	33	46	5	0.5	0.25
25.4	62	16	34	11.2	30.96	1	15.6	4.65	1591	474	0.27	9200	11000	**1206K**	35	39	56	9	0.5	0.347
31.75	80	18	38	12.4	40.08	2	19.7	6.55	2009	668	0.40	7100	8400	**1208K**	46	52	70	10	1	0.68
38.1	85	19	40	12.4	46.83	2	21.9	7.35	2233	749	0.44	6400	7500	**1209K**	54	57	75	11	1	0.753
50.8	100	21	46	13.6	57.15	2	26.8	10	2733	1020	0.60	5300	6200	**1211K**	63	69	88	13.5	1	1.08
63.5	130	25	56	15.3	76.71	2	38.7	16	3946	1632	0.93	3900	4600	**1215K**	81	93	118	18	1	2.354

15.4 Generation Hub Unit for Wheel Application

The Generation hub unit is a double-row ball bearing with a one-piece outer ring and a split or two-piece inner ring. It is greased, sealed and adjusted for long life. The Generation hub units are compact and simpler to mount. It is one of the most used wheel Maker



Lubrication

The objective of lubrication is to form a film of oil on rolling or sliding surface to prevent the metals from making direct contact with each other, Lubrication has the following effects:

1. Reduces friction and wear.
2. Extends Bearing life.
3. Prevents rusting.
4. Prevents penetration of foreign matter.

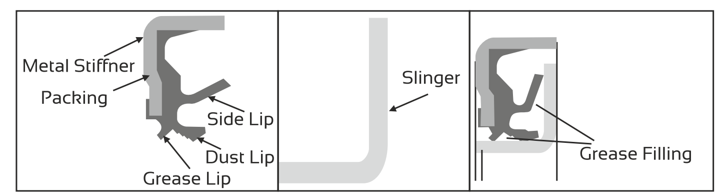
Fretting wear particularly tends to occur on the raceway of DRAC Bearing during transport of finished automobiles. Therefore the fretting resistance property of Lubricant should be taken into account while selecting lubricant for DRAC Bearings.

Characteristics	Resists fretting, enhances protection against rust
Maker	Nippon Oil Japan
Name	PYRONOC Universal N6B/N6C
Thickener	Urea
Base Oil	Mineral Oil
Working Temperature	-30 to 150 C
Colour	Cream
Remarks	Fretting Resistance Excellent Recommended grease for Passenger Cars

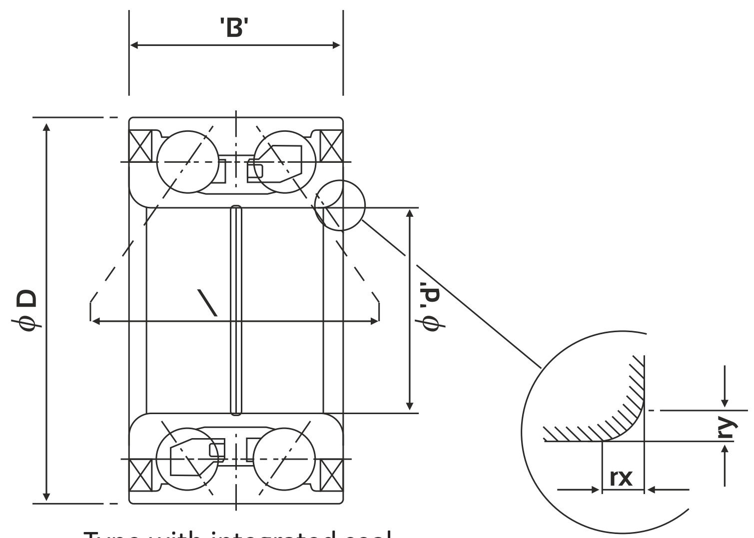
Fretting

Seals

A special Low torque high performance (LTHP) seal on both sides of the DRAC Bearing prevent water ingress in the bearing and have low torque. It consists of 3-lips-Grease Lip, Dust Lip and Side Lip. A stainless Steel Slinger is added to the 3-lip seal sliding part, which dramatically enhances rust resistance of the sliding part of the lips. Side lip is added for improving the sealing performance.



Wheel Application : Double Row Angular Contact Sealed Bearings - GEN1 Ball Type



Type with integrated seal

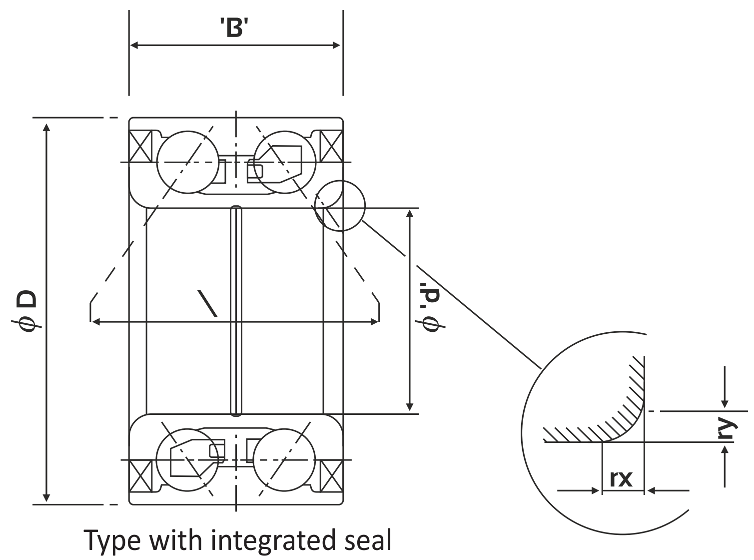
GEN 1 ball type

GEN 1

GEN 1 Hub Mounted

Boundry Dimensions					Distance Between Pressure Cone Apexes	Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass (Kg) (Approx.)
						Dynamic	Static	Dynamic	Static			
mm						KN		Kgf		KN		
d	D	B	$r_{x\ (min)}$	$r_{y\ (min)}$	mm	Cr	Co	Cr	Co	Cu		
22	48	37	3.5	2.5	40.3	26.6	21.6	2712	2203	1.2	**AUN1528-2LLX2**	0.32
25	52	42	3.5	2.5	50.3	33.6	27	3426	2753	**1.4**	**AU1109-2LLX2**	0.366
25	55	48	2.5	2.5	62.9	34	29	3467	2957	1.5	**AU0504-11LXUL588**	0.499
28	58	44	3.5	2.5	53	39.3	32	4007	3263	1.7	**AU1105-2LLX2**	0.47
28	58	33	3.5	2.5	40.3	36.9	31.3	3763	3192	1.7	**AUN1527-2LLX2**	0.38
35	61.8	40	3.5	3.5	54.7	35	34	3569	3467	1.8	**AU1103M-2LLX2**	0.422

Wheel Application : Double Row Angular Contact Sealed Bearings - GEN1 Ball Type



Type with integrated seal

GEN 1 ball type

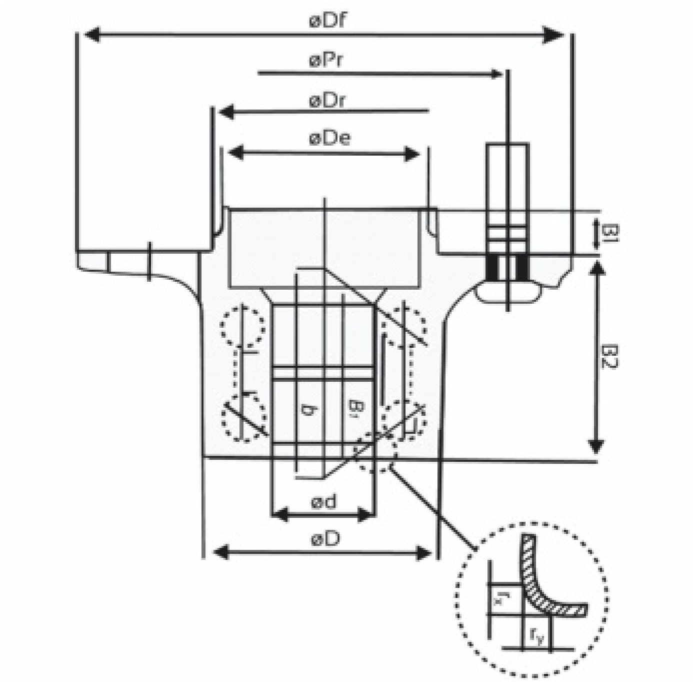

GEN 1


GEN 1 Hub Mounted

Boundry Dimensions					Distance Between Pressure Cone Apexes	Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass (Kg) (Approx.)
						Dynamic	Static	Dynamic	Static			
mm						KN		Kgf		KN		
d	D	B	$r_{x\ (min)}$	$r_{y\ (min)}$	mm	Cr	Co	Cr	Co	Cu		
35	68	37	3.5	3.5	52.6	45.9	43.1	4680	4395	2.3	**AU1101-2LLX2**	0.535
36	68	33	3.5	3.5	52.6	45.9	43.1	4680	4395	2.3	**AUll07-2LLX2**	0.47
37	72	37	2.5	2.5	53.1	56.2	52	5731	5302	2.8	**AU0727-14L UL588**	0.63
37	72	37	2.5	2.5	53.1	56.2	52	5731	5302	2.8	**AU0754-2LXUL588**	0.624
37	72	37	2.5	2.5	53.1	56.2	52	5731	5302	2.8	**AU0727-15LXUL588**	0.628

Wheel Application : Double Row Angular Contact Sealed Bearings - GEN 2 Ball Type

GEN 2 ball type



Boundry Dimensions											Distance Between Pressure Cone Apexes	Basic Load Rating (Single row)				Fatigue Load Limit	Bearing Number	No. of Hub bolts	Mass Kg
												Dynamic	Static	Dynamic	Static				
mm												KN		Kgf		KN			
d	D	B1	B2	B_1	Df	Dw	Db	Pb	rx min.	ry min.	min.	Cr	Cor	Cr	Cor	Cu			(reference)
28	64	18	49.5	40	134	60	64	14.3	3.5	2.5	49.7	26.2	16.5	2672	1683	1.947	BB1072	4	1.64

15.4.3 Wheel application Generation 3 Hub unit

3rd Generation Wheel Hub Bearing Units

Automotive OEM's are looking for compact, capable, light weight and reliable solutions for new model launch. Traditional wheel bearings were using more parts, more sub-assembly time and were difficult to mount. The Gen 3 wheel bearing is an integrated and modular solution for wheel ends.

NEI developed 3rd Generation wheel bearings which are highly integrated units with a brake disc mounting flange, bearing and wheel mount flange that guarantee highest running accuracy. The bearing clamping force (Preload) is applied and controlled via a specially formed shoulder, resulting in a maintenance free design.

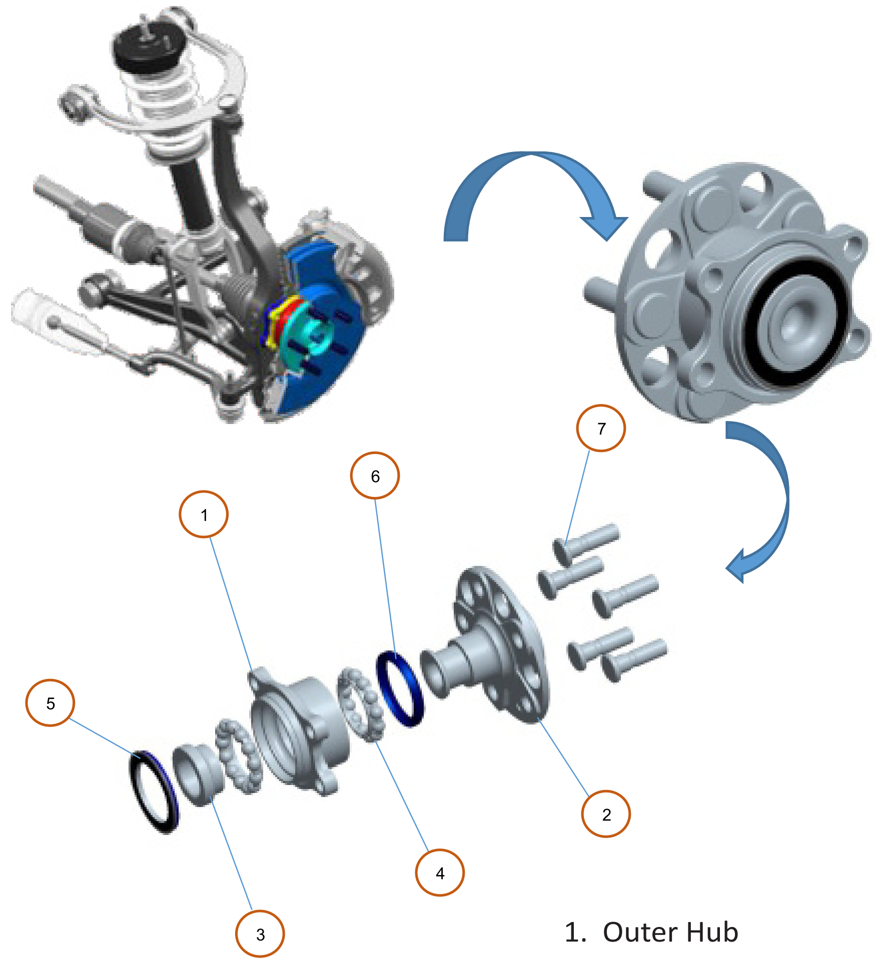
Double flange design and integrated approach reduces total cost of mounting the assembly in the vehicle. Reduced function and overall bearing life caused by incorrect mounting influences are finally eliminated with this Gen 3 bearing development.

It is also possible to provide integrated speed sensors required for signal of ABS/ESP suspension control.

Benefits:-

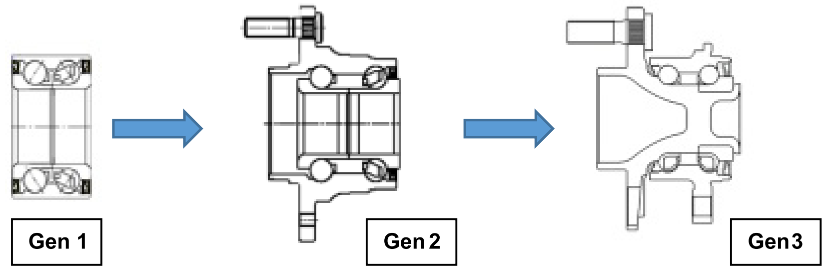
1. Integrated wheel speed sensor controle.g. ABS
2. Sealed and lubricated for life
3. "Plug in" for the vehicle. Preloaded and preassembled to precise high quality standards.
4. Reduced installation complexity.
5. High precision brake disc and wheel guidance.
6. Long service life.
7. Zero maintenance cost
8. Low life cycle cost.

Generation 3 Wheel Hub Bearings



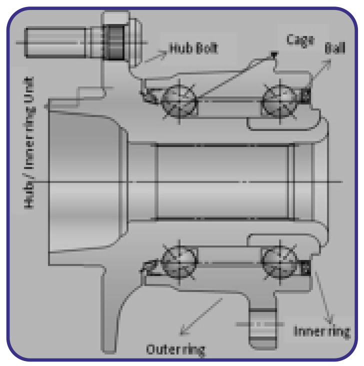
1. Outer Hub
2. Inner Hub
3. Separate Inner
4. Ball Cage Assembly
5. Inboard Seal
6. Outboard Seal
7. Hub Bolts

Evolution in Wheel Hub Bearings



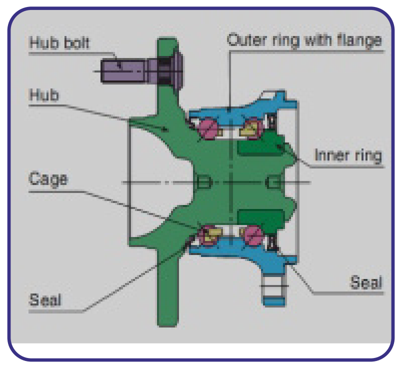
Types of Gen 3 Bearings

Driven Wheel



Splines in Hub inner bore get engaged with splined hub shaft to drive/move the vehicle along with supporting vehicle weight.

Non - Driven Wheel



Inner Ring Rotating type non driven bearing. Only supports vehicle weight

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Why Gen 3 Bearings?

Below table shows comparison of Hub unit bearings based on required characteristics. Gen-3 bearing is superior when compared to most of the required characteristics of Hub Unit bearings.

Characteristics	Items	GEN 1	GEN 2	GEN 3
		DRIVEN/ NON-DRIVEN	NON-DRIVEN	DRIVEN/ NON-DRIVEN
		Inner Ring Rotation	Outer Ring Rotation	Inner Ring Rotation
Functionality	Load Capacity	++	++	++
	Rigidity	+	+	++
	Rotation torque	++	++	+++
	Seizure resistance	+++	+++	+++
Compactness	Axle weight	+	+++	+++
	Cross-section space	+	+	+++
	Width space	+	+++	+++
Reliability	Width Seals	+++	+++	+++
	Preload range under motion	+	++	+++
	Reliability in service	+	++	+++
Maintenance	Preload Management	+	++	+++
	Mounting & Serviceability	+	++	+++
	Knuckle material applicability	+	++ **(Light alloys)**	++ **(Light alloys)**

Note: Superiority Ranking order +++ > ++ > +

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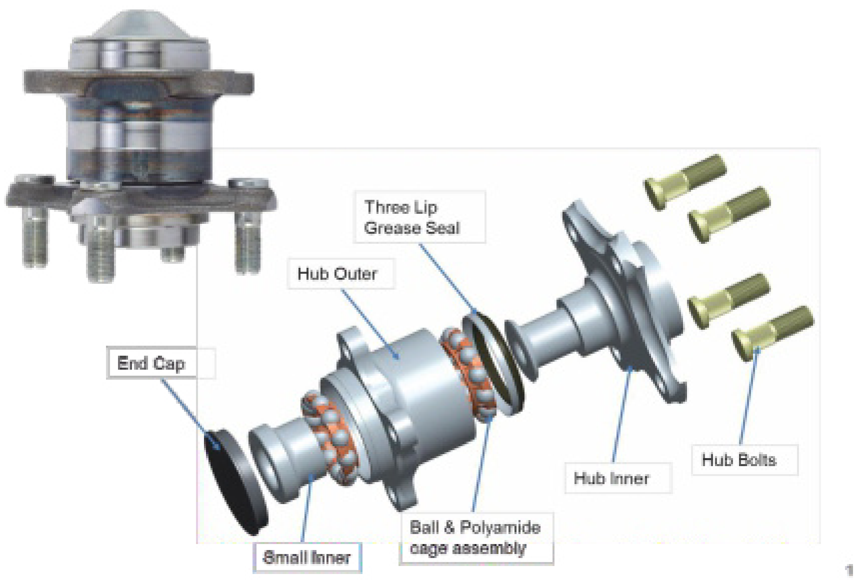
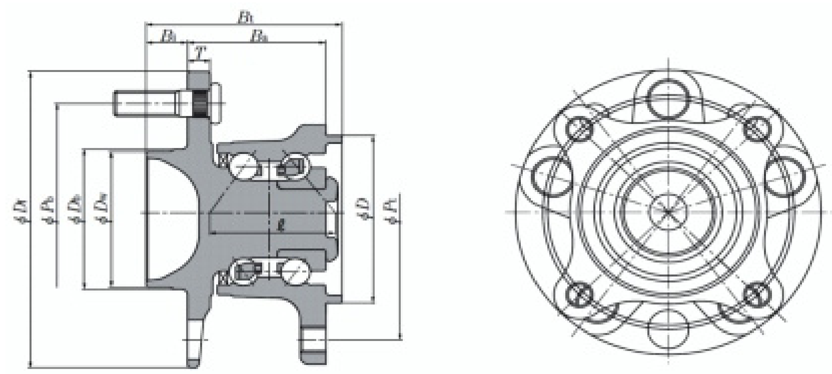
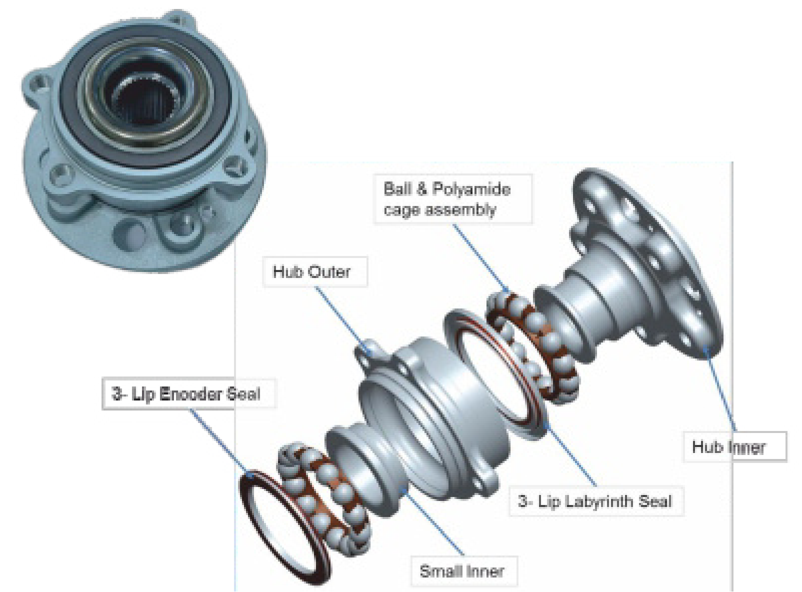
GEN -3 Non Driven Wheel Hub Unit

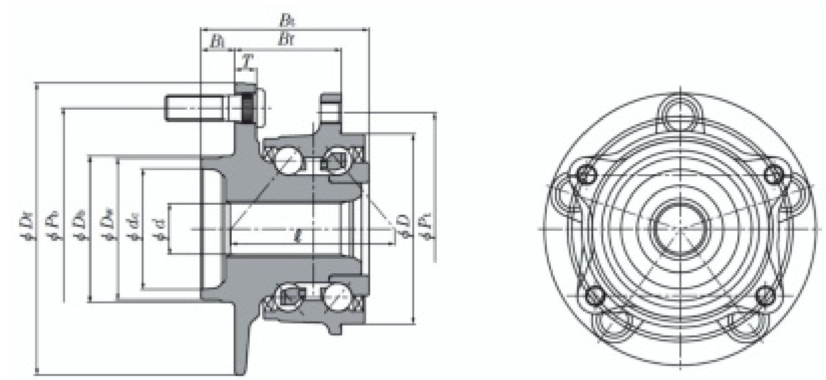




Project / Customer	Main Dimensions (MM)										Nos of Hub Bolts	No of Tap hole in outer	Mass (KG)
	Dw	D	Db	Ba	T	Bi	Bt	Pb	Pt	Df			
N1271	54	62	62	60	10	15	87.5	100	~90	120	4	4	2.0

GEN -3 Driven Wheel Hub Unit





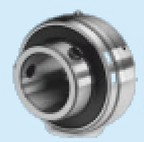
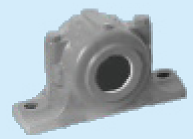
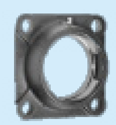
Project / Customer	Main Dimensions (MM)												Nos of Hub Bolts	No of Tap hole in outer	Mass (KG)
	d	dc	Dw	D	Db	Bt	Bf	T	Bi	Pb	Pt	Df			
N1379	26	59	66.5	98	69	91.5	57	17	17	112	116	148	NA (5 tap Holes)	4	3.5

16 Pillow Blocks

NBC offers Pillow blocks for both standard and special applications. The Pillow blocks are made of cast steel housing and meet the harsh environmental conditions of industry. The units are with strong base and have radial insert ball bearing with grub screws. Sealing protect from dirt and dust.

Designation System

- Prefixes- insert bearing or housing type
- Figures - dimension series or size
- Suffixes - types of design variants

Bearing insert with set screw	Housing type	Insert bearing housing
UC 	P 	UCP 
	T 	UCT 
	F 	UCF 
	FL 	UCFL 

UC

- Insert bearing with set screw

Housing type

- P- Pillow block unit
- F- Flanged unit, 4-bolt (square)
- FL- Flanged unit, 2-bolt (oval)
- T- Take-up unit

Dimension series

- 2 – Normal series
- 3 – Heavy series

Bore diameter

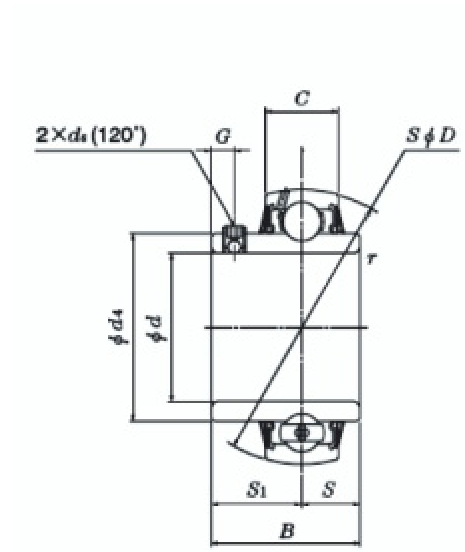
- 01
- 02
- 03
- 04 or higher = (bore dia. Code x 5)

Design variant

- Mounting
- Type of threads
- Cage.....

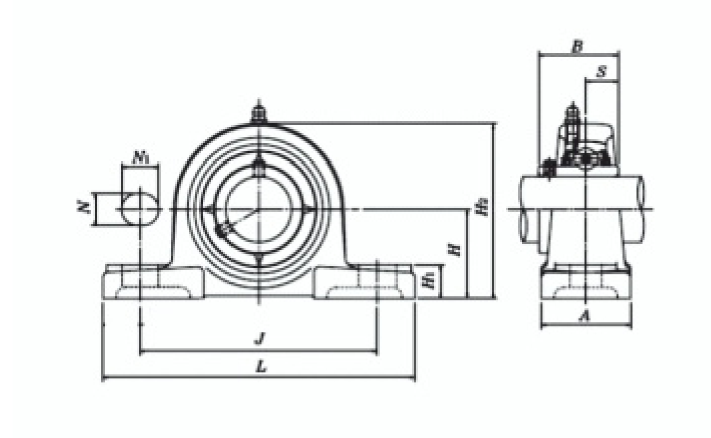
Example UCP205
UC
P
: Insert bearing with set screw : Pillow block housing
205 : 2-Normal series
55
05
: Bore diameter (Bore size 25 mm)
Example UCF305-18
UC
F
305-16
: Insert bearing with set screw : Flange unit 4-bolt (square)
3-Heavy duty series
05-16 16/16 or 1 inch bore diameter
After bearing size two-digit number separated by a hyphen, gives the bore size in inch. It is the number of sixteenths (1/16) of an inch.

UC Ball Bearing Set Screw Type



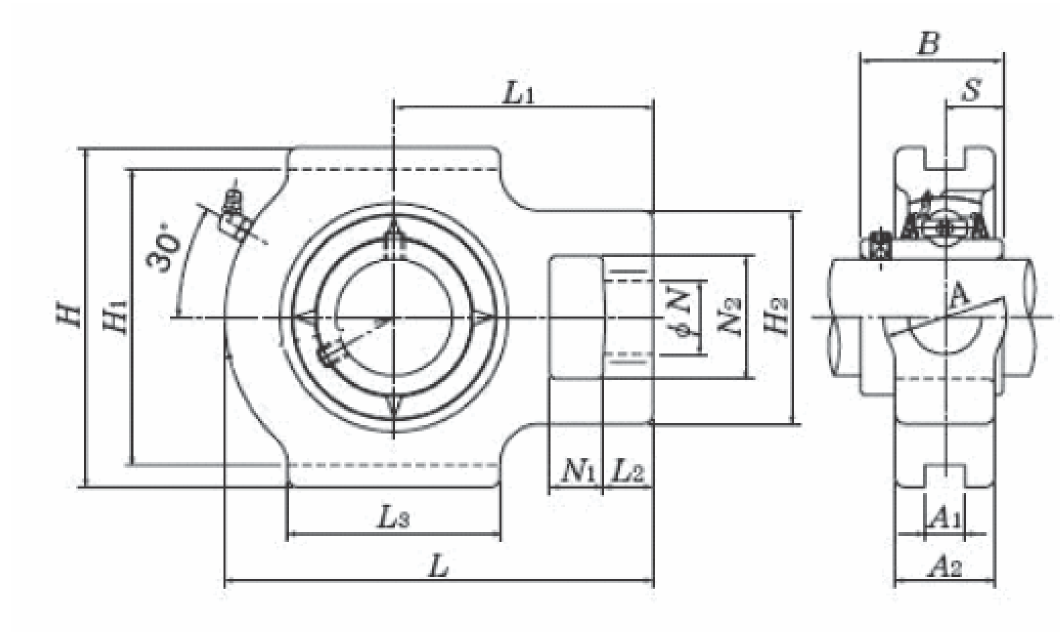
Shaft Dia	Unit no.	d	D	B	C	r_s Min.	S	S_1	G	d_s	Basic Load Rating		Mass (Kg.)
											Dynamic C_r (KN)	Static C_{or} (KN)	
19.05	UC204-12	19.05	47	31	16	1	12.7	18.3	5	2-1/4-28	12.8	6.65	0.16
20	UC204	20	47	31	16	1	12.7	18.3	5	2-M6 X 1	12.8	6.65	0.16
25	UC205	25	52	34	17	1	14.3	19.7	5.5	2-M6 X 1	14.1	7.88	0.19
25.4	UC205-16	25.4	52	34	17	1	14.3	19.7	5.5	2-1/4-28	14.1	7.88	0.19
30	UC206	30	62	38.1	19	1.1	15.9	22.2	5.5	2-M6 X 1	19.5	11.3	0.31
31.75	UC207-20	31.75	72	42.9	20	1.1	17.5	25.4	6.5	2-5/16-24	25.6	15.3	0.5
35	UC207	35	72	42.9	20	1.1	17.5	25.4	7	2-M8 X 1	25.7	15.3	0.5
38.1	UC208-24	38.1	80	49.2	21	1.1	19	30.2	8	2-5/16-24	31.7	20.7	0.68
40	UC208	40	80	49.2	21	1.1	19	30.2	8	2-M8 X 1	29.5	18.1	0.68
45	UC209	45	85	49.2	22	1.1	19	30.2	8	2-M8 X 1.25	31.7	23.1	0.68
50	UC210	50	90	51.6	23	1.1	19	32.6	10	2-M10 X 1.25	35	23.2	0.78
50.5	UC211-32	50.8	100	55.6	24	1.5	22.2	33.4	10	2-3/8-24	43.5	29.2	1.22
55	UC211	55	100	55.6	24	1.5	22.2	33.4	10	2-M10 X 1.25	43.5	29.2	1.22
60	UC212	60	110	65.1	26	1.5	25.4	39.7	10	2-M10 X 1.25	47.7	32.9	1.52
63.5	UC213-40	63.5	120	65.1	27	1.5	25.4	39.7	10	2-3/8-24	57.5	40	1.9
65	UC213	65	120	65.1	27	1.5	25.4	39.7	10	2-M10 X 1.25	57.5	40	1.9

UCP- Pillow Blocks(cast housing & set screw)



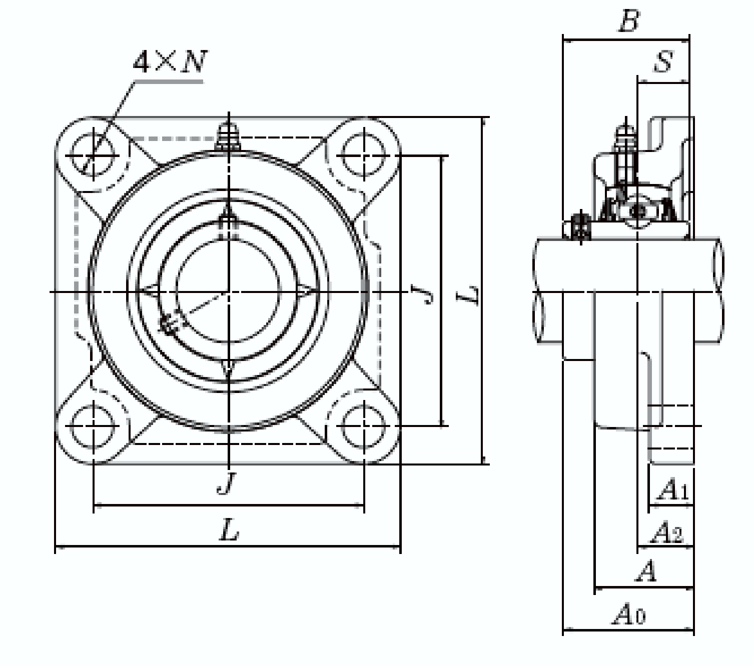
Shaft Dia	Unit no.	H	L	J	A	N	N_1	H_1	H_2	B	S	Bearing No.	Mass (Kg.)
19.05	UCP204-12	33.3	127	95	38	13	16	14	64	31	12.7	UC204-12	0.7
20	UCP204	33.3	127	95	38	13	16	14	64	31	12.7	UC204	0.7
25	UCP205DI	36.5	140	105	38	13	16	15	71	34.1	14.3	UC 205 D_1	0.8
25	UCP205	36.5	140	105	38	13	19	15	69.5	34	14.3	UC205	0.8
25.4	UCP205-16	36.5	140	105	38	13	19	15	69.5	34	14.3	UC205-16	0.8
28.575	UCP206-18	42.9	165	121	48	17	21	17	83	38.1	15.9	UC206-18	1.17
30	UCP206	42.9	160	121	44	14	19	16	82	38.1	15.9	UC206	1.28
31.75	UCP207-20	47.6	167	127	48	15	19	17	92	42.9	17.5	UC207-20	1.5
	UCP206-20	42.9	165	121	48	17	21	18	83	38.1	15.9	UC206-20	1.17
35	UCP207	47.6	167	126	48	17	21	18	94	42.9	17.5	UC207	1.5
38.1	UCP208-24	49.2	180	137	52	15	21	18	98	49.2	19	UC208-24	1.98
40	UCP208	49.2	183	136	54	17	21	19	98	49.2	19	UC208	1.91
44.45	UCP209-28	54	189	146	54	17	21	21	106	49.2	19	UC209-28	2.09
45	UCP209	54	189	146	54	15	21	20	106	49.2	19	UC209	2.08
50	UCP210	57.2	204	159	60	19	22	21	112	51.6	19	UC210	2.58
50.8	UCP211-32	63.5	217	171	60	19	22	22	125	55.6	22.2	UC211-32	3.62
55	UCP211	63.5	219	170	58	20	25	24	126	55.6	22.2	UC211	3.25
57.15	UCP212-36	69.8	238	183	70	20	23	26	138	65.1	25.4	UC212-36	4.5
60	UCP212	69.8	238	184	66	19	25	24	137	65.1	25.4	UC212	4.32
63.5	UCP213-40	76.2	262	203	70	23	29	26	149	65.1	25.4	UC213-40	5.38
65	UCP213	76.2	263	202	70	25	29	28	150	65.1	25.4	UC213	5.38
75	UCP215	82.6	275	216	75	25	30	28	161	77.8	33.3	UC215	7.2
76.2	UCP215-48	82.6	275	216	75	25	30	28	161	77.8	33.3	UC215-48	7.2

UCP Take-upunits (Blocks(cast housing & set screw)



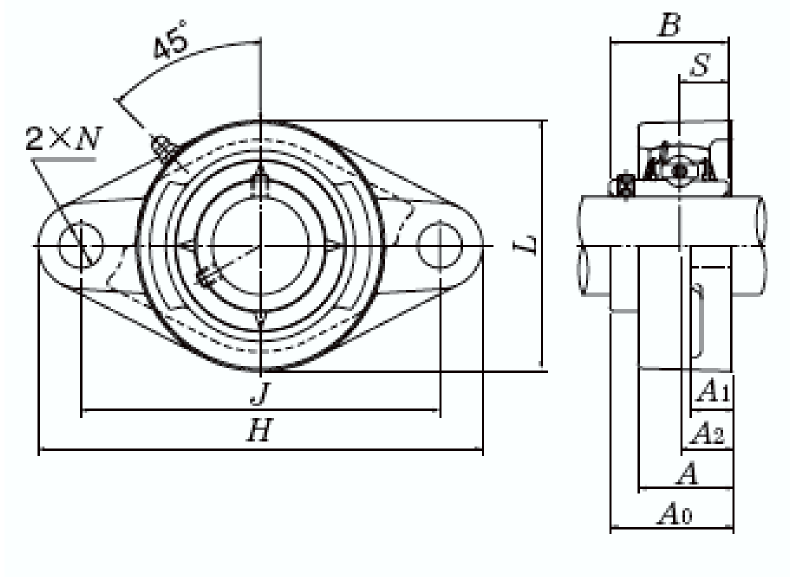
Shaft Dia	Unit no.	N_1	L_2	H_2	N_2	N	L_3	A_1	H_1	H	L	A_2	A	L_1	B	S	Mass (Kg.)
28.575	UCT206-18	16	10	56	37	22	57	12	89	102	113	27	37	70	38.1	15.9	1.05
30	UCT206	16	10	56	37	22	57	12	89	102	113	27	37	70	38.1	15.9	1.05
31.75	UCT206-20	16	10	56	37	22	57	12	89	102	113	27	37	70	38.1	15.9	1.05
	UCT207-20	16	13	64	37	22	64	12	89	102	129	28	37	78	42.9	17.5	1.66
35	UCT207	16	13	64	37	22	64	12	89	102	129	28	37	78	42.9	17.5	1.64
44.45	UCT209-28	19	16	83	49	29	83	16	102	117	144	34	49	87	49.2	19	2.33
45	UCT209	19	16	83	49	29	83	16	102	117	144	34	49	87	49.2	19	2.3
50	UCT210	19	16	83	49	29	86	16	102	117	149	34	49	90	51.6	19	2.5
50.8	UCT211-32	25	19	102	64	35	95	22	130	146	171	36	64	106	55.6	22.2	3.35
55	UCT211	25	19	102	64	35	95	22	130	146	171	36	64	106	55.6	22.2	3.3

UCF 4 - Bolt Flaged units(cast housing & set screw)



Shaft Dia	Unit no.	L	J	A_2	A_1	A	N	A_0	B	S	Mass (Kg.)
25	UCF205	95	70	16	13	27	12	35.7	34.1	14.3	0.7
28.575	UCF206-18	108	83	18	14	31	12	40.2	38.1	15.9	0.99
30	UCF206	108	83	18	14	31	12	40.2	38.1	15.9	0.99
35	UCF207	117	92	19	16	34	14	44.4	42.9	17.5	1.31
40	UCF208	130	102	21	16	36	16	51.2	49.2	19	1.7
45	UCF209	137	105	22	18	38	16	52.2	49.2	19	1.88
50	UCF210	143	111	22	18	40	16	54.6	51.6	19	2.39
55	UCF211	162	130	25	20	43	19	58.4	55.6	22.2	3.18

UCFL 2 Bolt Flanged units (Cast housing & screw type)



Shaft Dia	Unit no.	H	J	A_2	A_1	A	N	L	A_0	B	S
20	UCFL204	120	90	15	11	25.5	12	59	33.3	31	12.7
25	UCFL205	129	99	16	13	27	16	68	35.7	34.1	14.3
25.4	UCFL205-16	129	99	16	13	27	16	68	35.7	34.1	14.3
28.575	UCFL206-18	147	117	18	13	31	16	79	40.2	38.1	15.9
30	UCFL206-18	147	117	18	13	31	16	79	40.2	38.1	15.9
31.75	UCFL207-20	161	130	19	15	35	16	90	44.4	42.9	17.5
35	UCFL207	161	130	19	15	35	16	90	44.4	42.9	17.5
38.1	UCFL208-24	176	144	21	15	36	16	102	51.2	49.2	19
40	UCFL208	176	144	21	15	36	16	102	51.2	49.2	19
50	UCFL210	200	157	22	15	40	19	116	54.6	51.6	19
60	UCFL212	251	202	29	18	48	23	142	68.7	65.1	25.4

17 Needle roller Bearing

17.1 Classification & Characteristics Of Needle Bearings

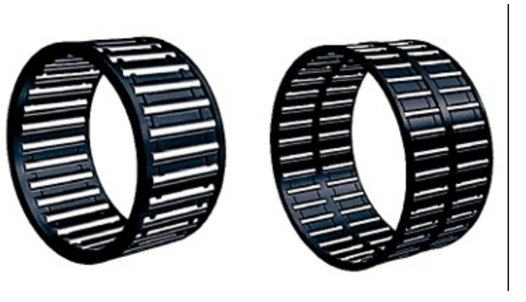
Needle roller bearings are generally composed of needle rollers and cages. Several needle rollers placed between two hardened and smooth surfaces and cage prevent the needle rollers to contact each other to accommodate smooth rolling action. The diameter of rolling element in Needle roller bearing is relatively small and having relatively large length/diameter ratio, this allows for more load carrying capacity and ideal for oscillating motion.

In comparison to other roller bearings, needle roller bearings are having small radial section height and smaller mass, which allows for more compact design and suitable for application where low inertia force is required.

There are different types of Needle roller bearings depending upon customer applications requirements

1.Needle roller and cage assembly

A needle roller and cage assembly comprises of needle rollers and a cage that guides and hold the rollers on its position to accommodate smooth rolling action. As needle roller and cage, assembly has no inner and outer ring, uses shaft and housing as raceway surface. Needle roller and cage assembly demands a hardened and ground surface on the shaft and housing races, reduces the cross-sectional thickness. The assembly can be made in both single-row and double-row.



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2. Needle roller and cage assembly for connecting rod bearings

A Needle roller and cage assembly for connecting rod bearings comprises of needle rollers and a cage that guides and hold the rollers on its position.

A connected rod bearing operated under extreme loading and operating conditions required a high rigidity bearing which is light-weight and have high load rating.

a) Needle roller and cage assembly for connecting rod large end

This product is design to withstand the crank motion involving the simultaneous rotation and revolution on the large end side of the connecting rod. The cage is made of special steel and heat treated. Cage is designed for outer diameter guided system so outer diameter is precision finished to avoid unwanted temperature rise during high speed and heavy shock loads.

Along with this, the cage can be surface treated using different non-ferrous metal to avoid friction due to poor lubrication.

b) Needle roller and cage assembly for small end

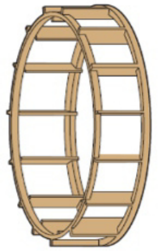
The small end bearing is designed to withstand high impact loads and high-speed oscillation. Cage is designed for inner diameter guide and guide surface is designed to minimize surface pressure.

To reduce the contact pressure on rollers, bearing is designed to incorporate with maximum possible length and small diameter of rollers.

3. Shell Type Needle Roller Bearing

Shell type needle roller bearing comprises of an outer shell ring made from special thin steel, needle rollers and cage. A hardened and ground inner ring/shaft is used as the raceway. This bearing needs no axial clamping due to easy installation and a press-fit in the housing so it can also be used in application where shell face abutment with the hosing is not possible. The outer ring of shell bearing is so thin that it gets deformed and take the shape of housing in which it is press fitted so dimensional accuracy of both shell bearing as well as housing is important for bearing performance.

4. Polyamide cage:



This injection moulded, window-type cage of glass fibre reinforced, and heat stabilized polyamide is used in small and medium size single row cylindrical roller bearings. Cages made from glass fiber reinforced polyamide 66 are suitable for long term temperatures up to +120 °C.
Its advantage:

- High elasticity,
- Light weight,
- Quiet running from good damping,
- Excellent tribological properties, and
- Very good behaviour under emergency running.

4. Machined-ring needle roller

Machined ring type needle roller bearing comprises of an outer ring made by machining, needle rollers and cage to guide the rollers. The outer ring is having high rigidity and easy to install. Machined ring needle roller bearing is suitable for heavy loads and used where high bearing accuracy required.

5. Thrust roller bearing

Thrust roller bearing comprises of needle, a cage that guides and retains the rollers. This bearing can take load in axial direction. Also thrust needle roller and cage assembly has no inner and outer ring, heat treated and finished mounting surface can be used as raceway. These bearings are having high rigidity and high load capacity and best-suited to small spaces.

Needle Bearing Characteristics

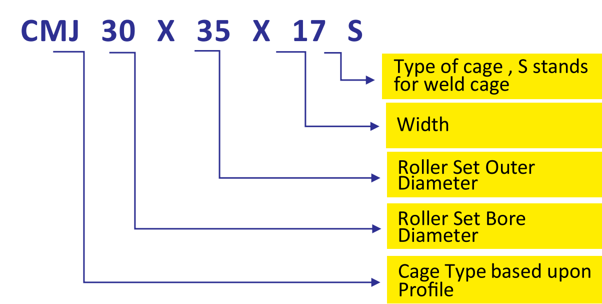
1. Compact design:
Since needle roller bearings are having small radial section height which allows for more compact design for bearings.
2. Low inertial forces:
Because of needle roller bearing compact design, they have a smaller mass, which makes it suitable for application where lower inertial forces is required.
3. High Load Carrying Capacity:
Needle roller bearing is relatively small and having relatively large length/diameter ratio, this allows more rollers to incorporate in same boundary dimension relatively to other bearing type and hence more load carrying capacity
4. Suitable for oscillation motion application:
As diameter of rolling element is small so can be arranged in small spacing pitch, and this is ideal for oscillation motion

Needle Bearing Nomenclature

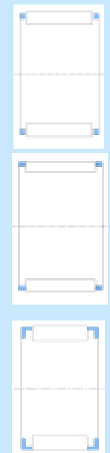
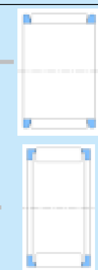
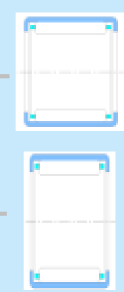
Bearing Type Code	Details
C	Needle roller and machined cage assembly
CBC	Needle roller and machined cage assembly for piston pins
PC	Needle roller and machined cage assembly for crank pins
CJ··S	Needle roller and weld cage assembly
CMJ··S	Needle roller and weld cage assembly
CV··S	Needle roller and weld cage assembly
HC	Drawn-cup needle roller bearing
HMC	Drawn-cup needle roller bearing for heavy loading
HC-F	Speical Type Drawn-cup
F	needle roller bearing Flat end type roller

Suffix	Details
Cage	
Q	Soft Nitriding on cage
E	Carburizing + Hardening + Tempering HT on cage
D	Black Oxide on cage
C	Copper Plating on cage
S	Silver Plating on cage
Roller	
-	Through Hardened treatment on roller
AS	Carbonitriding Treatment on Roller
E1	Crowning (End drop) on roller
SF	Improved surface finish on roller OD

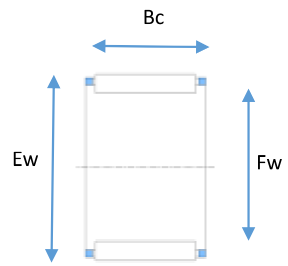
Designation



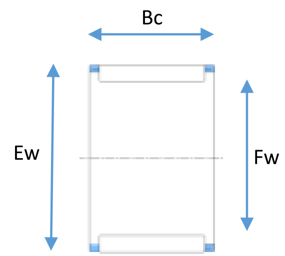
Needle Bearing Classification

Weld Cage Assembly	 Needle roller and cage assembly	 CJ..S, CMJ..S, CV..S
Machine Cage Assembly	 Needle Roller and Cage Assembly for Connecting Rod Bearings	 C CBC, PC
Shell Type Bearing	 Shell Type Needle Roller Bearings	 HC, HMC

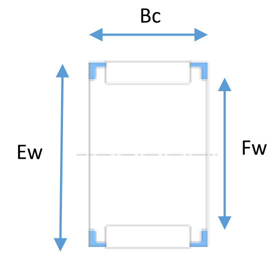
Needle Roller and Cage Assembly



CJ..S



CMJ..S



CV..S

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
15	18	14	7 850	11 600	800	1 190	C15x18x14	0.006
15	19	8	5 350	5 850	545	600	CV15x19x7.8XS	0.0033
15	19	10	6 850	8 050	700	820	C15x19x10	0.0055
15	19	13	8 250	10 200	840	1 040	C15x19x13	0.0067
15	19	17	10 900	14 600	1 110	1 490	C15x19x17	0.009
15	19	24	14 100	20 400	1 440	2 080	C15x19x24ZW	0.013
15	20	13	10 100	11 500	1 030	1 170	C15x20x13	0.0088
15	20	16	12 600	15 200	1 280	1 550	CMJ15X20X15.8XS	0.009
15	21	15	11 900	12 500	1 210	1 280	C15x21x15	0.013
15	21	17	14 900	16 800	1 510	1 720	CMJ15X21X16.8X1S	0.012
15	21	21	16 500	19 100	1 680	1 950	C15x21x21	0.017
16	20	10	7 500	9 250	765	945	C16x20x10	0.0057
16	20	11	8 300	10 500	845	1 070	C16x20x11	0.0061
16	20	13	9 050	11 800	925	1 200	C16x20x13	0.0071
16	22	12	11 700	12 500	1 190	1 280	C16x22x12	0.01
16	22	13	12 600	13 900	1 290	1 410	CMJ16X22X13	0.011
16	22	16	13 600	15 200	1 380	1 550	C16x22x15.8X	0.014
16	22	17	14 400	16 400	1 470	1 670	C16x22x17	0.015
16	22	20	16 000	18 800	1 640	1 920	C16x22x20	0.017
17	21	15	10 400	14 400	1 060	1 460	C17x21x15	0.0089
17	21	17	11 800	16 900	1 210	1 720	C17x21x17	0.0095
17	22	20	14 700	19 200	1 500	1 960	C17x22x20	0.015
17	23	17	14 400	16 500	1 460	1 690	C17x23x17	0.016
18	22	10	7 400	9 400	755	955	C18x22x10	0.0061
18	22	13	8 900	11 900	910	1 210	C18x22x13	0.0077
18	22	17	11 700	17 000	1 200	1 730	C18x22x17	0.011

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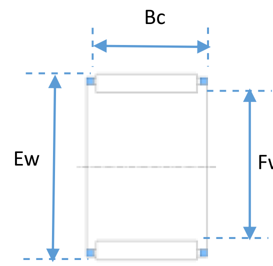

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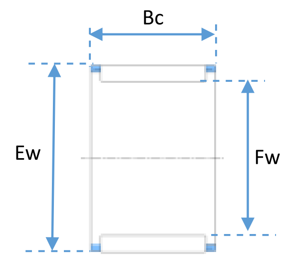

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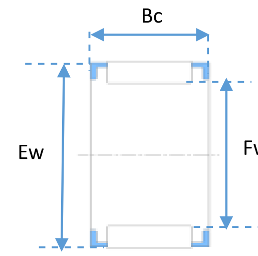

CV..S

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
18	24	12	12 300	13 800	1 250	1 410	C18x24x12	0.012
18	24	13	11 600	12 800	1 180	1 300	C18x24x13	0.013
18	24	17	16 000	19 300	1 630	1 970	CMJ18X24X17SV1	0.014
18	24	20	17 000	20 900	1 730	2 130	C18x24x20	0.019
18	25	17	18 000	20 400	1 830	2 080	C18x25x17	0.019
18	25	22	22 100	26 600	2 250	2 710	C18x25x22	0.024
19	23	13	9 650	13 500	985	1 370	C19x23x13	0.0082
19	23	17	12 700	19 200	1 300	1 960	C19x23x17	0.011
20	24	11	9 500	13 400	970	1 370	C20x24x11	0.0072
20	24	45	16 400	27 100	1 680	2 760	C20x24x45ZW	0.028
20	25	40	29 000	48 000	2 950	4 900	C20x25x40ZW	0.033
20	26	12	12 900	15 100	1 320	1 540	C20x26x12	0.013
20	26	13	14 000	16 700	1 420	1 700	CMJ20X26X13S	0.012
20	26	14	15 800	19600	16 100	2 000	CMJ20X26X13.8X1S	0.013
20	26	17	17 800	22 800	1 810	2 330	CMJ20x26x17S	0.016
20	26	20	20 600	27 600	2 100	2 820	CMJ20x26x20S	0.019
20	28	17	21 700	2 4600	2 210	2 510	CMJ20x28x17	0.022
20	28	20	24 600	2 8900	2 500	2 940	CMJ20x28x20	0.026
21	25	13	10 700	1 5900	1 090	1 620	CMJ21x25x12.8x1S	0.0081
21	25	17	13 600	2 1500	1 380	2 200	C21x25x17	0.012
22	26	11	10 100	1 4900	1 030	1 520	C22X26X11	0.009
22	26	13	10 200	1 5200	1 040	1 550	C22x26x13	0.0094
22	27	20	17 500	2 5900	1 780	2 640	C22x27x20	0.02
22	27	28.5	24 200	3 9500	2 470	4 000	C22x27x28.3X	0.0276
22	27	40	50 500	10 3000	5 150	10 500	C22x27x40ZW	0.039
22	28	17	17 700	2 3300	1 810	2 380	C22x28x17V1	0.02
22	29	16	18 700	2 2700	1 910	2 310	C22x29x16	0.023
22	30	15	19 300	21 700	1 970	2 210	C22x30x15	0.022

