



CK BIRLA GROUP



CATALOGUE/TC-106, 03/2021

This version supersedes all previously published versions. All the bearing mentioned in this catalogue are manufactured with normal tolerance class. We can, however, supply other class bearing against specific requirement.

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ROLLING BEARINGS

TECHNICAL CATALOGUE



2 WHEELERS



3 WHEELERS



4 WHEELERS



TRACTORS



LCV, HCV



INDUSTRIES



RAILWAYS



A symbol of dependability and flexible engineering solutions, NBC Bearings is the brand of National Engineering Industries. Founded in 1946, National Engineering Industries Ltd (NEI) is India's leading bearings manufacturer and exporter, renowned for excellence in quality and delivery. In 2021, NBC bearings completed 75 years of its incorporation.

Headquartered in Jaipur, having started with 30,000 bearings in 19 sizes in 1946, NBC has evolved to manufacture over 200 million bearings each year and supplying in 2300+ sizes to serve a host of customers in India and over 30 other countries across five continents in automotive, railways and industrial segments. NBC also serves the Indian aftermarket through a countrywide network of 550+ authorized stockists and thousands of retailers.

With an employee strength of over 2,800 and five manufacturing plants in Jaipur, Newai (Rajasthan), Manesar (Haryana) and Vadodara (Gujarat), NEI is equipped with global manufacturing and process technology and one of the best R&D centres in the country. In 2020, NEI acquired Kinex Bearings based in Europe.



Industry segments NEI caters to:

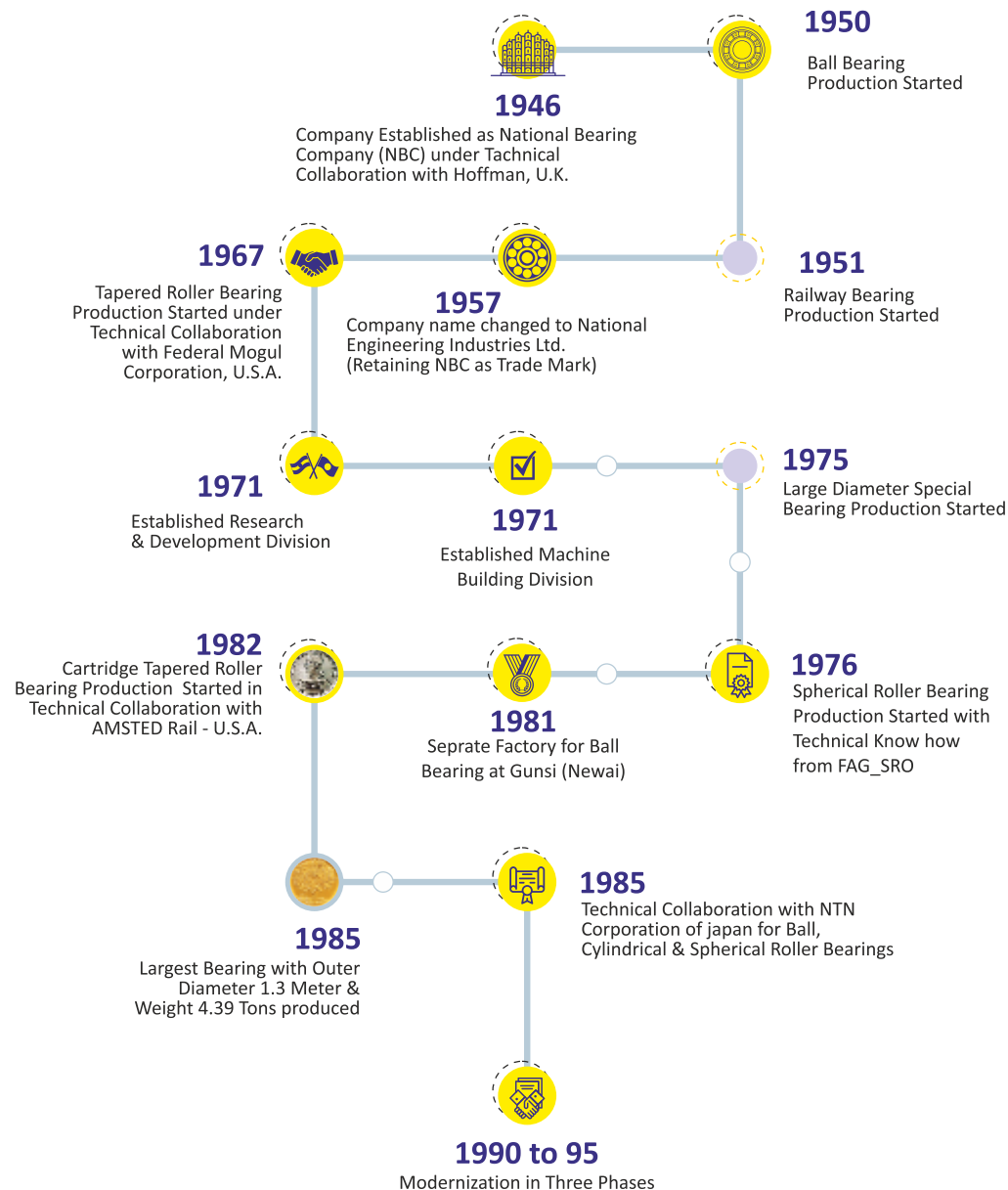
Automotive: Leading supplier to automotive OEMs and aftermarket with a wide range of products and services.