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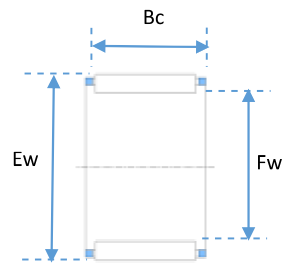
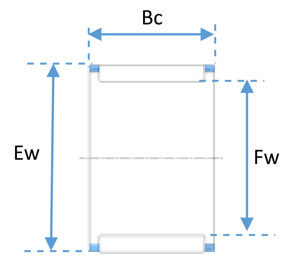
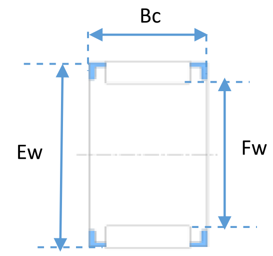


CJ..S

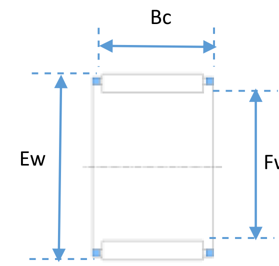


CMJ..S



CV..S

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
22	30	17.5	23 200	2 7500	2 370	2 800	CMJ22X30X17.3X2S	0.024
22	30	24	31 000	4 0000	3 150	4 100	CMJ22X30X23.8X3S	0.0348
23	27	13	11 400	1 7700	1 160	1 800	CMJ23X27X12.8X1S	0.0086
23	28	24	19 800	3 1000	2 020	3 150	C23x28x24	0.023
23	29	18	20 600	2 8800	2 100	2 930	CMJ23X29X17.8X2S	0.019
24	28	10	9 000	1 3200	915	1 350	C24x28x10	0.008
24	28	13	10 800	16 800	1 100	1 710	C24x28x13	0.01
24	28	17	14 300	23 900	1 460	2 440	C24x28x17	0.013
24	29	13	12 300	16 900	1 250	1 720	C24x29x13	0.012
24	30	17	18 400	25 200	1 880	2 570	C24x30x17	0.022
24	30	31	27 900	43 000	2 840	4 350	C24x30x31ZW	0.039
25	29	10	8 950	13 300	910	1 350	C25x29x10	0.0083
25	29	13	10 800	16 900	1 100	1 720	C25x29x13	0.01
25	30	13	13 200	18 800	1 350	1 920	C25x30x13	0.013
25	30	22	22 300	3 7000	2 270	3 750	CMJ25X30X21.8XS	0.02
25	30	26	36 500	7 1500	3 750	7 300	C25x30x26ZW	0.027
25	30	39	29 800	5 3500	3 050	5 450	C25x30x39ZW	0.04
25	31	13	15 200	19 900	1 550	2 030	C25x31x13V3	0.018
25	31	14	16 500	22 100	1 680	2 250	C25x31x14	0.018
25	31	17	18 300	25 300	1 870	2 580	C25x31x17	0.022
25	31	18.5	21 000	30 000	2 140	3 050	CMJ25X31X18.3X1S	0.021
25	31	21	22 500	33 000	2 290	3 350	C25x31x21V3	0.0283
25	32	16	19 500	24 700	1 990	2 520	C25x32x16	0.027
25	33	24	34 500	47 000	3 500	4 800	CMJ25X33X24S	0.04
26	30	13	11 800	19 200	1 200	1 960	C26x30x13	0.011
26	30	17	15 500	27 400	1 580	2 790	C26x30x17	0.015
26	31	24	21 400	35 500	2 180	3 600	C26X31X23.8X1ZW	0.029
26	34	22	24 200	30 000	2 470	3 050	C26x34x22	0.041



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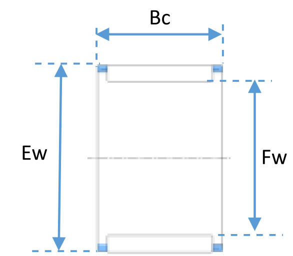

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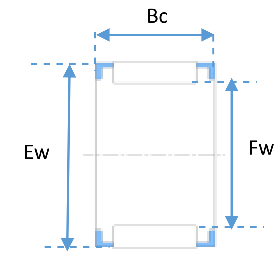
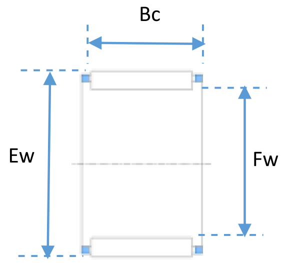


CV..S

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
28	32	17	15 300	27 500	1 560	2 810	C28x32x17	0.017
28	32	21	18 700	35 500	1 910	3 650	C28x32x21	0.02
28	33	13	13 900	20 900	1 420	2 130	C28x33x13	0.015
28	33	26	23 900	42 000	2 430	4 250	C28x33x26ZW	0.033
28	33	27	28 300	52 000	2 890	5 300	C28x33x27	0.032
28	34	14	17 500	24 800	1 790	2 530	C28x34x14	0.02
28	34	17	18 100	25 800	1 850	2 630	C28x34x17V1	0.025
28	35	16	21 200	28 400	2 160	2 900	C28x35x16	0.029
28	35	18	21 500	28 900	2 190	2 950	C28x35x18	0.031
29	34	27	28 100	52 000	2 870	5 300	C29x34x27	0.033
30	34	14	12 400	21 500	1 260	2 190	CV30x34x13.8XS	0.014
30	35	13	14 700	22 900	1 500	2 340	CV30x35x13S	0.017
30	35	17	18 800	31 500	1 910	3 200	CJ30x35x17S	0.021
30	35	26	25 200	46 000	2 570	4 650	C30x35x26ZWV1	0.036
30	36	14	18 600	27 400	1 900	2 790	CMJ30X36X14S	0.021
30	37	16	21 900	30 500	2 230	3 100	C30x37x16	0.029
30	37	18	23 300	33 000	2 370	3 350	C30x37x18	0.034
30	37	20	26 200	38 000	2 670	3 850	CMJ30X37X20S	0.032
30	37	48	40 000	65 500	4 050	6 700	C30x37x48ZW	0.075
30	38	18	25 000	33 000	2 550	3 350	C30x38x18	0.036
31	35	24	21 200	43 500	2 160	4 400	CV31x35x23.8XS	0.022
31	36	14	15 800	25 400	1 610	2 590	CV31x36x13.8XS	0.017
32	37	13	14 500	23 000	1 480	2 350	C32x37x13	0.018
32	37	24	22 900	41 500	2 340	4 200	C32x37x24.8X2	0.018
32	37	26	24 900	46 000	2 540	4 700	C32x37x26ZWV3	0.032
32	37	27	29 600	57 500	3 000	5 850	C32x37x27	0.037
32	38	14	19 800	30 500	2 020	3 100	CMJ32x38x14	0.022



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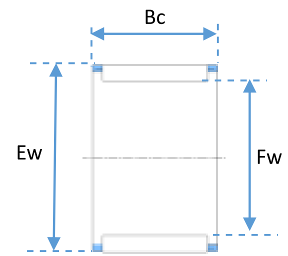

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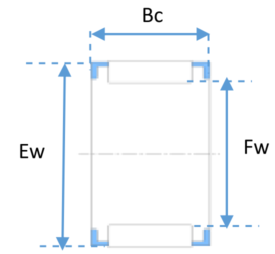
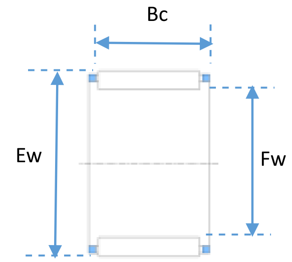


CV..S

Boundary dimensions (mm)			Basic load rating					
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	Mass (Kg) Approx.
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
32	38	20	25 100	41 000	2 560	4 150	CJ32x38x20S	0.031
32	38	26	31 500	54 000	3 200	5 550	C32x38x26	0.041
32	39	16	22 600	32 000	2 310	3 300	C32x39x16V1	0.033
32	39	18	24 000	35 000	2 450	3 550	C32x39x18	0.037
32	39	20	26 800	40 000	2 740	4 100	CJ32x39x20S	0.041
34	40	39.5	39 000	73 500	4 000	7 500	CV34x40x39.3X1ZWS	0.066
35	39	22.5	21 500	46 000	2 200	4 700	CV35x39x22.3XS	0.024
35	40	13	15 200	25 100	1 550	2 560	C35x40x13	0.019
35	40	17	20 000	36 000	2 040	3 650	C35x40x17	0.025
35	40	19	22 300	41 000	2 270	4 200	C35x40x19	0.029
35	40	26	44 000	100 000	4 450	10 200	C35x40x26ZW	0.037
35	40	27	32 000	65 000	3 250	6 600	CJ35x40x27S	0.039
35	40	30	26 100	50 000	2 660	5 100	C35x40x30ZW	0.043
35	41	14	19 400	30 500	1 980	3 100	C35x41x14	0.026
35	41	15	20 900	33 500	2 130	3 400	C35x41x15	0.027
35	41	24	31 000	55 500	3 200	5 650	C35x41x23.8X1	0.042
35	41	40	72 000	168 000	7 350	17 100	C35x41x40ZW	0.055
35	42	16	24 100	36 000	2 450	3 650	C35x42x16	0.035
35	42	18	24 700	37 000	2 510	3 750	C35x42x18	0.039
35	42	20	26 500	40 500	2 700	4 100	CV35x42x20SV2	0.04
35	42	30	39 500	68 000	4 050	6 950	C35x42x30	0.062
35	42	45	42 500	74 000	4 300	7 550	C35x42x45ZW	0.106
36	42	46	51 000	106 000	5 200	10 800	C36x42x46ZW	0.086
37	42	13	15 900	27 100	1 620	2 770	C37x42x13V4	0.021
37	42	17	21 000	38 500	2 140	3 950	C37x42x17V2	0.026
37	42	27	32 500	67 500	3 300	6 900	CJ37x42x27S	0.041
37	43	33.5	39 000	76 000	4 000	7 750	CV37x43x33.3XS	0.062
37	44	18	26 300	41 000	2 680	4 150	C37x44x18	0.042



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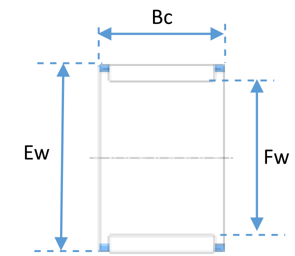

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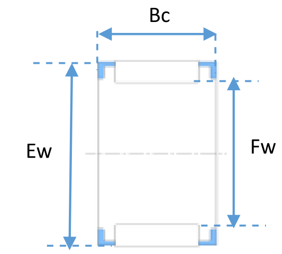
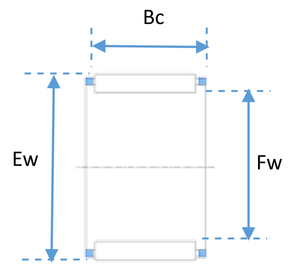


CV..S

Boundary dimensions (mm)			Basic load rating					
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	Mass (Kg) Approx.
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
38	43	17	20 900	38 500	2 130	3 950	C38X43X17	0.027
38	43	27	32 000	67 500	3 300	6 900	C38x43x27	0.043
38	43	29	32 500	68 000	3 300	6 950	C38x43x28.8X	0.047
38	46	20	34 000	52 000	3 450	5 350	CMJ38X46X20S	0.046
38	46	32	54 000	95 500	5 500	9 700	C38x46x32	0.073
40	45	13	16 500	29 200	1 680	2 980	C40x45x13V2	0.023
40	45	17	21 800	41 500	2 220	4 250	C40x45x17	0.027
40	45	21	26 700	54 000	2 720	5 500	C40x45x21V2	0.035
40	45	27	33 500	72 500	3 400	7 400	C40x45x27	0.044
40	46	17	24 600	43 000	2 500	4 350	C40x46x17	0.03
40	46	34	40 500	80 500	4 100	8 250	CV40x46x33.8XS	0.063
40	47	18	27 700	45 000	2 820	4 550	C40x47x18	0.045
40	47	20	31 000	51 500	3 150	5 250	C40x47x20	0.048
40	48	20	33 000	51 000	3 350	5 200	C40x48x20	0.052
40	48	25	41 000	68 000	4 200	6 900	CV40x48x25SV1	0.065
41	49	22	30 500	46 000	3 100	4 700	CV41X49X21.8XS	0.065
42	47	17	22 100	43 000	2 250	4 400	C42x47x17	0.028
42	47	27	34 000	75 500	3 450	7 700	C42x47x27	0.047
42	48	17	25 700	46 000	2 630	4 700	C42x48x17	0.036
42	50	20	34 000	53 500	3 450	5 500	C42x50x20	0.054
43	48	17	22 000	43 000	2 240	4 400	C43x48x17	0.029
43	48	27	34 000	75 500	3 450	7 700	C43x48x27	0.046
43	48	38	41 000	96 000	4 150	9 800	CV43x48x37.8XZWS	0.058
43	50	18	29 100	49 000	2 960	5 000	C43x50x18	0.049
44	50	31	43 500	91 500	4 400	9 300	CV44x50x30.8XS	0.067
45	49	19	22 100	52 000	2 260	5 300	C45x49x19	0.027
45	50	17	22 300	44 500	2 280	4 550	C45x50x17	0.033
45	50	25.8	30 500	66 500	3 100	6 750	CV45x50x25.8XS	0.045



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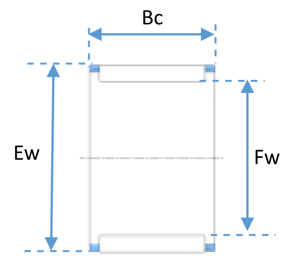

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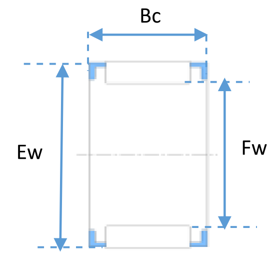
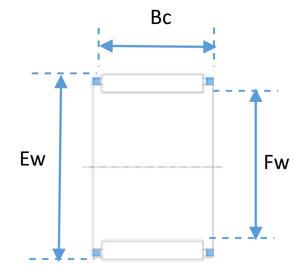


CV..S

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
45	50	27	34 500	78 000	3 500	7 950	C45x50x27	0.05
45	51	27	34 500	68 000	3 500	6 950	CV45x51x26.8XS	0.058
45	52	18	29 700	51 000	3 000	5 200	C45x52x18	0.051
45	52	21	32 000	56 500	3 300	5 750	C45x52x21	0.061
45	53	20	36 000	59 000	3 650	6 000	C45x53x20	0.062
45	53	25	46 500	82 000	4 700	8 400	C45x53x25	0.077
45	53	28	49 500	90 000	5 050	9 200	CJ45x53x28S	0.078
47	52	15.5	19 400	38 000	1 980	3 900	C47x52x15.3X2	0.031
47	52	17	23 200	47 500	2 360	4 850	C47x52x17	0.033
47	52	23	29 600	65 500	3 000	6 650	CV47x52x22.8XS	0.044
47	52	24	33 500	76 500	3 400	7 800	C47x52x23.8X	0.044
47	52	27	35 500	83 000	3 650	8 450	C47x52x27	0.051
47	52	33	38 000	90 500	3 900	9 250	CV47x52x32.8xZWS	0.064
48	53	22.5	31 000	69 500	3 150	7 050	CV48x53x22.3XS	0.042
48	53	30	36 500	85 500	3 700	8 750	C48x53x29.8X1	0.062
48	53	37	45 000	112 000	4 550	11 400	CV48x53x36.8XZWS	0.064
48	53	37.5	41 500	101 000	4 200	10 300	C48x53x37.5ZW	0.072
48	54	19	31 000	61 000	3 150	6 250	C48X54X19	0.044
48	55	24.5	39 000	73 500	4 000	7 600	CV48X55X24.3XS	0.07
50	55	13.5	18 100	35 500	1 850	3 600	C50X55X13.5	0.023
50	55	20	27 900	62 000	2 850	6 300	CV50X55X20S	0.04
50	55	27	37 000	88 500	3 750	9 000	C50X55X27	0.053
50	55	30	39 500	97 000	4 050	9 900	C50x55x30	0.059
50	57	18	31 500	57 000	3 200	5 800	C50x57x18	0.053
50	58	20	38 500	67 500	3 950	6 850	C50x58x20	0.065
50	58	25	48 500	90 000	4 950	9 150	C50x58x25	0.081
50	58	58	83 500	181 000	8 500	18 400	CV50x58x57.8XZWS	0.188



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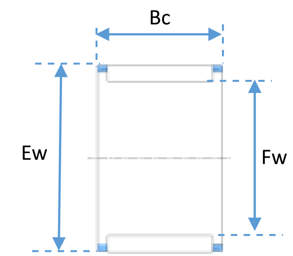

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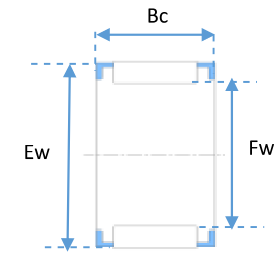
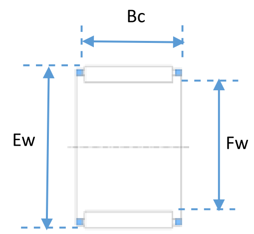


CV..S

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
52	57	18	22 800	48 000	2 320	4 900	CV52X57X17.8XS	0.037
52	57	23	30 500	69 500	3 100	7 100	CV52X57X22.8X1S	0.048
52	58	19	32 000	65 500	3 250	6 650	C52X58X19	0.048
54	59	23	31 500	73 500	3 200	7 500	CV54X59X22.8XS	0.049
55	60	17	25 800	58 000	2 630	5 900	C55x60x17	0.043
55	60	20	28 800	66 500	2 940	6 750	C55x60x20	0.045
55	60	30	42 000	108 000	4 300	11 000	CV55x60x30S	0.069
55	60	37	47 500	127 000	4 850	12 900	C55x60x36.8X	0.086
55	61	19	33 000	69 500	3 350	7 100	C55x61x19	0.051
55	61	20	33 000	69 500	3 350	7 100	C55x61x20	0.054
55	61	30	48 000	113 000	4 900	11 500	C55x61x30	0.081
55	62	18	33 500	63 000	3 400	6 450	C55x62x18	0.054
55	63	20	39 000	70 000	3 950	7 100	C55x63x20	0.073
55	63	25	50 500	97 500	5 150	9 950	C55x63x25	0.088
55	63	32	61 000	125 000	6 200	12 700	C55x63x32	0.117
57	65	40	66 000	140 000	6 750	14 300	CV57x65x39.8XZWS	0.145
58	64	19	34 000	73 500	3 450	7 500	C58x64x19	0.052
60	65	20	29 800	71 500	3 050	7 300	C60x65x20	0.051
60	65	27	40 000	104 000	4 050	10 600	C60x65x26.8X	0.067
60	65	30	43 500	116 000	4 450	11 800	C60x65x30	0.071
60	66	19	33 500	73 500	3 450	7 500	C60x66x19	0.053
60	66	20	33 500	73 500	3 450	7 500	C60x66x20	0.056
60	66	30	49 000	119 000	5 000	12 200	C60x66x30	0.084
60	68	15	27 200	45 500	2 780	4 650	C60x68x15	0.058
60	68	20	40 000	75 000	4 100	7 650	C60x68x20	0.077
60	68	23	44 500	85 000	4 500	8 700	C60x68x23	0.092
60	68	25	52 000	105 000	5 300	10 700	C60x68x25	0.097
60	68	27	52 000	105 000	5 300	10 700	C60x68x27	0.098



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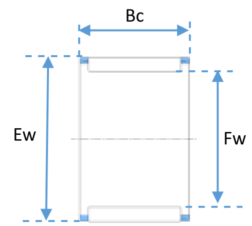

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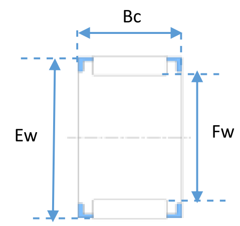


CV..S

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
60	68	30	46 500	91 000	4 750	9 300	C60x68x30ZW	0.119
61	66	20	29 700	71 500	3 050	7 300	C61x66x20	0.054
61	66	30	43 500	116 000	4 400	11 900	C61x66x30	0.073
63	70	21	44 500	95 500	4 500	9 700	C63x70x21	0.075
63	71	50.5	74 500	167 000	7 600	17 000	CV63x71x50.3XZWS	0.193
64	70	16	28 400	60 500	2 900	6 150	C64x70x16	0.053
65	70	20	30 500	75 000	3 100	7 650	C65x70x20	0.055
65	70	21.5	30 500	75 000	3 100	7 650	CV65x70x21.3X1S	0.056
65	70	30	45 000	124 000	4 600	12 700	C65x70x30	0.083
65	73	23	47 000	94 000	4 800	9 600	C65x73x23	0.1
65	73	30	61 000	132 000	6 200	13 400	C65x73x30	0.126

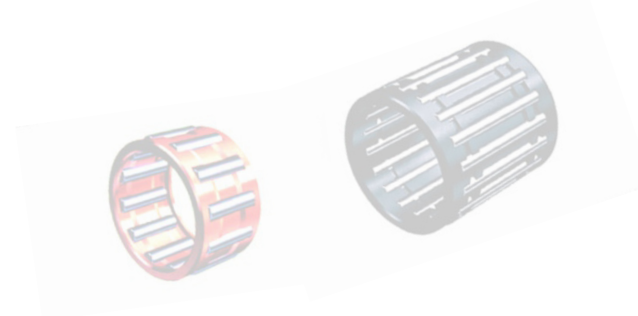
Needle Sorting Detail

Table 1 Color identification of diameter tolerances for needle rollers

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

CKA Birla Group

Needle bearings for Connecting Rod Applications



Radial Clearance Selection

Table 1 shows the recommended clearance values
The proper radial clearance can be got by proper selection and combination of roller diameter, connecting rod hole diameter and pin diameter. Table 2 shows the radial clearance values o btainable by various selection and combination

Table 1 Recommended clearance value

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

Table 2 Recommended fits

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

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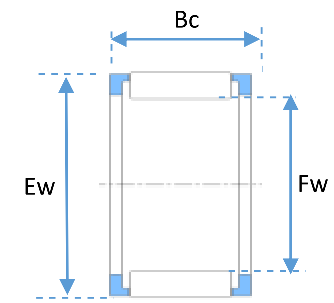
Table 2 Radial clearance value obtainable by selection and combination

Hole diameter tolerance range	0～+4	+4～+8	+8～+13
Tolerance range of needle roller used	−4～−6	−2～−4	0～−2
Pin diameter tolerance range			
0～−3	10～17	10～17	10～18
−3～−6	13～20	13～20	13～21
−6～−8	16～22	16～22	16～23

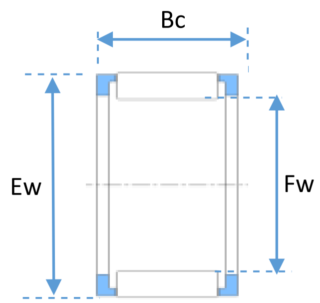
Recommended accuracy of Connecting rod and pin specifications

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



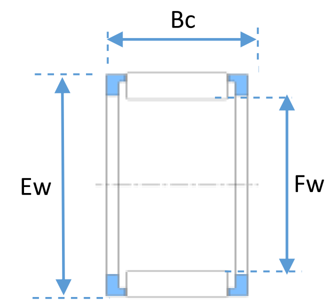
PC Type Needle Roller Bearing

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
10	14	9.8	5 050	4 900	515	500	PC10x14x9.8X14	0.0037
12	16	10	5 450	5 600	555	570	PC12x16x10.2	0.0044
12	17	9.8	6 800	6 550	695	670	PC12x17x9.8X15	0.0053
14	19	9.7	7 300	7 400	745	755	PC14x19x 9.7X1	0.0065
14	19	11.8	8 200	8 600	840	880	PC14x19x11.8X1	0.007
14	20	11.8	19 100	10 000	1 030	1020	PC14x20x11.8X3	0.0091
15	20	9.8	7 250	7 450	740	760	PC15x20x 9.8X	0.0067
15	21	11.8	10 000	10 200	1 020	1 040	PC15x21x11.8X8	0.0095
16	22	11.8	10 000	10 300	1 020	1 050	PC16x22x11.8X2	0.0097
16	22	13.2	10 900	11 500	1 110	1 170	PC16x22x13.2X	0.011
18	24	11.8	11 300	12 400	1 150	1 260	PC18x24x11.8X3	0.011
18	24	13.3	13 300	15 300	1 360	1 560	PC18x24x13.3X1	0.012
19	24	13.9	11 900	15 200	1 220	1 550	PC19x24x13.9X	0.011
19	25	15.8	14 300	17 000	1 460	1 730	PC19x25x15.8X1	0.015
20	26	13.8	14 000	16 700	1 420	1 700	PC20x26x13.8X6	0.014
22	28	15.8	15 900	20 200	1 620	2 060	PC22x28x15.8X1	0.017
22	29	17.8	18 800	22 800	1 920	2 320	PC22x29x17.8X7	0.024
22	30	14.7	16 900	18 200	1 720	1 860	PC22x30x14.7X2	0.024
22	30	17.8	21 900	25 400	2 230	2 590	PC22x30x17.8X2	0.027
24	31	16.8	20 800	26 600	2 120	2 710	PC24x31x16.8X7	0.024
24	32	19.8	22 900	27 500	2 340	2 810	PC24x32x19.8X6	0.033
26	31	13.8	14 200	20 900	1 450	2 130	PC26x31x13.8X31	0.0139
26	32	13.8	16 400	22 200	1 670	2260	PC26x32x13.8X	0.018
26	34	16.8	21 600	26 100	2 200	2 660	PC26x34x16.8X7	0.032



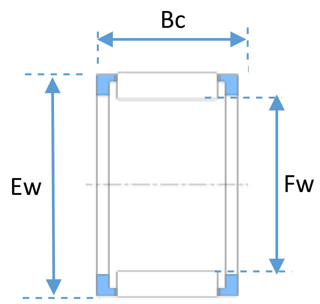
PC Type Needle
Roller Bearing

Boundary dimensions (mm)			Basic load rating Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	Mass (Kg) Approx.
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
27	36	20.8	30 500	38 500	3 150	3 950	PC27x36x20.8X1	0.044
28	35	14	18 400	23 700	1 880	2 420	PC28x35x13.8X1	0.0226
28	36	14	20 600	25 100	2 100	2 560	PC28x36x13.8X4	0.025
28	36	15.8	23 700	30 000	2 410	3 050	PC28x36x15.8X6	0.031
28	37	20.8	32 500	41 500	3 300	4 250	PC28x37x20.8X	0.048
29	39	21.4	32 500	39 500	3 300	4 000	PC29x39x21.4X2	0.055
30	37	15.9	21 900	30 500	2 230	3 100	PC30x37x15.9X	0.028
30	38	13.8	21 400	26 900	2 180	2 750	PC30x38x13.8X1	0.0294
30	38	15.8	24 600	32 000	2 510	3 300	PC30x38x15.8X	0.032
30	38	17.8	27 700	37 500	2 820	3 800	PC30x38x17.8X1	0.037
31	41	21.4	34 000	43 000	3 500	4 350	PC31x41x21.4X	0.057
32	43	22.4	40 000	49 500	4 100	5 050	PC32x43x22.4X	0.069
34	42	19.8	31 500	45 500	3 200	4 650	PC34x42x19.8X	0.046
38	47	19.8	35 500	51 000	3 600	5 200	PC38x47x19.8X1	0.056



C Type
CBC Type

Boundary dimensions (mm)			Basic load rating Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	Mass (Kg) Approx.
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
7	10	9.8	3 050	2 780	310	284	CBC 7x10x9.8x	0.0022
8	11	11.8	4 100	4 200	415	430	CBC 8x11x11.8x1	0.0028
9	12	11.5	4 400	4 750	450	485	CBC9×12×11.7V2	0.003
10	14	9.8	4 500	4 200	460	430	CBC10×14× 9.8x	0.0042
10	14	12.5	6 100	6 200	620	635	CBC10×14×12.5x1	0.0053
10	14	14.8	6 100	6 200	620	635	CBC10×14×14.8x	0.0064
11	14	13.5	5 850	7 250	595	740	CBC11×14×13.5x1	0.0044
11	15	12.3	7 050	7 700	720	785	CBC11×15×12.3x5	0.0049
11	15	15.8	7 050	7 650	720	780	CBC11×15×15.8x2	0.0069
12	15	16.4	7 500	10200	765	1040	CBC12×15×16.6V	0.0056
12	16	14.8	7 600	8 600	775	875	CBC12×16×14.8x1	0.0062
12	16	15.4	7 000	7 800	715	795	CBC12×16×15.6	0.0079
12	16	15.8	8 100	9 350	825	955	CBC12×16×16	0.0073
12	17	14.8	8 400	8 550	855	875	CBC12×17×14.8x	0.0094
14	18	16.8	9 750	12 400	995	1 260	CBC14×18×17	0.0089
14	18	19.8	9 150	11 300	930	1 160	CBC14×18×20	0.013
14	19	17.1	11 100	12 700	1 130	1 300	CBC14×19×17.1x	0.012
15	19	17.3	10 900	14 600	1 110	1 490	CBC15×19×17.3x	0.01
16	20	16.8	10 800	14 700	1 100	1 500	CBC16×20×17	0.01
16	20	19.6	10 200	13 600	1 040	1 390	CBC16×20×19.8	0.013
16	20	23.8	13 600	19 700	1 390	2 010	CBC16×20×23.8x	0.015
16	21	19.6	13 900	17 600	1 420	1 790	CBC16×21×19.6x	0.016
17	21	23	13 200	19 400	1 340	1 980	CBC17×21×23.2	0.016
17	21	25	13 100	19 200	1 340	1 960	CBC17×21×25x	0.017
17	22	22	16 900	22 900	1 720	2 340	CBC17×22×22x1	0.017
18	22	21.8	12 500	18 300	1 270	1 870	CBC18×22×21.8x3	0.015
18	22	23.8	13 000	19 300	1 330	1 970	CBC18×22×23.8x1	0.016



C Type

CBC Type

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
20	25	27.9	20 800	31 500	2 120	3 200	CBC20×25×27.9x	0.027
22	28	29.9	26 000	38 000	2 650	3 900	CBC22×28×29.9x4	0.038

Shell Type Needle Roller Bearing

Bearing Fits

Shell type needle bearing is press-fitted in a housing by interference fit so post press-fit inscribed circle diameter (Fw) comes to ISO Tolerance Rang Class F8.

The post press-fit inscribed circle diameter (Fw) depends on the housing material and rigidity. It is therefore desirable to decide the interference based on the data measured in pre-testing.

Recommended data of bearing fit in housing and on shaft as shown in Table-3.

The outer ring of shell bearing is so thin that it gets deformed and take the shape of housing in which it is press fitted so dimensional accuracy of both shell bearing as well as housing is important for bearing performance.

Recommended values of accuracy of housing and shaft as shown in table 4.

Table 3 Bearing fit in housing and on shaft (recommended)

Bearing type					Shaft	
	Iron series		Light alloy		Without inner ring	With inner ring
HC	N6	(N7)	R6	(R7)	h5 (h6)	k5 (j6)
HMC	J6	(J7)	M6	(M7)		

Table 4 Accuracy of housing bore (recommended)

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

Bearing Tolerances and Measuring Methods

As stated above the accuracy of housing is equally important as bearing Hence, it is meaningless to measure the dimensional accuracy of bearing itself before being press-fitted. So, the following measuring method is used; a bearing to be measured is press-fitted in a linkage of specific dimension and thereafter the inscribed circle diameter (Fw) is measured using a plug gauge or a taper gauge to evaluate the bearing accuracy.

Table 5 Dimensional tolerance for incribed circle diameter

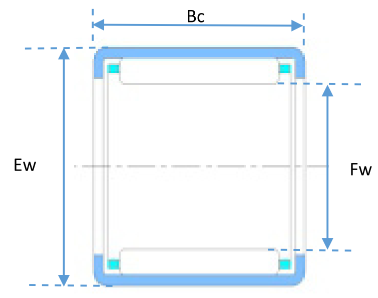
(Type HC) Units: mm

Nominal inscribed circle dia.	Nominal outer ring outer dia.	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
Fw	D		High	Low
3	6.5	6.484	3.016	3.006
4	8	7.984	4.022	4.01
5	9	8.984	5.022	5.01
6	10	9.984	6.022	6.01
7	11	10.98	7.028	7.013
8	12	11.98	8.028	8.013
9	13	12.98	9.028	9.013
10	14	13.98	10.028	10.013
12	16	15.98	12.034	12.016
12	18	17.98	12.034	12.016
13	19	18.976	13.034	13.016
14	20	19.976	14.034	14.016
15	21	20.976	15.034	15.016
16	22	21.976	16.034	16.016
17	23	22.976	17.034	17.016
18	24	23.976	18.034	18.016
20	26	25.976	20.041	20.02
22	28	27.976	22.041	22.02
25	32	31.972	25.041	25.02
28	35	34.972	28.041	28.02
30	37	36.972	30.041	30.02
35	42	41.972	35.05	35.025
40	47	46.972	40.05	40.025
45	52	51.967	45.05	45.025
50	58	57.967	50.05	50.025

Table 6 Dimensional tolerance for incribed circle diameter

(Type HMC) Units: mm

Nominal inscribed circle dia.	Nominal outer ring outer dia.	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
Fw	D		High	Low
8	15	14.995	8.028	8.013
9	16	15.995	9.028	9.013
10	17	16.995	10.028	10.013
12	19	18.995	12.034	12.016
14	22	21.995	14.034	14.016
15	22	21.995	15.034	15.016
16	24	23.995	16.034	16.016
17	24	23.995	17.034	17.016
18	25	24.995	18.034	18.016
19	27	26.995	19.041	19.02
20	27	26.995	20.041	20.02
21	29	28.995	21.041	21.02
22	29	28.995	22.041	22.02
24	31	30.994	24.041	24.02
25	33	32.994	25.041	25.02
26	34	33.994	26.041	26.02
28	37	36.994	28.041	28.02
29	38	37.994	29.041	29.02
30	40	39.994	30.041	30.02
32	42	41.994	32.05	32.025
35	45	44.994	35.05	35.025
37	47	46.994	37.05	37.025
38	48	47.994	38.05	38.025
40	50	49.994	40.05	40.025
45	55	54.994	45.05	45.025
50	62	61.994	50.05	50.025



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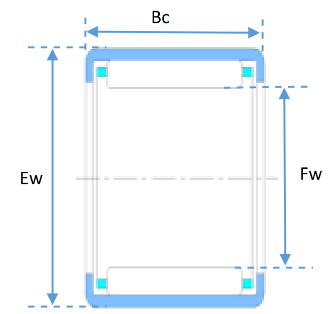
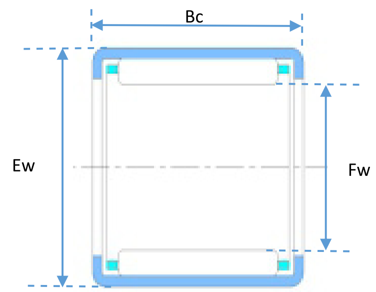


HMC

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
10	14	12	5 650	6 800	575	695	HC1012F	0.0045
10	14	15	7 250	9 400	740	955	HC1015F	0.0056
10	17	10	4 250	3 450	435	350	HMC1010	0.0079
10	17	12	5 600	4 850	570	495	HMC1012	0.0094
10	17	15	7 400	6 950	755	710	HMC1015	0.012
10	17	20	10 200	10 500	1 040	1 070	HMC1020	0.016
12	19	12	7 100	6 900	725	705	HMC1212	0.011
12	19	15	9 400	9 900	955	1 010	HMC1215	0.014
12	19	20	12 300	14 000	1 260	1 430	HMC1220	0.018
12	19	25	15 300	18 600	1 560	1 890	HMC1225	0.023
14	20	16	10 300	13 400	1 050	1 370	HC1416F	0.015
14	22	16	11 500	12 000	1 180	1 220	HMC1416C	0.019
14	22	20	14 600	16 200	1 490	1 650	HMC1420C	0.024
15	21	16	10 700	14 400	1 090	1 470	HC1516F	0.015
15	21	22	12 900	18 200	1 310	1 860	HC1522ZWFD	0.02
15	22	10	6 100	6 000	620	610	HMC1510	0.011
15	22	12	7 950	8 450	810	860	HMC1512	0.013
15	22	15	10 500	12 100	1 070	1 240	HMC1515C	0.016
15	22	20	14 900	18 900	1 510	1 920	HMC1520	0.022
15	22	25	18 500	25 000	1 880	2 550	HMC1525	0.027
16	22	16	11 100	15 300	1 130	1 560	HC1616F	0.016
16	22	22	13 300	19 400	1 360	1 980	HC1622ZWFD	0.022
16	24	16	12 400	13 500	1 260	1 370	HMC1616	0.021
17	24	15	12 100	15 000	1 230	1 530	HMC1715	0.018



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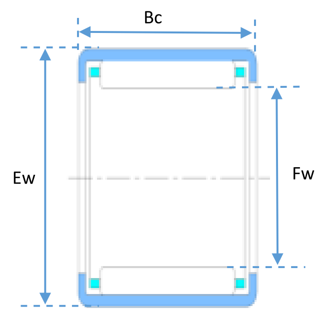
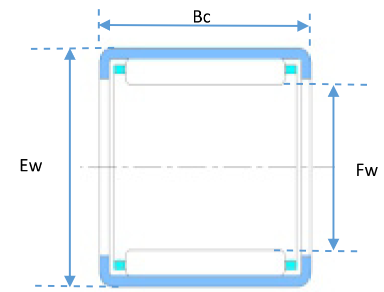


HMC

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
18	24	16	11 800	17 300	1 210	1 760	HC1816F	0.018
18	25	13	10 200	12 200	1 040	1 240	HMC1813	0.016
18	25	15	12 000	15 100	1 220	1 540	HMC1815	0.019
18	25	17	13 300	17 200	1 360	1 760	HMC1817C	0.021
18	25	19	15 500	20 900	1 580	2 130	HMC1819	0.024
18	25	20	16 300	22 300	1 660	2 280	HMC1820	0.025
18	25	25	20 300	29 600	2 070	3 000	HMC1825	0.031
19	27	16	13 900	16 300	1 410	1 660	HMC1916	0.025
19	27	20	17 500	22 100	1 790	2 250	HMC1920	0.031
20	26	16	12 500	19 200	1 280	1 960	HC2016F	0.019
20	26	20	16 000	26 200	1 630	2 670	HC2020F	0.024
20	26	30	21 500	38 500	2 190	3 900	HC2030ZWFD	0.035
20	27	15	13 000	17 300	1 330	1 760	HMC2015	0.021
20	27	20	17 700	25 600	1 800	2 610	HMC2020	0.027
20	27	25	22 000	34 000	2 240	3 450	HMC2025	0.034
20	27	30	26 100	42 000	2 660	4 300	HMC2030	0.041
21	29	16	15 300	19 100	1 560	1 940	HMC2116	0.027
21	29	20	19 400	25 800	1 970	2 630	HMC2120	0.033
22	28	16	13 200	21 100	1 340	2 150	HC2216F	0.021
22	28	20	16 800	28 800	1 710	2 940	HC2220F	0.026
22	29	10	8 400	10 100	855	1 030	HMC2210	0.015
22	29	15	13 400	18 500	1 370	1 890	HMC2215	0.022
22	29	20	18 200	27 400	1 860	2 790	HMC2220	0.03
22	29	25	23 600	38 500	2 410	3 900	HMC2225	0.037
22	29	30	26 900	45 000	2 740	4 600	HMC2230	0.045



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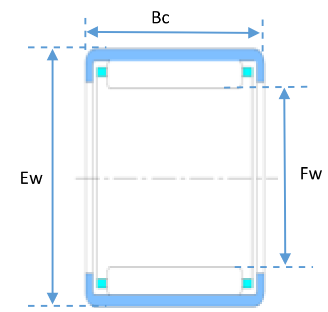


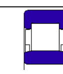
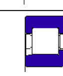
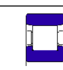
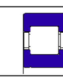
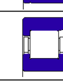
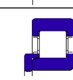
HMC

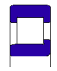
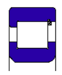
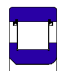
Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
24	31	28	26 000	44 500	2 650	4 500	HMC2428	0.045
25	32	12	11 100	15 200	1 140	1 550	HC2512F	0.021
25	32	16	15 900	24 000	1 620	2 450	HC2516F	0.027
25	32	20	20 300	33 000	2 070	3 350	HC2520	0.034
25	32	26	26 400	46 000	2 690	4 700	HC2526	0.045
25	32	38	35 000	65 500	3 550	6 700	HC2538ZWD	0.065
25	33	10	9 150	10 400	935	1 060	HMC2510	0.019
25	33	20	21 800	31 500	2 220	3 200	HMC2520	0.039
25	33	25	26 700	41 000	2 720	4 200	HMC2525	0.048
25	33	30	32 500	53 000	3 300	5 400	HMC2530	0.058
26	34	16	17 100	23 400	1 740	2 390	HMC2616	0.032
28	35	16	16 700	26 400	1 700	2 690	HC2816C	0.03
28	35	20	21 300	36 000	2 170	3 700	HC2820	0.038
28	37	20	23 600	32 500	2 410	3 350	HMC2820	0.049
28	37	30	35 000	54 500	3 600	5 550	HMC2830	0.073
29	38	20	24 600	35 000	2 510	3 550	HMC2920	0.05
29	38	30	34 500	54 000	3 550	5 550	HMC2930	0.075
30	37	12	13 000	19 500	1 320	1 990	HC3012	0.024
30	37	16	18 100	30 000	1 850	3 050	HC3016	0.032
30	37	20	22 300	39 500	2 280	4 000	HC3020F	0.04
30	37	26	28 500	54 000	2 910	5 500	HC3026F	0.053
30	37	38	38 500	78 500	3 900	8 000	HC3038ZWD	0.076
30	40	13	14 100	17 100	1 430	1 750	HMC3013	0.04
30	40	15	17 100	22 100	1 750	2 250	HMC3015	0.044
30	40	20	24 200	34 500	2 470	3 500	HMC3020	0.058
30	40	25	31 000	47 000	3 150	4 800	HMC3025	0.073
30	40	30	36 000	57 500	3 700	5 850	HMC3030	0.087

18 Cylindrical Roller Bearing

The cylindrical roller bearing consists of straight geometry for outer ring, inner ring and roller. The cage can be polyamide, steel or brass. The outer and inner rings are separable. These bearing can accommodate high radial load as the roller make a line contact with raceway. The bearings are available in number of design and sizes. Different types of bearings are designated as NU, NJ, NUP, N, NF and NH for single-row bearings and NNU & NN for double-row bearings

Depending on the type of flange on inner or outer, Cylindrical Roller Bearings are classified into the following types:

Configuration	Design	Description
NU		• Outer ring has flanges on both sides and inner does not have any flange • The outer assembly and inner are separable and can be mounted independently • Used as floating bearings
NJ		• Outer ring has flanges on both sides and inner has flange on one side only • The outer assembly and inner are separable and can be mounted independently • Can be used on floating side as well as fixed side
N		• Inner ring has flanges on both sides and outer does not have any flange • The inner assembly and outer are separable and can be mounted independently • Used as floating bearings
NUP		• Outer ring has flanges on both sides and inner has flange on one side only • Loose Lip is fixed on the inner ring flange less side • Can be used on fixed side
NF		• Inner ring has flanges on both sides and outer has flange on one side only • The inner assembly and outer are separable and can be mounted independently • Can be used on floating side as well as fixed side
NH		• Outer ring has both side flanges and inner has flange on one side only • L-shape collar rests on the inner outer diameter • Can be used on fixed side

NJK		• Outer ring has flanges on both sides and inner has a flange on one side only • The outer assembly and inner are separable and can be mounted independently • Can be used on floating side as well as fixed side
MUB		• Inner ring has flanges on both sides and outer has a flange on one side only • Retaining clip is mounted from inside in outer • Non-separable assembly
CR		• Inner ring has flanges on both side and outer does not have any flange • Retaining clip is mounted from inside in outer on both sides of rollers • Non-separable assembly

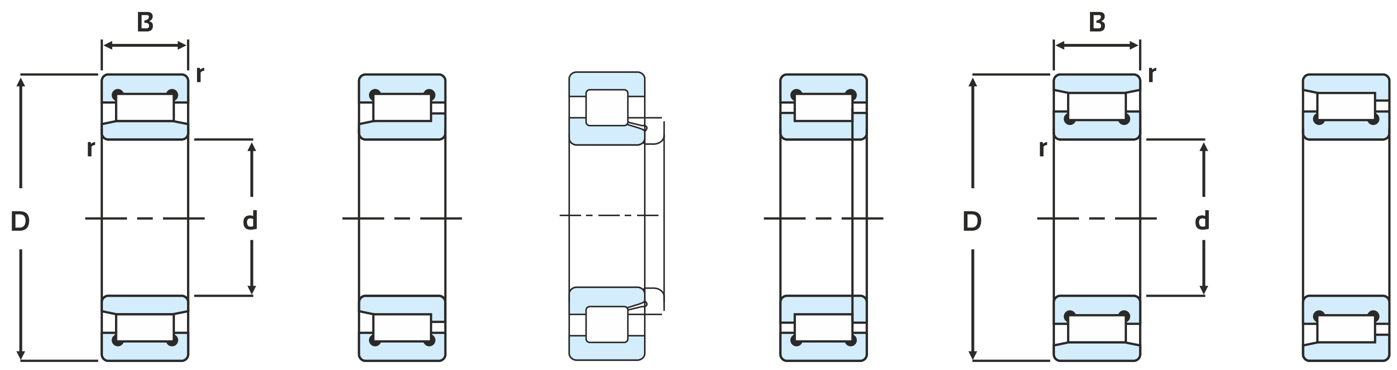
Some cylindrical roller bearings have no flange on either the inner or outer ring, so the rings can move axially relative to each other. These can be used on as floating bearings. Cylindrical roller bearings, in which either the inner or outer rings has two flange on both sides and the other ring has one, are capable of taking some axial load in one direction The bearings are designed for maximum load carrying capacity. With optimized design stress distribution is uniform and edge loading is minimized. The separable parts are interchangeable. The bearings are available in double-row and four row.