Railways : Partnering Railways around the world with bearings for Locomotives, Wagons and Coaches.

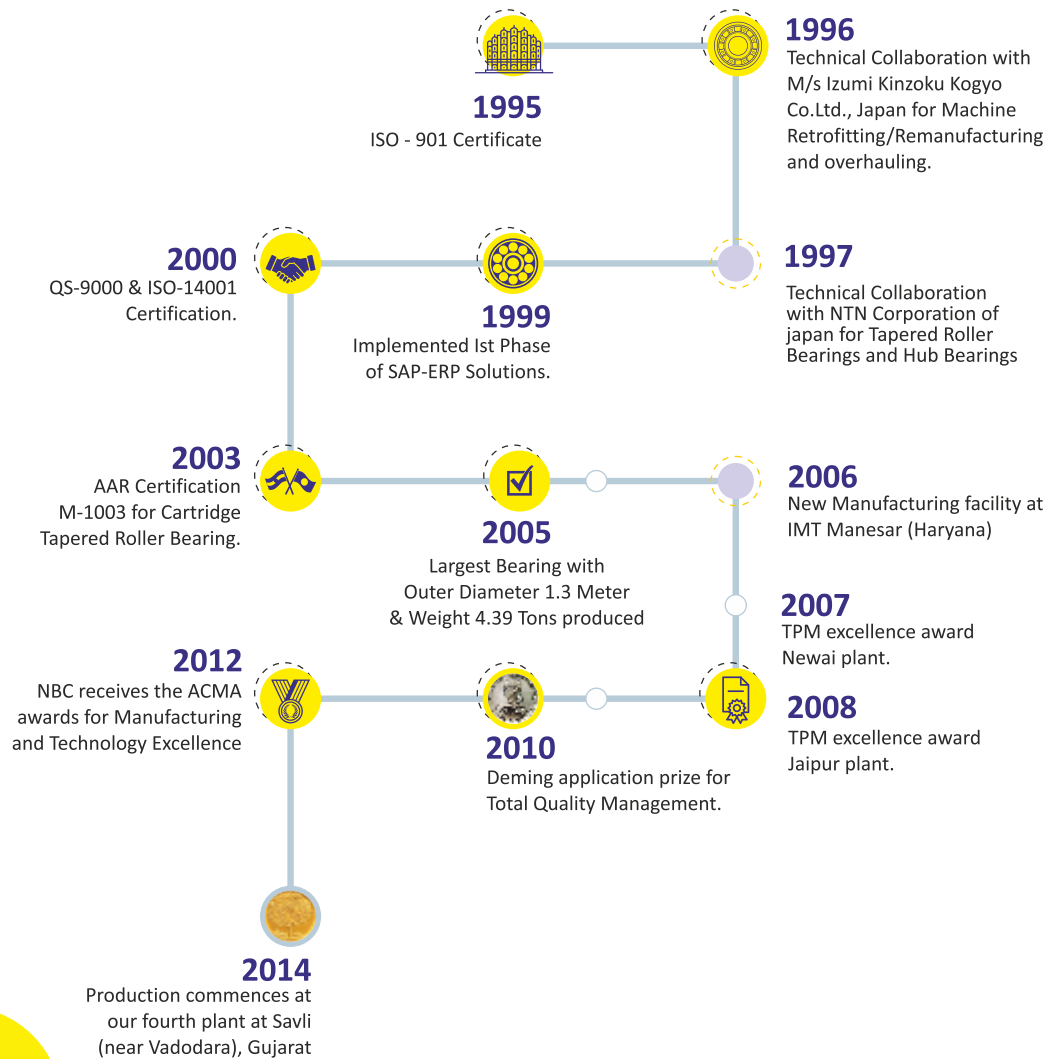
Industrial: Catering to diverse industries from Power, Steel, Cement, Construction, Mining to Electric motor, Material Handling, Textile etc.

Apart from being technologically advanced, the company practices methods of sustainability by using alternate sources of energy and increasing the efficiency of the manufacturing process by leveraging on the power of digitization.

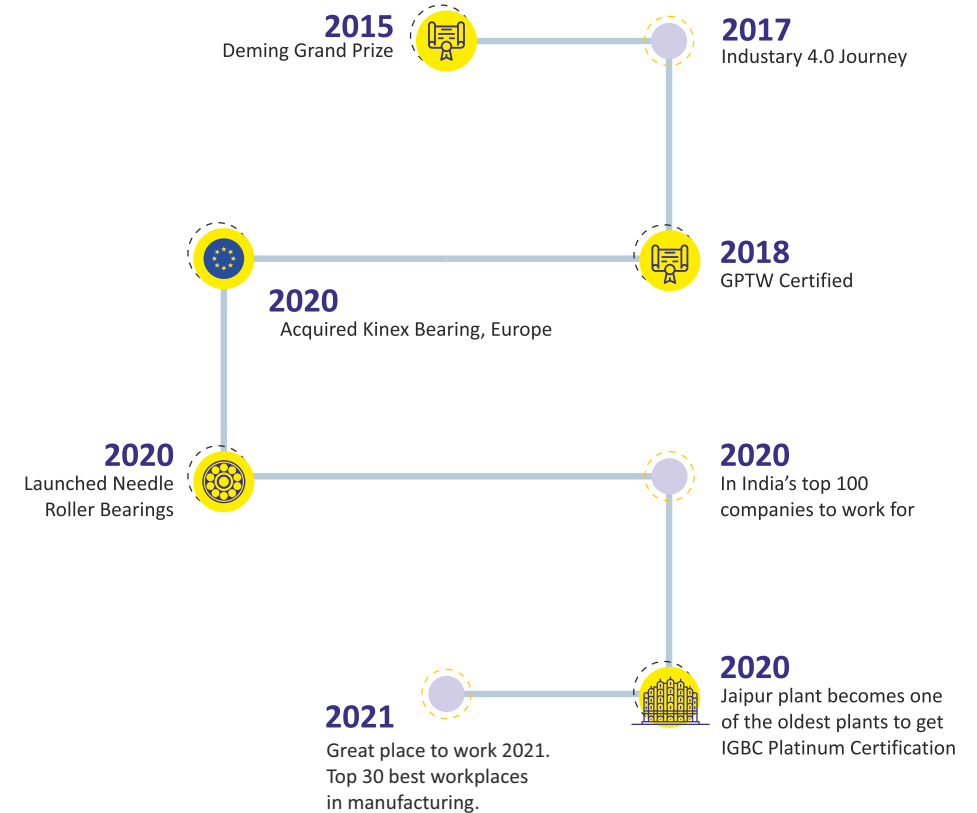
MILESTONES



MILESTONES



MILESTONES



Manufacturing Capabilities

- 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



Technology Centre

APPLICATION ENGINEERING

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

PRODUCT DEVELOPMENT

- Program Management
- Sourcing
- New Product Development

CENTRAL ENGINEERING

- Plant Support
- New Process Development

TECHNOLOGY FUNCTION

- Low Torque Bearings
- Fuel Efficient Bearings
- Tribology & 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



Value Proposition

-  Flexibility to provide new products within 150 days from concept to development
-  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 Bearings

When two metal parts of a machine comes 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 :

- (I) 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

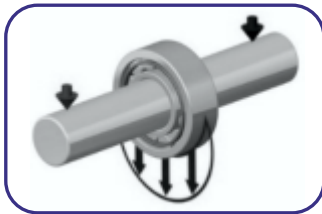
Due to their wide availability and versatility, rolling element bearings are, perhaps, the most widely used bearing type.