Single Row

Double Row

Four Row

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent radial load

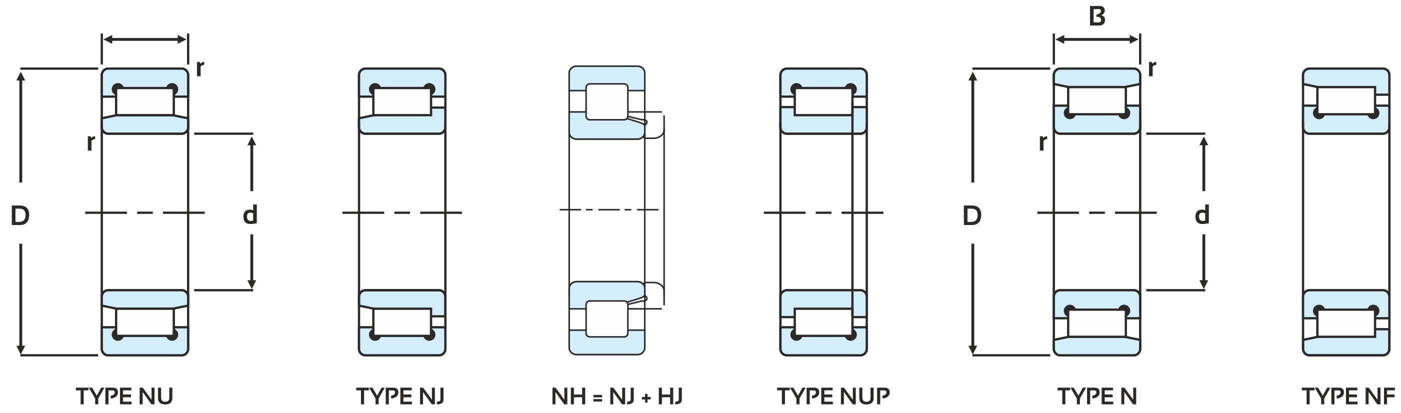
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
20	47	14	1.5	32	23	3255	2325	3	NJ204ECPC3	0.11
20	47	14	1.5	31	25	3129	2508	3	NJ204ET2X	0.12
20	52	15	2	34	27	3487	2763	3	NJ304E	0.17
22	58	17	1.5	36	38	3688	3843	5	22X58X17	0.240
25	52	15	1.0	33	28	3345	2824	3	NU205E	0.130
25	52	15	1.0	38	28	3823	2824	3	MLNU205EXAT2X	0.151
25	52	15	1.0	33	28	3345	2824	3	NJ205	0.137
25	52	15	1.0	36	27	3677	2733	3	NJ205E	0.140
25	52	15	0.6	33	28	3321	2895	3	N205E	0.210
25	52	15	0.6	33	28	3345	2824	3	NUP205E	0.140
25	52	18	1.0	32	30	3282	3017	4	NJ2205E	0.200
25	52	18	1.0	39	35	3974	3528	4	NJ2205ET2X	0.154
25	62	17	1.1	46	38	4738	3823	5	NJ305E	0.245
25	62	17	1.1	33	25	3334	2569	3	NU305	0.230
25	62	17	1.5	56	48	5686	4883	6	NJK305*	0.245
25	62	17	1.1	33	25	3334	2569	3	NJ305	0.240
25	62	17	1.1	33	25	3334	2569	3	N305	0.230
25	62	17	1.1	46	38	4738	3823	5	NU305E	0.386
25	62	24	1.1	64	56	6496	5719	7	NJ2305E	0.424
25	62	24	1.1	67	60	6832	6106	7	NU2305E	0.350
30	55	13	1.0	22	20	2238	1988	2	NUP1006	0.137
30	58	17	1.5	36	38	3688	3843	5	30X58X17	0.190
30	61.935	19.05	3.17/1.5	57	58	5857	5882	7	CR30	0.300
30	62	20	1.0	48	38	4944	3894	5	NJ2206EF	0.300
30	62	16	0.8	45	37	4573	3793	5	ASTN206E/TS1N206ET2X	0.203

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent radial load

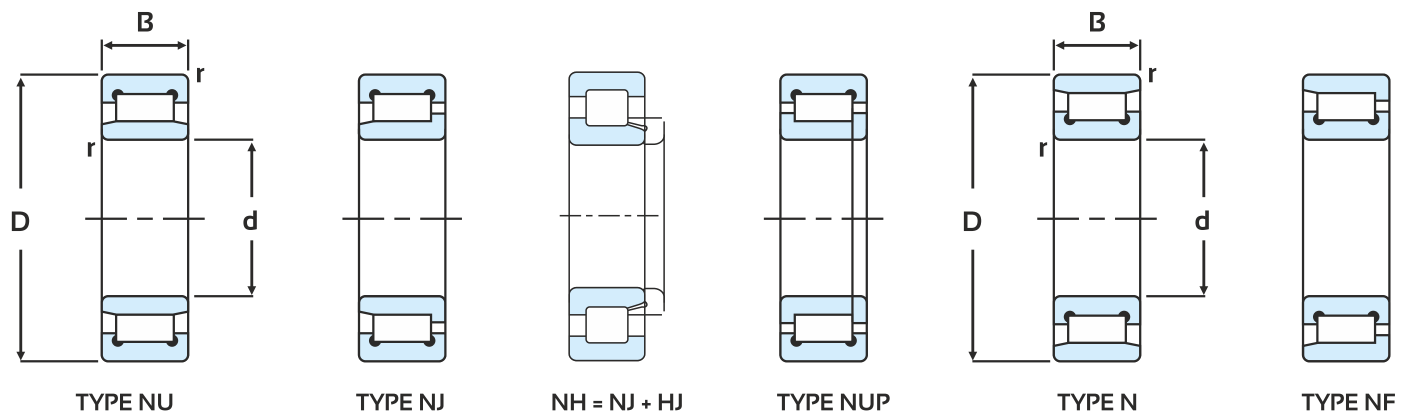
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
30	55	13	1.0	22	20	2238	1988	2	NUP1006	0.137
30	58	17	1.5	36	38	3688	3843	5	30X58X17	0.190
30	61.935	19.05	3.17/1.5	57	58	5857	5882	7	CR30	0.300
30	62	20	1.0	48	38	4944	3894	5	NJ2206EF	0.300
30	62	16	0.8	45	37	4573	3793	5	ASTN206E/TS1N206ET2X	0.203
30	62	16	1.0	44	38	4477	3824	5	NJ206EC3	0.210
30	62	16	1.0	45	39	4614	3977	5	NJ206ECPC3	0.240
30	72	19	1.1	77	68	7878	6932	8	NUP306EN	0.360
30	72	19	2.0	58	48	5903	4934	6	N306EF	0.350
30	72	19	2.0	61	52	6236	5302	6	NU306E	0.400
30	72	19	2.0	61	52	6236	5302	6	NJ306E	0.400
30	80	22	4.0	80	68	8175	6942	8	NI274	0.720
30	80	26	1.5	103	108	10504	11009	13	N1302	0.780
35	62	14	0.6	25	23	2581	2355	3	NU1007T2X	0.16
35	72	17	1.1	67	63	6873	6442	8	NJ207EF	0.300
35	72	17	1.1	56	50	5731	5107	6	NJ207ET2X	0.307
35	72	23	1.1	69	66	7010	6687	8	NJ2207E	0.460
35	72	17	1.1	56	50	5733	5109	6	TS1N1522EJ2	0.327
35	72	17	1.0	61	55	6190	5618	7	NU207E	0.320

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent radial load

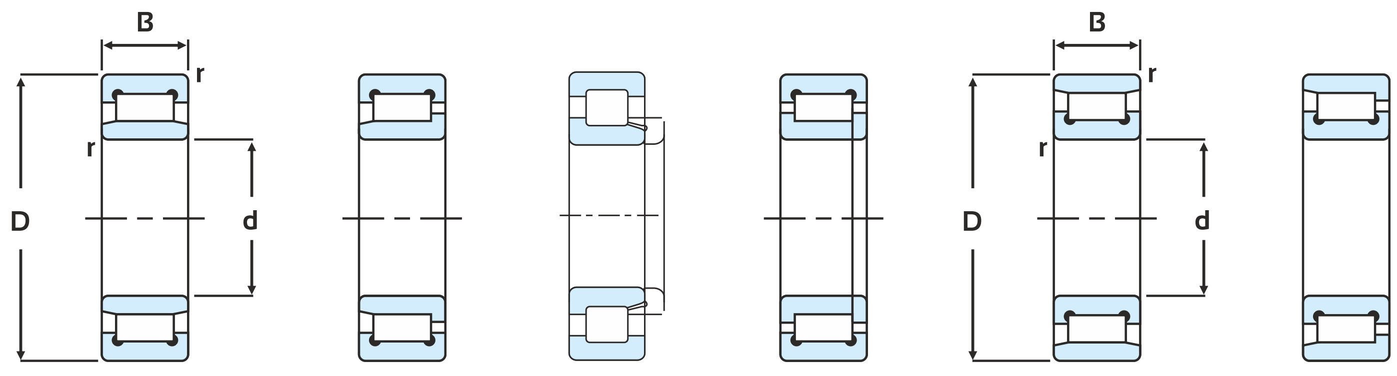
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
35	80	21	1.5	52	43	5297	4383	5	N307	0.464
35	80	21	1.1/1.5	52	43	5297	4383	5	NJ307/J	0.487
35	80	21	1.5	75	65	7606	6659	8	NJ307EJ	0.500
35	80	21	1.5/4	82	80	8323	8186	10	N1076	0.530
35	80	21	1.5	77	68	7878	6932	8	NJ307EF	0.480
35	80	23	1.0	81	78	8254	7910	9	NU307ENS	0.570
35	80	26	1.5	106	112	10800	11448	14	MUB7307	0.674
35	90	23	2.0	114	105	11668	10693	13	N1242	0.781
40	68	15	1	32	31	3232	3110	4	TS1RNU1008N	0.13
40	68	15	0.6	25	26	2549	2651	3	NU1008EMN	0.23
40	68	15	0.6	25	26	2549	2651	3	NU1008EM	0.23
40	74	21.5	1	35	34	3541	3487	4	ASTN1551/TS1N1551NT2X	0.347
40	80	18	1.1	49	43	4989	4373	5	N208	0.372
40	80	18	1.1	62	55	6348	5647	7	NUP208E	0.384
40	80	18	1.1	62	55	6348	5647	7	NUP208EN	0.380
40	80	18	1.1	62	55	6348	5647	7	NJ208	0.386
40	80	18	1.1	62	55	6348	5647	7	NU208E	0.377

Single Row Cylindrical Roller Bearing (Metric series)



TYPE NU TYPE NJ NH = NJ + HJ TYPE NUP TYPE N TYPE NF

Dynamic equivalent radial load

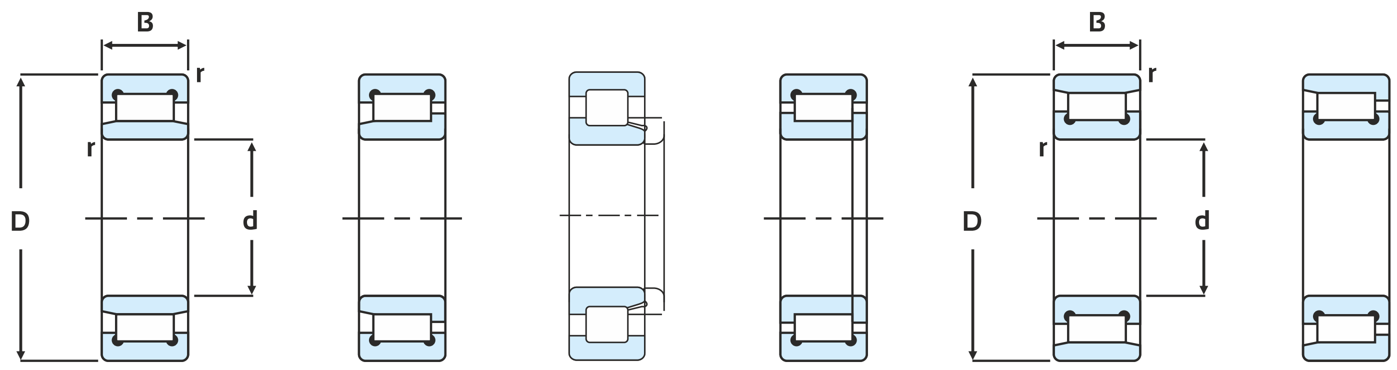
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
40	80	18	1.1	49	43	4989	4373	5	NUP208/J	0.340
40	80	23	1.1	85	83	8711	8481	10	NU2208E	0.480
40	80	23	1.1	85	83	8711	8481	10	NJ2208E	0.480
40	80	23	1.1	92	81	9343	8267	10	MLNU2208ET2X	0.482
40	80	23	1.1	76	83	7778	8481	10	NJ2208ECP	0.480
40	90	23	1.5	76	66	7798	6728	8	N308	0.643
40	90	23	1.5	93	78	9483	7954	10	N308EC3	0.650
40	90	23	1.5	84	83	8565	8433	10	NU308EC3	0.750
40	90	23	4.0	114	105	11668	10693	13	WUB61308UM	0.730
40	90	23	1.5	93	81	9453	8287	10	NJ308E	0.760
40	90	23	2.5	90	78	9179	7951	10	NF308E/C3	0.760
40	90	33	1.5	114	122	11645	12450	15	NJ2308E	1.060
45	85	19	1.1	71	67	7193	6779	8	NUP209E	0.504
45	85	19	1.1	71	67	7193	6779	8	NJ209E	0.493
45	85	23	1.1	89	90	9111	9195	11	NU2209EN	0.540
45	85	19	1.1	74	71	7549	7219	9	NUP209EJ2N	0.470
45	95	32	2.1	87	101	8871	10299	12	N8025FC	1.080

Single Row Cylindrical Roller Bearing (Metric series)



TYPE NU TYPE NJ NH = NJ + HJ TYPE NUP TYPE N TYPE NF

Dynamic equivalent radial load

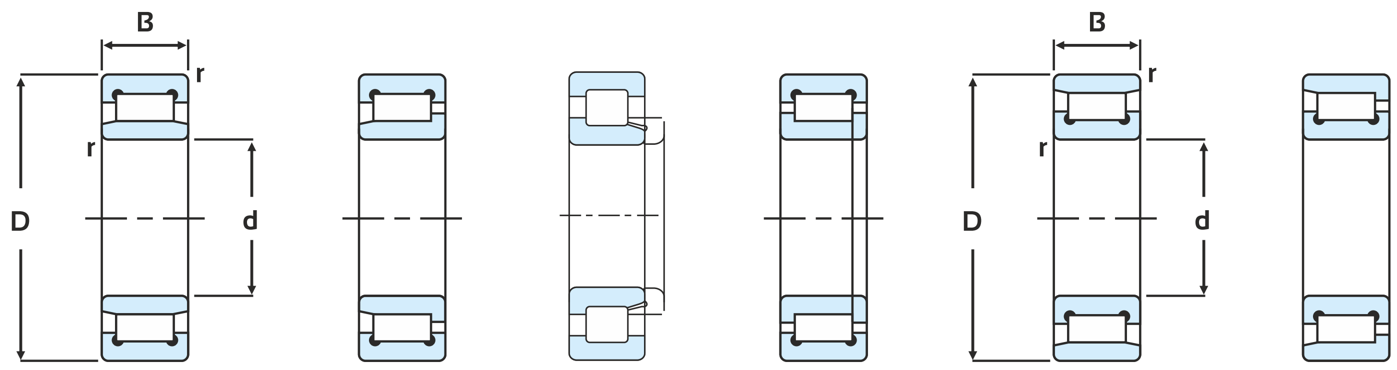
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
45	100	25	1.5	83	71	8426	7238	9	NU309	0.857
45	100	25	1.5	83	71	8426	7238	9	NU309N	0.845
45	100	25	1.5	83	71	8426	7238	9	NF309	0.870
45	100	25	1.5	83	71	8426	7238	9	NJ309	0.886
45	100	25	1.5	83	71	8426	7238	9	NUP309N	0.898
45	100	25	1.5	83	71	8426	7238	9	NJ309VN	0.919
45	100	25	1.5	113	102	11474	10438	12	NU309E	0.890
45	100	25	1.5	113	102	11474	10438	12	NU309EN	0.890
45	100	25	1.0	113	102	11474	10438	12	NUP309E	0.888
45	100	25	2.5	115	105	11691	10714	13	NUP309V	0.948
45	100	25	1.5	109	98	11120	10020	12	NUP309EM	0.940
45	100	31	1.5	157	171	16052	17401	21	MUB7309UM	1.249
45	100	36	2.0	177	176	18027	17971	22	WUB1304	1.350
45	100	36	4.5	202	176	20609	17977	22	MLGR-WUBN1304UM	1.354
45	100	36	2.0	202	176	20609	17987	22	MLGR-NJK2309	1.343
45	100	36	2.0	177	176	17930	17946	22	NJK2309N	1.330
45	120	29	3.0	138	122	14031	12416	15	NUP409ENEJP6	1.771

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent radial load

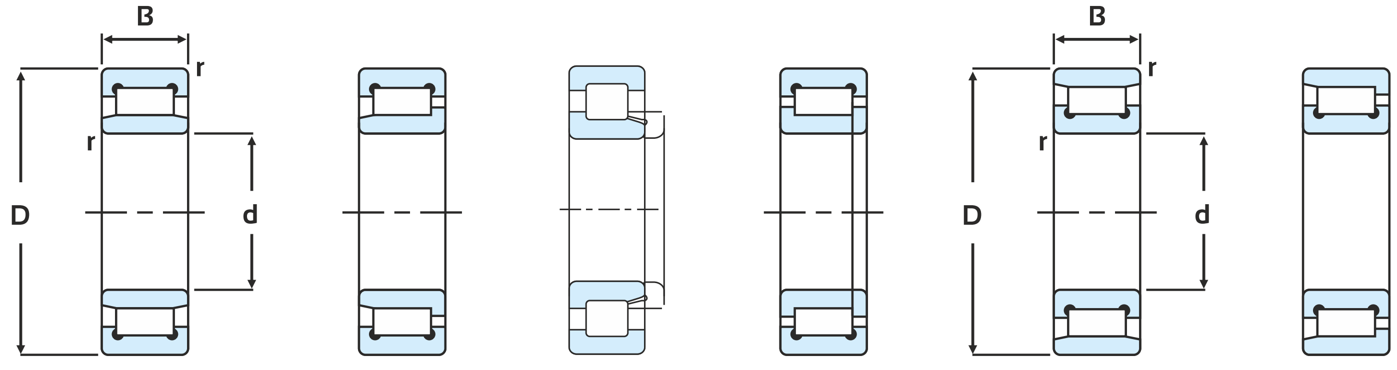
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
49.93	80	15	0.6	51	54	5149	5494	7	CR50	0.280
50	90	20	1.1	54	51	5492	5189	6	NJ210E	0.560
50	90	23	1.1	72	74	7318	7503	9	NH2210	0.648
50	110	27	2.0	97	86	9921	8787	11	N310	1.116
50	110	27	2.0	97	86	9921	8787	11	NU310	1.190
50	110	27	2.0	127	118	12951	11981	14	NU310E	1.100
50	110	27	2.0	97	86	9921	8787	11	NJ310	1.140
50	110	27	2.0	97	86	9921	8787	11	NUP310N	1.195
55	100	21	1.5	65	62	6610	6340	8	NU211	0.638
55	100	21	1.5	65	62	6610	6340	8	NJ211	0.652
55	120	29	2.0	152	141	15527	14373	17	NJ311EF	1.500
60	110	22	1.5	96	82	9784	8389	10	NUP212E	0.966
60	110	26	1.0	132	137	13449	13955	17	N1072	1.140
60	110	22	1.5	96	82	9784	8389	10	NUP212EJ	0.897
60	110	22	1.5	96	82	9784	8389	10	NU212ET2X	0.802
60	130	31	2.1	151	159	15362	16167	19	N312EM	1.800
60	130	31	2.1	151	159	15362	16167	19	N312EC3	1.800

Single Row Cylindrical Roller Bearing (Metric series)



TYPE NU | TYPE NJ | NH = NJ + HJ | TYPE NUP | TYPE N | TYPE NF

Dynamic equivalent radial load

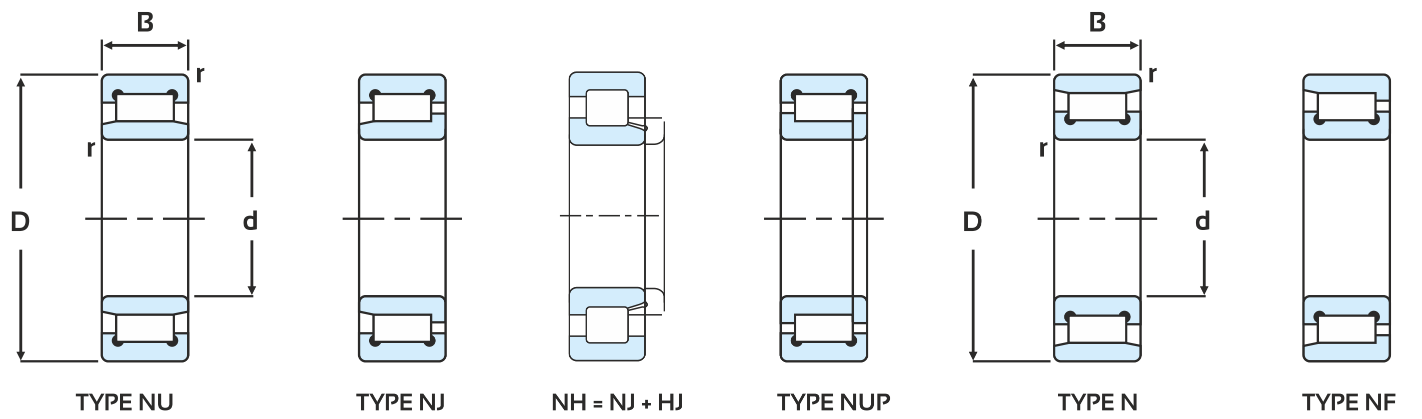
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
60	130	31	3.5	178	151	18119	15352	18	N312EF(2312)	1.800
60	130	31	2.1	174	165	17702	16825	20	NU312EJ2	1.865
65	140	33	2.1	204	193	20756	19715	23	NUP313E	2.370
65	140	33	2.1	181	193	20756	19721	23	NJ313EMC3	2.230
65	140	33	2.1	182	193	18532	19715	23	N313EM	2.300
70	150	35	2.1	158	168	18039	17125	20	N314	2.150
70	150	35	2.1	185	172	21087	17492	20	N314EF	2.150
70	150	35	2.1	219	242	22311	24635	29	NU314EMC4	2.700
75	160	37	2.1	267	261	27229	26585	30	NUP315E	3.450
75	160	37	2.1	248	274	25278	27929	32	NU315EC3	3.520
80	170	39	2.1	257	284	26206	28949	32	NU316EM	4.000
85	180	41	3.0	293	333	29866	33955	37	NU317EMC3	4.200
90	190	43	3.0	349	349	35609	35617	39	N318EC3	5.200
90	190	43	3.0	315	355	32120	36199	39	NU318EM	6.500
90	190	64	3.0	504	530	51376	54027	58	N2318E	8.000
95	200	45	3.0	331	381	33741	38838	41	NU319EMC3	7.500
95	200	45	3.0	340	390	34669	39768	42	NU319EM	8.000

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent radial load

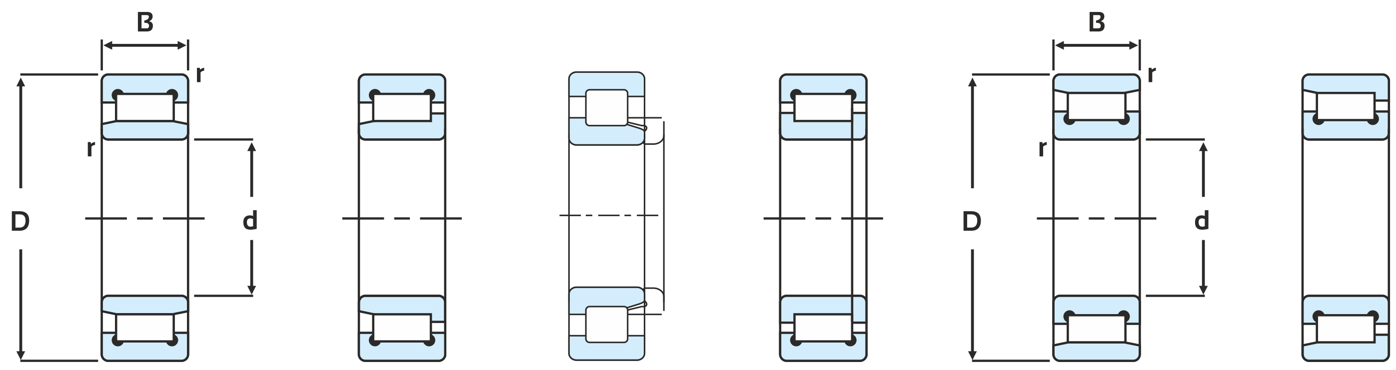
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
100	180	34	2.1	277	303	28245	30866	33	NU220E	3.500
100	215	47	3.0	353	395	35963	40265	42	NU320M	8.750
100	215	47	3.0	358	397	36534	40469	42	N320MC3	8.500
100	215	73	3.0	670	735	68319	74946	78	NJ2320EMC4	11.9
105	225	49	3.0	364	423	37105	43119	44	N321M	9.810
105	225	49	3.0	364	423	37105	43119	44	NU321M	9.910
110	200	38	2.1	255	315	26020	32142	34	NU222M	5.500
110	200	38	2.1	296	371	30183	37830	40	NU222EM	5.400
110	240	50	3.0	380	420	38736	42814	43	NU322M	11.600
120	180	28	1.1	173	259	17640	26410	28	NU1024MC3	2.600
120	215	40	2.1	288	365	29358	37207	38	NU224MC3	6.300
120	215	40	2.1	327	430	33344	43846	45	NU224EMC3	6.300
120	215	40	2.1	318	358	32424	36493	37	TS2NUP224	6.640
120	260	55	3.0	490	645	50000	65816	65	NU324M	15.500
130	230	40	3.0	295	385	30071	39246	39	NU226M	7.300
130	230	40	3.0	376	475	38360	48404	49	NU226EMC3	7.400
130	230	79.4	5.0	588	776	59985	79113	79	NU5226M	14.000

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent radial load

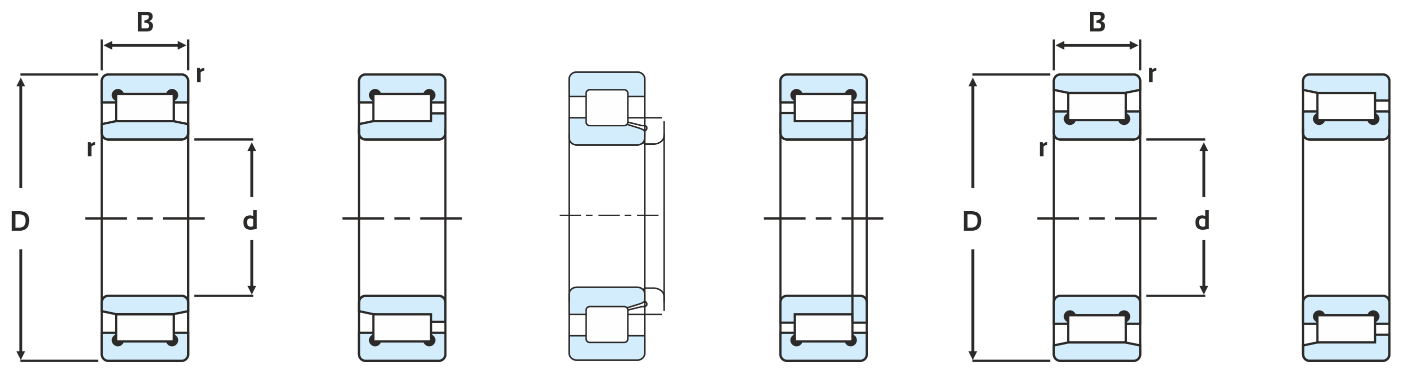
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
130	230	64	3.0	530	735	54081	75000	75	NU2226E	12.200
130	230	64	3.0	520	730	53023	74437	75	NU2226EM	11.500
130	280	58	4.0	561	671	57244	68469	66	NU326M	17.000
140	250	42	3.0	345	450	35168	45872	45	NU228M	9.300
140	250	42	3.0	413	548	42092	55858	55	NU228EMC3	9.400
140	250	68	3.0	510	750	52004	76476	75	NU2228MC3	14.400
150	270	45	3.0	405	550	41284	56065	54	NU230M	11.800
150	270	88.9	6.0	816	1104	83207	112528	108	NU5230M	22.000
150	280	93	3.0	790	1180	80530	120285	114	72727 (With Sleeve AHX3228)	32.000
150	320	65	4.0	800	985	81549	100407	93	NU330M1C3	25.600
160	290	196.8	2.0	1600	3000	163148	305904	287	NU160X290X197	36.560
160	340	68	4.0	685	970	69827	98879	90	NU332MC3	31.000
160	340	114	4.0	1330	1840	135714	187755	170	NU2332E	53.000
160	290	80	3.0	940	1170	95918	119266	112	NU2232E	24.000
160	240	38	2.1	235	335	23979	34183	33	NU1032C3	6.200
160	340	68	4.0	710	950	72448	96938	88	N332M	30.400

Single Row Cylindrical Roller Bearing (Metric series)



TYPE NU | TYPE NJ | NH = NJ + HJ | TYPE NUP | TYPE N | TYPE NF

Dynamic equivalent radial load

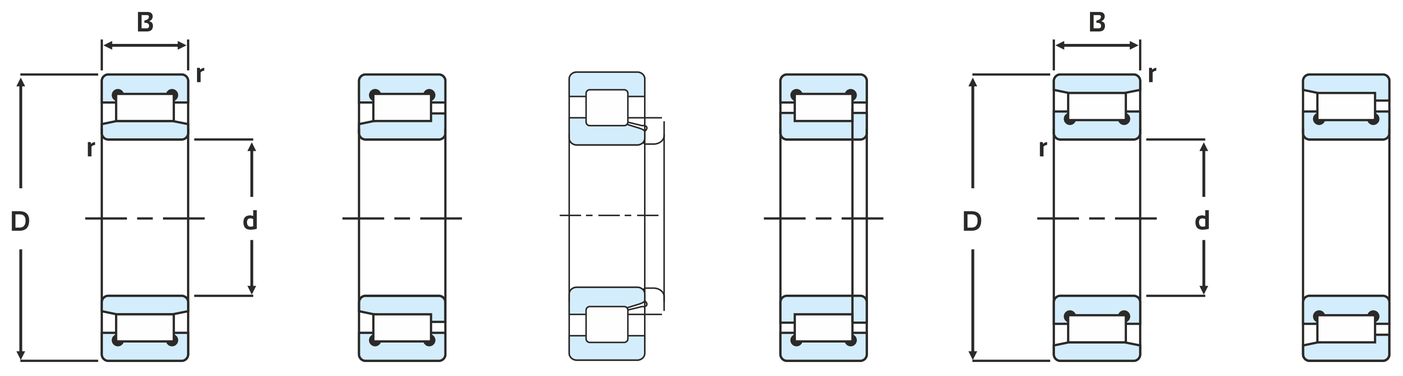
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
160	290	48	3.0	500	664	51020	67755	63	NU232M	14.400
170	360	72	5.0	920	1020	93781	103976	93	N334	38.700
170	310	52	4.0	600	790	61224	80612	74	N234M	18.000
170	310	52	4.0	610	850	62181	86646	80	NU234MC3	19.500
170	310	52	4.0	615	825	62710	84124	77	NU234EM	17.900
180	320	108	3.0	1106	1553	112787	158267	144	NU5236M	37.000
180	320	52	4.0	525	735	53571	75000	68	NU236M	18.500
180	380	75	4.0	917	118	93476	11978	11	NJ336E	43.500
180	280	46	2.1	381	465	38856	47448	44	NU1036	11.000
180	380	75	4.0	917	1175	93476	119776	105	NU336	43.000
190	400	78	5.0	975	1290	99388	128440	114	NU338M	50.400
200	360	120.65	6.0	1538	2229	156734	227217	200	NU5240	53.700
200	360	120.65	6.0	1620	2391	165173	243731	214	NU5240M	57.250
200	310	51	2.1	400	590	40816	60204	54	NU1040M	13.800
200	360	58	4.0	630	880	64220	89704	79	NU240	28.000
200	360	58	4.0	765	1060	78006	108086	95	NJ240M	26.900
200	420	138	5.0	1900	2620	193679	267074	228	NU2340EM	93.300

Single Row Cylindrical Roller Bearing (Metric series)



TYPE NU | TYPE NJ | NH = NJ + HJ | TYPE NUP | TYPE N | TYPE NF

Dynamic equivalent radial load

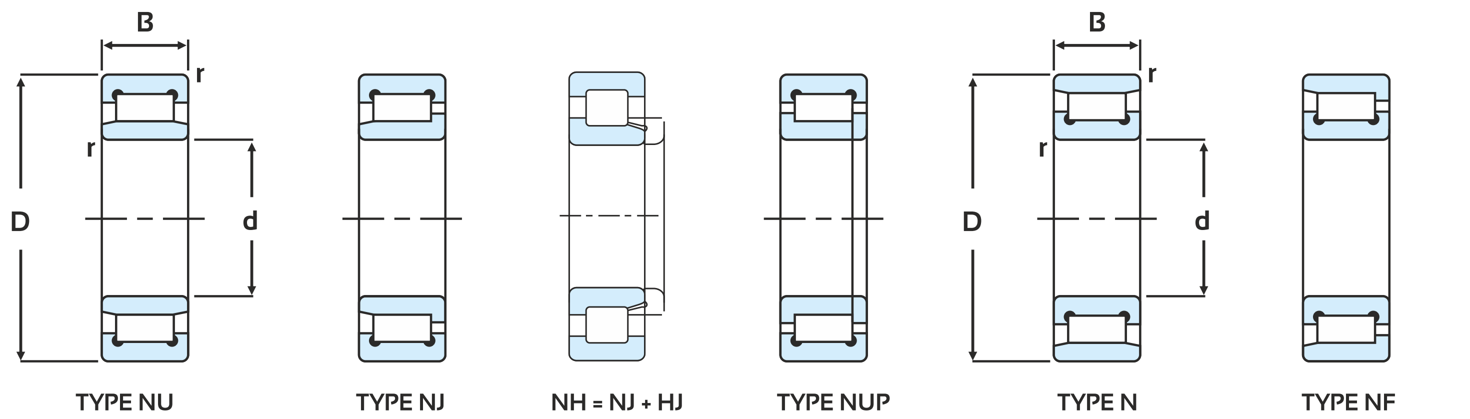
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
210	340	95.2	6.0	955	1835	97448	187244	165	NU5044M	31.000
220	400	65	4.0	799	1150	81448	117227	100	NU244M	38.000
220	400	65	4.0	1038	1264	105918	128979	110	NUP244	38.500
240	440	146.05	4.0	3010	4298	306784	438124	363	NU5248	100.000
240	360	56	3.0	534	832	54434	8645	73	NU1048M	19.700
260	400	65	4.0	655	1090	66836	111224	93	NU1052M	30.200
260	360	46	2.1	415	598	42265	60988	52	NF1952	14.050
280	500	165.1	4.0	3353	5239	341777	534027	425	NU5256	139.000
280	380	46	2.1	431	643	43908	65535	55	NU1956	14.960
280	380	46	2.1	431	643	43908	65535	55	NF1956	14.960
280	500	165.1	4.0	3416	5353	348165	545667	434	N1112	144.740
300	460	74	4.0	850	1350	86734	137755	110	NU1060E	44.500
320	440	56	3.0	700	1100	71355	112130	90	NU1964	25.310
320	670	200	7.5	3740	5920	381360	603650	447	NU2364M	341.000
340	710	212	7.5	4710	7250	480269	739268	538	NU2368EM	415.000
380	680	175	6.0	3832	5790	390600	590214	428	NU2276	274.240
380	680	177	6.0	3853	5800	393111	591836	429	N1205	281.750

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent radial load

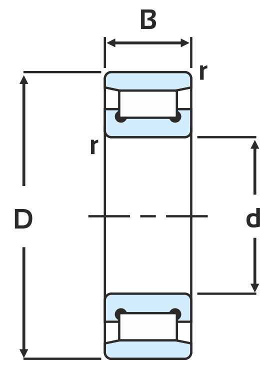
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
400	600	90	5.0	1370	2320	139653	236493	175	NU1080	91.000
400	700	162	5.0	3453	5039	351984	513660	368	N1130	271.200
440	540	40	2.1	330	720	33649	73417	55	N1888MW33C3	18.800
460	580	56	3.0	550	1100	56082	112165	82	N1892MW33C3	32.400
460	760	240	7.5	5600	10400	571428	1061224	737	NU3192M	467.000
460	680	100	6.0	1850	3360	188775	342857	243	NU1092M	124.700
480	790	248	7.5	5900	11000	602040	1122448	770	NU3196M	507.800
530	710	180	6.0	3731	8129	380285	828665	573	42629/530	220.000
600	730	60	3.0	560	1290	57102	131539	89	N18/600MW33C3	44.200
670	980	308	10.0	8188	10000	834659	1019368	648	N1009	780.000
700	930	160	8.0	3419	6903	348494	703619	449	327/700	300.000
720	880	62	4	860	2000	87692	203936	131	N18/720MW33C3	77.000

Single Row Cylindrical Roller Bearing (Metric series)



TYPE N

Dynamic equivalent radial load

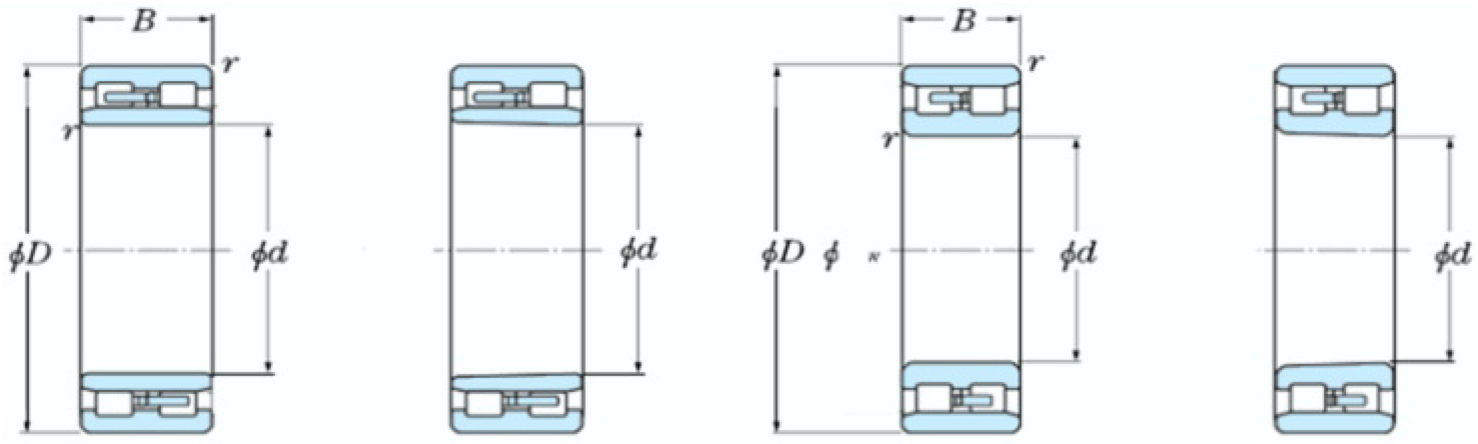
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
101.60	184.15	31.75	3.2	225	270	22936	27523	30	CRL32	3.800
101.60	215.9	44.4	4.0	390	450	39768	45886	49	CRM32	8.160
107.95	190.5	31.75	3.2	235	285	23979	29081	31	CRL34	4.000
114.30	203.2	33.337	3.2	255	315	25994	32110	35	CRL36	4.600
114.30	238.13	50.8	4.8	440	505	44852	51478	55	CRM36	11.000
127.00	228.6	34.925	3.2	288	370	29358	37717	41	CRL40	6.500
127.00	254	50.8	4.8	465	550	47401	56065	60	CRM40	12.000
139.70	241.3	34.925	3.0	296	390	30204	39795	43	CRL44	7.200
165.1	330.2	63.5	5.1	755	967	76989	98607	89	MRJ 6 1/2"	27.1
469.90	698.5	139.7	6.0	3866	6244	394254	636713	448	N1050	190.000

Two Row Cylindrical Roller Bearing



Cylindrical bore — Type NNU — Tapered bore

Cylindrical bore — Type NN — Tapered bore

Dynamic equivalent radial load

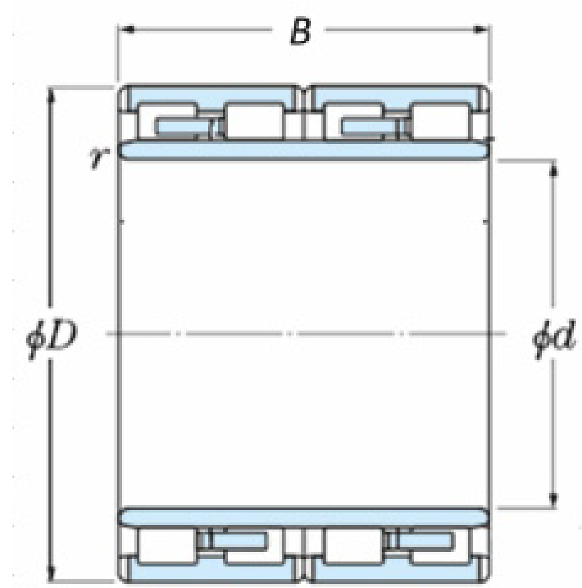
$P_r = F_r$

Static equivalent radial load

$P_{or} = F_r$

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
95	130	63	1.1	197	440	20088	44868	51.8	NA6919ZWC3	2.5
120	180	46	2.0	225	375	22936	38226	40.5	NN3024K	4.020
120	260	103	4.0	925	1452	94303	148012	146.1	N1081	31.850
130	200	52	2.0	305	530	31091	54027	55.6	NN3026K	5.340
130.06	300.02	171.6	3.0	1571	2394	160179	243996	232	549722	70.000
149	249	173	2.0	1108	2996	112981	305496	297	6675125	39.300
160	290	197	2.5	1600	3000	163155	305916	286.8	N1458(NU160X290X197)	36.560
200	310	82	2.1	740	1340	75459	136642	123.4	3182140	22.000
220	370	150	4.0	1600	2800	163099	285423	246.8	NNU4144MW33	66.000
280	440	135	4.0	1770	3360	180612	342857	279	132756	99.500
320	480	160	4.0	2050	4150	208970	423038	333.9	NNU4064MW33	103.000
370	520	220	1.5	2650	6500	270215	662792	507	NNU319961	136.000
460	680	218	9.0	4313	8560	439602	872579	619.3	4202192	240.000
710	950	243	6.0	5734	15165	584506	1545872	980.2	42629/710	495.000

Two Row Cylindrical Roller Bearing



Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		KN		
d	D	B	r	Cr	Cor	Cr	Cor	Cu		
100	140	80	1.5	356	503	36301.32	51290.91	58	N1105	3.61
120	165	90	1.5	597	813	60841	82875	89	N1106	5.560
150	230	156	2.5	969	1550	98756	158002	156	4R3040 (313891)	24.500
160	230	168	2.0	890	2150	90816	219387	215	315189	24.000
200	290	192	2.1	1500	3200	153061	326530	298	313811	41.000
230	330	206	2.1	1870	4000	190816	408163	358	313824	58.000
280	390	220	3.0	2200	5000	224489	510204	424	313822	81.500
340	480	350	1.5	4570	11200	466326	1142857	894	314485	207.000
480	680	500	12.5	9240	23530	942184	2399307	1693	N1452	598.200
650	900	650	7.5	19786	41510	2016896	4231397	2739	N1210	1246.000
690	980	715	20.0	18630	51500	1899664	5251351	3323	N1121	1805.000
698	1000	715	4.0	26686	53005	2720259	5403160	3403	N1227	1800.000
710	1000	715	4.0	26686	53005	2720261	5403160	3396	4R14205	1800.000
950	1360	975	6.0	34100	100000	3479591	10204081	5853	319862	5000.000

Special Cylindrical Roller Bearing

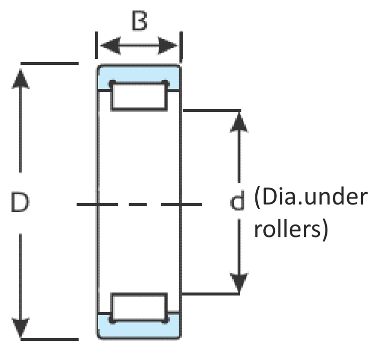


Fig 1

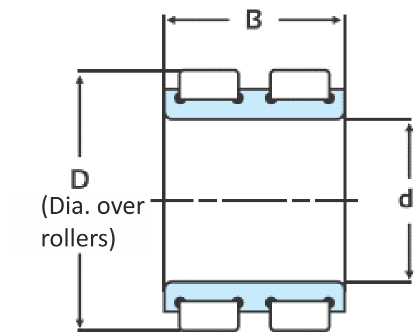


Fig 2

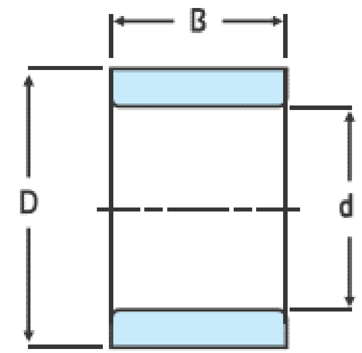


Fig 3

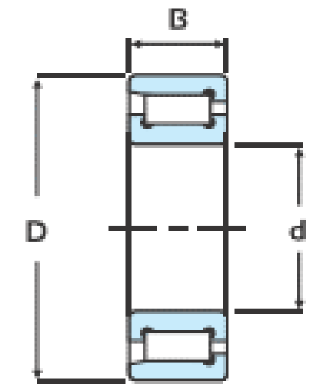


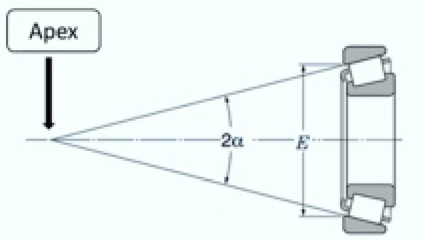
Fig 4

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Bearing Number	Mass Kg. (Approx.)	Refer figure
				Dynamic	Static	Dynamic	Static				
mm				KN		Kgf		KN			
d	D	B	r	Cr	Cor	Cr	Cor	Cu			
26.993	50.782	17.4625	1.6	-	-			-	- L3782 -	0.660	1
35	62	17	1.1	46	38	4738	3823	-	RNU305	0.187	1
58.5	100	25	2.4	83	71	8426	7238	-	RNU309	0.660	1
66.5	100	21	1.1	65	63	6622	6371	-	RNU211	0.450	1
120	260	103	4.0	925	1452	94304	148012	-	N1081	31.850	2
25.4	53.962	28.575	1.1	67	62	6850	6300	-	LO64	0.263	2
680	742.5	300	8	-	-	-	-	-	N1065	161.83	3
820	903	400	10	-	-	-	-	-	N1084	348.02	3
31.75	79.35	22.225	1.1	64	54	6565	5464	-	N1004	0.510	4

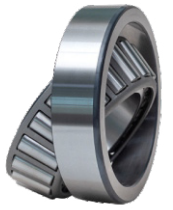
19 Taper Roller Bearing

Taper Roller Bearing Configuration

Taper roller bearing have cup, cone and rollers which are tapered in shape. The rollers are restrained by a flange on the cone, against which their large end slides. These bearings can take combined loads simultaneously i.e. radial and axial load. Projection lines of the cup and cone raceways and rollers meet at a common point on the bearing axis. The axial load carrying capacity of bearings increases with the increasing contact angle. Bearings are separable. Cup can be separated from cone assembly. Hence both can be mounted separately. The raceway and rollers have crown profiles. Improved surface finish of flange enable cooler running by forming a full lubrication film with roller head.



E : Nominal small end dimeter of outer ring
α : Nominal contact angle



Cone assembly Cup

Separable bearing

Depending upon the application requirement the taper roller bearings are available in double row and four row combinations. These bearings are preset assemblies ready to mount.

Double Row Taper Roller Bearing

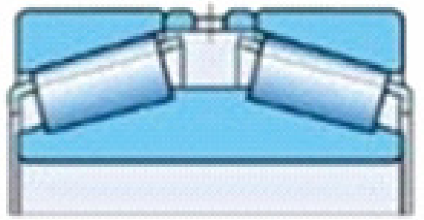
Face-to-face arrangement (TDI)

When the bearings are matched face-to-face,

➤ An intermediate spacer is positioned between the two cups.

➤The load lines converge towards the bearing axis.

➤ Axial loads acting in both directions can be accommodated by each bearing. Face-to-face arrangement (TDI)



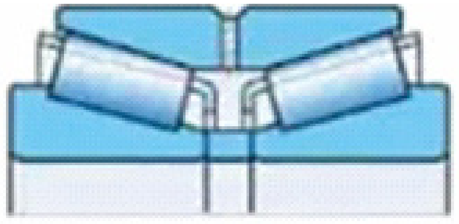
Back-to-back arrangement (TDO)

When the bearings are arranged back-to-back

➤ An intermediate spacer is positioned both between the two cones.

➤The load lines diverge towards the bearing axis, thus providing relatively rigid bearing arrangements, which can also take up tilting moments.

➤Axial loads acting in both directions can be accommodated by each bearing



Four-row tapered roller bearings

Four-row tapered roller bearings can accommodate radial and axial loads at low to moderate speeds. These bearings are specially designed for rolling mill applications. They are used in work roll and back up roll applications in rolling mills. The bearings may be in straight bore or tapered bore.

TQO (Straight bore four row bearing arrangement):

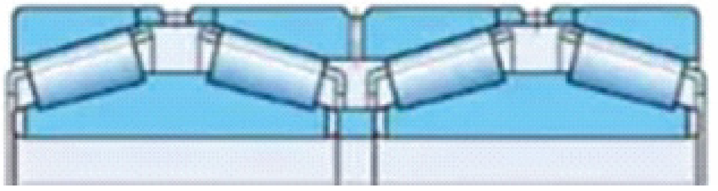
➤Two double cones with cone spacer, two single cups

➤Two single cups on sides and a Double cup in middle.

➤Two cup spacers separating single cup and double cup.

➤Spacers have holes for lubrication.

➤Cone spacers are hardened to reduce face wear.



2 X TDI: (Two double row straight bore bearings separated by spacer)
It comprises of two double row taper roller bearings matched face to face separated by spacer between inside two cups and two cones
NBC also provides set of 2X TDI.

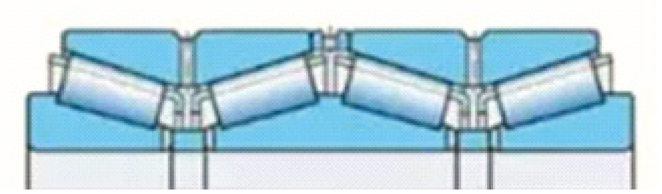
TQIT (Tapered Bore Four-Row Arrangement)

➤ One double cone & two single cones, all with tapered bore matched through all the cones and four single cups and three cup spacers or two double cups with spacer.

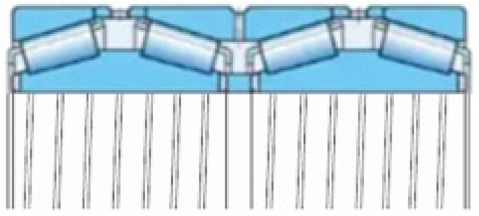
➤ Lubrication holes in three cup spacers.

➤ Faces of single cones and both faces of double cone contact each other.

TQI bearings are available in straight bore with two single cones and one double cone matched together & two double cups with spacer.

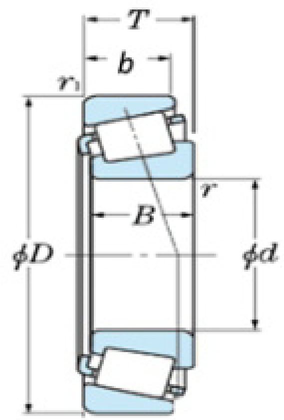


The variants are also provided with helical groove inside bore and slots on face of the bearings for better lubrication. The double and four row bearings are pre-set assemblies from company with exact spacer width to maintain initial bench end play (BEP).The bench end play in each bearing is adjusted by cup & cone spacers. The total spacer width is the measured distance between the adjacent cup & cones and BEP value. The bearings are mostly used in steel plants on roll neck.



4R- TRB with helical groove inside bore

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

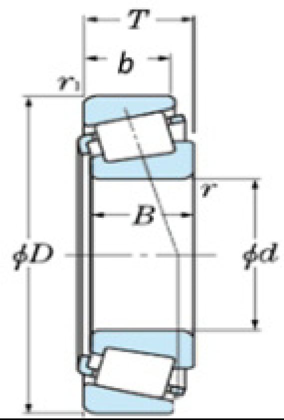
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu	e	Y_2	Y_0		
15.875	42.862	14.288	14.288	9.525	1.5	1.5	20	18	2055	1835	2.2	0.70	0.85	0.47	11590/11520	0.101
17.462	39.878	13.843	14.605	10.668	1.3	1.3	22	23	2283	2345	2.8	0.29	2.10	1.15	LM11749/LM11710	0.081
19.05	45.237	15.494	16.637	12.065	1.3	1.3	33	30	3345	3048	3.6	0.30	2.00	1.10	LM11949/LM11910	0.119
19.05	49.225	18.034	19.05	14.288	1.2	1.2	45	42	4625	4303	5.1	0.28	2.14	1.18	M12644/ M12611	0.180
21.43	50.005	17.526	18.288	13.97	1.3	1.3	45	42	4635	4322	5.2	0.28	2.16	1.19	M12649/M12610	0.166
23.812	61.912	28.575	30.416	23.812	2.36	3.3	82	79	8403	8012	9.6	0.28	2.14	1.18	3659/3620	0.300
25	57.15	16.8	17.2	12.7	1.0	1.5	45	46	4591	4691	5.6	0.40	1.49	0.82	N1449XA	0.210
25.4	57.15	19.431	19.431	14.732	1.6	1.6	47	49	4795	4995	6.0	0.54	1.11	0.61	M84548/ M84510	0.236
25.4	63.5	20.638	20.638	15.875	1.3	1.5	47	48	4818	4873	5.8	0.35	1.71	0.94	15100S/15250X	0.225
25.4	65.088	22.225	21.463	15.875	1.5	1.5	54	52	5457	5301	6.3	0.73	0.82	0.45	23100/23256	0.356
26.988	50.29	14.224	14.732	10.668	3.5	1.3	31	32	3174	3282	3.9	0.37	1.60	0.88	L44649/L44610	0.117
28.575	57.15	19.845	19.355	15.875	3.5	1.5	52	53	5332	5443	6.5	0.33	1.82	1.00	1988/1922	0.216
28.575	62	18.161	19.05	14.288	3.5	1.3	47	48	4818	4873	5.8	0.35	1.71	0.94	15112R/15245	0.274
28.575	73.025	22.225	22.225	17.462	0.8	3.3	68	74	6896	7564	9.0	0.45	1.32	0.73	02872/02820	0.477
29.985	62	19.05	20.638	14.288	1.3	1.3	47	48	4818	4873	5.8	0.35	1.71	0.94	15117/15245	0.275
30.162	64.292	21.433	21.433	16.67	1.6	1.6	58	61	5880	6259	7.5	0.55	1.09	0.60	M86649/M86610	0.336
31.75	59.131	15.875	16.764	11.811	3.56	1.3	39	42	3939	4230	5.1	0.41	1.46	0.80	LM67048/LM67010	0.184
31.75	62	18.161	19.05	14.288	3.5	1.3	47	48	4818	4873	5.8	0.35	1.71	0.94	15123/15245	0.225
31.75	62	19.05	20.638	14.288	3.5	1.3	47	48	4818	4873	5.8	0.35	1.71	0.94	15125/15245	0.239

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

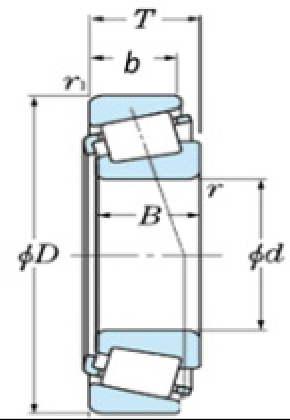
$P_{or} = 0.5F_r + Y_oF_a$

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

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

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
31.75	68.263	22.225	22.225	17.463	3.5	1.5	57	57	5777	5821	7.0	0.42	1.44	0.79	02475/02420	0.379
31.75	69.012	19.845	19.583	15.875	3.5	1.3	51	55	5240	5586	6.7	0.38	1.57	0.86	14125A/14276	0.350
31.75	72.626)	30.162	29.997	23.812	1.5	3.3	88	89	8962	9042	10.8	0.33	1.80	0.99	3188S/3120	0.574
33.338	68.262	22.225	22.225	17.462	0.8	1.6	64	72	6508	7339	8.8	0.55	1.09	0.60	M88048/M88010	0.382
33.338	69.012	19.845	19.583	15.875	0.8	1.3	51	55	5240	5586	6.7	0.38	1.57	0.86	14131/14276	0.334
34.925	76.2	29.37	28.575	23.02	1.5	3.3	88	106	8962	10836	13.0	0.55	1.10	0.60	HM89446X1XA/HM89410F	0.644
34.925	76.2	29.37	28.575	23.02	3.5	3.3	88	106	8962	10836	13.0	0.55	1.10	0.60	HM89446/HM89410	0.641
34.925	76.2	29.37	28.575	23.812	1.5	2.8	99	109	10092	11152	13.3	0.40	1.49	0.82	N1696XA/31520	0.641
34.925	65.088	18.034	18.288	13.97	3.5	1.3	56	61	5708	6218	7.4	0.38	1.59	0.88	LM48548/LM48510	0.250
34.925	69.012	19.845	19.583	15.875	1.5	1.3	51	55	5240	5586	6.7	0.38	1.57	0.86	14137A/14276	0.319
34.925	72.233	25.4	25.4	19.842	2.4	2.4	73	85	7421	8614	10.3	0.55	1.09	0.60	HM88649/HM88610	0.498
34.925	73.025	23.813	24.608	19.05	1.5	0.8	80	86	8152	8716	10.4	0.29	2.07	1.14	25877/25821	0.444
34.925	73.025	23.813	24.608	19.05	1.5	2.3	80	86	8152	8716	10.4	0.29	2.07	1.14	25877/25820	0.444
34.925	76.2	29.37	28.575	23.812	1.5	3.3	90	97	9213	9878	11.8	0.40	1.49	0.82	31594/31520	0.619
34.925	76.2	29.37	28.575	23.812	1.5	2.8	73	72	7478	7370	8.8	0.40	1.49	0.82	LTN1683FXA	0.583
34.989	79.985	32.751	30.925	25	2.5	2.5	97	104	9933	10632	12.7	0.37	1.64	0.90	3478X/3424S	0.765
34.989	82.931	23.812	25.4	19.05	0.8	0.8	86	98	8757	10031	12.0	0.33	1.79	0.99	25572/25520	0.645
37.966	63	17	17	13.5	2	1.3	44	53	4465	5445	6.5	0.42	1.43	0.79	N1504XA/JL69310	0.195

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

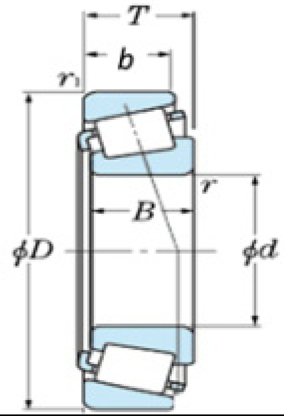
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
38.1	65.088	18.034	18.288	13.97	3.5	1.3	48	56	4864	5678	6.8	0.33	1.82	1.00	LM29749/LM29710	0.232
38.1	79.375	29.37	29.771	23.812	3.5	3.2	102	111	10389	11335	12.8	0.37	1.64	0.90	3490/3420	0.675
38.1	65.107	19.812	20	15.748	2.3	1.3	52	68	5320	6962	8.3	0.43	1.40	0.77	N1261X1/ N1261FPX1	0.267
38.1	65.107	19.812	20	15.748	2.3	1.3	52	68	5320	6962	8.3	0.43	1.40	0.77	TS1N1261FPX1X1	0.267
38.1	65.107	19.812	20	15.748	2.3	1.3	52	68	5320	6962	8.3	0.43	1.40	0.77	TS1N1261FPX1X1T2X	0.257
38.1	88.5	26.988	29.083	22.225	3.6	1.6	110	112	11210	11384	13.6	0.26	2.28	1.25	418/414	0.810
39.688	73.025	19.395	22.098	15.265	2.3	1.5	55	65	5608	6628	7.9	0.31	1.94	1.06	U399/U360L	0.36
39.688	76.2	23.812	25.654	19.05	3.5	0.8	86	97	8791	9888	11.8	0.30	2.00	1.10	TMB2789/2729	0.477
39.688	76.2	23.812	25.654	19.05	3.6	0.8	82	92	8334	9378	11.2	0.30	2.00	1.10	2789/2729	0.477
40	80	21	22.403	17.826	3.5	1.3	69	76	7034	7778	9.3	0.27	2.22	1.22	344/332	0.469
40.988	67.975	17.5	18	13.5	3.5	1.5	51	61	5172	6259	7.5	0.35	1.71	0.94	LM300849X/LM300811	0.239
41.275	73.431	19.558	19.812	14.732	3.6	0.8	65	73	6649	7458	8.9	0.40	1.50	0.83	LM501349/LM501310	0.333
41.275	76.2	22.225	23.017	17.462	3.6	0.8	74	83	7571	8494	10.2	0.39	1.53	0.84	24780/24720	0.423
41.275	82.55	26.543	25.654	20.193	3.5	3.3	94	112	9590	11366	13.6	0.55	1.09	0.60	M802048/M802011	0.619
41.275	82.55	26.543	25.654	20.193	3.5	3.3	92	106	9428	10758	12.9	0.55	1.09	0.60	ASTM802048XA/11F	0.628
41.275	82.55	26.543	25.654	20.193	3.5	3.3	92	106	9428	10758	12.9	0.55	1.10	0.60	LTASTM802048XA/11F	0.629
41.275	87.312	30.162	30.886	23.812	1.5	3.5	109	123	11074	12528	15.0	0.31	1.96	1.08	3585/3525	0.834
41.275	88.9	30.162	29.37	23.02	3.5	3.3	109	119	11093	12134	14.5	0.55	1.10	0.60	ASTBHM803146XA/10	0.857
41.275	95.25	30.958	28.575	22.225	3.5	0.8	110	118	11169	12063	14.4	0.74	0.81	0.45	HM903245XA/HM903210	1.036

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

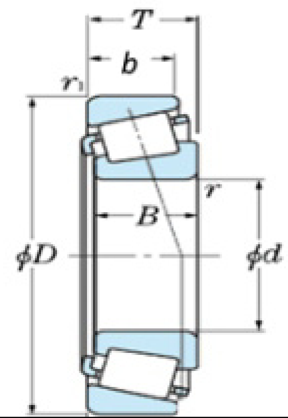
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
42.07	91	39.688	40.386	33.338	3.5	-	168	186	17120	18966	22.7	-	-	-	4T4395XA CONE ASSLY.	0.771
42.875	82.931	26.988	25.4	22.225	3.5	2.3	86	98	8768	10010	12.0	0.33	1.79	0.99	25577/25523	0.615
44.45	95.25	27.783	28.575	22.225	0.8	2.3	122	142	12433	14434	17.3	0.33	1.82	1.00	33885/33821	0.976
44.45	92.075	30.163	29.37	23.02	3.6	3.3	111	125	11303	12742	15.2	0.55	1.09	0.60	HM803149/HM803112	0.920
44.45	93.264	30.162	30.302	23.812	3.56	3.3	114	134	11645	13660	16.3	0.34	1.77	0.97	3782/3720	0.961
44.45	95.25	30.958	28.875	22.225	3.5	0.8	110	12	11234	1213	1.5	0.74	0.81	0.45	HM903249/HM303210	1.838
44.45	111.125	38.1	36.975	30.162	3.5	3.3	160	181	16360	18400	22.0	0.30	2.02	1.11	535/532A	1.838
44.45	112.713	30.133	26.909	20.638	0.8	3.3	119	141	12159	14322	17.1	0.88	0.68	0.37	55176C/55443	1.500
44.987	79.975	23.75	26	18	2.5	1.5	72	86	7311	8810	10.5	0.32	1.88	1.03	U497/U460	0.500
45.242	77.788	21.43	19.842	16.667	3.5	0.8	64	73	6496	7401	8.9	0.43	1.40	0.77	LM603049/LM603012	0.381
45.242	77.788	19.842	19.842	15.08	3.5	0.8	64	73	6496	7411	8.9	0.43	1.41	0.77	LM603049/LM603011	0.358
45.242	77.788	19.842	19.842	15.08	3.5	0.8	65	72	6649	7382	8.8	0.43	1.40	0.77	ASTLM603049/TS1LM603011	0.360
45.242	77.788	19.842	19.842	15.08	3.5	0.8	65	72	6649	7382	8.8	0.43	1.40	0.77	ASTLM603049T2X/TS1LM603011FT2X	
45.618	82.931	23.812	25.4	19.05	3.5	2.3	86	98	8757	10031	12.0	0.33	1.79	0.99	25590/25520	0.543
45.618	82.931	26.988	25.4	20	3.56	2.5	84	93	8574	9429	11.3	0.40	1.49	0.82	LTN1684FXA	0.550
45.618	83.058	23.876	25.4	19.114	3.58	2	88	98	8994	10034	12.0	0.33	1.82	1.00	4T25590/25522	0.538
45.618	88.9	20.638	22.225	16.513	3.5	1.3	87	94	8882	9562	11.4	0.32	1.88	1.03	369S/362A	0.548
45.618	95.25	30.162	29.37	23.02	3.5	3.3	123	149	12502	15158	18.1	0.55	1.10	0.60	HM804846/HM804810	0.773
49.213	103.18	43.658	44.475	36.51	3.5	3.3	195	232	19865	23649	28.3	0.30	2.02	1.11	5395/5335	0.773

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

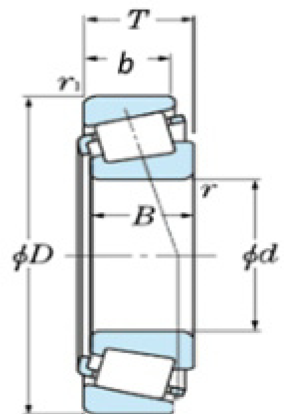
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y_2 and Yo

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Approx.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
49.987	112.713	30.188	26.909	20.638	3.5	3.3	119	141	12159	14322	17.1	0.88	0.68	0.37	55187C/55443	1.415
50	93.564	30.162	30.302	23.812	2.0	3.3	116	139	11874	14179	17.0	0.34	1.77	0.97	N1280/3720	0.862
50.8	93.264	30.162	30.302	23.812	3.56	3.3	114	134	11645	13660	16.3	0.34	1.77	0.97	3780XA/3720	0.840
50.8	92.075	24.608	25.4	19.845	3.56	0.8	95	116	9659	11865	14.2	0.38	1.59	0.87	28580/28521	0.703
50.8	93.264	30.162	30.302	23.812	3.56	3.3	114	134	11645	13660	16.3	0.34	1.76	0.97	3780/3720	0.618
50.8	95.25	27.783	28.575	22.225	3.5	0.8	125	142	12770	14438	17.3	0.33	1.82	1.00	4TB33889XA/22F	0.853
50.8	96.838	21	21.946	15.875	2.3	0.8	86	95	8734	9643	11.5	0.35	1.69	0.93	385A/382A	0.663
50.8	101.6	31.75	31.75	25.4	3.5	3.3	137	157	13952	15994	19.1	0.40	1.50	0.82	49585XA/20	1.135
50.8	104.775	30.163	30.958	23.812	0.8	3.18	146	169	14847	17233	20.6	0.33	1.80	0.99	45285AXA/45220	1.208
50.8	111.125	30.162	26.909	20.638	3.6	3.3	124	149	12673	15189	18.2	0.88	0.68	0.37	55200C/55437	1.340
50.8	111.125	30.162	26.909	20.638	3.5	3.3	98	126	10034	12859	15.30	0.88	0.68	0.38	ML55200CXA_55437	1.305
50.8	116.8	36.512	36.512	28.575	0.8	0.8	167	209	17051	21271	25.4	0.49	1.23	0.68	TS2HM807046XA/10TSF	1.545
52.388	111.125	30.162	26.909	20.638	3.6	3.3	111	149	11315	15189	18.2	0.88	0.68	0.38	55206C/55437	1.310
53.975	107.95	36.512	36.957	28.575	3.5	3.3	160	181	16360	18410	22.0	0.30	2.02	1.11	539/532X	1.450
53.975	114.981	65.085	26.909	44.445	2.3	0.50-Ch	200	287	20391	29246	35.0	0.88	0.68	0.38	55194/55452D	3.120
53.975	123.825	36.512	32.791	25.4	3.5	3.3	177	193	18004	19674	23.5	0.74	0.81	0.45	72212C/72487	2.010
57.15	104.775	30.162	29.317	24.605	2.3	3.3	131	155	13358	15800	18.9	0.34	1.79	0.98	462A/453X	1.060
57.15	112.712	30.162	30.162	23.813	8.0	3.3	170	219	17308	22294	26.7	0.34	1.77	0.97	39581/39520	1.315
59.985	109.985	29.751	28	23.813	2.4	1.5	131	172	13403	17492	20.9	0.40	1.50	0.83	3977X/3922X (X32212)	1.200

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

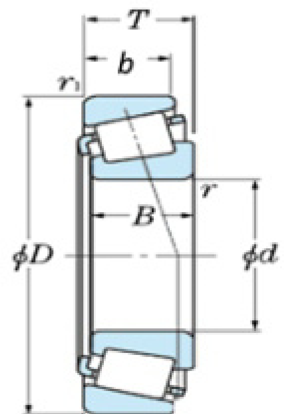
$P_{or} = 0.5F_r + Y_oF_a$

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

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

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
60	112.712	30.162	30.162	23.812	0.8	3	170	219	17313	22300	26.7	-	-	-	N1258 CONE ASSLY.	1.368
60.325	100	25.4	25.4	19.845	3.6	3.3	95	141	9684	14373	17.2	0.42	1.43	0.79	28985/28921	0.750
63.5	110	29.37	30.048	23.02	7.1	1.5	131	172	13403	17492	20.9	0.40	1.49	0.82	3982X/3927XA	1.100
63.5	112.712	30.163	30.048	23.813	7.1	3.3	131	172	13403	17492	20.9	0.40	1.50	0.83	3982X/3920	1.214
63.5	112.712	30.162	30.162	23.812	3.6	3.3	145	203	14781	20693	24.8	0.34	1.76	0.97	39585/39520	1.380
63.5	119.985	32.751	30.914	26.949	2.3	0.8	170	219	17319	22273	26.6	0.34	1.77	0.97	39586/39528	1.500
63.5	122.238	38.1	38.354	29.718	7.1	1.5	213	249	21692	25403	30.4	0.34	1.78	0.98	HM212047/HM212010	1.933
63.5	130	36.937	33.937	28	6.5	3.5	192	212	19580	21570	25.8	0.38	1.57	0.86	JHM513640/JHM513615	2.126
63.5	140.03	36.512	33.236	23.52	5.1	2.3	206	226	20996	23028	7.4	0.87	0.69	0.38	4TB78250/78551	2.488
65	105	24	23	18.5	3.0	1.0	94	128	9582	13048	15.6	0.45	1.33	0.73	JLM710949C/JLM710910	0.750
65.088	135.755	53.975	56.007	44.45	3.5	3.3	297	356	30255	36279	43.4	0.32	1.85	1.02	6379/6320	3.598
65.088	135.755	53.975	56.007	44.45	7.5	3.2	305	356	31075	36290	43.4	0.32	1.88	1.03	ASTB6379X1XA/6320	3.603
66.675	123.825	38.1	36.678	30.162	3.6	3.3	180	221	18381	22528	27.0	0.35	1.71	0.94	559/552A	1.900
66.675	110	22	21.996	18.824	3.6	1.3	96	114	9819	11621	13.9	0.40	1.50	0.83	395S/394A	0.784
66.675	112.712	30.162	30.048	23.813	3.5	3.3	131	172	13403	17482	20.9	0.40	1.49	0.82	3984/3920	1.142
66.675	112.712	30.162	30.048	23.813	4.51	2.6	138	183	14059	18650	22.3	0.40	1.50	0.83	3984MANXA/20F	1.157
66.675	112.712	30.162	30.162	23.813	3.6	3.0	170	219	17313	22300	26.7	0.34	1.76	0.97	39590/39520	1.203
66.675	122.238	38.1	38.354	29.718	3.56	3.3	209	244	21350	24873	29.8	0.34	1.76	0.97	HM212049/HM212011	1.860
66.675	122.238	38.1	38.354	29.718	3.56	3.3	212	248	21646	25321	30.3	0.34	1.78	0.98	N1691XA/HM212011	1.862

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
66.675	127	36.512	36.512	26.988	3.5	3.3	184	231	18758	23496	28.1	0.50	1.20	0.66	HM813844/10	1.961
68.262	110	22	21.996	18.824	2.3	1.3	86	114	8767	11621	13.9	0.40	1.50	0.83	399A/394A	0.759
68.262	152.4	47.625	46.038	31.75	3.5	3	284	283	28964	28847	33.5	0.65	0.92	0.51	AST9185XA/9121F	3.688
68.262	152.4	47.625	46.038	31.75	3.5	3	284	283	28964	28847	33.50	0.65	0.92	0.51	4T9185XA/9121F	3.687
69.85	120	29.794	29.007	24.237	3.5	2.0	150	190	15310	19368	23.2	0.38	1.56	0.86	482/472	1.320
69.85	127	36.512	36.17	28.575	3.5	3.3	185	233	18872	23741	28.4	0.36	1.65	0.91	566/563	1.900
69.85	146.05	41.275	39.688	25.4	3.5	3.3	243	250	24778	25492	29.8	0.78	0.77	0.42	H913849/10	2.870
69.865	120	32.545	32.545	26.195	3.6	3.3	168	219	17094	22343	26.7	0.36	1.67	0.92	47487/47420	1.467
71.438	120	32.545	32.545	26.195	3.5	3.3	173	219	17589	22331	26.7	0.36	1.67	0.92	4TB47490/47420	1.418
71.438	127	36.512	36.17	28.575	3.5	3.3	185	233	18872	23741	28.4	0.36	1.65	0.91	567A/563	1.85
73.025	139.992	36.512	36.098	28.575	3.5	-	196	27	20025	2742	3.2	-	-	-	576 CONE ASSLY.	1.705
73.025	112.712	25.4	25.4	19.05	3.56	3.3	107	151	10903	15392	18.4	0.49	1.23	0.68	TMB29685/TMB29620	0.873
73.025	127	36.512	36.17	28.575	3.5	3.3	185	233	18872	23741	28.4	0.36	1.65	0.91	567/563	1.825
76.2	149.225	53.975	54.229	44.45	9.65	3.3	323	411	32904	41845	48.5	0.36	1.66	0.91	6461A/6420	4.240
76.2	127	30.162	31	22.225	3.5	3.3	154	198	15675	20224	24.1	0.42	1.43	0.79	42687/42620	1.460
77.788	127	30.162	31	22.225	3.5	3.3	153	198	15635	20169	24.0	0.42	1.43	0.79	42690XA/42620F	1.376
80	140	35.25	33	28	3.0	3.0	208	282	21247	28767	33.5	0.40	1.49	0.82	M32216A/M32216E	2.192
82.55	139.992	36.512	36.098	28.575	3.5	3.2	195	258	19854	26300	30.6	0.40	1.49	0.82	580/572F	2.155
82.55	136.525	30.162	29.769	22.225	3.5	3.3	142	189	14477	19276	22.78	0.44	1.35	0.74	495/493	2.020
82.55	139.7	36.512	36.098	28.575	3.5	3.3	195	259	19900	26371	30.7	0.40	1.49	0.82	580/572X	2.138
82.55	139.992	36.512	36.098	28.575	3.5	3.3	195	259	19900	26371	30.7	0.40	1.49	0.82	580/572	2.138

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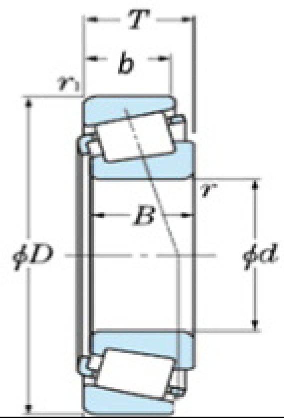
Single Row Taper Roller Bearing (Inch series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

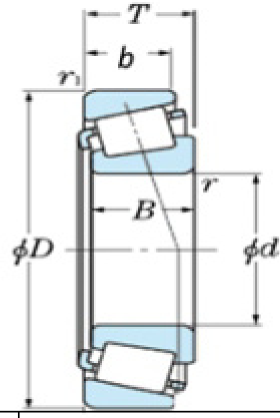
$P_{or} = 0.5F_r + Y_oF_a$

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

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

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
82.57	150	38.5	36	30	6.5	2	254	306	25924	31233	35.7	0.42	1.43	0.79	N1573/32217F	2.770
85	130	30	29	24	3.0	2.5	140	223	14271	22732	26.7	0.44	1.36	0.75	JM716649/JM716610	1.370
85.725	136.525	30.162	26.769	22.225	3.5	3.3	145	190	14739	19409	22.6	0.44	1.35	0.74	497/493	1.525
88.9	61.925	53.925	55.1	42.862	3.6	3.3	310	464	31611	47315	57	0.4	1.50	0.83	6580/6535	4.7
92.075	146.05	33.338	34.925	26.195	3.5	3.3	189	277	19261	28267	32.1	0.45	1.34	0.74	47890/20	2.057
92.075	152.4	39.688	36.322	30.162	3.56	3.3	202	280	20619	28573	32.2	0.44	1.36	0.75	598/592A	2.619
95	135	20	20	14	5.0	2.5	92	146	9407	14900	17.1	0.58	1.03	0.57	JL819349/JL819310	0.862
95.25	152.4	39.688	36.322	30.162	5.0	3.3	203	281	20665	28654	32.3	0.44	1.36	0.75	594A/592A	2.090
95.25	168.275	41.275	41.275	30.162	3.5	3.3	251	347	25574	35372	39.0	0.47	1.28	0.70	683/672	2.680
98.425	157.162	36.512	36.116	26195	3.5	3.3	213	308	21703	31346	34.8	0.47	1.26	0.70	52387/52618	2.521
99.975	156.975	42	42	34	3.0	3.5	281	381	28656	38807	43.2	0.33	1.82	1.00	HM220149/HM220110	2.797
101.6	200	52.761	49.212	34.25	3.5	3.3	352	481	35893	49047	51.9	0.63	0.95	0.52	98400/98788	6.850
107.95	158.75	23.02	21.438	15.875	3.56	3.3	129	197	13176	20061	22.1	0.61	0.98	0.54	TMB37425/TMB37625	1.370
107.95	158.75	23.02	21.438	15.875	3.5	3.3	130	191	13298	19435	21.4	0.61	0.98	0.54	4TB37425/37625F	1.385
127	165.895	18.258	17.462	13.495	1.5	1.5	96	148	9823	15117	16.1	0.29	2.04	1.12	4TBLL225749/10	0.922
127	182.56	39.69	38.1	33.34	3.5	3.3	260	439	26503	44766	47.0	0.31	1.94	1.06	48290/48220	3.320
127	228.6	53.975	49.428	38.1	3.4	3.3	474	594	48314	60571	61.0	0.74	0.81	0.45	HM926747/HM926710	8.830
127	304.8	88.9	82.55	57.15	6.4	6.4	991	1281	101153	130755	124.0	0.73	0.82	0.45	HH932132/HH932110	30.100
63.5	112.712	30.162	30.048	23.812	4.51	3.3	114	172	11625	17539	21	0.4	1.50	0.83	3982AN/3920	1.214
127	234.95	63.5	63.5	49.212	6.4	3.3	525	827	53533	84328	84.4	0.63	0.95	0.52	95500/95925	11.800

Single Row Taper Roller Bearing (Inch series)



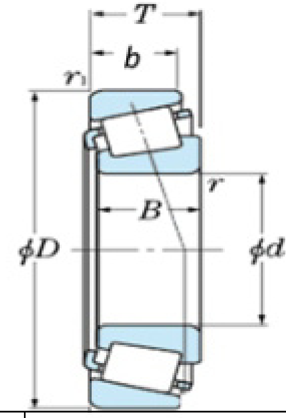
Equivalent radial load
dynamic
$P_r = XF_r + YF_a$

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

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
139.7	236.538	57.15	56.64	44.45	3.5	3.3	492	815	50153	83038	81.7	0.32	1.88	1.03	HM231132/HM231110	10.260
146.05	236.538	57.15	56.642	44.45	3.5	3.3	488	794	49795	81020	79.7	0.32	1.88	1.03	HM231140/HM231110	9.340
152.4	285.75	76.2	73.025	55.563	1.5	6.4	778	1101	79331	112267	106.1	0.40	1.50	0.83	EE217060/112	20.6
152.4	307.975	88.9	93.662	66.675	9.7	6.8	1000	1350	101937	137615	128.2	0.33	1.82	1.00	HH234048/HH234010	30.000
155.58	336.55	85.725	79.375	53.975	6.4	6	884	1287	90143	131238	120	0.81	0.74	0.41	ETB-H936340/13	33.6
155.58	336.55	85.725	79.375	53.975	6.4	6.0	1017	1287	103665	131238	120.0	0.81	0.74	0.41	H936340/H936313	36.600
159.95	244.475	47.625	46.83	33.338	3.5	3.3	354	585	36086	59633	57.8	0.35	1.71	0.94	81630/81962	7.210
165.1	336.55	92.07	95.25	69.85	3.3	6.4	1357	1743	138376	177737	161.0	0.37	1.62	0.89	HH437549/HH437510	39.000
165.1	225.425	41.275	39.688	33.338	3.5	3.3	261	575	26614	58632	57.4	0.38	1.58	0.87	46790/46720	4.650
174.625	311.15	82.55	82.55	65.088	6.4	6.4	1000	1600	101937	163099	149.5	0.33	1.82	1.00	H238148/H238110	27.500
174.625	247.65	47.62	47.62	38.1	3.5	3.3	393	691	40106	70463	67.0	0.44	1.36	0.75	67787/67720	1.230
190.5	266.7	47.63	46.83	38.1	3.5	3.3	408	748	41630	76275	71.0	0.48	1.25	0.69	67885/67820	8.000
190.5	428.625	106.36	95.25	61.912	6.4	6.4	1166	1522	118899	155201	132	0.76	0.79	0.43	ETB-EE350750/351687	65.9
190.5	428.625	106.36	95.25	61.912	6.4	6.4	1341	1521	136734	155099	132.0	0.76	0.79	0.43	EE350750/EE351687	63.100
203.2	482.6	117.48	95.25	73.025	6.4	6.4	1400	2000	142857	204081	168.5	0.87	0.69	0.38	EE380080/EE380190	96.000
206.38	336.55	98.25	100.01	77.79	3.3	3.3	1286	2046	131105	208635	185.0	0.33	1.82	1.00	H242649/H242610	34.280
228.6	320.68	50.8	49.21	33.34	6.4	3.3	462	742	47142	75663	67.0	0.49	1.22	0.67	88900/88126	12.660
234.95	384.175	112.71	112.71	90.488	6.4	6.4	1460	2730	148979	278571	237.8	0.33	1.82	1.00	H247549/H247510	50.500
247.65	346.075	63.5	63.5	50.8	6.4	6.4	805	1407	82087	143475	124.0	0.34	1.76	0.97	M348449/10	17.5
247.65	406.4	115.89	117.48	93.662	6.4	3.3	3181	6303	324363	642730	539.0	0.38	1.58	0.87	HH249949/H249910 (N1053)	60.200
254	533.4	133.35	120.65	77.78	6.4	6.4	2328	3301	239461	296535	267.0	0.87	0.69	0.38	HH953749/HH953710	135.000

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = 0.5F_r + Y_oF_a$

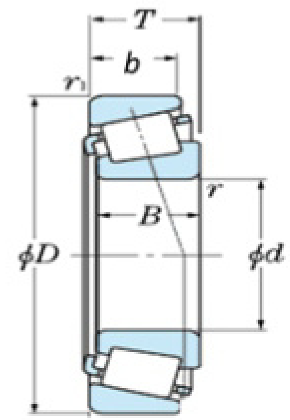
When $P_{or} < F_r$ *use* $P_{or} = F_r$

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

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Approx.)
							Dynamic	Static	Dynamic	Static		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
266.7	444.5	121.03	117.48	88.9	6.4	6.4	2057	3522	184462	312340	294.0	0.58	1.03	0.57	H852849/H852810	72.000
317.5	635	165.1	146.02	114.3	19.0	12.7	2910	4960	296938	506122	378.7	0.94	0.64	0.35	NP340527/NP360214	233.100
317.5	635	165.1	146.02	114.3	19	12.7	2910	4960	296739	505781	379	0.94	0.64	0.35	ETB-NP340527/NP360214	233.100
317.5	622.3	147.64	131.76	82.55	14.2	12.7	2946	4281	286133	349642	328.0	0.94	0.64	0.35	H961649/H961610	176.800
317.5	444.5	63.5	61.912	39.688	8.0	1.5	750	1300	76530	132653	106.1	0.38	1.58	0.87	EE291250/EE291750	26.500
368.3	609.6	142.88	139.7	111.13	8.0	6.4	2750	5060	280612	516326	383.3	0.35	1.71	0.94	EE321145/EE321240	156.000
371.48	501.65	74.612	66.675	50.8	6.4	3.3	910	1820	92763	185525	142.6	0.44	1.36	0.75	EE231462/EE231975	36.000
381	522.288	85.725	84.138	61.912	6.4	3.3	1320	2910	134693	296938	225.8	0.39	1.54	0.85	LM565949/565910	50.700
385.76	514.35	82.55	82.55	63.5	6.4	3.3	1300	3200	132518	326198	248.5	0.42	1.43	0.79	LM665949/LM665910	50.000
425.45	685.698	142.88	142.8	104.78	12.7	6.4	3050	5810	311224	592857	423.6	0.40	1.50	0.83	EE328167/328269	188.000
450.85	603.25	87.725	84.138	60.325	6.4	3.3	1560	3099	159076	316011	230	0.45	1.33	0.73	LM770945/LM770910	63.3
479.43	679.45	128.59	128.59	101.6	6.4	6.4	3000	7000	305810	713558	503.9	0.33	1.82	1.00	M272749/M242710	141.000
489.026	634.873	80.962	80.962	63.5	6.4	3.3	1440	3580	146834	365045	260.1	0.34	1.76	0.97	EE243192/243250	62.500
498.48	634.873	80.962	80.962	63.5	6.4	3.3	1500	3262	152958	332633	236	0.34	1.76	0.97	EE243196/243250	58.2
571.5	812.8	155.58	155.58	120.65	6.4	6.4	4546	9241	463560	942323	631.0	0.33	1.82	1.00	M278749/M278710	227.000
630	850	108	100	78	6.0	6.0	2500	5680	255102	579591	380.0	0.41	1.46	0.80	10079/630	164.000
660.4	939.8	136.53	127	98.425	6.4	6.4	3804	7629	387922	777944	499.0	0.41	1.46	0.80	EE538260/EE538370	293.730
710	950	114	106	80	6.0	6.0	2800	6500	285423	662589	420.1	0.46	1.30	0.72	10079/710	211.000
900	1180	124	122	87	8.0	8.0	4140	9740	422018	992864	588.5	0.40	1.49	0.82	10079/900	330.000
900	1280	190	170	135	7.5	7.5	6450	14500	657492	1478084	863.6	0.54	1.11	0.61	71/900	703.000
1320	1600	176	165	142	6.0	6.0	6350	20550	647299	2094801	1121.5	0.36	1.67	0.92	20078/1320	719.000

CKA Birla Group

19.2 Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

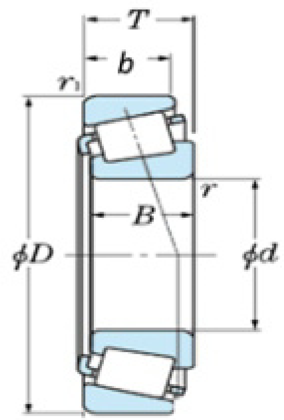
$P_{or} = 0.5F_r + Y_oF_a$

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

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

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	y_2	y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
15	35	11.75	11	10	0.6	0.6	16	15	1642	1509	1.8	0.32	1.88	1.03	30202	0.05
15	42	14.25	13	11	1.5	1.5	25	20	2592	2069	2.5	0.29	2.11	1.16	30302	0.096
17	40	13.25	12	11	1.0	1.0	24	22	2479	2234	2.7	0.35	1.74	0.96	30203	0.080
20	42	15	15	12	0.6	0.6	29	30	2980	3028	3.6	0.37	1.60	0.88	32004X	0.097
20	47	15.25	14	12	1.5	1.5	33	30	3345	3068	3.7	0.35	1.74	0.96	30204	0.121
20	52	16.25	15	13	1.5	1.5	35	33	3537	3384	4.0	0.30	2.00	1.10	30304	0.160
20	52.055	14.9	15	11	0.5	1.1	39	33	3981	3334	4.0	0.50	1.20	0.66	MLN1518FXA	0.159
21.5	47	16.5	16.5	13	1.0	1.0	39	40	4007	4067	4.9	0.37	1.60	0.88	N1061	0.136
22	52.055	14.9	15	12	1.1	1.1	38	31	3837	3181	3.8	0.35	1.70	0.93	MLN1519FXA	0.153
25	52	19.25	18	16	1.0	1.0	48	48	4912	4883	5.8	0.36	1.67	0.92	32205 (Low Carbon Steel)	0.184
25	47	15	15	11.5	3.3	0.6	31	34	3174	3445	4.1	0.43	1.39	0.77	32005	0.120
25	47	15	15	11.5	3.3	0.6	31	34	3174	3445	4.1	0.43	1.40	0.77	32005F	0.120
25	47	15	15	11.5	3.3	0.6	31	34	3174	3445	4.1	0.43	1.39	0.77	32005x1N	0.130
25	47	15	15	11.5	0.6	1.0	40	34	3615	4063	4.1	0.43	1.40	0.77	ML32005X1XAT2X	0.110
25	47	17	17	14	0.6	0.6	36	40	3676	4098	4.9	0.29	2.07	1.14	33005	0.130
25	47	17	17	14	0.6	0.6	41	40	4201	4098	4.9	0.29	2.07	1.14	ML33005	0.129
25	52	16.25	15	13	1.0	1.0	37	35	3772	3569	5.0	0.37	1.62	0.88	30205	0.148

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

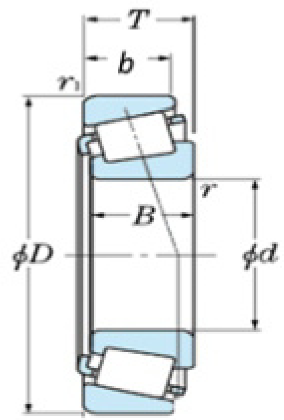
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension (mm)							Basic Load Rating Dynamic (KN)	Static (KN)	Dynamic (Kgf)	Static (Kgf)	Fatigue Load Limit (KN)	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu	e	Y_2	Y_o		
25	52	16.25	15	13	1.0	1.0	37	35	3772	3569	5.0	0.37	1.62	0.89	30205F	0.148
25	52	19.25	18	16	1.0	1.0	46	45	4681	4587	5.5	0.36	1.67	0.92	32205	0.184
25	52	22	22	18	1.0	1.0	53	58	5423	5861	7.0	0.35	1.71	0.94	33205	0.219
25	52	14.5	15	11	1.0	1.0	40	33	4059	3385	4.0	0.38	1.59	0.88	MLN1466XA	0.136
25	62	18.25	17	15	2.0	2.0	52	46	5299	4548	5.4	0.30	2.00	1.10	30305	0.260
25	62	18.25	17	14	1.5	2.2	47	42	4795	4312	5.2	0.55	1.10	0.60	30305C	0.264
25	62	18.25	17	15	2	2	52	45	5299	4548	5.4	0.30	2.00	1.10	30305P6	0.26
25	62	25.25	24	20	2.0	2.0	71	66	7193	6730	8.1	0.30	2.00	1.10	32305	0.381
28	58	20.25	19	16	1.0	1.0	58	56	5964	5749	6.9	0.27	2.21	1.21	ML322/28XA	0.246
28	67	30.5	32	24	2.5	1.0	94	91	9624	9256	11.1	0.24	2.53	1.39	N1114	0.513
30	55	17	17	13	1.0	1.0	44	48	4455	4842	5.8	0.43	1.40	0.77	32006X (Low Carbon steel)	0.172
30	55	17	17	13	1.0	1.0	43	48	4338	4842	5.8	0.43	1.39	0.77	32006X	0.172
30	62	17.25	16	14	1.0	1.0	49	49	5034	4975	6.0	0.37	1.60	0.88	30206	0.241
30	62	21.25	20	17	1.0	1.0	62	66	6336	6677	8.0	0.37	1.60	0.88	32206	0.299
30	62	25	25	19.5	1.0	1.0	71	75	7284	7686	9.2	0.34	1.76	0.97	33206	0.340
30	72	20.75	19	16	2.0	2.0	70	64	7094	6484	7.8	0.31	1.90	1.05	30306	0.387
30	72	20.75	19	14	1.5	2.2	66	57	6730	5812	70.6	0.55	1.10	0.60	30306C	0.381
30	72	20.75	19	14	1.5	1.5	49	52	4944	5250	6.3	0.83	0.72	0.40	30306D	0.398

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

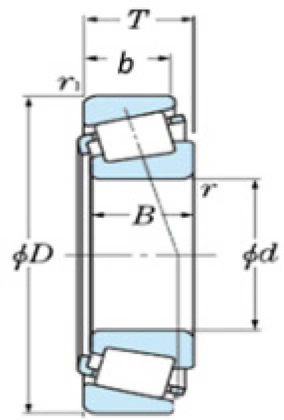
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Approx.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu	e	Y_2	Y_o		
30	72	28.75	27	23	1.5	1.5	85	96	8665	9786	11.7	0.31	1.94	1.06	32306	0.560
32	58	17	17	13	1.0	1.0	42	47	4304	4791	5.7	0.45	1.32	0.73	320/32X	0.188
35	62	18	18	14	1.5	0.5	48	54	4875	5545	6.6	0.45	1.32	0.73	32007X	0.224
35	72	18.25	17	15	2.0	2.0	59	58	6062	5923	7.1	0.37	1.60	0.88	30207	0.315
35	72	24.25	23	19	1.5	1.5	83	89	8472	9123	10.9	0.37	1.60	0.88	32207	0.447
35	72	24.25	23	19	2.0	2.0	71	78	7193	7910	9.5	0.58	1.03	0.57	32207B	0.457
35	72	28	28	22	1.5	1.5	98	109	9990	11111	13.3	0.35	1.70	0.93	33207	0.539
35	80	22.75	21	18	2.0	2.0	68	74	6930	7533	9.0	0.31	1.90	1.05	30307	0.520
35	80	22.75	21	15	2.0	1.5	71	72	7241	7291	8.7	0.83	0.73	0.40	30307DFXA	0.513
35	80	32.75	31	25	2.5	2.5	109	109	11154	11142	13.3	0.31	1.90	1.05	32307	0.737
36	62	17	17	13	1.5	1.5	45	50	4567	5097	6.1	0.45	1.32	0.73	TS2N1126	0.197
38	63	17	17	13.5	1.3	1.3	50	53	5103	5445	6.5	0.41	1.46	0.80	MLJL69349X1XA/10F	0.190
40	80	21	22.4	17.83	3.5	1.3	76	75	7764	7645	9.1	0.27	2.20	1.21	TMB344A/332	0.482
40	68	19	19	14.5	1.0	1.0	57	67	5834	6809	8.1	0.38	1.58	0.87	32008X	0.273
40	80	19.75	18	16	2.0	2.0	70	69	7147	7054	8.4	0.37	1.60	0.88	30208	0.435
40	80	24.75	23	19	1.5	1.5	89	94	9031	9541	11.4	0.37	1.60	0.88	32208	0.523
40	80	32	32	25	1.5	1.5	92	94	9346	9585	11.5	0.36	1.68	0.92	4TB33208XA	0.721

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic
$P_r = XF_r + YF_a$

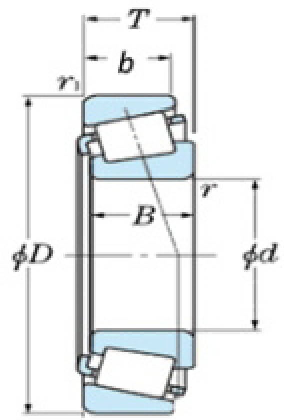
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
40	80	21	22.4	17.83	3.5	1.3	76	75	7764	7645	9.1	0.27	2.20	1.21	TMB344A/332	0.482
40	68	19	19	14.5	1.0	1.0	57	67	5834	6809	8.1	0.38	1.58	0.87	32008X	0.273
40	80	19.75	18	16	2.0	2.0	70	69	7147	7054	8.4	0.37	1.60	0.88	30208	0.435
40	80	24.75	23	19	1.5	1.5	89	94	9031	9541	11.4	0.37	1.60	0.88	32208	0.523
40	80	32	32	25	1.5	1.5	92	94	9346	9585	11.5	0.36	1.68	0.92	4TB33208XA	0.721
40	80	34	34	27	2.0	2.0	115	145	11759	14781	17.7	0.43	1.39	0.77	N1090	0.788
40	85	18.5	18.25	17	1.5	0.3	65	64	6588	6524	7.8	0.37	1.60	0.88	N1062	0.547
40	85	33	32.5	28	2.5	2.0	129	141	13202	14347	17.2	0.34	1.74	0.96	TS2T2EE040XA	0.870
40	90	25.25	23	20	2.0	1.5	94	91	9613	9317	11.1	0.35	1.74	0.96	30308	0.769
40	90	25.25	23	17	2.0	1.5	85	96	8665	9786	11.7	0.82	0.73	0.40	31308	0.725
40	90	35.25	33	27	2.5	2.5	132	142	13449	14465	17.3	0.35	1.74	0.96	32308	1.016
40	90	35.25	33	27	2.5	2.5	132	142	13449	14465	17.3	0.35	1.71	0.94	32308F	1.016
40	95	27.5	25	19	2.0	1.5	102	102	10412	10377	12.4	0.79	0.76	0.42	331257	0.895
45	75	20	20	15.5	1.3	2.0	66	78	7623	7974	9.5	0.39	1.54	0.85	32009X	0.347
45	75	20	20	15.5	1.0	1.0	75	78	7623	7974	9.50	0.39	1.54	0.85	ML32009XF	0.339
45	85	20.75	19	16	2.0	2.0	68	68	6941	6922	8.3	0.40	1.48	0.81	30209	0.451
45	85	24.75	23	19	1.5	1.5	95	104	9636	10571	12.6	0.40	1.48	0.81	32209	0.582
45	100	27.25	25	18	2.0	1.5	110	112	11246	11427	13.7	0.83	0.73	0.40	31309X1	0.957

(32309F)

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

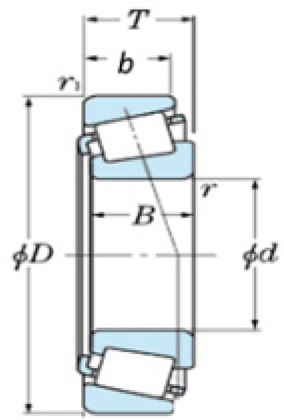
$P_{or} = 0.5F_r + Y_oF_a$

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

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

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
45	100	27.25	25	22	2.0	1.5	127	129	12947	13160	15.7	0.35	1.74	0.96	30309	1.009
45	100	27.25	25	18	2.5	2.5	111	114	11348	11570	13.8	0.83	0.73	0.40	31309	0.960
45	100	38.25	36	30	2.5	2.5	161	176	16452	17951	21.5	0.35	1.71	0.94	32309XA (32309)	1.372
45	100	38.25	36	30	2.5	2.5	161	176	16452	17951	21.5	0.35	1.71	0.94	32309 (32309F)	1.373
45	100	28.35	36	30	2.5	2.5	161	176	16452	17951	21.5	0.35	1.74	0.96	32309	1.360
45	100	38.25	36	30	2.5	2.5	166	176	18920	17951	12.3	0.35	1.74	0.96	ASTB32309	1.373
50	80	20	20	15.5	1.3	2.0	71	90	7250	9164	11.0	0.42	1.42	0.78	32010X	0.373
50	80	20	20	15.5	3.0	1.0	71	90	7250	9164	11.0	0.42	1.43	0.79	32010X1	0.366
50	80	24	24	19	1.5	1.0	79	104	8038	10632	12.7	0.32	1.90	1.04	33010	0.433
50	80	24	24	19	1.8	1.0	81	105	8291	10676	12.8	0.32	1.90	1.04	ASTBN1569XA	0.440
50	90	21.75	20	17	1.5	1.5	88	95	8985	9715	11.6	0.42	1.43	0.79	30210	0.552
50	90	24.75	23	19	1.5	1.5	95	104	9670	10632	12.7	0.42	1.43	0.79	32210	0.648
50	90	32	32	24.5	1.5	1.5	129	158	13129	16106	19.3	0.41	1.45	0.80	33210	0.860
50	90	21.75	20	17	3.5	1.5	90	95	9193	9667	11.6	0.42	1.43	0.79	ASTB30210X1	0.548
50	110	29.25	27	23	2.5	2.0	151	155	15413	15800	18.9	0.35	1.71	0.94	30310	1.280
50	110	29.25	27	19	2.5	2.0	111	126	11315	12844	15.4	0.83	0.72	0.40	31310	1.210
50	110	42.25	40	33	2.5	2.0	212	218	21582	22232	26.6	0.35	1.71	0.94	AST32310 (AST32310PX1)	1.819
50	110	42.25	40	33	2.5	2.0	124	126	12673	12844	15.4	0.35	1.74	0.96	32310	1.210
55	90	23	23	17.5	1.5	1.5	90	118	9134	12029	14.4	0.41	1.48	0.81	32011	0.557
55	95	30	30	23	2.0	2.0	127	160	12901	16259	19.5	0.37	1.60	0.88	33111	0.846

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

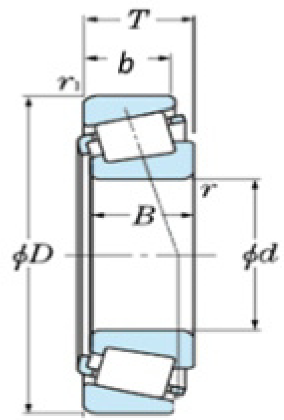
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
55	100	22.75	21	18	2.0	1.5	104	111	10618	11315	13.5	0.40	1.48	0.81	30211	0.740
55	100	26.75	25	21	2.5	2.5	121	134	12319	13619	16.3	0.40	1.48	0.81	32211	0.824
55	100	35	35	27	2.0	1.5	159	192	16212	19572	23.4	0.40	1.50	0.83	33211	1.160
55	105	36	36	28.5	2.5	2.5	171	193	17467	19643	23.5	0.35	1.70	0.93	ASTBN1091XA	1.326
55	105	36	36	25.5	2.5	2.5	159	129	16235	13099	15.7	0.35	1.70	0.93	N1091	1.324
55	120	31.5	29	25	2.5	2.0	177	184	18039	18756	22.4	0.35	1.74	0.96	30311	1.610
55	120	31.5	29	21	2.5	2.0	136	158	13827	16091	19.2	0.82	0.73	0.40	31311	1.560
55	120	45.5	43	35	2.5	2.0	236	269	24090	27421	32.8	0.55	1.10	0.60	32311C	2.370
55	120	45.5	43	35	2.5	2.0	239	274	24398	27941	33.4	0.35	1.74	0.96	32311	2.489
55	130	33.45	31.2	22	2.0	1.5	159	180	16171	18364	22.0	0.44	1.36	0.75	TMBSPN1099	1.850
55	140	45	40	33	2.5	2.0	233	276	23750	28124	33.6	0.65	0.92	0.51	4TN1243	3.427
55	140	45	45	32	2.5	3.0	197	276	20037	28104	33.6	1.06	0.57	0.31	N1649FXA	3.681
60	110	23.75	22	19	3.0	2.0	120	128	12205	13068	15.6	0.40	1.48	0.81	30212X1	0.902
60	95	27	27	21	1.5	1.5	97	151	9857	15403	18.4	0.33	1.82	1.00	33012	0.691
60	100	30	30	23	1.5	1.5	132	172	13461	17543	21.0	0.40	1.51	0.83	33112	0.907
60	110	23.75	22	19	2.0	1.5	121	129	12330	13150	15.7	0.40	1.48	0.81	30212	0.902
60	110	29.75	28	24	2.0	1.5	156	179	15870	18247	21.8	0.40	1.50	0.83	32212	1.160

Single Row Taper Roller Bearing (Metric series)



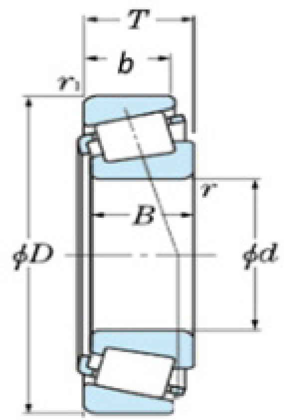
Equivalent radial load
dynamic
$P_r = XF_r + YF_a$

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

static
$P_{or} = 0.5F_r + Y_oF_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Yo

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
60	130	33.5	31	26	3.5	3.5	192	197	19546	20082	24.0	0.35	1.74	0.96	30312	1.930
60	130	48.5	46	37	3.0	2.5	273	315	27857	32110	38.4	0.35	1.74	0.96	32312	2.990
60	135	33.5	30.95	22	3.5	3.3	173	182	17651	18563	22.2	0.83	0.73	0.40	330632C	2.079
60	130	33.5	31	22	3.0	2.5	194	181	19734	18436	22.0	0.83	0.73	0.40	MLB30312DXA	1.925
60	130	48.5	46	37	3.0	2.5	281	315	28603	32110	38.4	0.35	1.74	0.96	ASTB32312	2.990
60	150	51	51	38	4.0	3.0	276	354	28131	36035	42.5	0.76	0.79	0.44	N1579FXA	4.609
65	100	23	23	17.5	1.5	1.5	93	128	9476	13048	15.6	0.46	1.31	0.72	32013X	0.629
65	100	27	21	21	1.5	1.5	110	158	11189	16106	19.3	0.35	1.71	0.94	33013	0.736
65	110	28	28	22.5	3.0	2.5	138	183	14059	18660	22.3	0.40	1.50	0.83	JM511946/JM511910	1.055
65	112.71	29.02	30	23.812	3.0	3.3	123	183	12552	18660	23.1	0.40	1.50	0.83	JM511945XAP6X/3920	1.188
65	120	24.75	23	20	2.0	1.5	140	151	14271	15392	18.4	0.40	1.48	0.81	30213	1.180
65	120	32.75	31	27	2.0	1.5	174	199	17719	20255	24.2	0.40	1.48	0.81	32213	1.574
65	120	41	41	32	2.0	1.5	221	266	22491	27115	32.4	0.39	1.54	0.85	33213	1.980
65	120	41	41	32	2.0	1.5	221	266	22491	27115	32.4	0.39	1.54	0.85	33213F	1.980
65	140	36	33	28	3.0	2.5	228	239	23291	24363	28.8	0.34	1.76	0.97	30313	2.430
65	140	36	33.0	23.0	3.0	2.5	194	210	19735	21384	25.30	0.82	0.73	0.40	30313D	2.361
65	140	36	33	23	3.0	2.5	173	204	17533	20387	24.7	0.82	0.73	0.40	31313	2.370
65	140	51	48	39	3.0	2.5	304	347	30940	35372	42.0	0.34	1.76	0.97	32313	3.660
65	145	39.75	36.5	26.5	3.5	3.3	208	223	21213	22691	26.8	0.81	0.74	0.41	77213L	2.955

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = 0.5F_r + Y_oF_a$

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

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

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Approx.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu	e	Y_2	Y_0		
65	145	87.25	36.5	26.5	3.5	3.3	353	488	35974	49730	58.6	0.81	0.74	0.41	477213LXA	6.350
70	110	25	25	19	1.5	1.5	116	160	11874	16310	19.5	0.43	1.40	0.77	32014	0.864
70	125	26.25	24	21	4.0	1.5	154	172	15687	17513	21.0	0.42	1.43	0.79	30214X1	1.242
70	125	26.25	24	21	2.5	2.5	176	172	17928	17513	21.0	0.42	1.43	0.79	MLB30214X2XA	1.231
70	125	26.25	24	21	2.5	2.5	154	172	15687	17513	21.0	0.42	1.43	0.79	30214X2XA	1.231
70	125	26.25	24	21	2.5	2.5	154	172	15687	17513	18.6	0.42	1.43	0.79	30214	1.240
70	125	33.25	31	27	2.0	1.5	180	211	18381	21478	25.7	0.42	1.43	0.79	32214	1.585
70	125	41	41	32	2.5	2.5	225	282	22948	28746	34.4	0.41	1.47	0.81	33214	2.100
70	150	38	35	25	3.0	2.5	187	231	19052	23547	27.4	0.82	0.73	0.40	31314	2.860
70	150	38	35	30	3.0	2.5	255	269	26031	27421	31.9	0.35	1.71	0.94	30314	2.990
70	150	54	51	42	3.0	2.5	349	406	35621	41386	48.5	0.34	1.76	0.97	32314	4.330
70	150	64	61	42	6.0	2.5	344	363	35050	37034	43.4	0.35	1.71	0.94	N1257 (32314)	4.676
70	165	51	51	34	3.0	2.5	299	366	30479	37309	42.1	0.75	0.80	0.44	4TN1244	5.177
75	160	45	45	30	3.0	2.5	286	328	29131	33466	37.9	0.75	0.80	0.44	4TN1247FP5	4.070
75	115	25	25	19	3.2	2.5	120	170	12273	17309	20.7	0.46	1.30	0.72	32015X1F	0.888
75	115	25	25	19	3.2	2.5	120	169	12250	17258	20.6	0.46	1.31	0.72	32015X1XA	0.888

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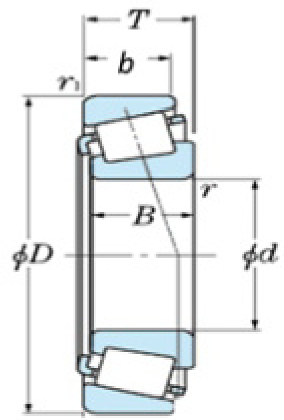
Single Row Taper Roller Bearing (Metric series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Approx.)
							Dynamic	Static	Dynamic	Static		e	y_2	y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
75	130	27.25	25	22	2.5	2.5	156	175	15870	17839	21.9	0.44	1.38	0.76	30215	1.410
75	130	33.25	31	27	2.0	1.5	199	240	20237	24471	29.0	0.44	1.38	0.76	32215	1.740
75	130	33.25	31	27	2	2	190	227.3	19381	23178	27.40	0.43	1.40	0.77	32215X2P6	1.697
75	130	41	41	31	2.5	3.0	235	303	23987	30846	36.7	0.43	1.40	0.77	33215	2.225
75	160	40	37	26	3.0	2.5	242	256	24661	26096	29.7	0.82	0.73	0.40	31315	3.380
75	160	40	37	31	3.0	2.5	287	310	29296	31621	36.0	0.35	1.74	0.96	30315	3.543
75	160	58	55	45	3.0	2.5	388	452	39503	46075	52.5	0.34	1.76	0.97	32315	5.280
80	170	61.5	58	48	3.0	2.5	397	543	40469	55352	61.9	0.34	1.76	0.97	32316	6.370
80	125	29	29	22	1.5	1.5	159	221	16166	22508	26.7	0.42	1.42	0.78	32016X	1.284
80	125	29	29	22	1.5	1.5	155	217	15755	22120	26.3	0.42	1.43	0.79	32016	1.270
80	130	35	34	28.5	3.0	2.5	193	253	19672	25810	30.4	0.39	1.55	0.85	JM515649/10	1.681
80	130	37	37	29	2.0	1.5	202	277	20585	28236	33.3	0.42	1.44	0.79	33116	1.839
80	140	28.25	26	22	3.0	3.0	158	169	16098	17248	20.1	0.42	1.43	0.79	30216	1.720
80	140	35.25	33	28	2.5	2.0	231	277	23524	28225	32.8	0.42	1.43	0.79	32216	2.180
80	140	46	46	35	2.5	2.0	246	362	25054	36892	42.9	0.42	1.43	0.79	33216	2.830
80	170	42.50	39	33	3.0	2.5	324	349	33006	35337	39.40	0.34	1.76	0.97	30316	4.20
85	180	44.5	41	28	4	3	284	340	28963	34630	37.80	0.82	0.73	0.40	30317D	4.836
85	140	41	41	32	2.5	2	215	353	21924	35996	42	0.41	1.46	0.80	33117	2.43
85	180	44.5	41	28	4.0	3.0	242	195	24669	19878	27.1	0.42	1.43	0.79	31317	4.600
85	192	64	64	45	4.0	3.0	451	538	46012	54811	59.1	0.75	0.80	0.44	4TN1248FP5	8.665
85	150	30.5	28	24	0.4	0.3	205	232	20893	23649	27.0	0.42	1.43	0.79	30217X	0.172

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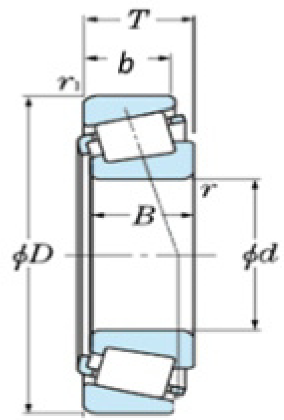
Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

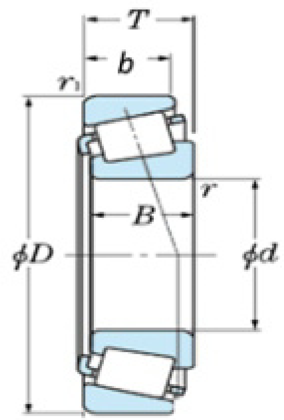
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	y_2	y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
85	150	38.5	36	30	2.5	2.0	251	300	25574	30581	34.9	0.42	1.43	0.79	32217	2.745
85	150	46	46	38	3.0	2.5	272	387	27735	39462	45.0	0.33	1.82	1.00	JH217249/JH217210	3.080
85	150	49	49	37	2.5	2.0	318	420	32424	42813	48.5	0.42	1.43	0.79	33217	3.600
85	180	44.5	41	34	4.0	3.0	306	363	31193	37003	40.7	0.34	1.76	0.97	30317	4.970
85	180	63.5	60	49	4.0	3.0	438	587	44648	59837	65.8	0.34	1.76	0.97	32317	7.300
85	150	38.5	36	30	2.5	2.0	258	300	26259	30581	34.9	0.42	1.43	0.79	ASTB32217	2.745
85	150	30.5	28	24	2.5	2.1	237	236	24133	24034	27.5	0.42	1.43	0.79	MLB30217XA	2.095
90	140	32	32	24	2.0	1.5	189	271	19295	27625	31.7	0.42	1.43	0.79	32018	1.790
90	140	32	32	24	2.0	1.5	189	271	19295	27625	31.7	0.42	1.43	0.79	32018XXA	1.763
90	150	45	45	35	2.5	2.0	254	420	25900	42827	48.5	0.39	1.54	0.85	33118	3.130
90	160	42.5	40	34	3.0	3.0	302	396	30803	40316	45.2	0.42	1.43	0.79	32218	3.439
90	190	46.5	43	36	4.0	3.0	376	405	38328	41319	44.40	0.34	1.76	0.97	TS230318XA	5.634
90	190	67.5	64	53	4.0	3.0	557	677	56742	69011	74.6	0.35	1.71	0.94	32318	8.780
95	200	49	45	32	4.0	3.0	292	355	29766	36188	38.5	0.82	0.73	0.40	31319	6.950
95	145	39	39	32.5	2.5	2.5	246	365	25049	37238	42.2	0.28	2.14	1.18	33019 (33019F)	2.277
95	170	34.5	32	27	3.0	2.5	242	318	24686	32395	35.6	0.42	1.43	0.79	30219	3.040

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Approx.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
95	170	45.5	43	37	3.0	2.5	353	445	35963	45362	49.9	0.42	1.43	0.79	32219	4.240
95	170	45.5	43	37	3.5	3.5	335	418	34136	42582	46.9	0.42	1.43	0.79	32219X1XA	4.129
95	200	49.5	45	38	4.0	3.0	369	478	37615	48726	51.9	0.34	1.76	0.97	30319	6.800
95	200	71.5	67	55	4.0	3.0	571	669	58158	68236	72.6	0.35	1.74	0.96	32319	9.669
100	215	77.5	73	60	4.0	3.0	580	861	59123	87768	91.6	0.34	1.76	0.97	32320	12.700
100	150	32	32	24	2.0	1.5	193	286	19626	29154	32.6	0.46	1.31	0.72	32020XF	1.904
100	150	32	32	24	2.5	3.0	193	287	19660	29225	32.7	0.46	1.31	0.72	32020X	1.912
100	150	39	39	32.5	2.0	1.5	251	390	25574	39755	44.6	0.29	2.09	1.15	33020	2.370
100	155	36	35	28	3.0	2.5	216	312	22030	31824	35.4	0.47	1.28	0.70	JM720249/10F	2.343
100	180	37	34	29	3.0	2.5	289	335	29501	34159	36.9	0.42	1.43	0.79	30220	3.780
100	180	49	46	39.0	3.0	2.5	372	460	37882	46891	50.7	0.42	1.43	0.79	32220	4.924
105	225	81.5	77	63	4.0	3.0	659	911	67176	92864	95.6	0.34	1.76	0.97	32321	14.500
105	160	35	35	26	2.5	2.0	205	336	20938	34230	37.6	0.44	1.36	0.75	32021	2.400
105	190	39	36	30	3.0	25.0	317	382	323430	38942	41.4	0.42	1.43	0.79	30221F	4.377
105	190	53	50	43	3.0	2.5	381	579	38838	59021	62.8	0.42	1.43	0.79	32221	6.300
110	200	41	38	32	3.0	2.5	327	440	33333	44852	47.0	0.42	1.43	0.79	30222	5.210
110	200	56	53	46	3.0	2.5	492	642	50120	65443	68.7	0.42	1.43	0.79	32222	7.430
110	240	54.5	50	42	4.0	3.0	430	580	43833	59123	59.9	0.34	1.76	0.97	30322	11.100

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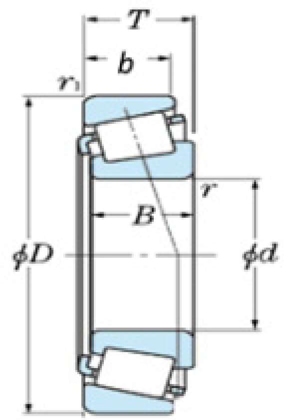
Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

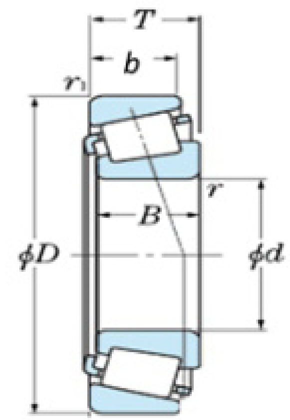
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
110	240	63	57	38	4.0	3.0	425	590	43323	60143	60.8	0.82	0.73	0.40	31322	12.500
110	240	84.5	80	65	4.0	3.0	816	1132	83140	115392	116.7	0.34	1.76	0.97	32322	18.000
110	170	47	47	37	2.5	2.0	323	500	32881	50968	55.1	0.29	2.07	1.14	33022	3.800
110	170	38	38	29	2.5	2.0	259	381	26434	38836	41.9	0.43	1.40	0.77	32022XF	3.000
110	170	38	38	29	2.5	2.0	266	381	27142	38836	41.9	0.43	1.40	0.77	ASTB32022X	3.003
120	215	61.5	58	50	3.0	2.5	557	751	56743	76555	78.5	0.44	1.36	0.75	32224	9.260
120	180	38	38	29	2.5	2.0	274	420	27971	42813	45.3	0.46	1.30	0.72	32024	3.250
120	260	59.5	55	46	4.0	3.0	589	746	60041	76045	75.0	0.34	1.76	0.97	30324	14.200
120	260	68	62	42	4.0	3.0	533	676	54332	68909	68.0	0.82	0.73	0.40	31324	15.200
120	260	90.5	86	69	4.0	3.0	864	1230	88073	125382	123.7	0.34	1.76	0.97	32324	15.200
120	215	43.5	40	34	3.0	2.5	345	470	35204	47959	49.1	0.44	1.36	0.75	30224	6.500
130	230	67.75	64	54	4.0	3.0	594	820	60510	83588	83.8	0.44	1.36	0.75	32226	11.500
130	280	98.75	93	78	5.0	4.0	895	1263	91233	128746	124.2	0.34	1.76	0.97	32326	27.600
140	250	71.75	68	58	4.0	3.0	610	980	62181	99898	97.8	0.44	1.36	0.75	32228	14.700
140	210	45	45	34	2.5	2.0	373	589	38068	60122	60.7	0.46	1.30	0.72	32028XF	5.280
150	225	48	48	36	3.0	2.5	365	670	37207	68298	67.7	0.46	1.30	0.72	32030	6.400
150	270	77	73	60	4.0	3.0	700	1130	71428	115306	110.3	0.43	1.40	0.77	32230	18.400

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

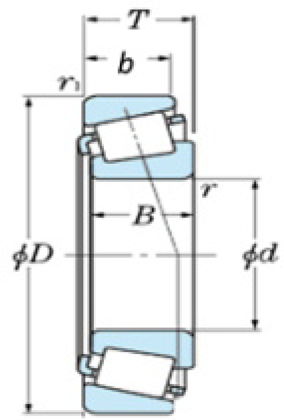
$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_o		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
160	240	51	51	38	3.0	2.5	415	730	42304	74414	72.3	0.46	1.30	0.72	32032	7.700
160	375	86.55	79.4	50	4.7	4.7	880	1090	89704	111111	98.9	0.66	0.91	0.50	7832	39.400
160	290	84	80	67	4.0	3.0	897	1430	91437	145770	136.7	0.43	1.40	0.77	32232	23.400
170	260	57	57	43	3.0	2.5	519	920	52905	93782	89.2	0.44	1.36	0.75	32034	10.600
170	260	57	57	43	3.0	2.5	519	920	52905	93782	89.2	0.44	1.36	0.75	32034X	10.600
170	360	127	120	100	5.0	4.0	1430	2120	145918	216326	193.0	0.36	1.67	0.92	32334	57.900
170	230	38	38	30	2.0	2.5	286	590	29183	60204	58.4	0.38	1.58	0.87	32934	4.500
170	230	39	38	31	3.1	2.5	335	590	34159	60161	58.4	0.38	1.58	0.87	JHM534149/110	4.510
170	310	57	52	43	5.0	4.0	654	859	66698	87594	80.0	0.43	1.40	0.77	30234	16.86
180	320	91	86	71	5.0	4.0	950	1650	96840	168196	152.9	0.46	1.30	0.72	32236	29.800
190	290	64	64	48	3.0	2.5	655	1210	66769	123344	113.5	0.44	1.36	0.75	32038X	14.700
190	340	97	92	75	5.0	4.0	1150	1850	117227	188583	168.4	0.43	1.40	0.77	32238	35.200
200	360	104	98	82	5.0	4.0	1300	2200	132558	224330	197.0	0.41	1.46	0.80	32240	43.2
220	340	76.5	66.675	62	4.0	4.0	987	1436	100616	146432	129.0	0.35	1.71	0.94	2007144	22.300
220	340	76	76	57	4.0	3.0	1044	1652	106479	168427	148.0	0.43	1.40	0.77	4TB32044X	24.305
220	400	72	65	54	5.0	4.0	1000	1460	101968	148873	126.8	0.43	1.40	0.77	7244(30244)	35.200
240	320	51	48	41	3.0	2.5	470	990	47910	100917	88.6	0.46	1.30	0.72	32948	11.000

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = 0.5F_r + Y_oF_a$

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

For values of e, Y2 and Yo see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constent	Axial Load Factor		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static						
mm							KN		Kgf		KN	e	Y_2	Y_0		
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
240	360	76	72	62	4.0	3.0	900	1750	91743	178389	153.5	0.46	1.30	0.72	32048	27.300
255	560	123.05	104.8	70	6.0	6.0	1780	2490	181632	254081	199.2	0.87	0.69	0.38	30651	120.000
260	360	64.5	60	52	3.5	3.5	800	1323	81543	134883	114.9	0.37	1.62	0.89	2007952	17.700
280	420	87	82	71	5.0	4.0	1110	2040	113265	208163	170.8	0.37	1.62	0.89	2007156	39.300
300	460	100.7	95	82	5.0	5.0	1699	2608	173205	265943	213.0	0.31	1.94	1.06	2007160	55.900
300	460	100	100	74	5.0	4.0	1484	2980	151428	304081	243.5	0.43	1.40	0.77	32060	58.000
320	480	100	100	74	5.0	4.0	1520	2940	155102	300000	236.5	0.42	1.43	0.79	32064	59.000
320	670	210	200	170	7.5	7.5	4570	8040	466326	820408	606.8	0.37	1.62	0.89	32364	331.200
500	670	85	78	60	6.0	5.0	1470	3100	149893	316101	222.5	0.43	1.40	0.77	10079/500	74.100

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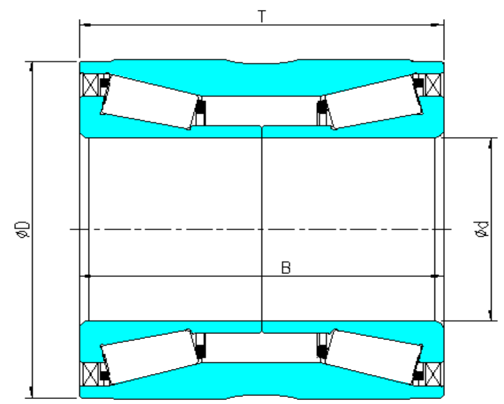
Unitized Taper Roller Bearing (Metric Series)



Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

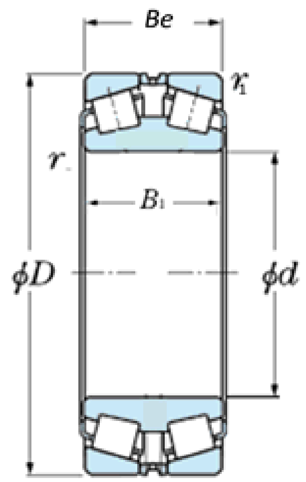
static

$P_{or} = F_r + Y_oF_a$

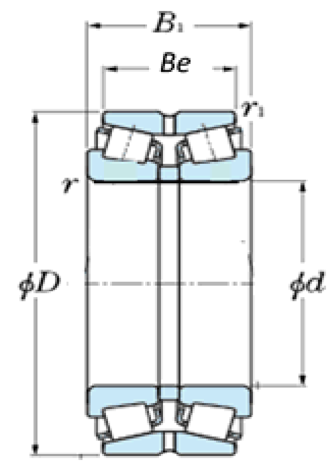
For values of e, Y_2 and Y_o see the table below.

Boundary Dimension				Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static						
mm				KN		Kgf		KN					
d	D	T	B	Cr	Cor	Cr	Cor	Cu	e	Y_2	Y_0		
40	73	55	55	99.6	158.4	10156	16152	19.3	0.39	1.55	0.85	TS2N1331XAT2XLLX	0.992
49	84	48	48	118.5	186.5	12084	19018	22.7	0.38	1.58	0.9	N1501XAT2XLLX	1.05
49	84	48	48.185	124	219.1	12645	22342	26.7	0.33	1.82	1	N1293XAT2XLLX	1.15
55	90	60	60	137.9	234.9	14062	23953	26.7	0.41	1.48	0.81	N1758XAT2XLLX	1.41
68	127	115	115	365.6	581.4	37281	59287	70.9	0.41	1.47	0.81	N1496XAT2XLLX	6.034
70	130	130	130.00	361.9	600.3	36904	61214	73.1	0.41	1.47	0.81	N1615XAT2XLLX	7.09
82	140	115	115.31	379	574	38647	58532	34.1	0.4	1.49	0.82	N1764XAT2XLLX	6.57
90	160	125	125	453.7	831.9	46265	84831	98.5	0.4	1.49	0.82	N1495XAT2XLLX	10.34
100	165	140	140.386	486.5	929	49609	94732	104.1	0.4	1.49	0.82	N1612XAT2XLLX	10.866

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimension (mm)						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static		e	y_1	y_2	y_0			
mm						KN		Kgf		KN							
d	D	Bi	Be	r	r	Cr	Cor	Cr	Cor	Cu							
101.6	146.05	49.212	39.688	1.5	0.8	182	331	18571	33775	38	0.39	1.73	2.58	1.69	L521945/L521910D	TDI	2.430
101.6	200.025	115.888	80.216	3.6	2.4	591	936	60245	95413	101	0.63	1.07	1.60	1.05	98400/98789D	TDO	15.000
105	190	117.25	96	3.0	1.1	610	1100	62181	112131	119	0.42	1.61	2.39	1.57	97521	TDO	14.000
109.987	159.987	74.612	58.738	3.6	0.8	318	642	32426	65463	72	0.40	1.69	2.51	1.65	LM522549/LM522510D	TDO	4.600
120	260	136	124	1.5	3.0	1050	1426	107142	145510	143	0.82	0.82	1.23	0.80	31324DF	TDI	30.200
120.65	174.625	77.788	61.913	3.6	0.8	359	728	36607	74233	79	0.33	2.05	3.05	2.00	M224749/M224710D	TDO	5.710
127	196.85	101.6	85.725	3.5	0.8	550	1150	56122	11734	121	0.34	1.99	2.96	1.94	67388/67322D	TDO	11.000
127	234.95	142.875	114.3	3.5	1.5	897	1654	91465	168655	169	0.37	1.82	2.72	1.78	NA95500/95927CD	TDO	27.300
127.792	228.6	115.888	84.138	3.5	2.3	570	1200	58104	122324	123	0.73	0.92	1.38	0.90	HM926749/HM926710D	TDI	19.000
130	230	150	120	4.0	2.0	1087	1645	110780	167686	168	0.42	1.61	2.39	1.57	97526	TDO	25.300
133.35	196.85	92.075	92.075	3.3	1.5	550	1200	56065	122324	126	0.34	1.99	2.96	1.94	67390D/67322	TDI	9.500
133.35	199.949	101.6	85.725	3.5	0.8	540	1138	55063	116040	119	0.34	1.99	2.96	1.94	67390/67326D	TDO	10.530
140	300	140	154	1.5	4.0	1200	1830	122324	186544	176	0.82	0.82	1.23	0.80	31328X/DF	TDI	51.500
149.225	236.538	131.76	106.362	3.5	1.5	815	1540	83107	157037	154	0.32	2.11	3.14	2.06	HM231149/HM231111CD	TDO	20.1
150	250	137.25	112	2.5	1.0	785	1560	80020	159021	155	0.25	2.70	4.02	2.64	2097730	TDI	25.800
150	270	172	138	4.0	1.5	1554	2388	158362	243425	233	0.42	1.61	2.39	1.57	97530	TDO	39.100
150	320	164	150	1.5	4.0	1360	2250	138775	229591	212	0.82	0.82	1.23	0.80	31330XDF	TDI	58.500

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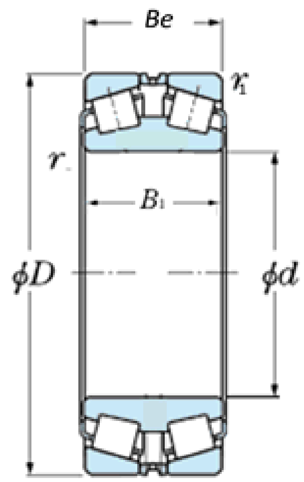
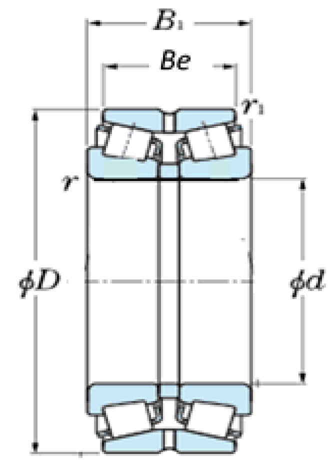
Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimension (mm)						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static		e	y_1	y_2	y_0			
mm						KN		Kgf		KN							
d	D	Bi	Be	r	r	Cr	Cor	Cr	Cor	Cu							
152.4	254	142.876	111.125	7.9	3.5	996	1930	101529	196738	190	0.41	1.65	2.45	1.61	NA99600/99102CD	TDO	27.300
159.95	244.48	107.95	79.37	3.5	1.5	665	1049	67781	106969	104	0.35	1.93	2.87	1.89	81630/81963D	TDO	18.180
160	270	150	120	2.5	1.0	1070	1890	109072	192661	183	0.32	2.11	3.14	2.06	2097732	TDI	27.200
165.1	288.925	142.875	111.125	1.5	7.0	1352	2175	137907	221789	207	0.32	2.11	3.14	2.06	HM237535/HM237510D	TDO	36.500
170	260	114	114	1.0	2.5	1050	1915	107142	195408	186	0.44	1.53	2.28	1.50	32034XDF	TDI	21.000
177.8	279.4	133.353	96.838	3.3	1.6	863	1872	87971	190826	178	0.53	1.27	1.90	1.25	82680X/82620D	TDO	29.000
177.8	288.925	123.825	123.825	1.5	3.3	1090	1980	111111	201835	176	0.32	2.11	3.14	2.06	HM237546D/HM237510	TDI	31.000
180	280	128	128	1.0	2.5	1100	2320	112130	236493	220	0.42	1.61	2.39	1.57	32036X/DF	TDI	29.500
180	300	163.25	134	3.0	1.0	1543	2496	157373	254522	234	0.26	2.60	3.87	2.54	2097736	TDO	43.500
180	280	133.25	108	3.0	1.0	1064	1929	108473	196704	183	0.29	2.33	3.47	2.28	2097136	TDO	29.000
190.5	266.7	103.188	84.138	3.5	0.8	625	1540	63730	157031	147	0.48	1.41	2.09	1.38	67885/67820D	TDO	16.900
190.5	368.3	158.75	152.4	3.3	3.3	1690	3200	172448	326530	287	0.40	1.69	2.51	1.65	EE420750D/EE421450	TDI	77.900
190.5	368.3	193.675	136.525	6.4	1.5	1800	3300	183542	336494	296	0.40	1.69	2.51	1.65	EE420751/421451	TDO	87.000
200	310	151	123	3.0	1.0	1144	2080	116641	212029	192	0.37	1.82	2.72	1.78	2097140	TDI	38.300
200	340	183	150	4.0	1.5	1808	3062	184345	312238	277	0.24	2.81	4.19	2.75	2097740	TDO	65.500

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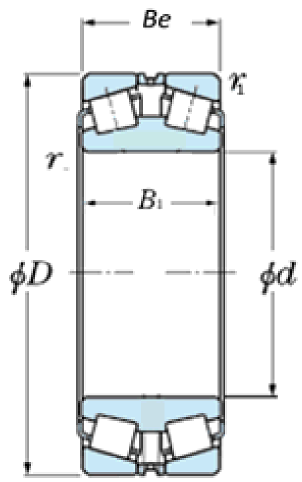
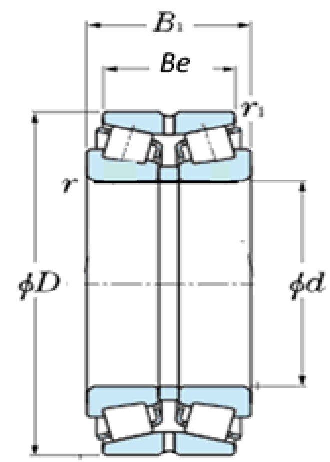
Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

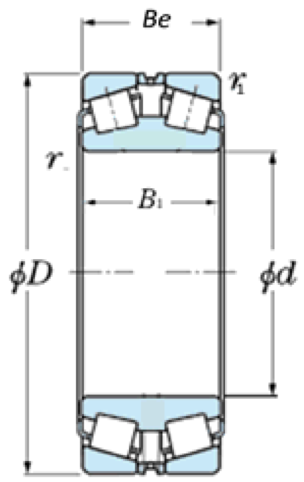
static

$P_{or} = F_r + Y_o F_a$

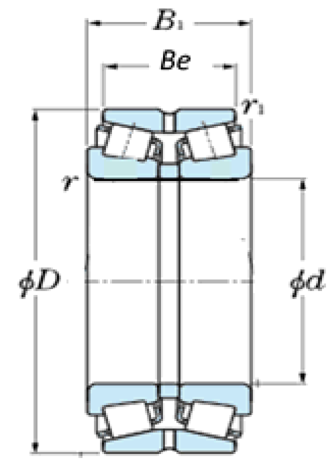
For values of e, Y_2 and Y_o see the table below.

Boundary Dimension (mm)						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static								
mm						KN		Kgf		KN							
d	D	Bi	Be	r	r	Cr	Cor	Cr	Cor	Cu	e	y_1	y_2	y_0			
200.025	317.5	146.05	111.125	4.3	1.5	1257	2337	128174	238299	214	0.52	1.30	1.93	1.27	93787/93127CD	TDO	40.800
203.2	276.225	95.25	73.025	3.5	0.8	706	1467	71989	149587	138	0.32	2.11	3.14	2.06	LM241149NW/LM241110D	TDO	15.6
206.375	336.55	184.15	180.975	3.3	1.5	2205	4092	224802	417269	370	0.33	2.05	3.05	2.00	H242649D/H242610	TDI	63.750
209.55	317.5	146.05	111.125	4.3	15	1060	2310	108090	235555	211	0.52	1.2981	1.93	1.27	93825/93127D	TDO	38.1
220	340	163	130	4.0	1.5	1691	2873	172384	292966	257	0.35	1.93	2.87	1.89	2097144	TDO	49.300
220.662	314.325	131.762	106.362	6.4	1.5	1070	2450	109183	250000	222	0.33	2.05	3.05	2.00	M244249/M244210D	TDO	30.600
228.46	431.8	184.15	184.15	6.4	6.4	1687	2484	172032	253298	212	0.88	0.77	1.14	0.75	EE113091/EE113170	TDI	108.400
228.46	355.6	158.751	117.475	6.8	0.8	1200	2500	122362	254920	221	0.33	2.05	3.05	2.00	EE130902/131402D	TDO	52.300
234.95	384.175	238.125	193.675	6.4	1.5	2500	5450	255102	556122	474	0.33	2.05	3.05	2.00	H247549/H247510D	TDO	105.000
240	320	109	90	3.0	1.1	794	1610	80886	164118	144	0.36	1.88	2.79	1.83	2097948	TDI	22.000
240	360	165	130	4.0	1.0	1360	2940	138634	299694	258	0.31	2.18	3.24	2.13	2097148	TDI	46.000
240	400	209	168	5.0	2.0	2151	4050	219215	412844	348	0.36	1.88	2.79	1.83	2097748	TD1	98.500
241.3	327.025	185.224	217.466	3.3	2.0	765	1740	77982	177370	155	0.41	1.65	2.45	1.61	8578/8520DF	TDI	54.000
247.65	406.4	234.95	231.776	1.5	6.4	3181	6303	324363	642730	539	0.82	0.82	1.23	0.80	HH249949D/HH249910	TDO	98.000
247.65	406.4	247.65	206.2	1.5	6.4	2680	5800	273191	591233	496	0.33	2.05	3.05	2.00	NP985601/NP490062	TDO	122.000
260	360	133	109	3.5	1.2	1380	2652	140673	270336	230	0.37	1.82	2.72	1.78	2097952	TDO	36.800

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

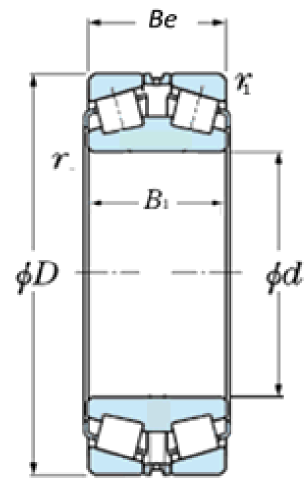
static

$P_{or} = F_r + Y_o F_a$

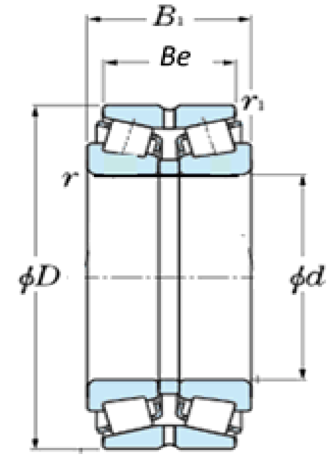
For values of e, Y_2 and Y_o see the table below.

Boundary Dimension (mm)						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type	Mass Kg. (Approx.)
						Dynamic	Static	Dynamic	Static		e	Y_1	Y_2	Y_0			
mm						KN		Kgf		KN							
d	D	Bi	Be	r	r	Cr	Cor	Cr	Cor	Cu							
260	400	185	146	1.3	3.7	1760	3790	179409	386341	323	0.29	2.33	3.47	2.28	2097152	TDO	74.300
260	420	170	170	5.0	5.0	2392	4047	243786	412559	342	0.40	1.69	2.51	1.65	47752	TDI	88.500
260	440	225	180	4.0	1.3	2440	4750	248726	484200	398	0.24	2.81	4.19	2.75	2097752	TDI	124.000
279.4	457.2	244.475	244.475	1.5	6.4	4793	8838	408326	785286	729	0.33	2.05	3.05	2.00	HH255149D/HH255110	TDI	163.600
280	420	188	154	5.0	2.0	1910	4080	194897	416326	342	0.37	1.82	2.72	1.78	2097156	TDO	85.000
300	420	160	128	4.0	1.0	1973	3947	201232	402483	328	0.36	1.88	2.79	1.83	2097960	TDO	62.900
300	500	204	152	1.8	4.7	2510	4910	255861	500510	395	0.32	2.11	3.14	2.06	1097760	TDO	148.000
300	440	105	105	4.0	4.0	980	2050	99929	209034	169	0.88	0.77	1.14	0.75	370660D	TDO	55.500
303.213	495.3	263.525	263.525	6.4	3.3	4180	9420	426226	960538	758	0.33	2.05	3.05	2.00	HH258249DW/HH258210	TDI	220.000
304.8	438.048	152.4	153.984	4.8	1.5	1450	3400	147808	346585	280	0.42	1.61	2.39	1.57	EE129120X/EE129172DF	TDO	71.000
305	510	200	200	5.0	5.0	1650	6000	168196	611621	480	0.74	0.91	1.36	0.89	N1326	TDI	163.000
305	510	200	200	5.0	5.0	2596	4620	264673	471111	371	0.76	0.89	1.32	0.87	N1883	TDI	152.27
305.08	500	200	200	5.0	4.0	2620	4830	267136	492525	388	0.87	0.78	1.16	0.76	N1021	TDI	154.600
305.08	500	200	200	5.0	5.0	2620	4830	267136	492525	388	0.87	0.78	1.16	0.76	N1021M	TDI	154.600
320	620	250	282.75	6.0	2.5	4285	6360	436940	648542	488	0.73	0.92	1.38	0.90	N1051	TDI	400.000
333.375	469.9	109.5	152.4	6.4	1.5	2320	5500	236734	561224	442	0.33	2.05	3.05	2.00	HM261049/HM261010D	TDO	97.000

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

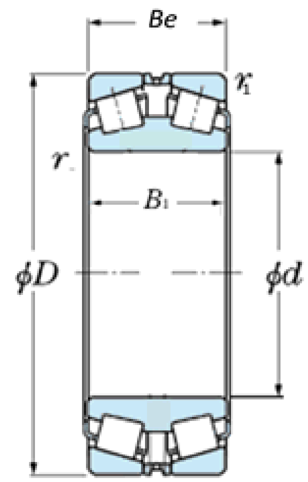
static

$P_{or} = F_r + Y_o F_a$

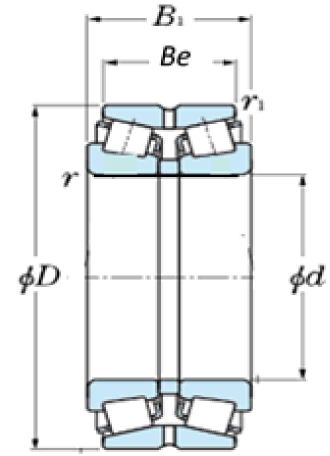
For values of e, Y_2 and Y_o see the table below.

Boundary Dimension (mm)						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static								
mm						KN		Kgf		KN							
d	D	Bi	Be	r	r	Cr	Cor	Cr	Cor	Cu	e	Y_1	Y_2	Y_0			
340	460	159	128	4.0	1.0	1986	4087	202521	416759.6	329	0.36	1.88	2.79	1.83	2097968	TDO	71.000
340	580	241	170	1.8	5.0	3200	6080	326530	620408	469	0.42	1.61	2.39	1.57	1097768	TDO	235.000
360	480	159	128	4.0	1.0	1760	4380	179591	446938	347	0.32	2.11	3.14	2.06	2097972	TDO	73.700
379	681.5	307	307	6.0	6.0	7449	14402	759544	1468601	1065	0.40	1.69	2.51	1.65	N1208	TDI	522.550
380	620	240	170	6.0	2.5	4031	7026	411024	716455.3	529	0.46	1.47	2.18	1.43	1097776	TDO	250.000
384.18	546.1	222.25	177.8	6.4	1.6	3696	8234	376899	839637.4	633	0.33	2.05	3.05	2.00	HM266449/HM266410D	TDO	165.000
390	590	200	200	2.5	7.0	3121	6915	318265	705136.4	524	0.73	0.92	1.38	0.90	JM966747DW/JM966718W	TDI	190.157
400	650	240	240	6.0	6.0	3951	7487	402932	763464	551	0.87	0.78	1.16	0.76	N1885	TDI	297.9
400	701.5	380	380	3.0	6.0	7919	15339	807506	1564149	1121	0.50	1.35	2.01	1.32	N1129	TDI	633.100
440	650	211	152	6.0	2.5	2860	6900	291836	704081	506	0.46	1.47	2.18	1.43	97188	TDO	212.000
457.2	596.9	165.1	120.65	9.7	1.5	2080	5462	212093	556949	405	0.40	1.69	2.51	1.65	EE244180/244236D	TDO	109.000
480	650	179	130	6.0	2.5	2589	5510	263868	561672	400	0.42	1.61	2.39	1.57	1097996	TDO	151.000
482.6	615.95	184.15	146.05	6.4	1.5	2850	8150	290609	831039	596	0.33	2.05	3.05	2.00	LM272249/LM272210D	TDO	129.000
488.95	634.873	180.975	136.525	6.4	1.5	2700	7800	275314	795350	567	0.47	1.44	2.14	1.40	LM772748/LM772710D	TDO	135.000
488.95	660.4	206.38	158.75	6.4	1.5	3500	9100	356779	927625	656	0.31	2.18	3.24	2.13	EE640192/EE640261CD	TDO	200.000
510	800	285	285	6.0	6.0	6586	13408	671593	1367241	930	0.87	0.78	1.16	0.76	N1219	TDI	518.335

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimension (mm)						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type	Mass Kg. (Approx.)
						Dynamic	Static	Dynamic	Static		e	Y_1	Y_2	Y_0			
mm						KN		Kgf		KN							
d	D	Bi	Be	r	r	Cr	Cor	Cr	Cor	Cu							
530	710	190	136	5.0	1.5	2780	6720	283673	685714	468	0.40	1.69	2.51	1.65	10979/530	TDO	182.000
558.8	736.6	225.425	177.8	6.4	1.5	4120	11380	420108	1160396	792	0.40	1.69	2.51	1.65	LM377449/LM377410CD	TDO	239.000
558.8	736.6	225.425	177.8	6.4	1.5	4120	11380	420108	1160396	792	0.35	1.93	2.87	1.89	LM377449/LM377410D	TDO	248.00
558.8	736.5	165.1	114.3	6.4	3.3	2300	6220	234526	634241	433	0.51	1.32	1.97	1.29	EE542220/542291D	TDO	171.000
560	750	213	156	6.0	2.5	3633	8049	370449	820772.6	559	0.34	1.99	2.96	1.94	10979/560	TDO	235.000
560	820	242	242	8.0	11.0	5031	11505	513047	1173188	786	0.83	0.81	1.21	0.80	8471/560	TDI	427.000
600	800	210	160	6.0	2.5	3982	9822	406098	1001569	668	0.37	1.82	2.72	1.78	10979/600	TDO	242.000
630	850	242	182	6.0	2.5	4050	11100	412987	1131889	743	0.38	1.78	2.64	1.74	10979/630	TDO	359
635	939.8	304.8	304.8	3.3	6.4	8206	17645	836823	1799296	1156	0.57	1.18	1.76	1.16	LM881245DW/14	TDI	733.43
710	950	240	175	6.0	2.5	5495	12374	560306	1261802	800	0.46	1.47	2.18	1.43	10979/710	TDO	440.000
850	1120	268	188	6.0	2.5	6860	18700	700000	1908163	1148	0.46	1.47	2.18	1.43	10979/850	TDO	647.000

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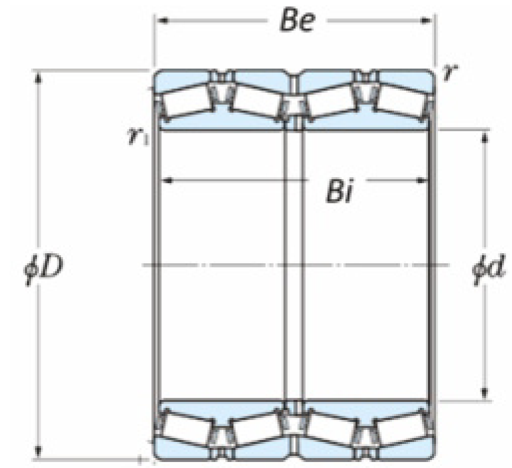
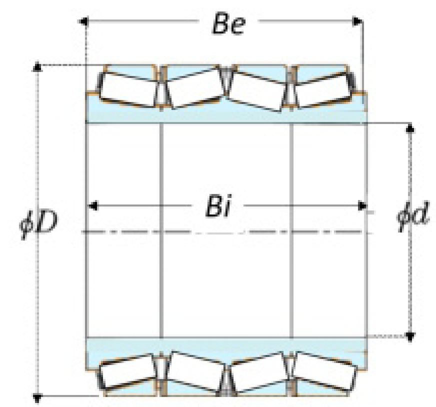
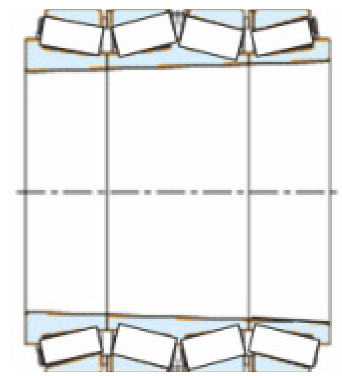
Four Row Taper Roller Bearing



TQO(X- Arrangement)



TQI (O- Arrangement with Straight bore)



TQIT (O- Arrangement with tapered bore)

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type*	Mass Kg. (Apporox.)
mm							Dynamic	Static	Dynamic	Static								
							KN		Kgf		KN							
d	D	C	Be	Bi	r_1	r	Cr	Cor	Cr	Cor	Cu	e	Y_1	Y_2	Y_0			
60.325	100	106.362	106.362	106.362	0.8	3.3	286	559	29163	57000	68	0.43	1.57	2.34	28985D/28921/29921D	TQO	3.30
127	182.53	158.75	158.75	158.750	3.3	3.3	765	1758	77983	179267	188	0.31	2.18	3.24	48290DGW/20/20D	TDI	13.800
136.53	190.5	161.925	161.925	161.925	1.6	3.3	807	1890	82346	192857	199	0.32	2.11	3.14	48393DW/20/20D	TQI	14.000
177.8	247.65	192.088	192.088	192.088	1.5	3.2	1156	2765	117854	281952.58	269	0.44	1.53	2.28	67790DW/20/21D	TQO	28.130
180.84	284.16	101.6	239.715	239.715	3.3	1.5	1727	3959	176136	403707.148	375	0.33	2.05	3.05	M240631T/44TD/47T/44D	TQIT	60.000
187.33	269.88	211.138	211.138	211.138	3.3	1.5	1540	3484	157022	355270	332	0.33	2.05	3.05	M238849D/10/10D	TQO	41.800
190.5	266.7	188.912	187.325	187.325	1.5	3.3	1313	3185	133884	324768	303	0.48	1.41	2.09	67885DW/20/20D	TQO	33.400
200	340	305	305	305.000	4.0	4.0	2899	5746	295632	585931.112	515	0.35	1.93	2.87	2077144	TQO	104.000
206.38	282.58	190.5	190.5	190.500	3.3	3.3	1224	3140	124773	320192	293	0.51	1.32	1.97	67985DW/20/21D	TDI	36.500
215.9	288.93	177.8	177.8	177.800	0.8	3.3	1400	3600	142712	366972	334	0.43	1.57	2.34	LM742749DW/14/14D	TDI	32.000
220.66	314.33	239.713	239.713	239.713	1.5	3.3	1984	4548	202287	463769	413	0.33	2.05	3.05	M244249D/10/10D	TDI	60.400
228.6	311.15	200.025	200.025	95.25	1.5	3.3	1440	3800	146840	387494	344	0.33	2.05	3.05	LM245149DW/10/10D	TDI	43.9
241.48	349.18	228.6	228.6	228.600	1.5	3.3	2080	4920	212093	501682	434	0.36	1.88	2.79	EE127097D/135/136D	TQO	71.000
244.48	327.03	193.675	193.675	193.675	1.5	3.3	1743	4124	177778	420533	367	0.32	2.11	3.14	LM247748DGW/10/10D	TDI	43.590
246.33	381	301.625	301.625	301.625	6.4	1.5	3160	7678	322252	782941	665	0.33	2.05	3.05	M252330T/45TD/49T/10DM	TQIT	111.000

Type*:
TQO: Two double cones, one cone spacer, two single cups, two cup spacers, one double cup
TQI:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with straight bore.
TQIT:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with tapered bore.
TDI: 2sets of double row taper roller bearings of TDI configuration separated by spacer between insides two cups and two cones.

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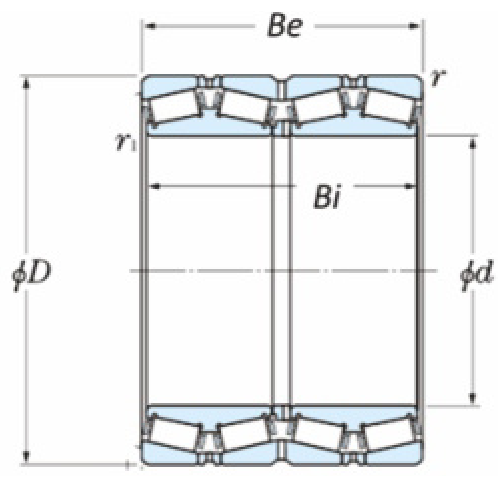
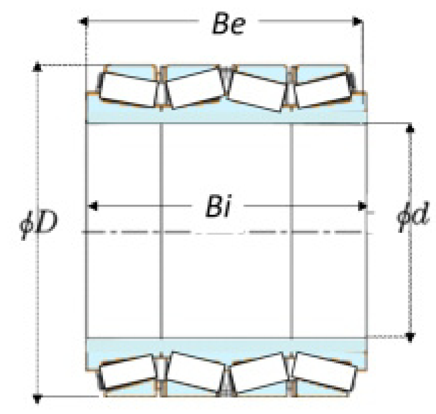
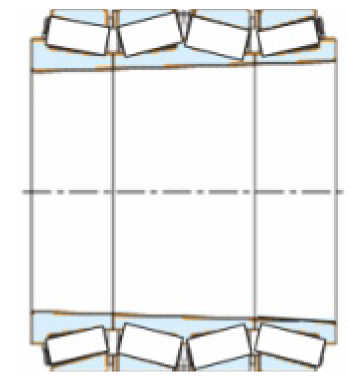
Four Row Taper Roller Bearing



TQO(X- Arrangement)



TQI (O- Arrangement with Straight bore)



TQIT (O- Arrangement with tapered bore)

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type*	Mass Kg. (Apporox.)
mm							Dynamic	Static	Dynamic	Static								
							KN		Kgf		KN							
d	D	C	Be	Bi	r_1	r	Cr	Cor	Cr	Cor	Cu	e	Y_1	Y_2	Y_0			
254	358.78	269.875	269.875	269.875	3.3	3.3	3200	7100	326198		723751	619	0.33	2.05	3.05	M249748D/10/10D	TDI	86.000
260	440	128	330	330.000	5.0	1.5	3816	7748	389095		790079.056	649	0.30	2.25	3.35	477752	TQIT	196.000
266.7	355.6	228.6	230.19	230.190	1.6	3.2	2056	5134	209675		523524.248	445	0.36	1.88	2.79	LM451349DW/10/10D	TQO	65.500
269.88	381	282.575	282.575	282.575	4.0	4.0	3048	7328	310760		747251	627	0.33	2.05	3.05	M252349D/10/10D	TDI	96.590
279.4	393.7	269.875	269.875	269.875	1.5	6.4	2340	6560	238775		669387	556	0.38	1.78	2.64	EE135111DW/55/56D	TQO	103.000
279.58	380.9	244.48	244.48	244.480	1.5	3.2	2297	6008	234184		612647.776	512	0.43	1.57	2.34	LM654644DW/10/10D	TQO	81.670
280	460	324	324	324.000	3.0	6.0	3853	8350	392711		851172	685	0.46	1.47	2.18	1077756	TQO	220.000
280.27	379.89	244.48	244.48	244.480	1.5	3.2	2297	6008	234184		612647.776	512	0.43	1.57	2.34	N1028	TQO	79.200
285.75	380.9	244.48	244.48	244.480	1.5	3.2	2297	6008	234184		612647.776	511	0.43	1.57	2.34	LM654648DW/10/10D	TQO	76.420
288.93	406.4	298.45	298.45	298.450	3.3	3.3	3598	8942	366931		911834	750	0.33	2.05	3.05	M255449D/10/10D	TQO	125.000
300	460	390	390	390.000	5.0	5.0	4994	10435	509294		1064078	853	0.31	2.18	3.24	2077160	TDI	238.000
304.648	438.048	279.400	279.40	280.990	3.3	4.8	3126	6901	318734		703709	568	0.47	1.44	2.14	M757448DW/10/10D	TQO	130
317.5	422.28	269.875	269.875	269.875	1.5	3.3	3360	8150	342857		831632	671	0.32	2.11	3.14	LM258648DGW/10/10D	TQO	105.000
317.5	447.68	327.025	327.025	327.025	3.3	3.3	4298	10676	438258		1088610	871	0.33	2.05	3.05	HM259049DGW/10/10D	TQO	166.000
343.05	457.1	254	254	254.000	1.6	3.2	2757	6779	281091		691268	545	0.47	1.44	2.14	LM761649DW/10/10D	TQO	110.000
355.6	482.6	269.875	265.112	265.112	1.5	3.3	3245	7768	330930		792118	616	0.47	1.44	2.14	LM763449DW/10/10D	TQO	134.000
355.6	488.95	317.5	317.5	317.500	1.5	3.3	3500	10500	356779		1070336	831	0.33	2.05	3.05	M263349DW/10/10D	TQO	177.000

Type*:
TQO: Two double cones, one cone spacer, two single cups, two cup spacers, one double cup
TQI:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with straight bore.
TQIT:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with tapered bore.
TDI: 2sets of double row taper roller bearings of TDI configuration separated by spacer between insides two cups and two cones.

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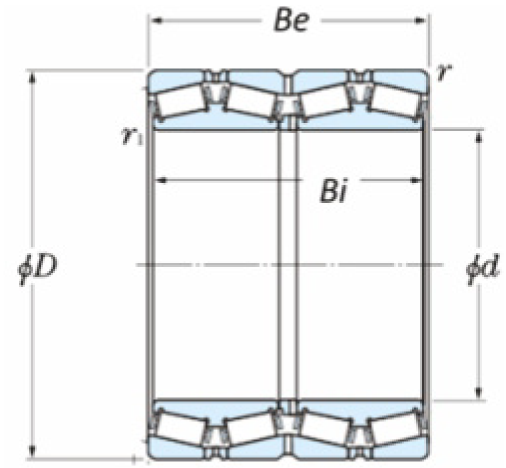
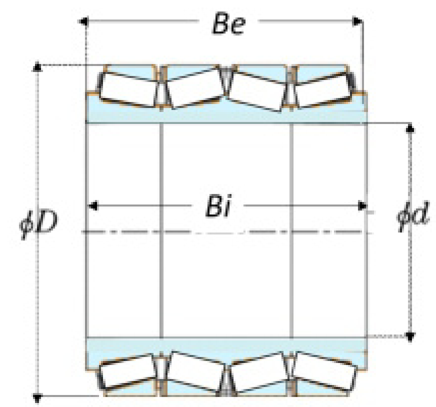
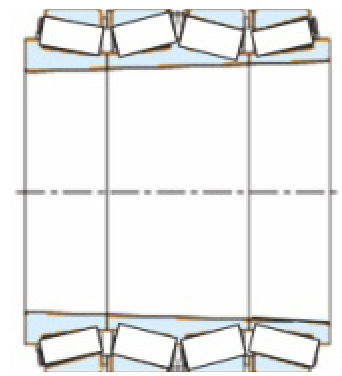
Four Row Taper Roller Bearing



TQO(X- Arrangement)



TQI (O- Arrangement with Straight bore)



TQIT (O- Arrangement with tapered bore)

Boundary Dimension mm							Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type*	Mass Kg. (Apporox.)
							Dynamic KN	Static KN	Dynamic Kgf	Static Kgf	KN							
d	D	C	Be	Bi	r_1	r	Cr	Cor	Cr	Cor	Cu	e	Y_1	Y_2	Y_0			
368.3	523.88	382.588	382.588	382.588	3.3	6.4	4800	14000	489297	1427115	1090	0.33	2.05	3.05	HM265049DW/10/10D	TDI	267.000
380	620	418.5	420	420.000	6.0	6.0	6910	14052	704662	1432911	1057	0.46	1.47	2.18	1077776	TDI	480.000
384.18	546.1	400.05	400.05	400.050	3.3	6.4	8165	15800	832314	1610601	1216	0.33	2.05	3.05	HM266449DW/10/10D	TDI	305.000
385.76	514.35	317.5	317.5	317.500	3.3	3.3	4248	12029	433160	1226573	934	0.42	1.61	2.39	LM665949DW/10/10D	TQO	188.000
400	530	370	370	370.000	3.0	5.0	4350	13650	443877	1392857	1050	0.40	1.69	2.51	N1325	TDI	213.000
400	530	370	370	370.000	3	5	4460	12105	454765	1234371	930	0.28	2.41	3.59	N1479	TQO	213.09
406.4	546.1	288.93	288.93	288.930	1.5	6.4	3703	10271	377602	1047354	784	0.48	1.41	2.09	LM767749DW/10/10D	TQO	185.000
431.8	571.5	336.55	336.55	336.550	1.5	6.4	4050	12900	412844	1314985	970	0.47	1.44	2.14	LM769349DW/10/10D	TQO	230.000
450	595	368	368	368.000	3.0	6.0	5835	16487	595017	1681212	1224	0.33	2.05	3.05	M270449DGW/10/10D	TDI	284.000
460	730	438.5	438.5	438.500	5.0	10.0	7294	15499	743830	1580464	1107	0.73	0.92	1.38	777792	TQO	728.000
460	625	421	421	421.000	9.5	8.0	7292	20015	743595	2040970	1470	0.33	2.05	3.05	M271149D/10/10D	TQO	377.150
475	620	380	380	380.000	3.0	5.0	6737	18014	686955	1836924	1319	0.31	2.18	3.24	JM171649DGW/10/10D	TQO	293.800
475	620	380	380	380	3	5.5	6737	18014	686955	1836924	1319	0.31	2.18	3.24	N1752	TQO	294.81
480	700	77	420	420.000	6.0	2.5	9824	18500	1001473	1885831	1315	0.37	1.82	2.72	577796	TQO	537.000
482.6	647.7	417.512	417.512	417.512	3.3	6.4	6050	19000	616718	1936799	1378	0.33	2.05	3.05	M272647DW/10/10D	TDI	398.000
488.95	660.4	361.95	365.125	365.125	8.0	6.4	6146	15975	626679	1629003	1153	0.31	2.18	3.24	EE640193DW/60/61D	TDI	358.800
489.03	634.87	320.675	320.68	320.680	3.3	3.3	5053	14344	515275	1462686	1042	0.34	1.99	2.96	EE243193DW/250/251D	TQO	270.000

Type*:
TQO: Two double cones, one cone spacer, two single cups, two cup spacers, one double cup
TQI:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with straight bore.
TQIT:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with tapered bore.
TDI: 2sets of double row taper roller bearings of TDI configuration separated by spacer between insides two cups and two cones.

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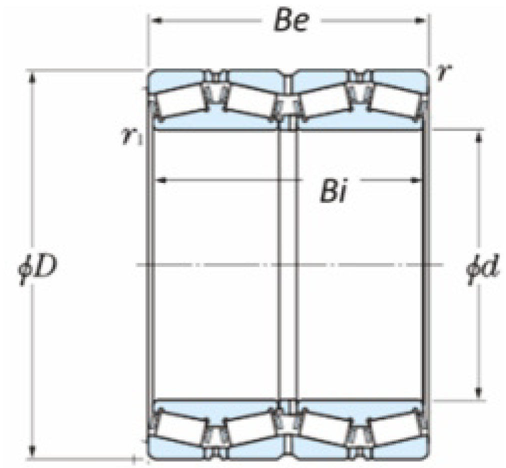
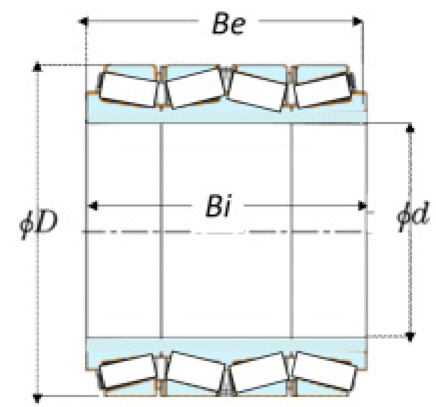
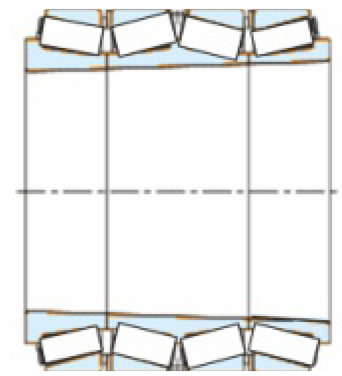
Four Row Taper Roller Bearing



TQO(X- Arrangement)



TQI (O- Arrangement with Straight bore)



TQIT (O- Arrangement with tapered bore)

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type*	Mass Kg. (Apporox.)
mm							Dynamic	Static	Dynamic	Static								
							KN		Kgf		KN							
d	D	C	Be	Bi	r_1	r	Cr	Cor	Cr	Cor	Cu	e	Y_1	Y_2	Y_0			
500	720	420	420	420.000	8.0	8.0	8005	18910	816301	1928291	1341	0.33	2.05	3.05	771/500	TQO	560.000
500	830	570	570	570.000	10.0	10.0	12639	26600	1288773	2712455	1837	0.38	1.78	2.64	10777/500	TQO	1250.000
509.946	654.924	379	379	377	1.5	6.4	5751	16547	586456	1687331	1190	0.41	1.65	2.45	N1480	TQO	310.5
558.8	736.6	322.26	322.26	322.260	3.3	6.4	6230	16098	635240	1641545	1121	0.34	1.99	2.96	EE843221D/90/91D	TQO	375.000
571.5	812.8	593.725	593.725	593.725	3.3	6.4	11800	33800	1202854	3445464	2305	0.33	2.05	3.05	M278749DGW/10/10D	TDI	1012.000
600	800	365	365	365.000	5.0	5.0	6829	19643	696336	2003036	1336	0.37	1.82	2.72	779/600	TQO	531.000
630	920	515	515	515.000	10.0	10.0	11388	27535	1161303	2807799	1817	0.42	1.61	2.39	771/630	TQO	1160.000
649.92	914.9	674	672	672.000	3.6	6.0	13900	44600	1418367	4551020	2934	0.33	2.05	3.05	M281349D/10/10D	TQO	144.000
660.4	812.8	365.13	365.13	365.130	3.2	6.4	7192	23277	733393	2373602	1559	0.48	1.41	2.09	L281149D/10/10D	TQO	420.000
710	900	610	610	610.000	1.6	6.6	8554	26495	872238	2701748	1731	0.46	1.47	2.18	N1217	-	771.000

Type*:
TQO: Two double cones, one cone spacer, two single cups, two cup spacers, one double cup
TQI:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with straight bore.
TQIT:Two double cups with one spacer in between, two singe cone and one double cone all matched (without spacer) with tapered bore.
TDI: 2sets of double row taper roller bearings of TDI configuration separated by spacer between insides two cups and two cones.

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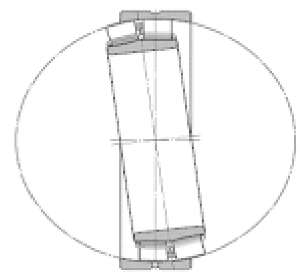
20 Spherical Roller Bearing

Spherical Roller Bearing Configuration

Spherical roller bearing inner consists of two rows with asymmetrical rollers and outer. The outer has a spherical raceway. These bearings have a large capacity for radial loads and axial loads in either directions. In addition to straight bore, tapered bore are also available. The standard taper ratio of 1:12 have 'K 'suffix. With a taper ratio of 1:30 as in the case of 240 series, the suffix is 'K30'. Most of the tapered bore bearings use adaptor sleeve or withdrawal sleeve. The spherical roller bearing have a self-aligning property.



Steel press cage and machined brass cages are widely used in Spherical roller bearings. The bearings with steel cage has 'CC' suffix and with brass cage 'MB' suffix.

Brass cage (MB)

Steel cage (CC)

Type of configuration

CA - Bearing with symmetrical rollers and retaining ribs. The cage is a one-piece, double pronged machined cage of brass

CC - Bearing with symmetrical rollers, flangeless inner ring, a non-integral guide ring between the two rows of rollers centred on the inner ring and one pressed steel window-type cage for each roller row

MB-Machined brass cage

In addition to beatings with cylindrical bore those with tapered bore are also available. Bearings with tapered bore are specified by attaching te suffix "K" to the end of the bearing's basic number. The standard taper ratio is 1:12 for

Bearings with a "K" suffix, but for bearings in series 240 and 241 the suffix "K30" indicates the taper ration for a bearings is 1:30. Most tapered bore bearings incorporate the use of adapters and withdrawal sleeves for shaft mounting

K-Tapered bearing bore. taper 1:12

K30- Tapered bearing bore, taper 1:30

Oil inlets and oil groove dimensions

Spherical roller bearings with an outer diameter of 320mm or more are provided with an oil inlet and oil grooveon the outer ring for the purpose of supplying lubricant to the bearing's moving parts When necessary, oil inlets and oil grooves can also be provided on bearings with outer diameters less than 320 mm.

W33-Bearing with annular groove and three lubrication holes in the outer ring

W33X-Bearing with annular groove and six lubrication holes in the outer ring

Adapters and withdrawal sleeves

Adapters are used for installation of bearings with tapered bore on Cylindrical shafts. Withdrawal sleeves are also used to install and disassemble bearings with tapered bore onto and off cylindrical shafts. In disassembling the bearing From the shaft, the nut is pressed down against the edge of the inner ring utilizing the bolt provided on the withdrawal sleeve, and then the sleeve is drawn away from the bearing's inner diameter surface. As shown in diagram 2 construction is designed to reduce friction by injecting high pressure oil between the surfaces of the adapter sleeve and bearing inner bore by means of a pressure fitting.

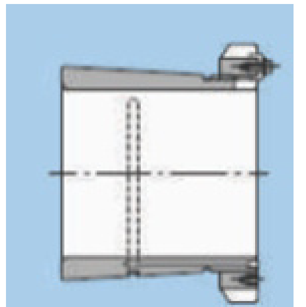
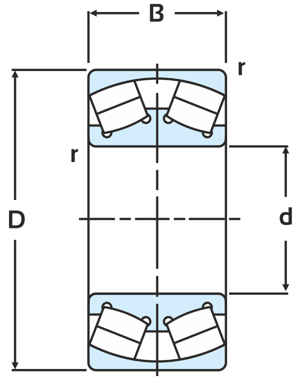


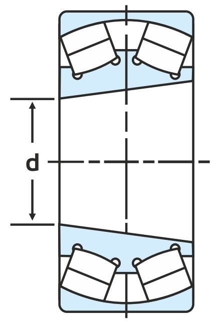
Diagram 2

* Adapter as well as withdrawal sleeves are also available

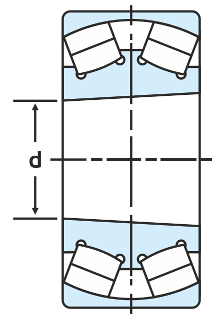
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

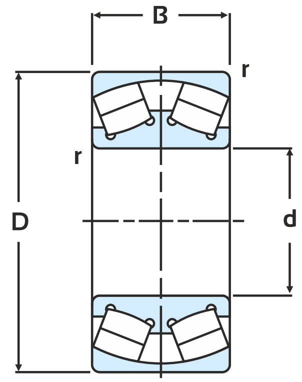
static

$P_{or} = F_r + Y_o F_a$

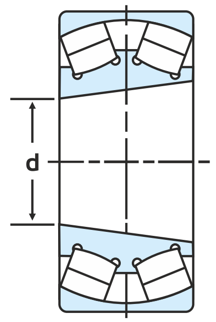
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions mm				Basic Load Rating (KN) Dynamic KN	Static KN	Dynamic Kgf	Static Kgf	Fatigue load limit KN	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
25	52	18	1	42.1	43.5	4293	4436	5.3	0.35	1.9	2.9	1.9	22205 CC W33	0.18
25	52	18	1	42.1	43.5	4293	4436	5.3	0.35	1.9	2.9	1.9	22205K CC W33	0.16
25	52	18	1	39.0	43.5	4293	4436	5.3	0.35	1.9	2.9	1.9	22205 MB W33	0.19
25	52	18	1	39.0	43.5	4293	4436	5.3	0.35	1.9	2.9	1.9	22205K MB W33	0.17
30	62	20	1	51.7	55	5272	5608	6.7	0.32	2.1	3.1	2.1	22206 CC W33	0.28
30	62	20	1	51.7	55	5272	5608	6.7	0.32	2.1	3.1	2.1	22206K CC W33	0.27
30	62	20	1	52.0	55	5302	5608	6.7	0.33	2.0	3.0	2.0	22206 MB W33	0.32
30	62	20	1	52.0	55	5302	5608	6.7	0.33	2.0	3.0	2.0	22206K MB W33	0.28
35	72	23	1.1	68.0	77	6934	7852	9.4	0.31	2.2	3.0	2.2	22207K CA W33	0.43
35	72	23	1.1	69.8	73.9	7118	7536	9.0	0.32	2.1	3.2	2.1	22207 MB W33	0.45
35	72	23	1.1	69.8	73.9	7118	7536	9.0	0.32	2.1	3.2	2.1	22207K MB W33	0.43
35	72	23	1.1	70.4	78.7	7179	8025	9.6	0.32	2.1	3.2	2.1	22207 CC W33	0.44
35	72	23	1.1	70.4	78.7	7179	8025	9.6	0.32	2.1	3.2	2.1	22207K CC W33	0.41
40	80	23	1.1	79.1	87.9	8066	8963	10.7	0.28	2.4	3.5	2.3	22208 CC W33	0.53
40	80	23	1.1	79.1	87.9	8066	8963	10.7	0.28	2.4	3.5	2.3	22208K CC W33	0.52
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.28	2.4	3.5	2.3	22208 CA W33	0.47

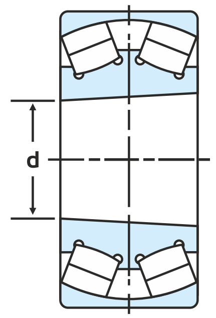
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.28	2.4	3.5	2.3	22208K CA W33	0.45
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.31	2.2	3.2	2.1	22208 MB W33	0.47
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.31	2.2	3.2	2.1	22208K MB W33	0.47
40	90	23	1.5	85.6	88.1	8729	8984	10.7	0.24	2.8	4.1	2.8	21308 CC W33	0.72
40	90	23	1.5	85.6	88.1	8729	8984	10.7	0.24	2.8	4.1	2.8	21308 MB W33	0.73
40	90	23	1.5	85.6	88.1	8729	8984	10.7	0.24	2.8	4.1	2.8	21308K MB W33	0.70
40	90	23	1.5	85.6	88.1	8729	8984	10.7	0.24	2.8	4.1	2.8	21308K CC W33	0.93
40	90	33	1.5	123.6	142.1	12603	14490	17.3	0.39	1.7	2.5	1.7	22308 CC W33	1.01
40	90	33	1.5	123.6	142.1	12603	14490	17.3	0.39	1.7	2.5	1.7	22308K CC W33	0.95
40	90	33	1.5	123.6	142.1	12603	14490	17.3	0.39	1.7	2.5	1.7	22308 MB W33	1.03
40	90	33	1.5	123.6	142.1	12603	14490	17.3	0.39	1.7	2.5	1.7	22308K MB W33	1.00
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.37	1.8	2.7	1.8	22209 CA W33	0.61
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.37	1.8	2.7	1.8	22209K CA W33	0.60
45	85	23	1.1	82.6	95	8423	9687	11.6	0.26	2.6	3.8	2.5	22209 CC W33	0.59
45	85	23	1.1	82.6	95	8423	9687	11.6	0.26	2.6	3.8	2.5	22209K CC W33	0.58
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.28	2.4	3.5	2.3	22209 MB W33	0.61

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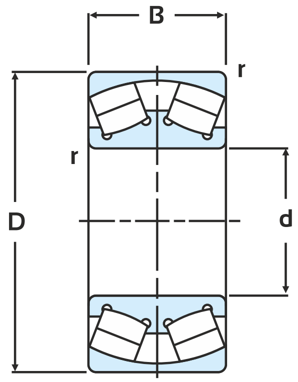
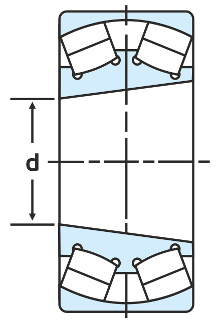
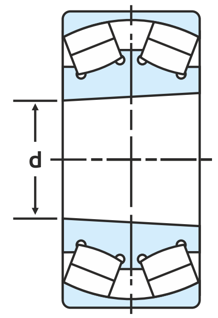
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

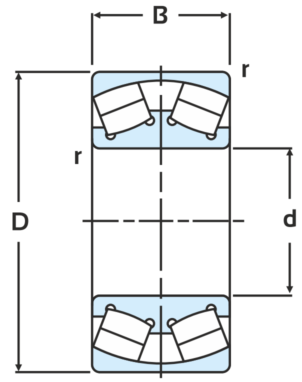
static

$P_{or} = F_r + Y_o F_a$

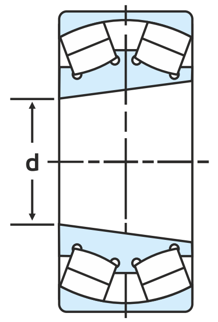
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.28	2.4	3.5	2.3	22209K MB W33	0.61
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309 CC W33	1.30
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309K CC W33	1.10
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309 CA W33	1.37
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309 MB W33	1.40
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309K MB W33	1.38
50	90	23	1.1	82.5	95.8	8413	9769	11.7	0.24	2.8	4.1	2.7	22210 CA W33	0.64
50	90	23	1.1	82.5	95.8	8413	9769	11.7	0.24	2.8	4.1	2.7	22210K CA W33	0.62
50	90	23	1.1	85.9	102	8759	10401	12.4	0.24	2.8	4.1	2.7	22210 CC W33	0.62
50	90	23	1.1	85.9	102	8759	10401	12.4	0.24	2.8	4.1	2.7	22210K CC W33	0.60
50	90	23	1.1	86.6	103.3	8831	10534	12.6	0.26	2.6	3.8	2.5	22210 MB W33	0.64
50	90	23	1.1	86.6	103.3	8831	10534	12.6	0.26	2.6	3.8	2.5	22210K MB W33	0.63
50	110	27	2	126	142	12848	14480	17.3	0.24	2.8	4.2	2.8	21310 CC W33	1.20
50	110	27	2	126	142	12848	14480	17.3	0.24	2.8	4.2	2.8	21310K CC W33	1.01
50	110	27	2	126	142	12848	14480	17.3	0.24	2.8	4.2	2.8	21310 MB W33	1.50
50	110	27	2	126	142	12848	14480	17.3	0.24	2.8	4.2	2.8	21310K MB W33	1.30

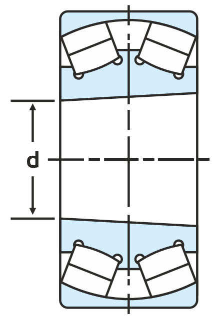
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
50	110	40	2	193	227	19680	23147	27.7	0.37	1.8	2.7	1.8	22310 CA W33	1.83
50	110	40	2	193	227	19680	23147	27.7	0.37	1.8	2.7	1.8	22310 MB W33	1.88
50	110	40	2	193	227	19680	23147	27.7	0.37	1.8	2.7	1.8	22310K MB W33	1.84
55	100	25	1.5	98.9	118.9	10085	12124	14.5	0.27	2.5	3.7	2.5	22211 MB W33	0.87
55	100	25	1.5	98.9	118.9	10085	12124	14.5	0.27	2.5	3.7	2.5	22211K MB W33	0.85
55	100	25	1.5	106	126	10809	12848	15.4	0.24	2.8	4.2	2.8	22211 CA W33	0.83
55	100	25	1.5	106	126	10809	12848	15.4	0.24	2.8	4.2	2.8	22211K CA W33	0.81
55	100	25	1.5	108	128	11013	13052	15.6	0.24	2.8	4.2	2.8	22211 CC W33	0.83
55	100	25	1.5	108	128	11013	13052	15.6	0.24	2.8	4.2	2.8	22211K CC W33	0.83
55	120	29	2	145	163	14786	16621	19.9	0.24	2.8	4.2	2.8	21311 CC W33	1.61
55	120	29	2	145	163	14786	16621	19.9	0.24	2.8	4.2	2.8	21311K CC W33	1.45
55	120	29	2	145	163	14786	16621	19.9	0.24	2.8	4.2	2.8	21311 MB W33	1.66
55	120	29	2	145	163	14786	16621	19.9	0.24	2.8	4.2	2.8	21311K MB W33	1.62
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311 CA W33	2.33
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311K CA W33	2.30
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311 MB W33	2.33

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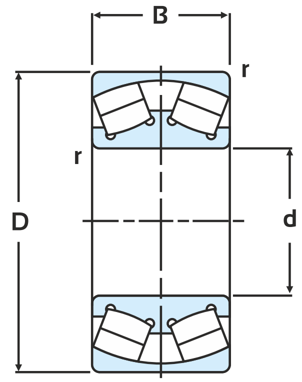
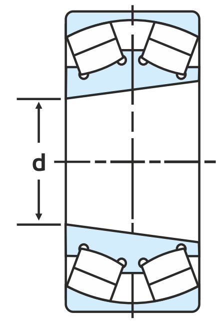
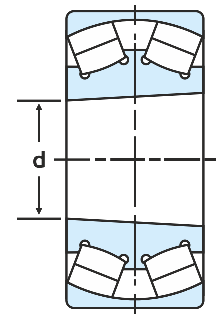
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311K MB W33	2.30
60	110	28	1.5	132	156	13460	15907	19.0	0.25	2.7	4.0	2.7	22212 MB W33	1.23
60	110	28	1.5	132	156	13460	15907	19.0	0.25	2.7	4.0	2.7	22212K MB W33	1.20
60	110	28	1.5	135	157	13766	16009	19.1	0.24	2.8	4.1	2.7	22212 CA W33	1.18
60	110	28	1.5	135	157	13766	16009	19.1	0.24	2.8	4.1	2.7	22212K CA W33	1.15
60	110	28	1.5	150	182	15296	18559	22.2	0.24	2.8	4.1	2.7	22212 CC W33	1.18
60	110	28	1.5	150	182	15296	18559	22.2	0.24	2.8	4.1	2.7	22212K CC W33	1.15
60	130	31	2.1	167	191	17029	19476	23.3	0.24	2.8	4.2	2.8	21312 CA W33	2.10
60	130	31	2.1	174	202	17743	20598	24.6	0.24	2.8	4.2	2.8	21312 CC W33	1.98
60	130	31	2.1	174	202	17743	20598	24.6	0.24	2.8	4.2	2.8	21312K CC W33	1.93
60	130	46	2.1	240	310	24473	31611	37.8	0.36	1.9	2.8	1.8	22312 CC W33	2.87
60	130	46	2.1	240	310	24473	31611	37.8	0.36	1.9	2.8	1.8	22312 CA W33	2.91
60	130	46	2.1	240	310	24473	31611	37.8	0.38	1.8	2.7	1.8	22312 MB W33	2.93
60	130	46	2.1	240	310	24473	31611	37.8	0.38	1.8	2.7	1.8	22312K MB W33	2.90
60	130	46	2.1	240	310	24473	31611	37.8	0.36	1.9	2.8	1.8	22312K CC W33	2.82
65	120	31	1.5	112	158	11421	16111	19.3	0.28	2.4	3.6	2.3	22213K MB W33	1.48

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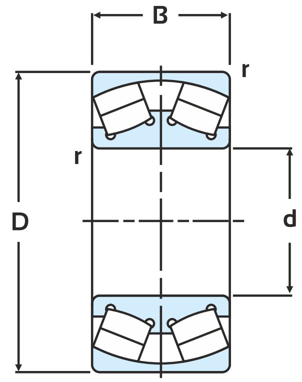
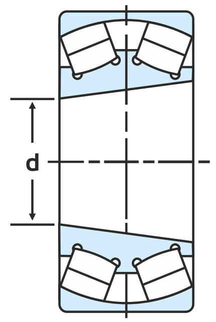
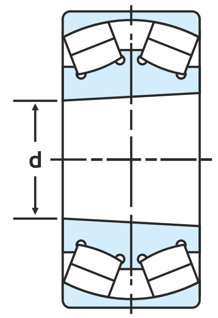


Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions mm				Basic Load Rating (KN) Dynamic KN	Static KN	Dynamic Kgf	Static Kgf	Fatigue load limit KN	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
65	120	31	1.5	147	181	14990	18457	22.1	0.28	2.4	3.6	2.3	22213 MB W33	1.54
65	120	31	1.5	157.2	196.8	16030	20068	24.0	0.25	2.7	4.0	2.6	22213K CC W33	1.46
65	120	31	1.5	164	197	16723	20088	24.0	0.25	2.7	4.0	2.6	22213 CC W33	1.49
65	120	31	1.5	164	197	16723	20088	24.0	0.25	2.7	4.0	2.6	22213K CA W33	1.52
65	140	48	2.1	275	327	28042	33344	39.6	0.35	1.9	2.9	1.9	22313 CC W33	3.50
65	140	48	2.1	275	327	28042	33344	39.6	0.35	1.9	2.9	1.9	22313K CC W33	3.50
65	140	48	2.1	295	353	30081	35995	42.7	0.35	1.9	2.9	1.9	22313 CA W33	2.61
65	140	48	2.1	295	353	30081	35995	42.7	0.35	1.9	2.9	1.9	22313 MB W33	3.61
65	140	48	2.1	295	353	30081	35995	42.7	0.35	1.9	2.9	1.9	22313K MB W33	3.54
70	125	31	1.5	161.4	203.8	16458	20781	25.0	0.24	2.8	4.2	2.8	22214 CC W33	1.65
70	125	31	1.5	161.4	203.8	16458	20781	25.0	0.24	2.8	4.2	2.8	22214K CC W33	1.63
70	125	31	1.5	170	218	17335	22229	26.6	0.24	2.8	4.2	2.8	22214 MB W33	1.64
70	125	31	1.5	170	218	17335	22229	26.6	0.24	2.8	4.2	2.8	22214K MB W33	1.64
70	150	35	2.1	204.6	219.6	20863	22393	26.0	0.25	2.7	4.1	2.7	21314 MB W33	3.00
70	150	35	2.1	204.6	219.6	20863	22393	26.0	0.25	2.7	4.1	2.7	21314K MB W33	2.67

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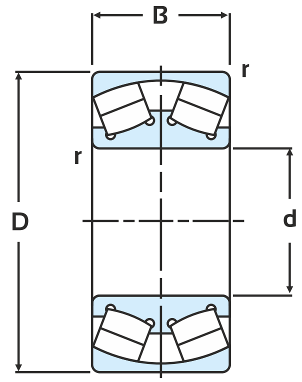
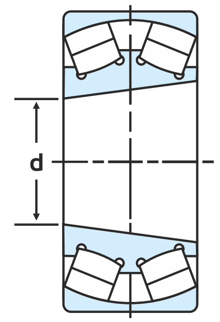
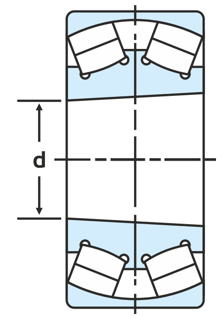


Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

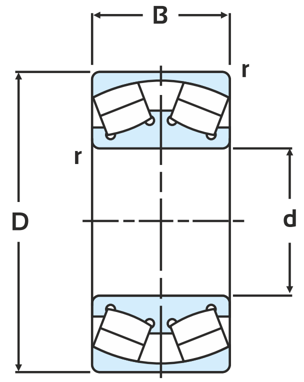
static

$P_{or} = F_r + Y_o F_a$

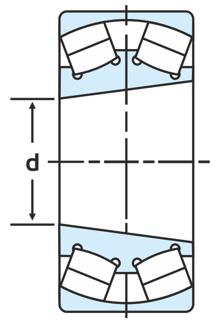
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
70	150	35	2.1	210	247	21414	25187	29.3	0.23	2.9	4.3	2.9	21314 CA W33	3.05
70	150	35	2.1	210	247	21414	25187	29.3	0.23	2.9	4.3	2.9	21314 CC W33	3.08
70	150	35	2.1	210	247	21414	25187	29.3	0.23	2.9	4.3	2.9	21314K CC W33	3.06
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	2.9	1.9	22314 CC W33	4.36
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	2.9	1.9	22314K CC W33	4.31
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	2.9	1.9	22314 CA W33	4.39
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	3.0	1.9	22314 MB W33	4.41
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	3.0	1.9	22314K MB W33	4.32
75	130	31	1.5	163	215	16621	21924	26.0	0.24	2.9	4.3	2.8	22215K MB W33	1.80
75	130	31	1.5	170	220	17335	22433	26.6	0.22	3.0	4.5	2.9	22215 CC W33	1.80
75	130	31	1.5	170.2	220.3	17355	22464	26.7	0.22	3.0	4.5	2.9	22215K CA W33	1.71
75	130	31	1.5	170.2	220.3	17355	22464	26.7	0.22	3.0	4.5	2.9	22215K CC W33	1.71
75	130	31	1.5	190	240	19374	24473	29.1	0.24	2.9	4.3	2.8	22215 MB W33	1.69
75	160	37	2.1	239	287	24371	29265	33.3	0.23	2.9	4.4	2.9	21315 CA W33	3.65
75	160	37	2.1	242	287	24371	29265	33.3	0.23	2.9	4.4	2.9	21315 CC W33	3.80
75	160	37	2.1	242	287	24371	29265	33.3	0.23	2.9	4.4	2.9	21315K CC W33	3.30

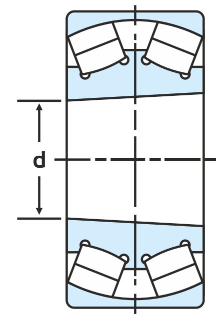
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

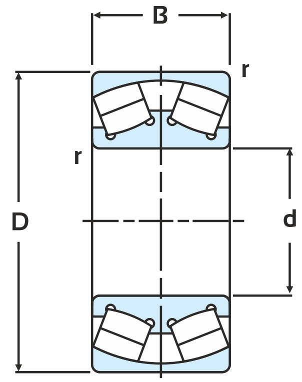
static

$P_{or} = F_r + Y_o F_a$

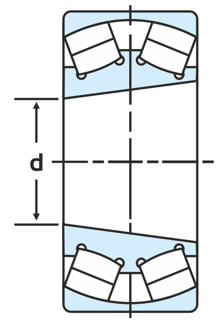
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions mm				Basic Load Rating (KN) Dynamic KN	Static KN	Dynamic Kgf	Static Kgf	Fatigue load limit KN	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
75	160	37	2.1	262	288	26716	29367	33.5	0.32	2.1	3.2	2.1	21315 MB W33	3.70
75	160	37	2.1	262	288	26716	29367	33.5	0.32	2.1	3.2	2.1	21315K MB W33	3.65
75	160	55	2.1	357	449	36403	45785	52.2	0.32	2.1	3.2	2.1	22315 CC W33	5.35
75	160	55	2.1	357	449	36403	45785	52.2	0.32	2.1	3.2	2.1	22315K CC W33	5.31
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315 CA W33	5.85
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315K CA W33	5.81
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315 MB W33	5.89
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315K MB W33	5.85
80	140	33	2	174	234	17743	23861	27.7	0.22	3.0	4.5	3.0	22216 MB W33	2.26
80	140	33	2	175	234	17845	23861	27.7	0.35	2.0	2.9	2.0	22216K CC W33	2.10
80	140	33	2	175	234	17845	23861	27.7	0.22	3.0	4.5	3.0	22216K MB W33	2.26
80	140	33	2	175	234	17845	23861	27.7	0.35	2.0	2.9	2.0	22216 CC W33	2.2
80	140	33	2	179	240	18253	24473	28.4	0.22	3.0	4.5	3.0	22216 CA W33	2.26
80	140	33	2	179	240	18253	24473	28.4	0.22	3.0	4.5	3.0	22216K CA W33	2.24
80	170	39	2.1	256	325	26104	33140	37.1	0.24	2.8	4.2	2.8	21316 CC W33	4.50
80	170	39	2.1	256	325	26104	33140	37.1	0.24	2.8	4.2	2.8	21316K CC W33	4.1

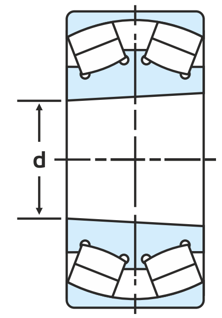
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316 CA W33	6.19
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316K CA W33	6.15
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316 MB W33	6.34
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316K MB W33	6.2
85	150	36	2	213	282	21720	28756	32.8	0.23	3.0	4.4	2.9	22217K CA W33	2.87
85	150	36	2	224	290	22841	29571	33.7	0.24	2.8	4.2	2.8	22217 MB W33	2.92
85	150	36	2	224	290	22841	29571	33.7	0.24	2.8	4.2	2.8	22217K MB W33	2.88
85	150	36	2	225	293	22943	29877	34.0	0.23	3.0	4.4	2.9	22217 CC W33	2.71
85	150	36	2	225	293	22943	29877	34.0	0.23	3.0	4.4	2.9	22217K CC W33	2.68
85	180	60	3	433	560	44153	57103	62.8	0.34	2.0	3.0	2.0	22317 MB W33	7.31
85	180	60	3	433	560	44153	57103	62.8	0.34	2.0	3.0	2.0	22317K MB W33	7.27
85	180	60	3	438	560	44663	57103	62.8	0.34	2.0	3.0	2.0	22317 CA W33	7.31
85	180	60	3	446	563	45479	57409	63.1	0.34	2.0	3.0	2.0	22317 CC W33	7.25
85	180	60	3	446	563	45479	57409	63.1	0.34	2.0	3.0	2.0	22317K CC W33	7.21
90	160	40	2	202	286	20598	29163	32.6	0.25	2.7	4.1	2.7	22218K MB W33	3.32
90	160	40	2	248	345	25289	35180	39.3	0.24	2.9	4.3	2.8	22218 CC W33	3.50

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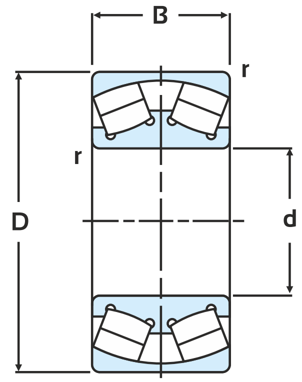
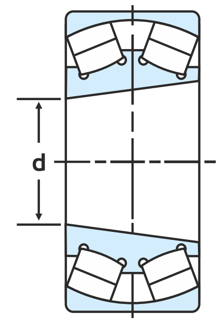
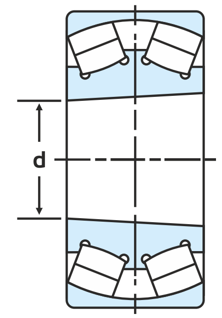
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$P_r = XF_r + YF_a$

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

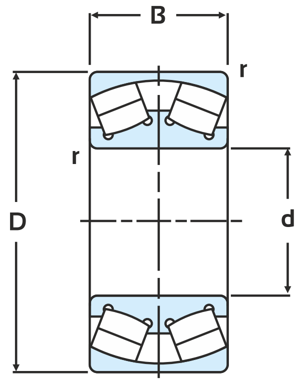
static

$P_{or} = F_r + Y_o F_a$

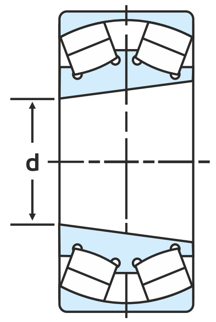
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
90	160	40	2	254	336	25900	34262	38.3	0.25	2.7	4.1	2.7	22218 MB W33	3.36
90	160	40	2	265	353	27022	35995	40.3	0.24	2.8	4.2	2.8	22218K CC W33	3.42
90	160	40	2	265	353	27022	35995	40.3	0.23	3.0	4.4	3.0	22218K CA W33	3.40
90	160	52.4	2	335	492	34160	50169	56.1	0.33	2.1	3.1	2.0	23218 MB W33	4.58
90	160	52.4	2	339	492	34568	50169	56.1	0.33	2.1	3.1	2.0	23218K MB W33	4.54
90	190	64	3	489	641	49863	65363	70.7	0.34	2.0	3.0	2.0	22318 MB W33	8.35
90	190	64	3	489	641	49863	65363	70.7	0.34	2.0	3.0	2.0	22318K MB W33	8.34
95	170	43	2.1	314.4	410.2	32059	41828	46.0	0.25	2.7	4.0	2.6	22219 MB W33	4.57
95	170	43	2.1	314.4	410.2	32059	41828	46.0	0.25	2.7	4.0	2.6	22219K MB W33	4.52
95	170	43	2.1	317	411	32059	41828	46.0	0.25	2.7	4.0	2.6	22219 CC W33	4.52
95	170	43	2.1	317	411	32059	41828	46.0	0.25	2.7	4.0	2.6	22219K CC W33	4.10
95	200	67	3	500	615	50985	62712	66.7	0.34	2.0	3.0	2.0	22319K MB W33	10.11
95	200	67	3	536	709	54656	72297	76.9	0.34	2.0	3.0	2.0	22319K CA W33	10.09
95	200	67	3	536	709	54656	72297	76.9	0.34	2.0	3.0	2.0	22319 MB W33	10.11

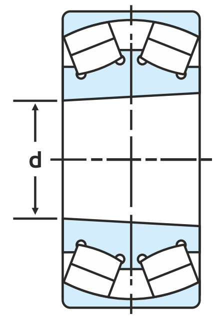
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions mm d	D	B	r	Basic Load Rating Dynamic KN Cr	Static KN Cor	Dynamic Kgf Cr	Static Kgf Cor	Fatigue load limit KN Cu	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
95	200	67	3	551	714	56185	72807	77.5	0.34	2.0	3.0	2.0	22319 CC W33	10.28
95	200	67	3	551	714	56185	72807	77.5	0.34	2.0	3.0	2.0	22319K CC W33	9.60
100	180	46	2.1	324	449	33038	45785	49.5	0.24	2.8	4.2	2.8	22220 CC W33	4.95
100	180	46	2.1	324	449	33038	45785	49.5	0.24	2.8	4.2	2.8	22220K CC W33	4.90
100	165	52	2	335	520	34160	53024	58.3	0.31	2.2	3.2	2.2	23120 MB W33	4.58
100	165	52	2	335	520	34160	53024	58.3	0.31	2.2	3.2	2.2	23120K MB W33	4.54
100	165	52	2	340	525	34670	53534	58.8	0.30	2.2	3.3	2.2	23120 MB W33	4.34
100	165	52	2	340	525	34670	53534	58.8	0.30	2.2	3.3	2.2	23120K MB W33	4.30
100	165	52	2	345	530	34670	53534	58.8	0.30	2.2	3.3	2.2	23120 CC W33	4.00
100	165	52	2	345	530	34670	53534	58.8	0.30	2.2	3.3	2.2	23120K CC W33	3.90
100	180	46	2.1	360	474	36709	48334	52.3	0.26	2.6	3.9	2.6	22220 MB W33	5.03
100	180	46	2.1	360	474	36709	48334	52.3	0.26	2.6	3.9	2.6	22220K MB W33	4.97
100	180	60.3	2.1	420	580	42827	59143	63.9	0.32	2.1	3.2	2.1	23220 MB W33	6.80
100	180	60.3	2.1	420	580	42827	59143	63.9	0.32	2.1	3.2	2.1	23220K MB W33	6.68
100	180	60.3	2.1	437	638	44561	65057	70.3	0.30	2.2	3.3	2.2	23220 CC W33	6.75
100	180	60.3	2.1	437	638	44561	65057	70.3	0.30	2.2	3.3	2.2	23220K CC W33	6.71

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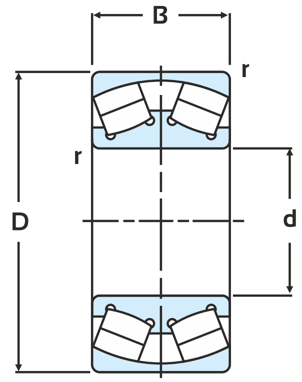
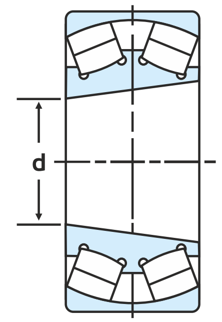
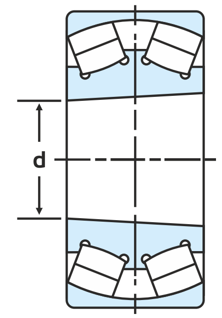
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

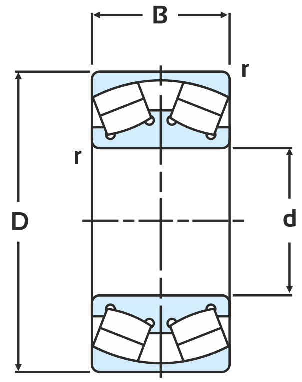
static

$P_{or} = F_r + Y_o F_a$

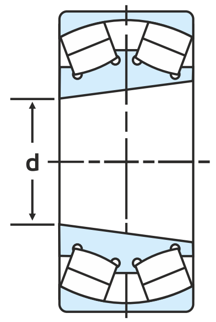
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
100	215	73	3	626	840	63833	85655	89.4	0.24	2.8	4.2	2.8	22320K MB W33	12.90
100	215	73	3	626	840	63833	85655	89.4	0.34	2.0	2.9	1.9	22320 MB W33	12.95
100	215	73	3	630	840	63833	85655	89.4	0.24	2.8	4.2	2.8	22320 CC W33	12.90
100	215	73	3	630	840	63833	85655	89.4	0.24	2.8	4.2	2.8	22320K CC W33	11.87
110	170	45	2	282	455	28756	46396	50.2	0.24	2.8	4.2	2.8	23022 MB W33	3.63
110	170	45	2	282	455	28756	46396	50.2	0.24	2.8	4.2	2.8	23022K MB W33	3.60
110	180	56	2	325	580	33140	59143	63.3	0.31	2.2	3.3	2.2	23122 MB W33	5.90
110	180	56	2	325	580	33140	59143	63.3	0.31	2.2	3.3	2.2	23122K MB W33	5.87
110	200	53	2.1	424	591	43235	60264	63.2	0.27	2.5	3.7	2.5	22222 MB W33	7.54
110	200	53	2.1	424	591	43235	60264	63.2	0.27	2.5	3.7	2.5	22222K MB W33	6.95
110	200	69.8	2.1	510	750	52005	76478	80.2	0.35	1.9	2.8	1.9	23222K MB W33	9.50
110	200	69.8	2.1	536.5	802.3	54707	81811	85.8	0.35	1.9	2.8	1.9	23222 MB W33	9.90
110	200	53	2.1	572	651	58327	66382	69.6	0.25	2.7	4.0	2.6	22222 CC W33	7.40
110	200	53	2.1	572	651	58327	66382	69.6	0.25	2.7	4.0	2.6	22222K CC W33	7.37

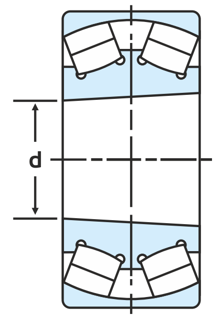
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
110	240	80	3	723	949	76478	98197	99.3	0.36	1.9	2.8	1.8	22322 MB W33	18.20
110	240	80	3	723	949	73724	96770	97.8	0.36	1.9	2.8	1.8	22322K MB W33	17.80
110	240	80	3	744	935	75866	95342	96.4	0.35	1.9	2.9	1.9	22322 CC W33	17.90
110	240	80	3	744	935	75866	95342	96.4	0.35	1.9	2.9	1.9	22322K CC W33	17.88
120	180	46	2	296	495	30183	50475	53.5	0.23	2.9	4.4	2.9	23024 MB W33	4.20
120	180	46	2	324.5	513.5	33089	52362	55.4	0.23	2.9	4.4	2.9	23024K MB W33	4.06
120	180	60	2	353	638	35995	65057	68.9	0.30	2.3	3.4	2.2	24024 CA W33	5.30
120	180	60	2	390	700	39768	71379	75.6	0.30	2.3	3.4	2.2	24024 MB W33	5.27
120	180	60	2	390	700	39768	71379	75.6	0.30	2.3	3.4	2.2	24024K30 MB W33	5.22
120	215	58	2.1	396	582	40380	59347	60.8	0.28	2.4	3.6	2.4	22224K MB W33	9.14
120	200	62	2	460	705	46906	71889	74.7	0.30	2.3	3.4	2.2	23124 MB W33	8.00
120	200	62	2	460	705	46906	71889	74.7	0.30	2.3	3.4	2.2	23124K MB W33	7.70
120	215	58	2.1	507	697	51699	71073	72.8	0.28	2.4	3.6	2.4	22224 MB W33	9.14
120	215	76	2.1	595	950	60672	96872	99.2	0.35	1.9	2.9	1.9	23224 MB W33	12.30
120	215	76	2.1	595	950	60672	96872	99.2	0.35	1.9	2.9	1.9	23224K MB W33	11.90
120	215	58	2.1	652	765	66484	78007	79.9	0.26	2.6	3.8	2.5	22224 CC W33	9.00

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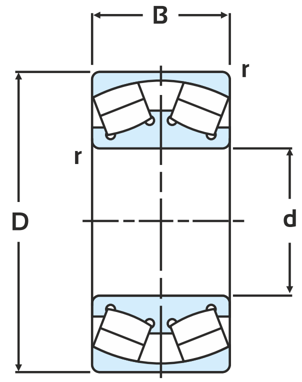
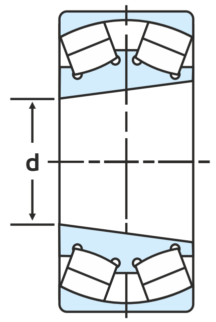
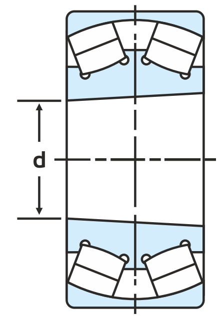
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

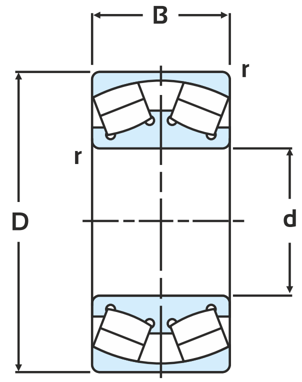
static

$P_{or} = F_r + Y_o F_a$

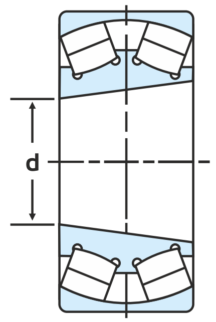
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
120	215	58	2.1	652	765	66484	78007	79.9	0.26	2.6	3.8	2.5	22224K CC W33	8.86
120	260	86	3	880	1130	89734	115226	113.7	0.34	2.0	3.0	2.0	22324 CC W33	23.50
120	260	86	3	880	1130	89734	115226	113.7	0.34	2.0	3.0	2.0	22324K CC W33	22.73
120	260	86	3	884	1154	90141	117673	116.1	0.35	1.9	2.9	1.9	22324 MB W33	22.67
120	260	86	3	884	1154	90141	117673	116.1	0.35	1.9	2.9	1.9	22324K MB W33	22.40
130	200	52	2	375	620	38239	63221	65.1	0.25	2.7	4.0	2.6	23026 MB W33	6.00
130	200	52	2	375	620	38239	63221	65.1	0.25	2.7	4.0	2.6	23026K MB W33	5.87
130	210	64	2	459	721	46804	73520	75.0	0.28	2.4	3.6	2.4	23126 MB W33	8.60
130	210	64	2	459	721	46804	73520	75.0	0.28	2.4	3.6	2.4	23126K MB W33	8.11
130	230	64	3	563	832	57409	84839	85.1	0.26	2.6	3.8	2.5	22226 CC W33	11.10
130	230	64	3	563	832	57409	84839	85.1	0.26	2.6	3.8	2.5	22226K CC W33	11.05
130	230	64	3	570	729	58123	74336	74.5	0.28	2.4	3.6	2.4	22226 MB W33	11.30
130	230	64	3	570	729	58123	74336	74.5	0.28	2.4	3.6	2.4	22226K MB W33	11.26
130	280	93	4	1142	1377	116490	140413	135.4	0.33	2.0	3.0	2.0	22326 MB W33	27.50
130	280	93	4	1142	1377	116490	140413	135.4	0.33	2.0	3.0	2.0	22326K MB W33	27.10
130	230	80	3	662	1008	67504	102786	103	0.34	2.0	3.0	2.0	23226 MB W33	14.4

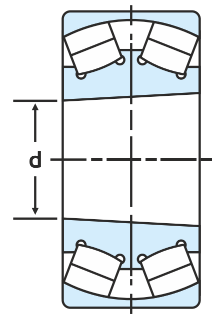
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

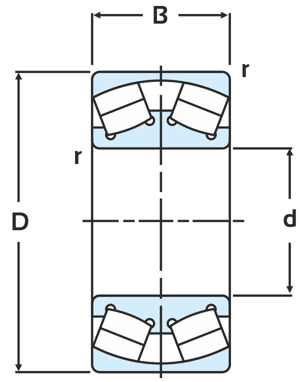
static

$P_{or} = F_r + Y_o F_a$

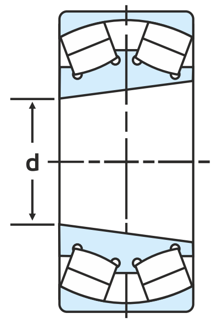
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
130	230	80	3	662	1008	67504	102786	103	0.34	2.0	3.0	2.0	23226K MB W33	13.8
140	210	53	2	400	675	40788	68830	69.6	0.23	3.0	4.4	2.9	23028 CA W33	7.00
140	210	53	2	400	675	40788	68830	69.6	0.23	3.0	4.4	2.9	23028K CA W33	6.77
140	210	53	2	415	695	42318	70869	71.7	0.23	3.0	4.4	2.9	23028 MB W33	6.66
140	210	53	2	415	695	42318	70869	71.7	0.23	3.0	4.4	2.9	23028K MB W33	6.62
140	210	69	2	525	945	53534	96362	97.4	0.29	2.3	3.4	2.2	24028 CC W33	8.45
140	210	69	2	525	945	53534	96362	97.4	0.29	2.3	3.4	2.2	24028K30 CC W33	8.40
140	210	69	2	510	930	52005	94832	95.9	0.32	2.1	3.2	2.1	24028 MB W33	8.50
140	210	69	2	510	930	52005	94832	95.9	0.32	2.1	3.2	2.1	24028K30 MB W33	8.47
140	225	68	2.1	540	895	55064	91263	91.1	0.29	2.4	3.5	2.3	23128 MB W33	10.7
140	225	68	2.1	540	895	55064	91263	91.1	0.29	2.4	3.5	2.3	23128K MB W33	10.4
140	225	68	2.1	550	900	56084	91773	91.6	0.28	2.4	3.6	2.4	23128 CC W33	11.8
140	225	68	2.1	550	900	56084	91773	91.6	0.28	2.4	3.6	2.4	23128K CC W33	11.1
140	250	68	3	634	924	64649	94220	92.2	0.27	2.5	3.7	2.4	22228 MB W33	14.8
140	250	68	3	634	924	64649	94220	92.2	0.27	2.5	3.7	2.4	22228K MB W33	14.0
140	250	68	3	639	933	65159	95138	93.1	0.27	2.5	3.7	2.4	22228 CC W33	14.3
140	250	68	3	639	933	65159	95138	93.1	0.27	2.5	3.7	2.4	22228K CC W33	14.0

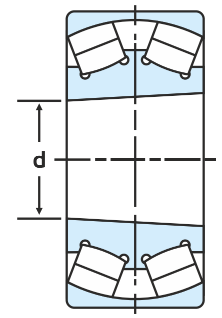
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
140	250	88	3	826	1320	84227	134600	131.7	0.34	2.0	3.0	2.0	23228K MB W33	19.3
140	250	88	3	826	1320	84227	134600	131.7	0.34	2.0	3.0	2.0	23228 MB W33	18.5
140	280	93	4	830	1250	84635	127463	122.0	0.36	1.9	2.8	1.8	73727	26.0
140	300	102	4	1292	1620	131793	165191	155.9	0.35	1.9	2.9	1.9	22328 MB W33	35.5
140	300	102	4	1292	1620	131793	165191	155.9	0.35	1.9	2.9	1.9	22328K MB W33	35.5
150	225	56	2.1	450	795	45887	81066	80.3	0.23	2.9	4.3	2.8	23030 MB W33	8.10
150	225	56	2.1	450	795	45887	81066	80.3	0.23	2.9	4.3	2.8	23030K MB W33	7.50
150	225	56	2.1	531	820	54146	83615	82.8	0.24	2.8	4.2	2.8	23030K CC W33	7.70
150	225	56	2.1	531	820	54146	83615	82.8	0.24	2.8	4.2	2.8	23030 CC W33	8.35
150	225	75	2.1	680	1116	69323	110128	112.7	0.33	2.0	3.0	2.0	24030EK30 MB W33	10.37
150	225	75	2.1	680	1116	69323	113799	112.7	0.33	2.0	3.0	2.0	24030E MB W33	10.52
150	270	73	3	680	965	69340	98401	94.2	0.27	2.5	3.7	2.4	22230 MB W33	21.1
150	250	80	2.1	730	1190	74438	121344	117.9	0.31	2.2	3.2	2.1	23130K MB W33	16.0
150	250	80	2.1	745	1244	75968	126851	123.2	0.31	2.2	3.2	2.1	23130 MB W33	16.3
150	270	73	3	800	1200	81576	122364	117.1	0.27	2.5	3.7	2.4	22230K MB W33	18.6
150	270	96	3	950	1500	96872	152955	146.4	0.36	1.9	2.8	1.8	23230K MB W33	23.4

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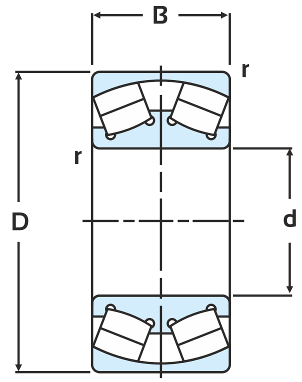
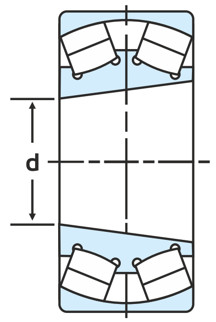
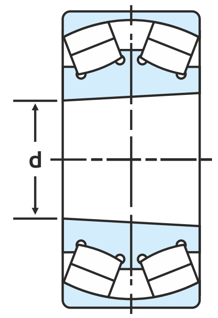
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

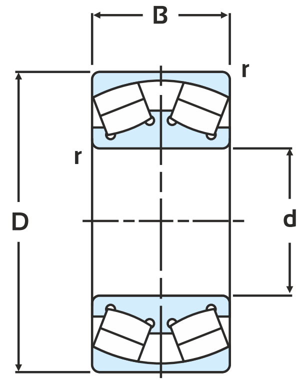
static

$P_{or} = F_r + Y_o F_a$

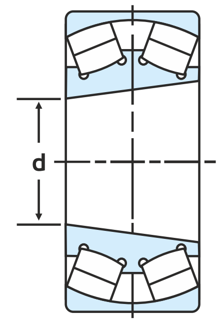
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
150	270	96	3	960	1520	96872	152955	146.4	0.36	1.9	2.8	1.8	23230 MB W33	24.4
150	320	108	4	1270	1750	129502	178448	165.2	0.36	1.9	2.8	1.8	22330E1 MB W33	43.9
150	320	108	4	1270	1750	129502	178448	165.2	0.36	1.9	2.8	1.8	22330 MB W33	43.9
150	320	108	4	1270	1750	129502	178448	165.2	0.36	1.9	2.8	1.8	22330K MB W33	41.9
160	240	60	2.1	500	875	50985	89224	86.7	0.22	3.0	4.5	2.9	23032 MB W33	9.60
160	240	60	2.1	500	875	50985	89224	86.7	0.22	3.0	4.5	2.9	23032K MB W33	9.57
160	240	80	2.1	796	1329	81201	135518	131.6	0.32	2.1	3.1	2.0	24032E MB W33	12.8
160	240	80	2.1	796	1329	81201	135518	131.6	0.32	2.1	3.1	2.0	24032EK30 MB W33	12.6
160	270	86	2.1	837	1362	85349	138883	131.6	0.31	2.2	3.2	2.1	23132K MB W33	20.5
160	270	86	2.1	839	1350	85553	137660	130.9	0.31	2.2	3.2	2.1	23132 MB W33	20.2
160	290	80	3	862	1276	87898	130114	122.0	0.28	2.4	3.6	2.4	22232 MB W33	23.5
160	290	80	3	862	1276	87898	130114	122.0	0.28	2.4	3.6	2.4	22232K MB W33	20.1
160	290	104	3	1100	1760	112167	179467	168.3	0.36	1.9	2.8	1.8	23232 MB W33	30.9
160	290	104	3	1100	1760	112167	179467	168.3	0.36	1.9	2.8	1.8	23232K MB W33	29.6
170	260	67	2.1	630	1090	64241	111147	105.7	0.24	2.8	4.2	2.8	23034K MB W33	12.7
170	260	67	2.1	640	1080	65261	110128	104.7	0.24	2.8	4.2	2.8	23034 MB W33	13.2

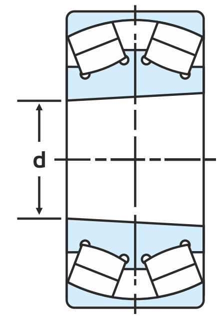
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

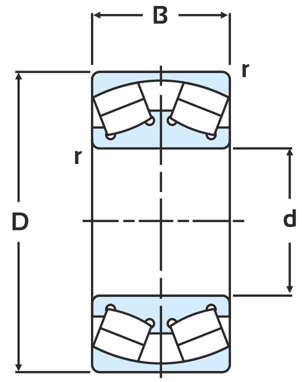
static

$P_{or} = F_r + Y_o F_a$

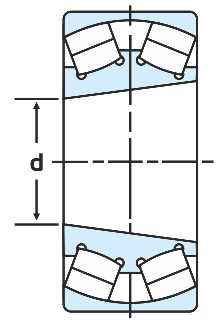
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions mm				Basic Load Rating (KN) Dynamic KN	Static KN	Dynamic Kgf	Static Kgf	Fatigue load limit KN	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
170	260	90	2.1	700	1450	71379	147857	140.5	0.34	2.0	3.0	2.0	24034 MB W33	17.9
170	260	67	2.1	728	1100	74234	112167	106.6	0.23	2.9	4.3	2.9	23034 CC W33	12.8
170	260	67	2.1	728	1100	74234	112167	106.6	0.23	2.9	4.3	2.9	23034K CC W33	11.7
170	260	90	2.1	820	1500	83615	152955	145.4	0.34	2.0	3.0	2.0	24034K30 MB W33	17.5
170	280	88	2.1	840	1530	85655	156014	146.3	0.30	2.2	3.3	2.2	23134 MB W33	21.9
170	280	88	2.1	895	1550	91263	158054	148.2	0.30	2.2	3.3	2.2	23134K MB W33	21.8
170	310	86	4	990	1440	100950	146837	135.0	0.27	2.5	3.8	2.5	22234K MB W33	27.1
170	310	86	4	999	1518	101868	154790	142.4	0.27	2.5	3.8	2.5	22234 MB W33	28.5
170	280	109	2.1	1020	1800	104009	183546	172.1	0.36	1.9	2.8	1.8	24134 MB W33	26.9
170	280	109	2.1	1020	1800	104009	183546	172.1	0.36	1.9	2.8	1.8	24134K30 MB W33	24.5
170	280	88	2.1	1086	1519	110739	154892	145.2	0.30	2.2	3.3	2.2	23134 CC W33	21.4
170	280	88	2.1	1086	1519	110739	154892	145.2	0.30	2.2	3.3	2.2	23134K CC W33	19.1
170	310	110	4	1180	1960	120325	199861	183.8	0.35	1.9	2.9	1.9	23234K MB W33	35.3
170	310	110	4	1206	1946	122976	198434	182.5	0.35	1.9	2.9	1.9	23234 MB W33	37.3
170	360	120	4	1400	1790	142758	182526	163.0	0.36	1.9	2.8	1.8	22334E1 MB W33	63.2

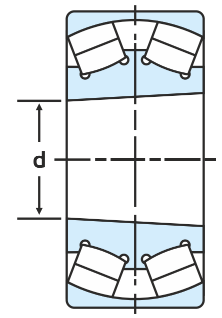
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions mm				Basic Load Rating (KN) Dynamic KN	Static KN	Dynamic Kgf	Static Kgf	Fatigue load limit KN	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
170	310	110	4	1472	1980	150100	201901	185.7	0.35	1.9	2.9	1.9	23234 CC W33	37.0
170	360	120	4	1540	2240	157034	228413	203.9	0.36	1.9	2.8	1.8	22334E1 CC W33	58.5
170	360	120	4	1550	2150	158054	219236	195.7	0.35	1.9	2.9	1.9	22334 CA W33	60.0
170	360	120	4	1550	2200	158054	224334	200.3	0.36	1.9	2.8	1.8	22334 MB W33	61.5
170	360	120	4	1550	2200	158054	224334	200.3	0.36	1.9	2.8	1.8	22334K MB W33	59.3
180	280	74	2.1	756	1308	77089	133377	124.2	0.25	2.7	4.0	2.6	23036 MB W33	17.5
180	280	74	2.1	740	1290	75458	131541	122.5	0.25	2.7	4.0	2.6	23036K MB W33	16
180	280	74	2.1	752.5	1300	76732	132551	123.5	0.24	2.8	4.2	2.7	23036 CC W33	17.2
180	280	74	2.1	752.5	1300	76732	132551	123.5	0.24	2.8	4.2	2.7	23036K CC W33	16.8
180	280	100	2.1	930	1700	94832	173349	161.5	0.35	1.9	2.9	1.9	24036 CA W33	23.5
180	320	86	4	940	1390	95852	141738	128.8	0.28	2.4	3.6	2.3	22236 MB W33	30
180	280	100	2.1	970	1770	98911	180487	168.1	0.33	2.0	3.0	2.0	24036K30 MB W33	22.5
180	300	96	3	1030	1730	105029	176408	162.2	0.33	2.0	3.0	2.0	23136 MB W33	26
180	300	96	3	1030	1730	105029	176408	162.2	0.33	2.0	3.0	2.0	23136K MB W33	25.9
180	320	86	4	1040	1610	106049	164172	149.2	0.28	2.4	3.6	2.3	22236K MB W33	28.1

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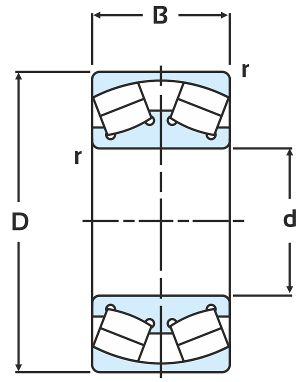
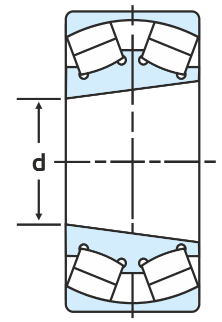
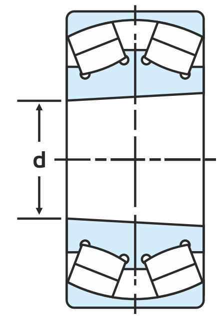
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

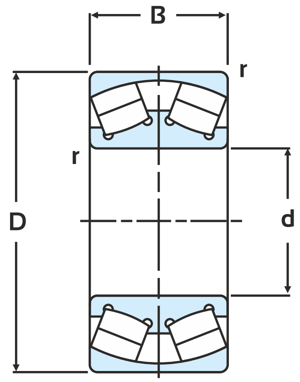
static

$P_{or} = F_r + Y_o F_a$

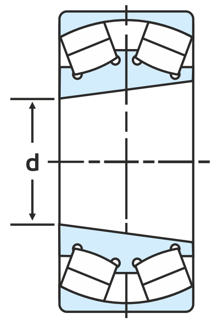
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
180	300	96	3	1050	1750	107069	178448	164.1	0.30	2.3	3.4	2.2	23136K CA W33	26.64
180	320	112	4	1230	2030	125423	206999	188.1	0.35	1.9	2.9	1.9	23236 MB W33	39.4
180	320	112	4	1230	2130	125423	217196	197.3	0.35	1.9	2.9	1.9	23236K MB W33	36.2
180	300	118	3	1438	2201	146633	224436	206.4	0.38	1.8	2.7	1.7	24136 CC W33	33.5
180	380	126	4	1730	2560	176408	261043	229	0.36	1.9	2.8	1.9	22336K MB W33	69
180	380	126	4	1730	2560	176408	261043	229	0.36	1.9	2.8	1.9	22336 MB W33	70.5
180	280	100	2.1	970	1770	98911	180487	168	0.35	1.9	2.9	1.9	24036 MB W33	22.9
180	300	118	3	1110	1890	113187	192723	177	0.39	1.7	2.5	1.7	24136 MB W33	33.4
180	300	118	3	1110	1890	113187	192723	177	0.39	1.7	2.5	1.7	24136K30 MB W33	32.9
190	290	75	2.1	657	1319	66994	134498	123.7	0.23	2.9	4.3	2.9	23038 CC W33	17.6
190	290	75	2.1	760	1350	77497	137660	126.6	0.23	2.9	4.4	2.9	23038 MB W33	18
190	290	75	2.1	760	1350	77497	137660	126.6	0.23	2.9	4.4	2.9	23038K MB W33	17.5
190	290	75	2.1	916	1355	93405	138169	127.1	0.23	2.9	4.3	2.8	23038K CC W33	17.4
190	340	92	4	1120	1680	114206	171310	152.9	0.28	2.4	3.6	2.4	22238 MB W33	37
190	340	92	4	1150	1820	117266	185585	165.7	0.27	2.5	3.7	2.4	22238K MB W33	35.6
190	320	104	3	1190	2020	121344	205979	186.0	0.33	2.1	3.1	2.0	23138 MB W33	35.1

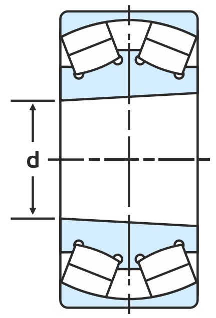
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

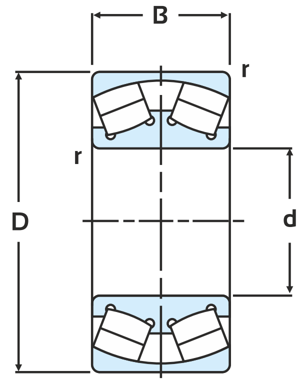
static

$P_{or} = F_r + Y_o F_a$

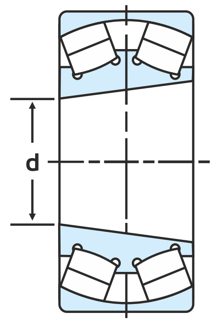
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
190	320	104	3	1190	2020	121344	205979	186.0	0.33	2.1	3.1	2.0	23138K MB W33	34.7
190	320	128	3	1420	2480	144797	252886	228.4	0.39	1.7	2.6	1.7	24138 MB W33	41.6
190	340	120	4	1450	2370	147857	241669	215.8	0.35	1.9	2.9	1.9	23238 MB W33	48.1
190	340	120	4	1450	2350	147857	239630	213.9	0.35	1.9	2.9	1.9	23238K MB W33	47.6
190	320	128	3	1420	2480	144797	252886	228	0.39	1.7	2.6	1.7	24138K30 MB W33	41.2
200	310	82	2.1	910	1614	92793	164580	148.6	0.25	2.7	4.0	2.6	23040 MB W33	23.7
200	310	82	2.1	1038	1606	105845	163764	147.9	0.24	2.8	4.2	2.7	23040 CC W33	23.1
200	310	82	2.1	1038	1606	105845	163764	147.9	0.24	2.8	4.2	2.7	23040K CC W33	22.3
200	310	109	2.1	1150	2150	117266	219236	198.0	0.33	2.0	3.0	2.0	24040K30 MB W33	30
200	360	98	4	1190	1810	121344	184566	162.1	0.28	2.4	3.6	2.4	22240 MB W33	44.5
200	360	98	4	1190	1810	121344	184566	162.1	0.28	2.4	3.6	2.4	22240K MB W33	44.0
200	310	109	2.1	1310	2090	133581	213117	192.5	0.34	2.0	2.9	1.9	24040 MB W33	30.4
200	340	112	3	1340	2220	136640	226373	201.0	0.32	2.1	3.2	2.1	23140K MB W33	42.0
200	340	112	3	1355	2280	138169	232492	206.4	0.32	2.1	3.2	2.1	23140 MB W33	42.5
200	360	98	4	1500	1950	152955	198842	174.6	0.26	2.6	3.9	2.5	22240K CC W33	42.2
200	360	98	4	1500	1950	152955	198842	174.6	0.26	2.6	3.9	2.5	22240 CC W33	42.7

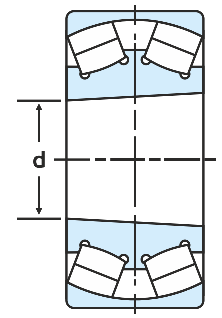
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

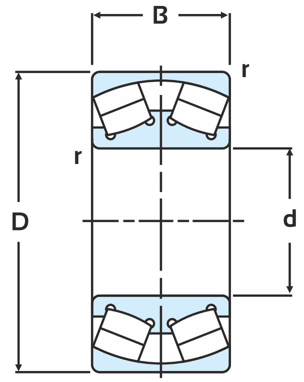
$P_{or} = F_r + Y_o F_a$

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

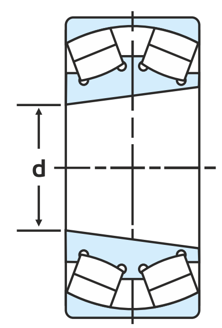
Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
200	360	128	4	1620	2630	165191	268181	235.5	0.35	1.9	2.8	1.9	23240 MB W33	57.9
200	360	128	4	1620	2640	165191	269201	236.4	0.35	1.9	2.8	1.9	23240K MB W33	57.4
200	420	138	5	2040	3050	208019	311009	264.9	0.35	1.9	2.9	1.9	22340 MB W33	94.5
200	420	138	5	2040	3050	208019	311009	264.9	0.35	1.9	2.9	1.9	22340K MB W33	90.3
200	310	82	2.1	878	1550	89530	158054	143	0.25	2.7	4.1	2.7	23040K MB W33	22.6
220	340	90	3	1100	1920	112167	195782	171.9	0.25	2.7	4.1	2.7	23044 MB W33	30.1
220	340	90	3	1100	1920	112167	195782	171.9	0.25	2.7	4.1	2.7	23044K MB W33	30.95
220	340	118	3	1355	2580	138169	263083	231.0	0.33	2.1	3.1	2.0	24044K30 MB W33	38.6
220	340	118	3	1355	2580	138169	263083	231.0	0.33	2.1	3.1	2.0	24044 MB W33	39.3
220	400	108	4	1835	2460	187115	250846	213.7	0.27	2.5	3.7	2.4	22244 MB W33	62.0
220	400	108	4	1835	2460	187115	250846	213.7	0.27	2.5	3.7	2.4	22244K MB W33	59.0
220	370	120	4	1520	2590	154994	264102	228	0.32	2.1	3.1	2.1	23144 MB W33	52.7
220	370	120	4	1520	2590	154994	264102	228	0.32	2.1	3.1	2.1	23144K MB W33	51.1
220	400	144	4	1870	3020	190684	307949	262	0.37	1.8	2.7	1.8	23244 MB W33	79.2
220	400	144	4	1870	3020	190684	307949	262	0.37	1.8	2.7	1.8	23244K MB W33	78.0
240	360	92	3	1130	2170	115226	221275	190.3	0.25	2.7	4.0	2.7	23048K MB W33	33.5

nbc CKA Birla Group

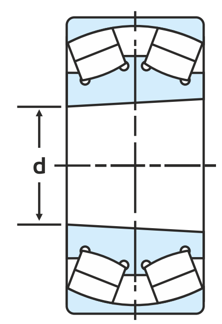
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

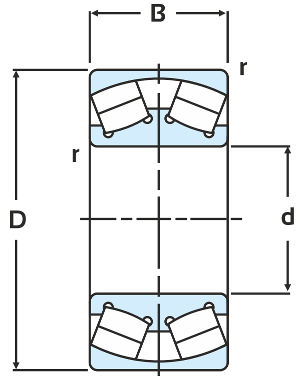
static

$P_{or} = F_r + Y_o F_a$

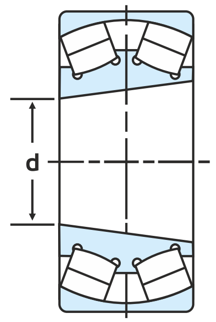
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
240	360	92	3	1130	2170	115226	221275	190.3	0.25	2.7	4.0	2.7	23048 MB W33	33.7
240	360	118	3	1370	2670	139699	272260	234.2	0.31	2.2	3.2	2.1	24048K30 MB W33	40.0
240	360	118	3	1370	2670	139699	272260	234.2	0.31	2.2	3.2	2.1	24048 MB W33	42.0
240	400	128	4	1730	3050	176408	311009	262.4	0.30	2.2	3.3	2.2	23148K MB W33	64.6
240	400	128	4	1770	3090	180487	315087	265.8	0.30	2.2	3.3	2.2	23148 MB W33	67.0
240	440	120	4	1900	3050	193743	311009	257.7	0.27	2.5	3.7	2.4	22248 MB W33	83.0
240	440	120	4	1900	3050	193743	311009	257.7	0.27	2.5	3.7	2.4	22248K MB W33	82.6
240	440	120	4	1940	3130	197822	319166	264.4	0.27	2.5	3.7	2.5	22248 CC W33	81.4
240	440	120	4	1940	3130	197822	319166	264.4	0.27	2.5	3.7	2.5	22248K CC W33	79.9
240	400	128	4	2130	3240	217196	330383	278.7	0.30	2.3	3.4	2.2	23148 CC W33	62.2
240	400	128	4	2130	3240	217196	330383	278.7	0.30	2.3	3.4	2.2	23148K CC W33	61.8
240	440	160	4	2430	4100	247787	418077	346	0.36	1.9	2.8	1.9	23248 MB W33	110
240	440	160	4	2430	4100	247787	418077	346	0.36	1.9	2.8	1.9	23248K MB W33	107
260	360	75	2.1	976	1790	99523	182526	155.5	0.18	3.8	5.6	3.8	23952 CA W33	22.9
260	400	104	4	1400	2610	142758	266142	222.5	0.24	2.8	4.2	2.7	23052K MB W33	45
260	400	104	4	1450	2700	147857	275319	230.1	0.24	2.8	4.2	2.7	23052 MB W33	47.2

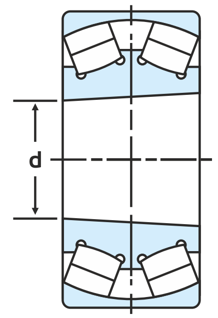
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

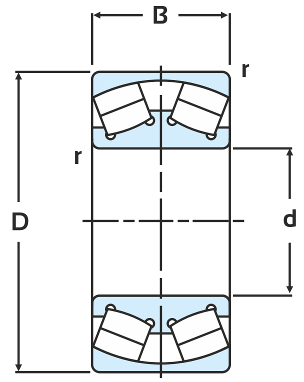
static

$P_{or} = F_r + Y_oF_a$

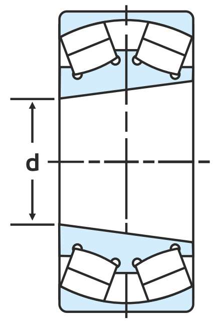
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
260	400	104	4	1671	2580	170392	263083	219.9	0.23	2.9	4.3	2.8	23052 CC W33	47.2
260	400	104	4	1671	2580	170392	263083	219.9	0.23	2.9	4.3	2.8	23052K CC W33	46.4
260	440	144	4	2120	3830	216176	390545	320.7	0.32	2.1	3.2	2.1	23152K MB W33	92.0
260	440	144	4	2120	3830	216176	390545	320.7	0.32	2.1	3.2	2.1	23152 MB W33	94.0
260	540	165	6	3200	4750	326304	484358	382.2	0.31	2.1	3.2	2.1	22352 CC W33	181
260	540	165	6	2880	4460	293674	454786	359	0.34	2.0	2.9	2.0	22352 MB W33	186
260	540	165	6	2880	4460	293674	454786	359	0.34	2.0	2.9	2.0	22352K MB W33	182
260	480	174	5	2610	4260	266142	434392	351	0.37	1.8	2.7	1.8	23252 MB W33	139
260	480	174	5	2610	4260	266142	434392	351	0.37	1.8	2.7	1.8	23252K MB W33	135
260	400	140	4	1830	3550	186605	361994	303	0.33	2.0	3.0	2.0	24052 MB W33	65.4
260	400	140	4	1830	3550	186605	361994	303	0.33	2.0	3.0	2.0	24052K30 MB W33	64.3
280	420	106	4	1320	2850	134600	290615	238.7	0.24	2.9	4.3	2.8	23056 MB W33	52.5
280	420	106	4	1500	2800	152955	285516	234.5	0.24	2.9	4.3	2.8	23056K CA W33	54
280	420	106	4	1540	2950	157034	300812	247.1	0.23	2.9	4.3	2.8	23056K MB W33	49.8
280	460	146	5	2295	4150	234021	423176	341.8	0.30	2.3	3.4	2.2	23156K MB W33	96.2
280	460	146	5	2300	4250	234531	433373	350.0	0.30	2.3	3.4	2.2	23156E CA W33	97.5

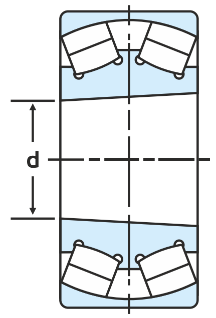
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

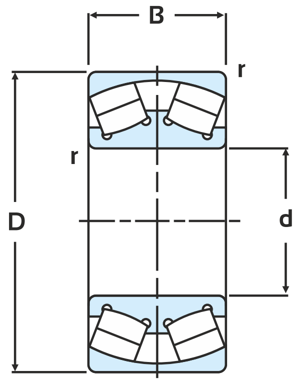
Equivalent radial load
dynamic
$P_r = XF_r + YF_a$

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

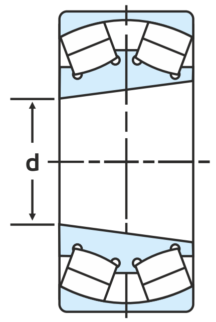
static
$P_{or} = F_r + Y_o F_a$
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_o	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
280	500	130	5	2310	3800	235551	387486	308.1	0.26	2.6	3.8	2.5	22256 MB W33	113
280	500	130	5	2310	3800	235551	387486	308.1	0.26	2.6	3.8	2.5	22256K MB W33	111
280	460	180	5	2730	5200	278378	530244	428.3	0.40	1.7	2.5	1.6	24156E CC W33X	121
280	460	180	5	2767	5308	282151	541257	437.2	0.36	1.9	2.8	1.8	24156 CC W33	114
280	500	176	5	2820	4790	287555	488436	388.3	0.36	1.9	2.8	1.8	23256K MB W33	145
280	500	176	5	2820	4790	287555	488436	388.3	0.36	1.9	2.8	1.8	23256 MB W33	148
280	580	175	6	3340	5080	340580	518008	400	0.31	2.2	3.2	2.2	22356 MB W33	225
280	580	175	6	3340	5080	340580	518008	400	0.31	2.2	3.2	2.2	22356K MB W33	221
280	460	146	5	2295	4150	234021	423176	342	0.30	2.3	3.4	2.3	23156 MB W33	99.3
280	420	140	4	1800	3570	183546	364033	299	0.32	2.1	3.2	2.1	24056 MB W33	67.8
280	420	140	4	1800	3570	183546	364033	299	0.32	2.1	3.2	2.1	24056K30 MB W33	66.7
300	440	105	4	1450	2760	147857	281437	227.3	0.21	3.2	4.7	3.1	3760	55
300	460	118	4	1840	3440	187625	350777	281.1	0.24	2.9	4.3	2.8	23060CK W33	70
300	460	118	4	1890	3550	192723	361994	290.1	0.24	2.9	4.3	2.8	23060K MB W33	70
300	460	118	4	1890	3550	192723	361994	290.1	0.24	2.9	4.3	2.8	23060 MB W33	72.5
300	500	160	5	2720	4690	277358	478239	377.3	0.31	2.2	3.3	2.2	23160K MB W33	127

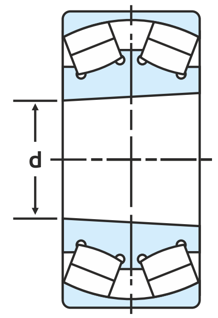
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

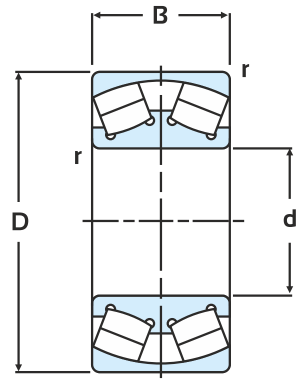
static

$P_{or} = F_r + Y_o F_a$

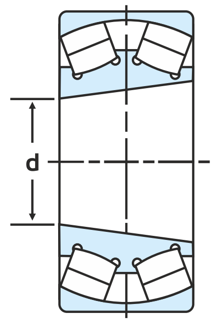
For values of e, Y_2 and Y_o see the table below.

Boundary Dimensions mm				Basic Load Rating (KN) Dynamic KN	Static KN	Dynamic Kgf	Static Kgf	Fatigue load limit KN	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
300	500	160	5	2720	4690	277358	478239	377.3	0.31	2.2	3.3	2.2	23160 MB W33	131
300	500	200	5	3300	6400	336501	652608	514.9	0.40	1.7	2.5	1.7	24160E CC W33X	159
320	480	121	4	1940	3790	197822	386466	304.9	0.23	2.9	4.4	2.9	23064 CA W33	80.1
320	480	160	4	2511	5201	256047	530346	418.5	0.35	1.9	2.9	1.9	24064 CC W33	97.8
320	480	160	4	2892	5212	294897	531468	419.3	0.30	2.3	3.4	2.2	24064 CA W33	103.6
320	540	176	5	3650	5800	372191	591426	456.6	0.32	2.1	3.1	2.1	23164 MB W33	167
320	540	176	5	3650	5800	372191	591426	456.6	0.32	2.1	3.1	2.1	23164K MB W33	164
320	580	208	5	4000	7050	407880	718889	547.5	0.36	1.9	2.8	1.8	23264 CA W33X	240
320	580	208	5	4000	7050	407880	718889	547.5	0.36	1.9	2.8	1.8	23264 CA W33	246
320	580	208	5	4050	7130	412979	727046	553.7	0.36	1.9	2.8	1.8	23264K MB W33	243
320	580	208	5	4050	7130	412979	727046	553.7	0.36	1.9	2.8	1.8	23264 MB W33	247
320	480	121	4	1900	3695	193743	376779	297	0.24	2.8	4.1	2.8	23064 MB W33	84.8
320	480	121	4	1900	3695	193743	376779	297	0.24	2.8	4.1	2.8	23064K MB W33	76.8
340	460	90	3	1290	2720	131541	277358	218.8	0.17	4.0	6.0	3.9	23968 CA W33	44
340	520	133	5	2310	4450	235551	453767	350.4	0.24	2.8	4.2	2.8	23068K MB W33	103
340	520	133	5	2310	4450	235551	453767	350.4	0.24	2.8	4.2	2.8	23068 MB W33	107

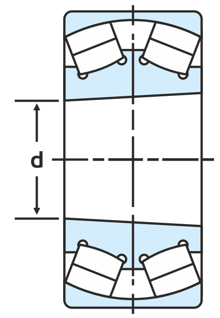
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

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

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
340	580	190	5	3600	6600	367092	673002	509.2	0.34	2.0	2.9	1.9	23168 MB W33	211
340	580	190	5	3600	6600	367092	673002	509.2	0.34	2.0	2.9	1.9	23168K MB W33	209
340	620	224	6	5128	7980	522851	813761	607.9	0.36	1.9	2.8	1.8	23268 CA W33	303.4
340	580	243	5	5168	8950	526981	912632	690.5	0.39	1.7	2.6	1.7	24168E CA W33	266.5
340	580	243	5	4620	8620	471101	878981	665	0.40	1.7	2.5	1.7	24168 MB W33	259
340	580	243	5	4620	8620	471101	878981	665	0.40	1.7	2.5	1.7	24168K30 MB W33	255
360	540	134	5	2370	4750	241669	484358	368.9	0.22	3.1	4.5	3.0	23072 CC W33	110
360	540	134	5	2370	4750	241669	484358	368.9	0.22	3.1	4.5	3.0	23072K CC W33	107
360	540	180	5	3100	6500	316107	662805	504.8	0.36	1.9	2.8	1.8	24072 CA W33	145
360	540	180	5	3200	6650	326304	678101	516.5	0.31	2.2	3.3	2.2	24072 MB W33	147
360	600	192	5	3650	6850	372191	698495	522	0.31	2.2	3.2	2.2	23172 MB W33	227
360	600	192	5	3650	6850	372191	698495	522	0.31	2.2	3.2	2.2	23172K MB W33	220
360	540	180	5	3200	6650	326304	678101	516	0.36	1.9	2.8	1.9	24072K30 MB W33	145
400	590	142	5	2450	5000	249827	509850	377.4	0.22	3.1	4.6	3.0	3880	134
400	600	148	5	2980	6050	303871	616919	455.3	0.22	3.1	4.6	3.0	23080 CA W33	154
400	650	250	6	5100	10500	520047	1070685	778.6	0.36	1.9	2.8	1.8	24180E CA W33	322

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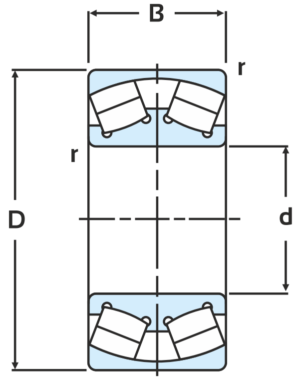
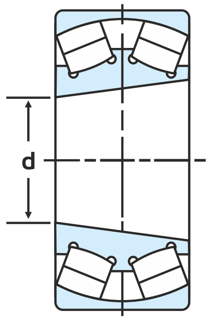
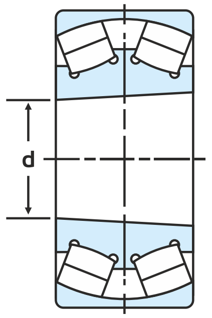
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K) (1:12)



Tapered bore (K30) (1:30)

Equivalent radial load dynamic

$P_r = XF_r + YF_a$

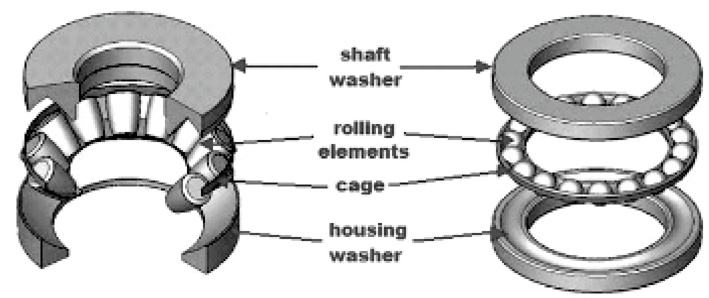
$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$P_{or} = F_r + Y_o F_a$

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

Boundary Dimensions				Basic Load Rating (KN)				Fatigue load limit	e	Y_1	Y_2	Y_0	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static							
mm				KN		Kgf		KN						
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
420	760	272	7.5	6550	12100	667904	1233837	866.4	0.36	1.9	2.8	1.9	23284K MB W33	526
420	760	272	7.5	6550	12100	667904	1233837	866.4	0.36	1.9	2.8	1.9	23284 MB W33	521
440	720	226	6	5200	10100	530244	1029897	726.9	0.30	2.2	3.3	2.2	23188 CA W33	377
440	720	280	6	6450	13100	657707	1335807	942.8	0.37	1.8	2.7	1.8	24188 MB W33	473
440	720	280	6	6450	13100	657707	1335807	942.8	0.37	1.8	2.7	1.8	24188K30 MB W33	467
480	870	310	7.5	8350	15500	851450	1580535	1066	0.36	1.9	2.8	1.9	23296K MB W33	784
480	650	128	5	2875	5684	293164	579597	412.3	0.18	3.8	5.6	3.7	23996 MB W33	125
480	790	308	7.5	7450	15300	759677	1560141	1071.6	0.38	1.8	2.7	1.7	24196E CA W33	587
480	870	310	7.5	8300	15500	846351	1580535	1065.9	0.36	1.9	2.8	1.8	23296 CA W33	820
480	870	310	7.5	8350	15500	851450	1580535	1065.9	0.36	1.9	2.8	1.8	23296 MB W33	808
750	920	170	5	3600	11050	367092	1126769	712.9	0.16	4.2	6.2	4.1	40038/750 (248/750 MB W33)	245
850	1220	365	7.5	12700	31500	1295019	3212055	1905.5	0.27	2.5	3.7	2.5	40031/850 (240/850 CA W33)	1410
850	1420	620	12	23300	49260	2375901	5023042	2898.6	0.34	2.0	3.0	1.9	241/900K30 MB W33/AH241_900G_H	3480
1180	1420	180	6	5620	17200	573071	1753884	971.7	0.10	6.4	9.6	6.3	238/1180 CA W33	565

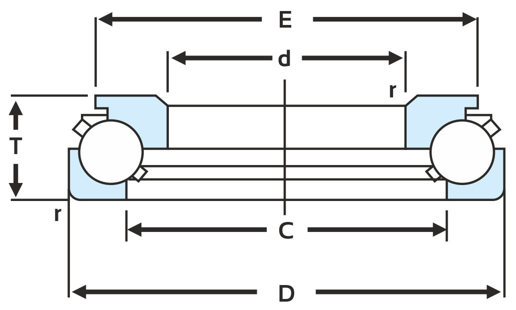

shaft
washer
rolling
elements
cage
housing
washer

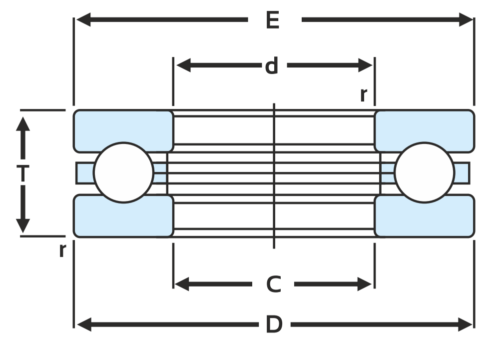
- Tapered roller thrust bearings consist of tapered rollers arranged so that their axes all converge at a point on the axis of the bearing. They are used in pairs to accommodate axial thrust in either direction, as well as radial loads. They can support greater thrust loads than the ball type due to the larger contact area.

- Spherical roller thrust bearings use rollers of spherical shape, rolling inside a housing washer with a raceway with spherical inner shape. They can accommodate combined radial and axial loads and also accommodate misalignment of the shafts.

Note: Replacing a spherical roller bearing of same size but with different design (brass or steel cage) may require to modify the existing sleeve or use a new sleeve during mounting. For support contact application engineer.

Thrust Roller Bearing





Equivalent bearing load dynamic

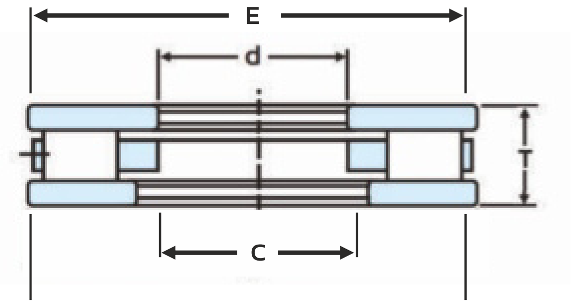
$P_a = F_a$

Static

$P_{oa} = F_a$

Boundary Dimension						Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Type	Mass Kg. (Approx.)	Figure
						Dynamic	Static	Dynamic	Static					
mm						KN		Kgf						
d	C	D	E	T	r	Ca	Coa	Ca	Coa	Cu				
100	123	220	100	143	2.1	325	931	33140	94934	33	**48324**	BALL	23	1
110	113	187	190	63	2.0	280	705	28511	71919	26	**51322**	BALL	7.2	1
280	284	380	375	80	2.1	493	1980	50271	201901	50	**51256M**	BALL	25.3	1
710	711	950	950	185	8.0	1215	8018	123853	817616	127	**N1013**	BALL	407	1

Cylindrical Roller Thrust Bearing



Equivalent bearing load

dynamic

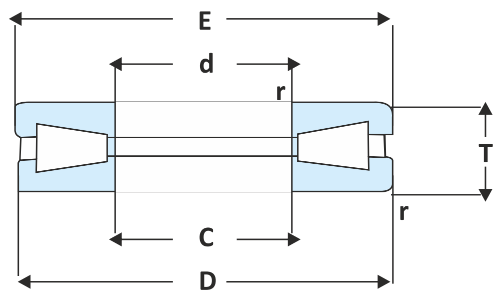
$P_a = F_a$

Static

$P_{oa} = F_a$

Boundary Dimension						Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Type	Mass Kg. (Approx.)	Figure
						Dynamic	Static	Dynamic	Static					
mm						KN		Kgf						
d	C	D	E	T	r	Ca	Coa	Ca	Coa	Cu				
76.2	82.55	119.84	116.66	25.4	9.5X45°	156	467	15938	47579	21	**T624**	CRB	1.07	2
88.9	90.475	138.887	129.362	33.325	-	167	528	16978	53840	62	**AT626**	CRB	1.87	2
152.4	154	254	252.4	50.8	4.0	716	3214	72991	327744	317	**9923**	CRB	10.98	2
260	260.5	420	419.5	95	5.0	1475	5850	150406	596525	494	**9809352**	CRB	58	2
304.8	307.181	609.6	607.219	114.3	9.5	3907	23042	398367	2349543	1781	**N1011**	CRB	157	2
460	460	800	800	206	9.5	5940	15180	605714	1547935	1065	**9889492**	CRB	471.700	2

Taper Roller Thrust Bearing



Equivalent bearing load

dynamic

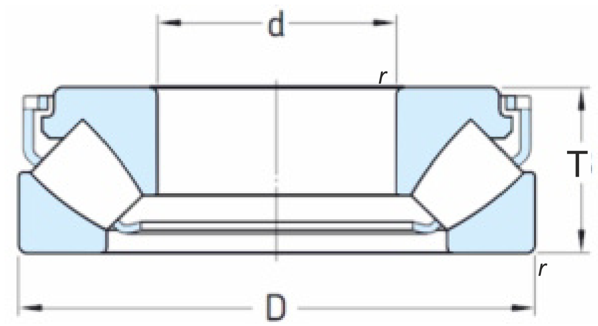
$P_a = F_a$

Static

$P_{oa} = F_a$

Boundary Dimensions						Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Type	Mass Kg. (Approx.)	Figure
						Dynamic	Static	Dynamic	Static					
mm						KN		Kgf						
d	C	D	E	T	r	Ca	Coa	Ca	Coa	Cu				
127	127	266.7	266.7	58.738	4.8	1.35	4.5	138	457	0.45	**T511-TTHD**	TRB	19	3
203.2	203.2	419.1	419.1	92.075	9.7	2.49	10.6	254	1081	0.92	**T811-TTHD**	TRB	69	3
228.6	228.6	482.6	482.6	104.775	11.2	3.50	14.7	357	1499	1.23	**T911-TTHD**	TRB	103	3
260	265	480	475	132	6.0	3.30	12.8	337	1305	1.05	**9019452**	TRB	115	3
279.4	282.575	603.25	601.726	136.525	11.2	7.70	7.9	785	807	0.62	**T1100-TTHD**	TRB	198	3
279.4	282.575	603.25	601.726	136.525	11.2	7.91	32.7	807	3335	2.55	**N1146**	TRB	198	3

Spherical Roller Thrust Bearing



Equivalent bearing load

dynamic

$P_a = F_a + 1.2F$

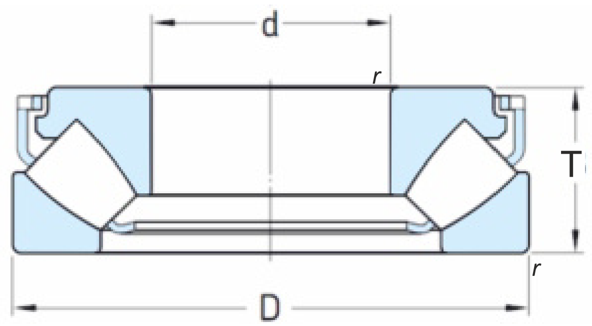
Static

$P_{oa} = F_a + 1.2F$

When $\frac{F_r}{F_a} \leq 0.55$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf				
d	D	T	r	Ca	Coa	Ca	Coa	C_u		
60	130	42	1.5	320	950	32630	96872	116	**29412EM**	2.800
70	150	48	2.0	400	1260	40788	128482	149	**29414EM**	4.100
80	170	54	2.1	490	1600	49965	163152	182	**29416EM**	5.810
90	190	60	2.1	580	1980	59143	201901	218	**29418EM**	7.550
100	210	67	3.0	715	2420	72909	246767	259	**29420EM**	10.900
110	230	73	3.0	850	2900	86675	295713	302	**29422EM**	12.700
110	190	48	2.0	610	1730	62202	176408	187	**29322E**	5.240
120	210	54	2.1	765	2100	78007	214137	220	**29324E**	7.320
120	250	78	4.0	1120	3370	114206	343639	342	**29424EM**	17.900
130	270	85	4.0	1380	3850	140719	392585	381	**29426E**	22.100
130	270	85	4.0	1360	4310	138679	439491	427	**29426EM**	22.800
130	225	58	2.1	753	2500	76783	254925	257	**29326E**	8.860
140	240	60	2.1	850	2840	86675	289595	286	**29328EM**	11.000
150	250	60	2.1	1020	2900	104009	295713	287	**29330EM**	11.500
150	250	60	2.1	1000	2900	101970	295713	287	**29330E**	10.900

Spherical Roller Thrust Bearing



Equivalent bearing load

dynamic

$P_a = F_a + 1.2F$

Static

$P_{oa} = F_a + 1.2F$

When $\frac{Fr}{Fa} \leq 0.55$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Mass Kg. (Approx.)
mm				Dynamic	Static	Dynamic	Static			
				KN		Kgf				
d	D	T	r	Ca	Coa	Ca	Coa	C_u		
170	340	103	5.0	2360	6550	240649	667904	603	**29434E**	40.000
170	280	67	3.0	1220	3600	124403	367092	344	**29334EM**	15.500
180	360	109	5.0	2600	7350	265122	749480	665	**29436E**	47.700
190	380	115	5.0	2500	8300	254925	846351	739	**29438EJ**	60.500
190	380	230	5.0	2654	8306	270628	846963	740	**29438DE**	112.000
190	380	230	5.0	2850	8000	290615	815760	713	**29438D**	118.000
190	320	78	4.0	1170	4850	119305	494555	447	**29338EM**	25.000
200	340	85	4.0	1600	5200	163152	530244	471	**29340EJ**	28.500
200	340	85	4.0	1860	5500	189664	560835	498	**29340E**	28.700
260	420	95	5	2300	7800	234531	795366	659	**29352EM**	49.000
260	480	132	6.0	4050	12900	412979	1315413	1062	**29452E**	97.800
300	480	109	5.0	2700	10850	275319	1106375	880	**29360EM**	73.500
300	480	109	5.0	2700	10850	275319	1106375	880	**29360MB**	72.700
320	500	109	5.0	3250	10600	331403	1080882	847	**9039364X**	75.400
320	500	109	5.0	3250	10300	331403	1050291	823	**29364 MB**	75.800

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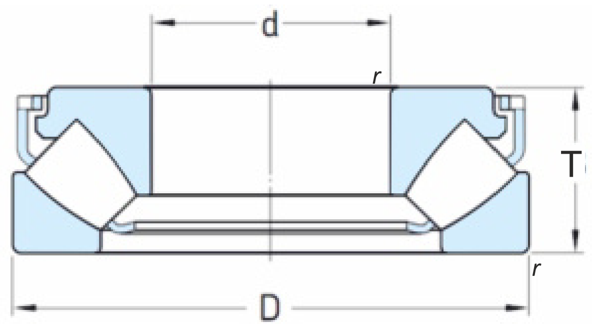
Spherical Roller Thrust Bearing



Equivalent bearing load

dynamic

$P_a = F_a + 1.2F$

Static

$P_{oa} = F_a + 1.2F$

When $\frac{Fr}{Fa} \leq 0.55$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf				
d	D	T	r	Ca	Coa	Ca	Coa	C_u		
360	500	85	4	1840	8200	187625	836154	455	**29272M**	45.90
360	640	170	7.5	5340	19700	544520	2008809	1130	**29472**	245.0
380	520	85	5.0	2000	9550	203940	973814	742	**29276EM**	51.50
380	670	175	7.5	6800	24000	693396	2447280	1780	**29476EM**	245.0
400	710	185	7.5	7600	26200	774972	2671614	1911	**29480EM**	290.0
420	580	95	5.0	1950	9500	198842	968715	715	**29284EM**	77.0
440	780	206	9.5	7650	30000	780071	3059100	1570	**29488**	394.0
460	800	206	9.5	7620	30500	777011	3110085	2141	**29492EM**	420.0
480	850	224	9.5	9300	36500	948321	3721905	1920	**29496**	493.0
500	870	224	9.5	9320	37100	950360	3783087	2540	**294/500M**	540.0
560	980	250	12.0	11900	48600	1213443	4955742	3213	**294/560E**	760.0
630	1090	280	12.0	14400	62000	1468368	6322140	3965	**294/630EM**	1010.0
750	1280	315	15.0	18700	85000	1906839	8667450	5172	**294/750EF**	1569.0
750	1280	315	15.0	15000	76000	1529550	7749720	4624	**294/750EM**	1520.0

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22 Railway Bearing Technical Data

22.1 Bearing and Axle Box details for Railway Applications

NBC provides cost effective solution and bearings to meet railway requirements. The bearings are specially designed to sustain harsh environment, shock & variable loads and high temperature. The railway product includes axle boxes and different types of bearings.

NBC is manufacturing axle boxes and bearings for fitment to

- locomotives
- ICF broad and meter gauge coaches, as well as
- For various wagon builders.

Cylindrical Roller bearings

Cylindrical Roller bearings are used in all traction motors for electric locomotives and electric cars. These bearings are utilized due to their high-speed and heavy-load capabilities, as well as their ease of assembly and disassembly.

Insulated bearings were developed for traction motor

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Cartridge Tapered Roller Bearing

CTRB bearings are highly integrated with surrounding components and advanced sealing mechanisms. They offer outstanding performance and durability.

CTRB inch series are approved by the Association of American Railroads (AAR) for use on freight car axles and has been widely used in markets all over the world.

Optimo series: Upgraded cartridge tapered roller was developed for 25 ton axle load.

Spherical Roller Bearings

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

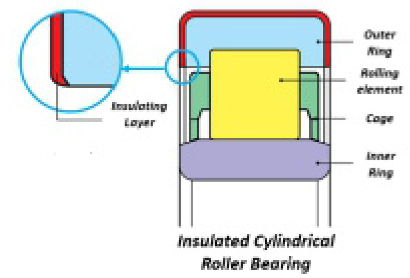
"Insuohm" Insulated Cylindrical Roller Bearing

Electrical insulation coating to prevent electrical pitting in the bearings and hence improved bearing life in Traction motor bearings. Features:

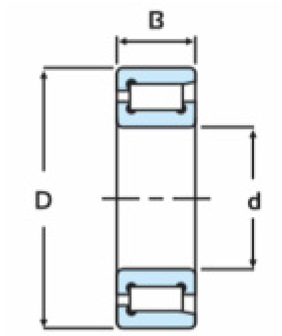
- Improves bearing life in electrical current passage
- Optimized coating with plasma spray process
- High insulation resistance
- High dimensional stability after coating
- Easy to mount

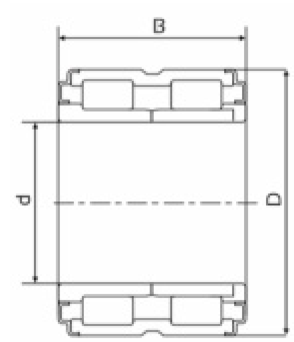
Benefits:

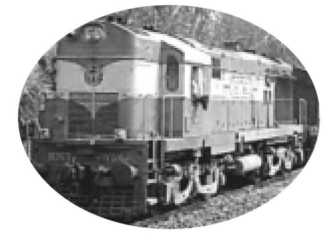
- Benefits:
- Higher operational reliability
- Increased machine uptime
- Reduced overall operating costs
- Improves lubricant life
- Insulation over wide range of operating temperature.



Bearings and Axle Boxes For Diesel Electric Locomotives

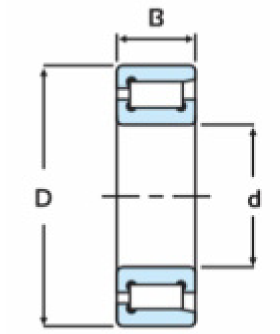


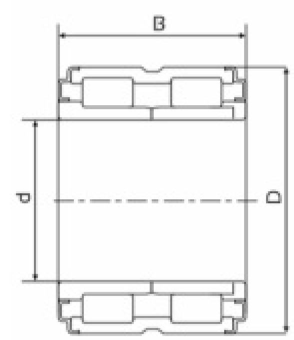


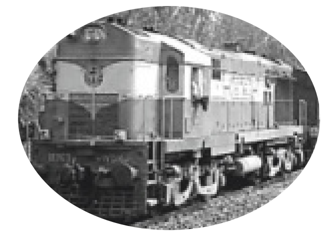


Locomotives	NEI Assembly Drg.	Boundary Dimensions mm				Basic Load Rating KN		Basic Load Rating Kgf		Fatigue load limit KN	Bearing Number
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
ZDM4	X-158	100	200	67	4.0	441	496	44963	50536	54	WJ100X200 & WU100X200W
YDM4, YDM4A	92-4253 X-151 (Step Size)	120 118	215 215	60 60	4.0 4.0	419 419	540 540	42713 42713	55054 55054	56 56	L6179 & L6180 RB5069 & RB5070
WDS5, WDS6, WDM2, WCG2, WAM4, WAM4A, WAG5, WAG5A, WCAM1	92-4271C X-119 (Step Size)	150 148	270 270	80 80	2.0 2.0	718 718	932 932	73206 73206	95036 95036	91 91	L6204 & L6205 RB5043 & RB5044
WDM3A, WAM4	X-105 X-141 (Step Size)	150 148	270 270	80 80	2.0 1.5	718 718	932 932	73206 73206	95036 95036	91 91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022 RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
WDS3	92-4204	200	360	98	4.0	1022	1370	104245	139691	123	L6019 (2 Nos.)
WDS4	92-4277A	200	360	236	1.6	1756	2742	179019	279551	245	L6207 (1-Set)
WDP3A, WAP3, WAP6	X-180 (End Axle) X-180 (Middle Axle)	150 150	270 270	80 80	2.0 2.0	718 718	932 932	73206 73206	95036 95036	91 91	L6204 & L6205 RB5020 (2 Nos.) with Special Loose Lip RB5022
WDP1	X-174	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
WDG3A, WDM3B, WDM3D	X-171 X-182	150 148	270 270	80 80	2.0 1.5	718 718	932 932	73206 73206	95036 95036	91 91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022 RB5062 (2 Nos.)

Bearings and Axle Boxes For Diesel Electric Locomotives

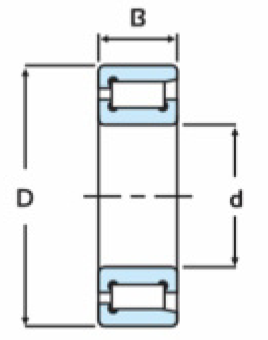


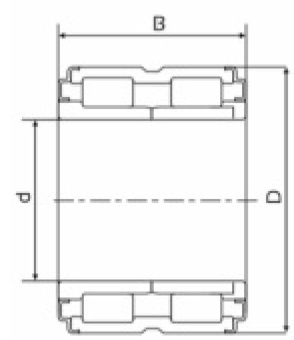


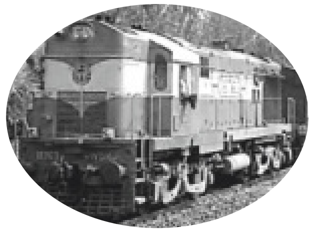


Locomotives	NEI Assembly Drg.	Boundary Dimensions mm				Basic Load Rating KN		Basic Load Rating Kgf		Fatigue load limit KN	Bearing Number
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
WAP1, WAP4	X-122	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-186 (Step Size)	148	270	80	1.5	718	932	73206	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
Sri Lankan Railways (SL3200WB)	X-187	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
Malaysian Railways 2300HP	X-188	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
WDP4	X-190	Refer CTRB Page of Catalogue									Adapter Assembly with CTRB 6-1/2x12 Class 'F' Bearing
WDG3A, WDM3D	X-191	150	270	174	1.2	1434	1980	146184	201901	193	RB5081D-E (End Axle) RB5081D-M (Middle Axle)
WDM3D, WDM3E, WDM3F	X-192	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
2300 HP Cape Gauge Diesel Electric Locomotive	X-194	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022

Bearings and Axle Boxer For Diesel Electric Locomotives

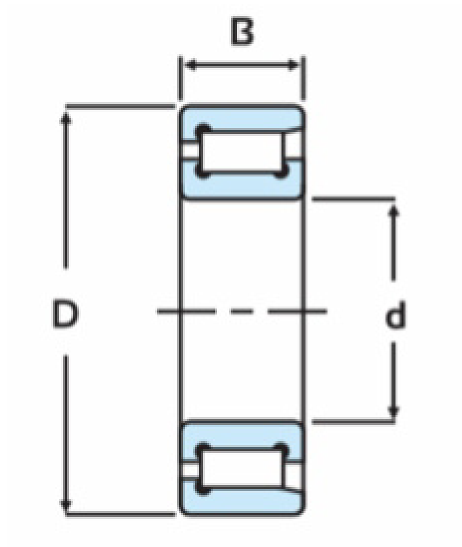


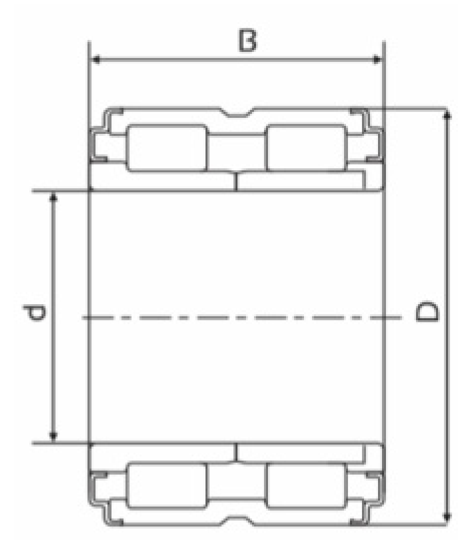


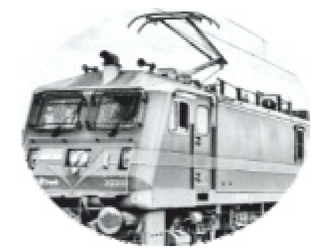


Locomotives	NEI Assembly Drg.	Boundary Dimensions mm				Basic Load Rating KN		Basic Load Rating Kgf		Fatigue load limit KN	Bearing Number
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
WDM3A	X-197	150	270	174	1.2	1434	1980	146184	201901	193	RB5081D-E (End Axle) RB5081D-M (Middle Axle)
WDG3A, WDM3D	X-198	150	270	174	1.2	1434	1980	146184	201901	193	RB5081D-E (End Axle) RB5081D-M (Middle Axle)
WAG9, WAP7	X-181 X-202 (Step Size)	150 148	250 250	160 160	2.1 2.1	1326 1326	1800 1800	135163 135163	183546 183546	178 178	RB5080D RB5088D
Sri Lankan Railways M8A Loco	X-205	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
WDP1M	X-211	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021
WDP3AM	X-212	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5022 L6204 & L6205

Bearings and Axle Boxer For Electric Locomotives

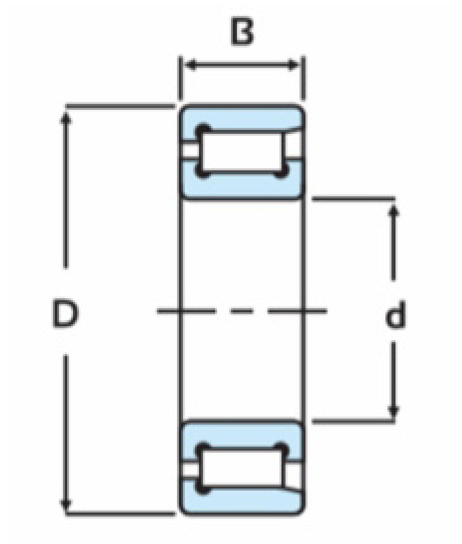


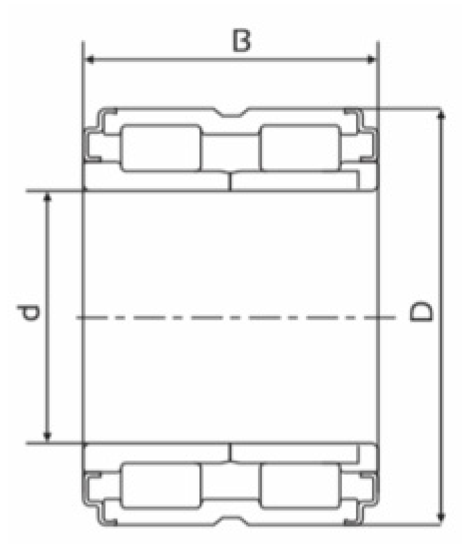




Locomotives	NEI Assembly Drg.	Boundary Dimensions mm				Basic Load Rating KN		Basic Load Rating Kgf		Fatigue load limit KN	Bearing Number
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
WAM4, WAM4A, WAG5, WAG5A,	92-4271C	150	270	80	2.0	718	932	73206	95036	91	L6204 & L6205
WAG5C, WAG5D, WCAM1, WCG2	X-119 (Step Size)	148	270	80	2.0	718	932	73206	95036	91	RB5043 & RB5044
WAM4, WAG5B, WCAM1	X-105	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-141 (Step Size)	148	270	80	1.5	718	932	73206	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
WAP3, WAP6	X-180 (End Axle)	150	270	80	2.0	718	932	73206	95036	91	L6204 & L6205
	X-180 (Middle Axle)	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5022
WAG7, WCM6	X-171	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-182 (Step Size)	148	270	80	1.5	718	932	73206	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064

Bearings and Axle Boxer For Electric Locomotives

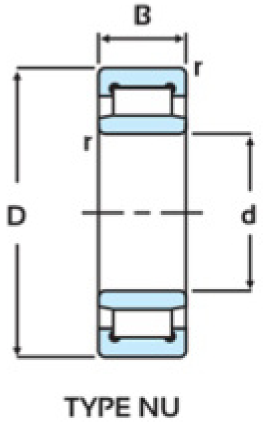


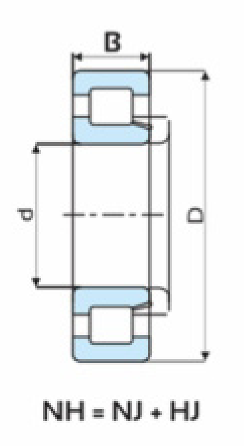


Locomotives	NEI Assembly Drg.	Boundary Dimensions mm				Basic Load Rating KN		Basic Load Rating Kgf		Fatigue load limit KN	Bearing Number
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
WAP1, WAP4	X-122	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-186(Step Size)	148	270	80	1.5	718	932	73206	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
WAP3, WAP6	X-149	150	270	80	2.0	718	932	73206	95036	91	L6204 & L6205
WAG9, WAP7	X-181	150	250	160	2.1	1326	1800	135163	183546	178	RB5080D
	X-202(Step Size)	148	250	160	2.1	1326	1800	135163	183546	178	RB5088D
WAG7	X-207	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-182(Step Size)	148	270	80	1.5	718	932	73206	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
WAG5HB, 1400 HP LOCO	X-179	150	270	80	2.0	718	932	73206	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022

Bearings for Traction Motor Suspension Unit Application

Cylindrical roller bearing





Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number	Mass Kg. (Approx.)
mm				KN		Kgf		KN		
d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu		
220	340	56	3	561	750	57217	76478	67	NH1044	20.6
320	440	56	3	700	1107	71379	112881	90	NU1964	24.7

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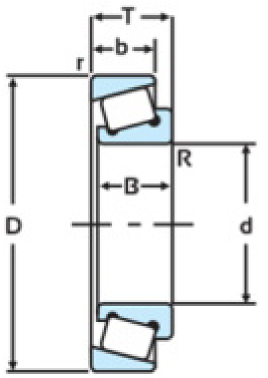
Single Row Taper Roller Bearings(Inch series)



Boundary Dimensions							Basic Load Rating				Fatigue load limit	e	Bearing Number	Mass Kg. (Apporox.)
mm							KN		Kgf		KN			
d	D	T	B	b	R	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu			
198.298	279.4	46.038	49.212	36.513	3.5	3.3	409	787	41685	80230	73	0.51	67981/67919	9.3
199.949	2794	46.038	49.212	36.513	3.5	3.3	409	787	41685	80230	73	0.51	67982/67919	9.0
220.662	314.325	61.912	66.675	49.212	1.6	5.0	700	1239	71379	126341	113	0.33	M244249A/N1060	15.0
221.17	314.325	61.91	66.675	49.212	1.6	5.0	700	1239	71379	126341	113	0.33	M244210/N1059	14.0
255.6	342.9	57.15	63.5	44.45	1.5	3.3	689	1282	70237	130766	113	0.35	M349547/M349510	13.80
257.175	358.775	71.438	76.2	53.975	1.5	3.3	920	1664	93763	169637	145	0.33	M249747/M249710	20.65

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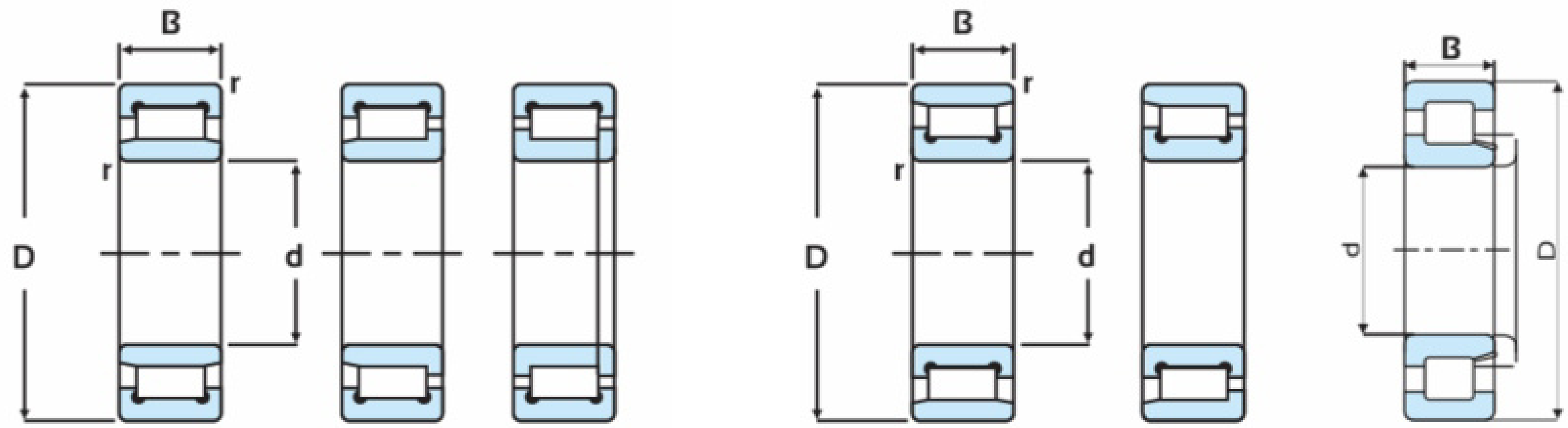
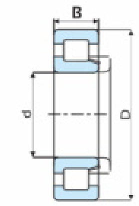
Cylindrical Roller Bearing for Traction Motor

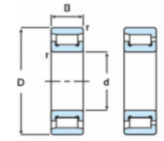


TYPE NU TYPE NJ TYPE NUP TYPE N TYPE NF NH = NJ + HJ

Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number	Mass Kg. (Apporox.)
mm				KN		Kgf		KN		
d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu		
90	190	43	3	315	355	32121	36199	39	TS2-NH318C L1BX C4 P6	6.7
90	190	43	3	315	355	32121	36199	39	TS2-NH318C L1BX2 C4 P6	6.6
100	215	47	3	380	425	38749	43337	45	TS2-NH320C L1BX CS123 PX1	9.8
100	215	47	3	380	425	38749	43337	45	TS2-NH320C L1BX2 CS123 PX1	9.8
120	215	40	2	390	430	39768	43847	45	TS2-NU224E L1BX C4 P6	6.8
120	260	55	4	475	550	48436	56084	55	TS2-NH324 L1BX1 CS175M P6	17.0
130	280	58	4	620	795	63221	81066	78	TS2-NU326C L1BX C4 PX1	18.8
140	300	62	4	663	797	67606	81270	77	TS2-NU328E L1BX C4 P6	22.4
140	300	62	4	663	797	67606	81270	77	TS2-NU328E L1BX2 C4 P6	22.3
150	320	65	4	800	985	81576	100440	93	TS2-NU330E L1BX1 CS188 P6	26.9
150	320	65	4	800	985	81576	100440	93	TS2-NU330C L1BX2 CS188 PX4	26.7
160	340	68	4	888	1102	90549	112371	102	TS2-N332E L1BX2 CS355	31.5
180	320	86	4	1100	1501	112167	153057	139	TS2-NU2236E L1BX2 C4	30.2

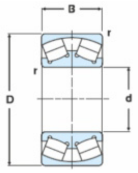
Insulated Cylindrical Roller Bearing for Traction Motor





Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number	Mass Kg. (Apporox.)
mm				KN		Kgf		KN		
d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu		
95	170	32	2.1	220	265	22433	27022	30	TS2-NH219E L1BX C4 P6 ZC2	3.5
100	215	47	3	450	469	45887	47824	50	TS2-NH320C L1BX CS123 PX1 ZC2	9.8
160	340	68	4	888	1102	90549	112371	102	TS2-N332E L1BX2 CS355 ZC2	31.5

Spherical Roller Bearing for Passenger Car Wheel Application



Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number	Mass Kg. (Apporox.)
mm				KN		Kgf		KN		
d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu		
100	215	73	3	600	730	61182	74438	77	22320	12.9
130	280	93	4	974	1231	99319	125525	120	22326	27.7
140	300	102	4	1131	1464	115328	149284	139	22328 BL1C3	33.8

Gear Box Bearing for Traction Motor Drive System

Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number	Mass Kg. (Apporox.)
mm				KN		Kgf		KN		
d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu		
320.675	406.4	50.8	3.3	510	1120	52005	114206	93	4TBL558548/10	14.8
157.162	223.838	46.038	3.3	300	555	30591	56593	56	4TBM432148A/11	5.5
127	206.375	47.625	3.3	295	485	30081	49455	51	4TB798/792	5.8
220	285	41	3	396	830	40380	84635	77	ETBT2DC220	6.4
210	285	41	3	396	830	40380	84635	77	ETBN1778	7.4
213	285	41	3	396	830	40380	84635	77	ETBN1779	7.1
216.5	285	41	3	396	830	40380	84635	77	ETBN1780	6.7
203.987	276.225	42.862	3.3	391	780	39870	79537	73	ETBLM241147/10	7.2
200.025	276.225	42.862	3.3	391	780	39870	79537	73	ETBLM241148/10	7.7

22.4 AAR Standard Cartridge Taper Roller Bearing (CTRB)

Cartridge Tapered Roller Bearings (CTRB) are manufactured by National Engineering Industries Ltd. Jaipur under the technical collaboration and license of M/s Amsted Rail INC, USA.
This bearing is a self-contained, pre-assembled, pre-adjusted, pre-lubricated and completely sealed unit. The bearing has been designed for rapid mounting/dismounting and long service life.

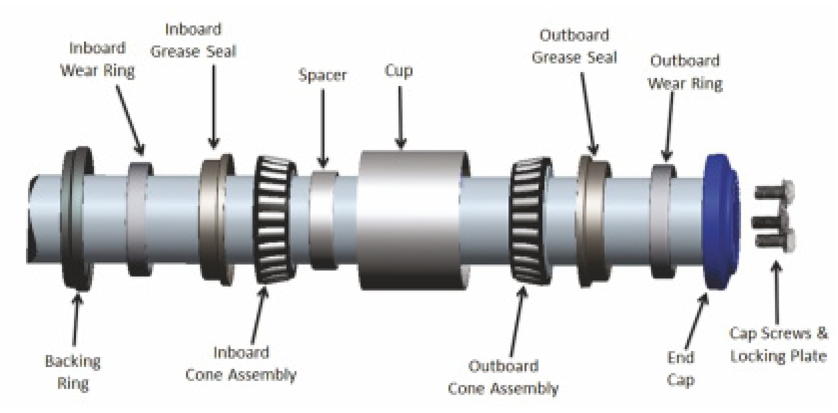


Fig. 1 Exploded View of Cartridge Tapered Roller Bearinga

CTRB parrt number details:

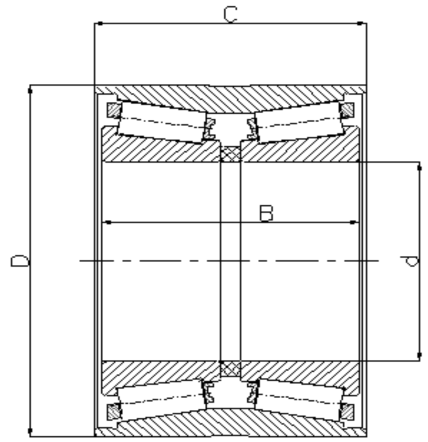
			CLASS 'C' (5X9)	CLASS 'D' (5-1/2X10)	CLASS 'E' (6X11)	CLASS 'F' (6-1/2X12)	CLASS 'K' (6-1/2x9)
REF	DESCRIPTION	QTY.	PART NO.	PART NO.	PART NO.	PART NO.	PART NO.
1	CONE ASSEMB	2	HM124646	HM127446	HM129848	HM133444	HM133444
2	DOUBLE CUP	1	HM124618XD	HM127415XD	HM129814XD	HM133416XD	G202
3	SPACER	1	HM124646XA	HM127446XA	HM129848XA	HM133444XA	G205
4	WEAR RING	2	906Z	1006Z	1106Z	1206Z	G206
5	EFFICIENCY PLU DDL SEAL	2	907ST	1007ST	1107G	1207G	G207G
6	BACKING RING	1	915NFZ	1015FZ	1115FZ	1215FZ	G215
7	AXLE END ASSEMBLY	1	911	1011	1111	1211	G211
7.1	AXLE END CAP	1	900	1000	1100	1200	G200
7.2	LOCKING PLAT	1	913	1013	1113	1213	1213
7.3	CAP SCREW	3	1012	1012	1112	1212	1212

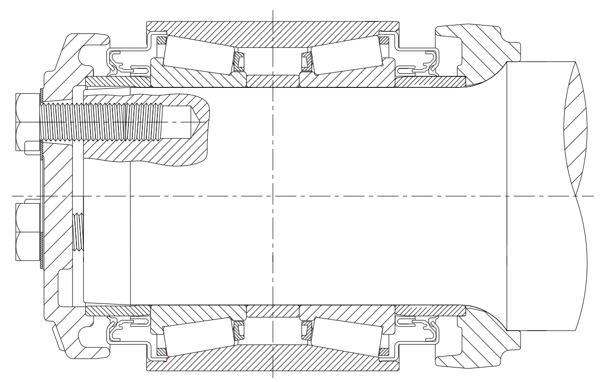
Upgraded Class E (6x11) CTRB OPTIMOX

Upgraded (OptimoX) Cartridge Taper Roller Bearing (CTRB 6x11 Class 'E') for 25 tonne axle load
Upgraded (Optimo series) Cartridge Tapered Roller Bearings (CTRB 6x11 Class 'E') are manufactured by National Engineering Industries Ltd. Jaipur.

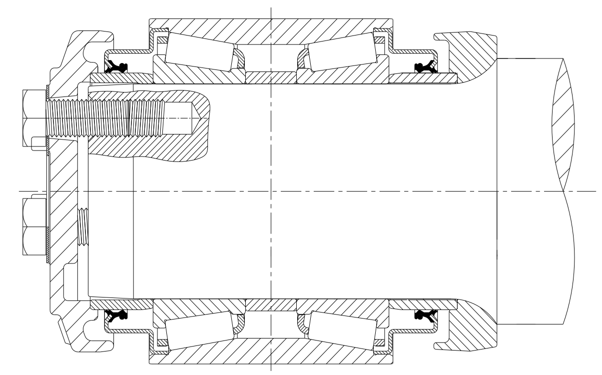
Upgraded (Optimo series) Bearing Benefits
- Best Grease Retention and Lower Torque (Efficiency Plus®)
-Increase in L, Bearing Life
-Stronger Polymer Cage for Rail Impact Conditions
- Optimized Raceways for the Rail Environment

AAR Standard Cartridge tapered Roller Bearings





CTRB Optimo Series



CTRB

Boundary Dimensions				Basic Load Rating				Fatigue load limit	Weight Kg	Designation	Performance	Cage	Bearing Size	Specification	Main Application
mm				KN		Kgf		KN							
d	D	B	C	Dynamic Cr	Static Co	Dynamic Cr	Static Co	Cu							
119.063	195.263	137.14	142.9	684	1109	69747	113085	119	25	CTRB CLASS C (5x9)	-	J	Class C	AAR	Freight
131.75	207.963	146.71	152.4	724	1232	73826	125643	129	27	CTRB CLASS D (5 1/2X10)	-	J	Class D	AAR	Freight
144.45	220.663	156.31	163.5	774	1348	78925	137436	138	33	CTRB CLASS E (6x11)	-	J	Class E	AAR	Freight
144.45	220.663	156.31	163.5	774	1348	78925	137436	138	33	CTRB CLASS E (6x11) - Optimo	LT	T2X	Class E	AAR	Freight
157.15	252.413	178.46	184.15	1052	1825	107272	186095	180	50	CTRB CLASS F (6 1/2X12) - Optimo	LT	T2X	Class F	AAR	Loco
157.15	249.873	154.25	160	1052	1825	107272	186095	180	40	CTRB CLASS K (6 1/2X9) - Optimo	LT	T2X	Class K	AAR	Freight

Codes	Description
LT	Low Torque Seal
T2X	Polyamide Cage
J	Pressed Steel Cage
AAR	According to AAR standard for axle bearings

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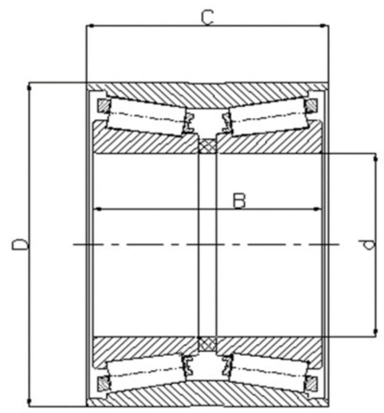
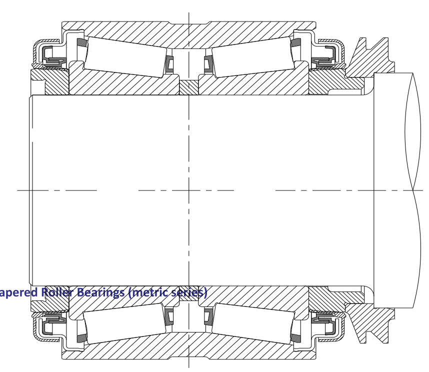
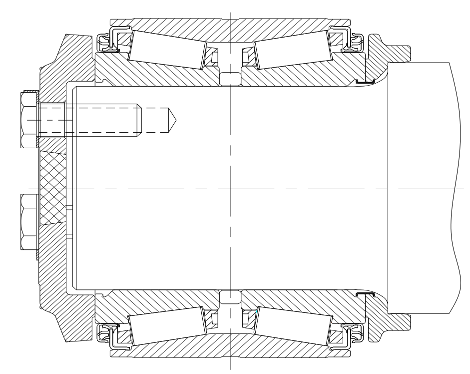
METRIC CARTRIDGE TAPERED ROLLER BEARINGS





CTRB Optimo (TBU)



CTRB Optimo (UTRB/ CTBU)

Boundary Dimensions				Basic Load Rating				Fatigue load limit	Weight	Designation	Performance	Cage	Bearing Size	Specification	Main Application
mm				KN		Kgf		KN	Kg						
d	D	B	C	Dynamic Cr	Static Co	Dynamic Cr	Static Co	Cu							
120	195	125	131.5	787	1109	80252	113087	118	17.3	UTRB 120x195x131.5 - Optimo(CTBU)	-	T2X	CTRB 120x195	EN 12080	Metro/Tram
120	195	125	131.5	787	1109	80252	113087	118	17.3	UTRB 120x195x131.5 (CTBU)	-	J	CTRB 120x195	EN 12080	Metro/Tram
130	230	151	160	980	1636	99933	166826	167	30.6	CTRB 130x230x160 - Optimo(TBU)	-	T2X	CTRB 130X230	EN 12080	Metro
130	230	151	160	980	1636	99933	166826	167	32.1	CTRB 130x230x160 - Optimo(TBU)	ZT	T2X	CTRB 130X230	EN 12080	Coach
130	240	170	160	1129	1727	115126	176106	176	34.0	CTRB 130x240x160 - Optimo(TBU)	-	T2X	CTRB 130X240	EN 12080	Coach
130	250	151	160	980	1636	99933	166826	167	40.07	CTRB 130x250x160 - Optimo(TBU)	-	T2X	CTRB 130x25	EN 12080	Loco
150	250	180	160	1054	1834	107478	187017	181	31.5	CTRB 150x250x160 - Optimo(TBU)	-	T2X	CTRB 150X250	EN 12080	Freight
150	250	154.5	160	1054	1834	107478	187017	181	31.5	CTRB 150x250x160 (TBU)	ZT	T2X	CTRB 150X250D	IR	Loco

Codes	Description
ZT	Zero Torque Seal
T2X	Polyamide Cage
J	Pressed Steel Cage
D	Groove with Oil hole on Cup for lubrication

Codes	Description
UTRB	Unitized Tapered Roller Bearing
CTRB	Cartridge Tapered Roller Bearing
EN 12080	According to EN 12080 for axle bearings
IR	Indian Railway

Electrically Insulated Bearings

Reliable Performance Where Electric Currents Threaten Bearing Life

Product Overview

Stray electrical currents in motor systems can silently damage standard bearings, leading to pitting, premature failure, and costlydowntime. Our specially coated Deep Groove Ball Bearings and Cylindrical Roller Bearings offer a proven solution—engineered with a high-performance electrical insulation coating to safeguard your assets and maximize uptime.

Why Choose Electrically Insulated Bearings?

- Protection Against Electrical Pitting
- Optimized Plasma Spray Coating
- High Resistance to Current Flow
- Preserved Dimensional Accuracy
- Easy Installation – No Special Fittings Required

Key Benefits

Boosts Bearing Longevity

Effectively blocks stray currents, minimizing damage and extending bearing life even in harsh, high load motor environments.

Maximizes Equipment Availability

Fewer failures mean less downtime—keeping your operations running longer and more efficiently.

Lowers Maintenance Costs

Reduces the need for frequent replacements and lubricant changes, offering a strong return on investment.

Improves Lubricant Performance

By preventing arcing and heat generation, the coating helps preserve lubricant quality for extended intervals.

Performs in a Wide Temperature Range

Delivers reliable insulation in various temperature conditions, ideal for demanding industrial and traction applications.

Ideal Applications

- Railway Traction Motors

Built to withstand vibrations, high loads, and electrical exposure in locomotives and rolling stock.

- Industrial Electric Motors

Perfect for automated systems, fans, compressors, pumps, and general-purpose motors vulnerable to stray currents.

- EV Motor Platforms

Tailored for the growing demands of high-performance electric vehicles, combining efficiency and endurance.

Built for the Future

Whether you're designing next-gen motors or upgrading existing systems, our electrically insulated bearings offer the durability, protection, and ease of integration you need to meet today’s performance standards.

Optimize your system reliability—choose coated bearings for electrical insulation.

HYBRID BEARINGS

Ceramic Balls & Rollers for High-Speed & Electrically Challenging Applications

ENGINEERED FOR THE FUTURE OF MOBILITY

NEI's Hybrid Bearings feature ceramic rolling elements and steel raceways, providing an advanced solution to the evolving demands of Electric Vehicles (EVs), high-speed motors, and electrically stressed environments. These bearings are optimized for reduced weight, electrical insulation, and superior speed stability.

FEATURE HIGHLIGHTS

Ultra-Hard Ceramic Balls - Withstand surface fatigue, minimize wear, and provide a longer lifespan.

Electrically Insulating Design - Ceramic rolling elements act as a natural barrier to current flow, eliminating electrical pitting.

Lubrication Flexibility - Performs reliably even under thin lubrication films or minimal lube conditions.

Low Friction Contacts - Reduced rolling resistance leads to smoother, quieter operation.

KEY BENEFITS

High-Speed Performance - Ceramic's light weight helps maintain stability at extreme rotational speeds.

Weight Reduction - Each ceramic ball reduces weight by approx. 58.5%, enhancing system efficiency.

Frictional Torque Reduction - Cut friction by up to 50%, resulting in energy savings and reduced heat generation.

Self-Healing Surface Properties - Improves service life and reliability in dusty or contaminated operating conditions.

APPLICATION SUITABILITY

?? High-Speed Electric Motors - Used in e-mobility systems, compressors, and industrial drives.

?? EV Transmissions & Axle Drives - Ideal for space-constrained, high-torque, high-RPM configurations.

?? Insulated Induction Motor Bearings - Protects against electrical leakage and improves motor lifespan.

PRODUCT OPTIONS

- Deep Groove Ball Bearings
- Cylindrical Roller Bearings
- Custom sizes available on request
- Coatings and seals optional for added protection

POLYMER INSULATED BEARINGS

Reliable Electrical Insulation through Advanced Polymer Overmolding
(Available in Deep Groove Ball Bearings and other standard configurations)

ROBUST INSULATION – BUILT RIGHT INTO THE BEARING STRUCTURE

NEI introduces the **Polymer Insulated Bearing Series**, a cost-effective and high-performance solution for electrical insulation. These bearings feature a specially formulated **polymer overmolded outer ring**, designed to act as an effective electrical barrier – achieving insulation resistance of **=400 M? at 2500 V DC** under standard conditions *(T < 40°C, RH = 60%)*. A reliable alternative to ceramic or coated solutions in motors subject to stray current damage.

FEATURE HIGHLIGHTS

- **Integrated Electrical Insulation**
  Polymer encapsulation provides superior protection against current leakage across the bearing.
- **Engineered for Cost Efficiency**
  A practical and affordable solution to prevent **electrical pitting** in motor applications.
- **Excellent Creep Resistance**
  The polymer maintains its structural integrity and adhesion, even under thermal or vibrational stress.
- **Moisture-Resistant Insulation**
  High insulation resistance is retained even in humid conditions, enhancing long-term reliability.

KEY BENEFITS

- **Prevents Bearing Damage from Electrical Currents**
  Reduces risk of surface fluting and arcing in electric motor bearings.
- **Improves System Reliability**
  Avoids unplanned downtime due to electrical erosion in motors and generators.
- **Cost-Effective Insulation Technology**
  Eliminates the need for additional insulating components or complex motor redesigns.
- **Versatile for Industrial Environments**
  Performs well across various climates and motor types, including environments prone to moisture or temperature variation.

APPLICATION SUITABILITY

- **Industrial Electric Motors**

Ideal for pumps, fans, conveyors, and compressors.

- **HVAC Systems and Generators**

Where continuous operation and reliability are critical.

- **General-Purpose AC Induction Motors**

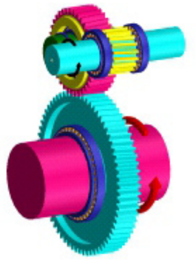
An excellent drop-in replacement for standard bearings to prevent stray current damage.

PRODUCT OPTIONS

- Deep Groove Ball Bearings
- Available in multiple bore sizes and outer diameters
- Customized solutions available for OEM applications
- Compatible with both sealed and open bearing configurations

LOCOMOTIVE DRIVE SYSTEM BEARINGS

Precision-Engineered for Power, Load, and Endurance in Rail Applications



DESIGNED FOR RAILWAY PERFORMANCE, BUILT FOR LONG-HAUL RELIABILITY

NEI's Locomotive Drive System Bearings are purpose-built to meet the high-load, high-impact, and continuous-duty demands of traction and drive systems in railway locomotives. Engineered using superior materials and precision design, these bearings deliver dependable performance over long service intervals in some of the harshest operating conditions.

FEATURE HIGHLIGHTS

- **Premium Bearing Steel**
  Manufactured using high-purity steel for exceptional fatigue life and wear resistance
- **Enhanced Micro-Geometry**
  Optimized roller and raceway profiles ensure smooth rolling contact, reduced stress concentrations, and better load distribution.
- **Versatile Cage Options**
  Available with polyamide or pressed steel cages, each tailored for performance and reliability under dynamic load conditions.
- **Superior Surface Finish**
  Polished raceway and roller surfaces reduce friction and operating temperature, extending bearing and lubricant life.
- **Improved Guiding Flange Design**
  Modified flange geometry ensures stable guidance of rolling elements under shock and axial forces—critical for locomotive traction loads.

- APPLICATION SUITABILITY
  - Traction Drive Systems in Diesel & Electric Locomotives
  - Built to withstand variable speeds, high torques, and demanding track conditions.
  - Gearbox and Final Drive Assemblies
  - Ensures long-life operation under vibration, shock loads, and misalignment.

ADVANTAGES AT A GLANCE

- Robust Construction for Rail Environments
- Extended Maintenance Intervals

Low Friction – High Efficiency

- Dimensional Accuracy for High-Speed Assembly Compatibility
- Customizable Cage and Design Options Available

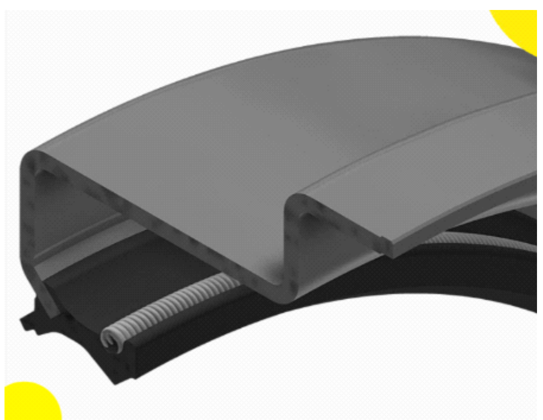
Seals

Our Joint Venture

NEI and Amsted® Seals are collaborating their diverse expertise and experience to develop a Greenfield project. We are best-in-class railway bearing seal manufacturing techniques products with the brand name nbc-*BRENCO*.

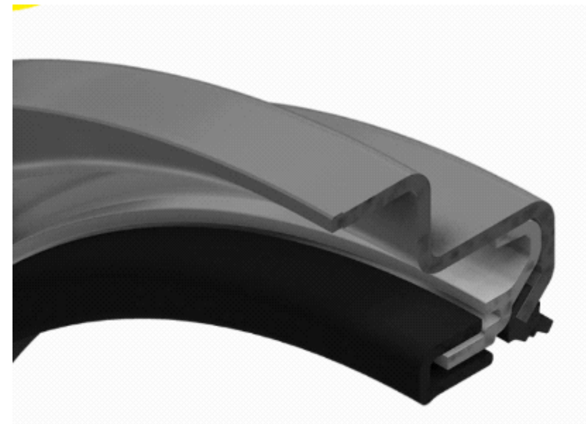
At NEI, we continually push the limits of sealing performance by engineering solutions that reduce maintenance, enhance bearing life, and ensure reliability under real-world operating conditions.

DDL® (Double Dust Lip Seal) BEARING SEALS



The Double Dust Lip (DDL) seal is a garter spring design seal. As the name suggests, it has two dust lips and a fluid lip that contains a garter spring to keep the lip tight to the wear ring. With the continued evolution in bearing seals design, this seal would be considered an entry-level seal. This design was, and still is in some markets, the workhorse in the freight industry for over 50 years; this Bearing Seal provides the basic function of keeping grease in and contaminates out. Due to the garter spring, this seal would contribute the highest torque and temperature addition to the bearing.

EFFICIENCY PLUS® BEARING SEALS



The Efficiency Plus (EP) seal has a lower torque value, less than 15 in-lbs, due to the removal of fluid lip by using poly inserts and rotors. The dust lip remains a molded part of the design but has a triple dust lip instead of a double dust lip. It also replaces the fluid lip with an interlocking insert and rotor that create a labyrinth. This labyrinth reduces the amount of resistance, torque, needed to rotate the seal while providing excellent grease.

Seal Descriptions

DDL

A reliable sealing system for general-purpose applications, offering **excellent grease and contamination control**. Suitable for **standard performance environments** with moderate operating speeds and temperatures.

- **Grease Retention:** High
- **Venting & Torque Performance:** Balanced
- **Best For:** Traditional rail and industrial bearing systems

Efficiency Plus Seal

A **next-generation seal design** with advanced geometry that balances **superior sealing performance** and **energy efficiency**. Designed for systems needing **low torque** and **extended service intervals**.

- **Torque & Temperature Range:** Exceptional
- **Venting Capability:** Superior
- **Best For:** High-speed, low-maintenance applications

Tru-Guard Seal

The **premium sealing solution** offering **maximum protection** in extreme environments. Built to withstand high contamination, moisture, and aggressive operating conditions.

- **All-Around Performance:** Exceptional across all key parameters
- **Ideal For:** Harsh-duty applications such as **heavy rail, off-highway, and mining**

Seal Type	**DDL - Seal**	**Efficiency Plus Seal**	**Tru - Guard Seal**
Grease Retention	Excellent	Exceptional	Exceptional
Dirt Exclusion	Excellent	Excellent	Exceptional
Water Exclusion	Excellent	Excellent	Exceptional
Operating Temperature	Good	Exceptional	Exceptional
Operating Torque	Good	Exceptional	Exceptional
Venting Capability	Good	Excellent	Exceptional

23 SI Units

Units Specified in SI System

Force

1 KN (Kilo newton)	=	1000N	=	102Kgf
1 Kgf	=			

Pressure

	=	9.81 N		
1 bar	=	10 N/cm^2	=	1.02 Kg/cm^2
1 Kgf/mm^2	=	9.81 N/cm^2	=	0.981 bar

Stress Contact Pressure

1 N/mm^2	=	1 Mpa (Mega pascal)
	=	0.102 Kgf/mm^2
1 Kgf/mm^2	=	9.81 N/mm^2

Torque

1 Nm	=	0.102 Kgf-m
1 Kgf-m	=	9.81 Nm

Energy

1 J (Joule)	=	1 Nm	=	1Ws (Watt Second)
	=	0.102 Kgf-m		
1 Kgf-m	=	9.81 ws	=	9.81 Nm
			=	9.81 J

Power

1 W	=	1J/s	=	1 Nm/s = 0.102 Kgf-m/s
1 KW	=	1.36 PS	=	102 Kgf-m/s
1 PS	=	0.736 KW	=	75 Kgf-m/s
1 Kgf-m/s	=	9.81 N-m/s	=	9.81 J/s
	=	9.81 W		

Kinematic Viscosity

$1mm^2/s$	=	1cSt (Centistoke)

24 Steel Balls

Steel Balls

INCH SIZE		METRIC SIZES	
Basic Diameter	Weight per 1000 balls in kg	Basic Diameter	Weight per 1000 balls in kg
7/64	0.08722	3	0.1102
1/8	0.1302	3.5	0.1769
5/32	0.2543	4	0.2630
3/16	0.4395	4.5	0.3707
7/32	0.6979	5	0.5086
15/64	0.8583	5.5	0.6804
1/4	1.042	6	0.8788
17/64	1.250	6.5	1.1295
9/32	1.483	7	1.4107
5/16	2.035	7.5	1.7418
11/32	2.708	8	2.1001
3/8	3.516	8.5	2.522
13/32	4.469	9	3.003
7/16	5.582	10	4.110
15/32	6.867	11	5.489
31/64	7.576	12	7.121
1/2	8.333	13	9.027
17/32	9.996	14	11.295
9/16	11.87	15	13.73
19/32	13.96	16	16.78
5/8	16.28	17	20.18
21/32	18.84	18	24.00
11/16	21.66	20	32.88
23/32	24.75	21	38.10
3/4	28.13	22	43.82
25/32	31.79	23	49.90
13/16	35.77	24	56.70
		25	64.41
27/32	40.05		
7/8	44.66		
29/32	49.62		
15/16	54.93		
31/32	60.61		
1	66.67		

25 Conversion Table

Conversion Table

INCHES TO MILLIMETERS
FRACTIONS

Inches	Inches (fraction)	mm	Inches	Inches (fraction)	mm
1/64	.015625	.3969	33/64	.515626	13.0969
1/32	.03125	.7937	17/32	.53125	13.4937
3/64	.046875	1.1906	35/64	.546875	13.8906
1/16	.0625	1.5875	9/16	.5625	14.2875
5/64	.078125	1.9844	37/64	.578125	14.6844
3/32	.09375	2.3812	19/32	.59375	15.0812
7/64	.109375	2.7781	39/64	.609375	15.4781
1/8	.125	3.1750	5/8	.625	15.8750
	.140625	3.5719	41/64	.640625	16.2719
5/32	.15825	3.9687	21/32	.65625	16.6637
11/64	.171875	4.3658	43/64	.671875	17.0656
3/16	.1875	4.7625	11/16	.6875	17.4625
13/64	.201325	5.1594	45/64	.703125	17.8594
7/32	.21875	5.5562	23/32	.71875	18.2562
15/64	.234375	5.9531	47/64	.734375	18.6531
1/4	.25	6.3500	3/4	.75	19.0500
17/64	.255625	6.7469	49/64	.765625	19.4469
9/32	.28125	7.1437	25/32	.78125	19.8437
19/64	.296875	7.5408	51/64	.796875	20.2406
5/16	.3125	7.9375	13/16	.8125	.206375
21/64	.328125	8.3344	53/64	.828125	21.0344
11/32	.34375	8.7312	27/32	.84375	21.4312
23/64	.359375	9.1281	55/64	.859375	21.8281
3/8	.375	9.5250	7/8	.875	22.2250
25/64	.390625	9.9219	57/64	.890625	22.6219
13/32	.40625	10.3187	29/32	.90625	23.0187
27/64	.421875	10.7156	59/64	.921875	23.4156
7/16	.4375	11.1125	15/16	.9375	23.8125
29/64	.413125	11.5094	61/64	.953125	24.2094
15/32	.46875	11.9062	31/32	.96875	24.6062
31/64	.484375	12.3030	63/64	.984375	25.0031
1/2	.5	12.7000			

MILLIMETERS TO INCHES UNITS.

mm		10	20	30	40	50	60	70	80	90
0		.39370	.78740	1.18110	1.57480	1.96851	2.36221	2.75591	3.14961	3.54331
1	.03937	.43360	.82677	1.22047	1.61417	2.00788	2.40158	2.79528	3.18898	3.58288
2	.07874	.47244	.86614	1.25984	1.65354	2.044.95	2.83465	3.22835	3.22835	3.62205
3	.11811	.51181	.90551	1.29921	2.08662	2.08662	2.48034	2.87402	3.26772	3.66142
4	.15748	.55118	.94488	1.33858	1.73228	2.12599	2.15969	2.91339	3.30709	3.70079
5	.19685	.59055	.98425	1.37795	1.77165	2.16536	2.55906	2.95276	3.34646	3.74016
6	.23622	.62992	1.02362	1.41732	1.81103	2.20473	2.59843	2.99213	3.38583	3.77953
7	.27559	.66929	1.06299	1.45669	1.85040	2.24410	2.63780	3.03150	3.42520	3.81890
8	.31496	.70866	1.10236	1.49606	1.88977	2.28347	2.67717	3.07087	3.46457	3.85827
9	.35433	.74803	1.14173	1.53543	1.92914	2.32284	2.71654	3.11024	3.50395	3.89764

CONVERSION TABLE

MILLIMETERS TO INCHES UNITS.

mm		100	200	300	400	500	600	700	800	900
0		3.93701	7.87402	11.8110	15.7480	19.6851	23.6221	27.5591	31.4961	35.4331
10	.39370	4.33071	8.26772	12.2047	16.1417	20.0788	24.0158	27.9528	31.8898	35.8268
20	.78740	4.72441	8.66142	12.5984	16.5354	20.4725	24.4095	28.3465	32.2835	36.2205
30	1.18110	5.11811	9.05513	16.9921	16.9291	20.8662	24.8032	28.7402	32.6772	36.6142
40	1.57480	5.51181	9.44883	13.3858	17.3228	21.2599	25.1969	29.1339	33.0709	37.0079
50	1.96851	5.90552	9.84252	13.7795	17.7165	21.6536	25.5906	29.5276	33.4646	37.4016
60	2.36221	6.29922	10.2362	14.1732	18.1103	22.0473	25.9843	29.9213	33.8583	37.7953
70	2.75591	6.69292	10.6299	14.5669	18.5040	22.4410	26.3780	30.3150	34.2520	38.1890
80	3.14961	7.08662	11.0236	14.9606	18.8977	22.8347	26.7717	30.7087	34.6457	38.5827
90	3.54331	7.48032	11.4173	15.3543	19.2914	23.2284	27.1654	31.1024	35.0394	38.9764

FRACTIONS

mm	Inch	mm	Inch	mm	Inch
0.001	.000039	0.01	.00039	0.1	.0039
0.002	.000079	0.02	.00079	0.2	.0079
0.003	.000118	0.03	.00118	0.3	.0118
0.004	.000157	0.04	.00157	0.4	.0157
0.005	.000197	0.05	.00197	0.5	.0197
0.006	.000236	0.06	.00236	0.6	.0236
0.007	.000276	0.07	.00276	0.7	.0276
0.008	.000315	0.08	.00315	0.8	.0315
0.009	.000354	0.09	.00354	0.9	.0354

Inch	mm	Inch	mm	Inch	mm
0.001	.0254	0.01	0.254	0.1	2.54
0.002	.0508	0.02	0.508	0.2	5.08
0.003	.0762	0.03	0.762	0.3	7.62
0.004	.1016	0.04	1.016	0.4	10.16
0.005	.1270	0.05	1.270	0.5	12.70
0.006	.1524	0.06	1.524	0.6	15.24
0.007	.1778	0.07	1.778	0.7	17.78
0.008	.2032	0.08	2.032	0.8	20.32
0.009	.2286	0.09	2.286	0.9	22.86

Inch		mm		
		10	20	30
0		254.0	508.0	762.0
1	25.4	279.4	533.4	787.4
2	50.8	304.8	558.8	812.8
3	76.2	330.2	584.2	838.2
4	101.6	355.6	609.6	863.6
5	127.0	381.0	635.0	889.0
6	152.4	406.4	660.4	914.4
7	177.8	431.8	685.8	939.8
8	203.2	457.2	711.2	965.2
9	228.6	482.6	736.6	990.6

26 Hardness Conversion Table

Hardness Conversion Table (reference)

Rockwell hardness C scale 1471.0N (150kgf)	Vicker's hardness	BRINELL HARDNESS Standard steel ball	BRINELL HARDNESS Tungsten carbide steel ball	ROCKWELL HARDNESS A scale 588.4N (60kgf)	ROCKWELL HARDNESS B scale 980.7N (100kgf)	Shore hardness
68	940			85.6		97
67	900			85.0		95
66	865			84.5		92
65	832		739	83.9		91
64	800		722	83.4		88
63	772		705	82.8		87
62	746		688	82.3		85
61	720		670	81.8		83
60	697		654	81.2		81
59	674		634	80.7		80
58	653		615	80.1		78
57	633		595	79.6		76
56	613		577	79.0		75
55	595	-	560	78.5		74
54	577	-	543	78.0		72
53	560	-	525	77.4		71
52	544	500	512	76.8		69
51	528	487	496	76.3		68
50	513	475	481	75.9		67
49	498	464	469	75.2		66
48	484	451	455	74.7		64
47	471	442	443	74.1		63
46	458	432	432	73.6		62
45	446	421	421	73.1		60
44	434	409	409	72.5		58
43	423	400	400	72.0		57
42	412	390	390	71.5		56
41	402	381	381	70.9		55
40	392	371	371	70.4	-	54
39	382	362	362	69.9	-	52
38	372	353	353	69.4	-	51
37	363	344	344	68.9	-	50
36	354	336	336	68.4	(109.0)	49
35	345	327	327	67.9	(108.5)	48
34	336	319	319	67.4	(108.0)	47
33	327	311	311	66.8	(107.5)	46
32	318	301	301	66.3	(107.0)	44
31	310	294	294	65.8	(106.0)	43
30	302	286	286	65.3	(105.5)	42
29	294	279	279	64.7	(104.5)	41
28	286	271	271	64.3	(104.0)	41
27	279	264	264	63.8	(103.0)	40
26	272	258	258	63.3	(102.5)	38
25	266	253	253	62.8	(101.5)	38
24	260	247	247	62.4	(101.0)	37
23	254	243	243	62.0	100.0	36
22	248	237	237	61.5	99.0	35
21	243	231	231	61.0	98.5	35
20	238	226	226	60.5	97.8	34
(18)	230	219	219	-	96.7	33
(16)	222	212	212	-	95.5	32
(14)	213	203	203	-	93.9	31
(12)	204	194	194	-	92.3	29
(10)	196	187	187		90.7	28
(8)	188	179	179		89.5	27
(6)	180	171	171		87.1	26
(4)	173	165	165		85.5	25
(2)	166	158	158		83.5	24
(0)	160	152	152		81.7	24

1 Meter = 39.370113 inches
1 Inch = 25.399978 millimeters

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