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 a turning and a 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



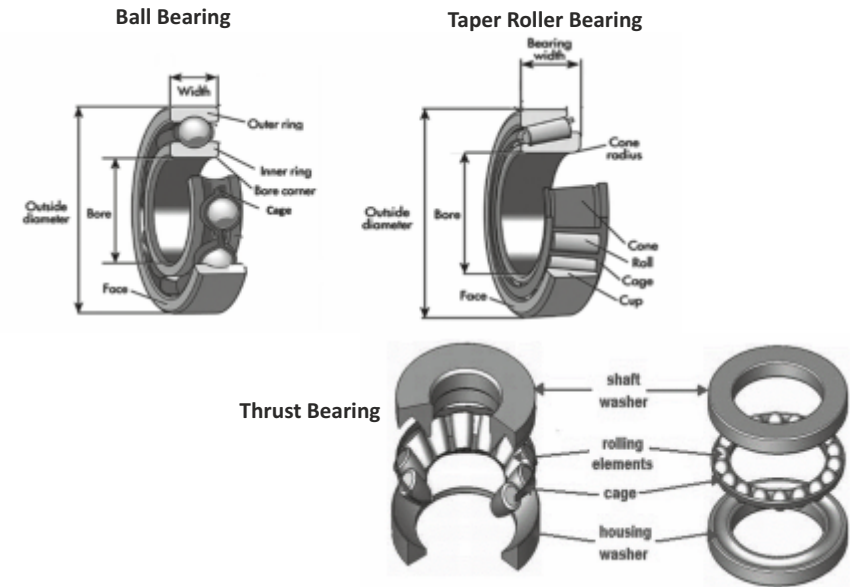
In addition depending upon the type of rolling elements these are further classified into

- 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.

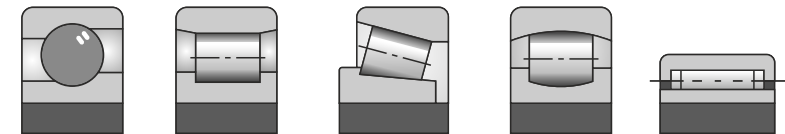
Depending on the design of the rolling bearing, the rolling surfaces may vary, but the standard configuration of a rolling element bearing comprises two rings (inner and outer), rolling elements like rollers or balls and a cage which keeps the rolling element apart and guides them. Some bearings also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



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.



Ball Cylindrical Roller Tapered Roller Spherical Roller Needle Roller

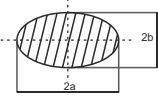
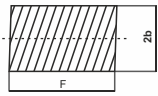
Cages: Main function is to separate rolling element and to maintain rolling at a uniform pitch such that load is never applied directly to the cage and also to prevent the rolling elements from falling out. Types of cages differ according to way they are manufactured, and include pressed, machined and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

1.2 Characteristics of Rolling Bearings

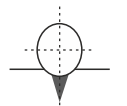
When compared with sliding bearings, rolling bearings have the following advantages:

- 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

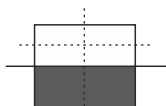
	Ball Bearing	Roller Bearing
Contact with raceway	 Point Contact Contact surface is oval when load is applied	 Linear Contact Contact surface is generally rectangular when load is applied.
Characteristics	Because of point contact there is little rolling resistance, ball bearing are suitable for low torque 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.

BALLS



Small Contact Area

ROLLERS

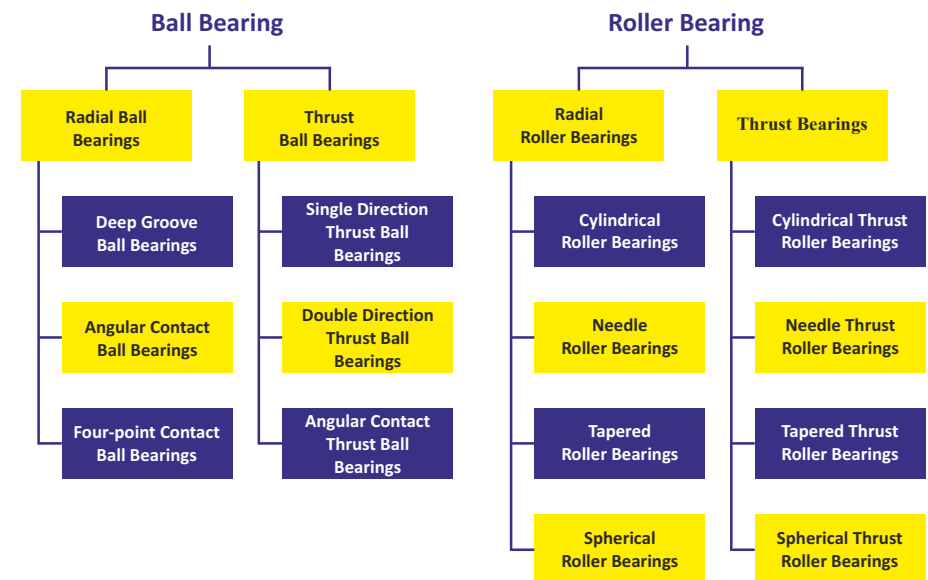


Large Contact Area

1.3 Rolling Bearing Classification

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

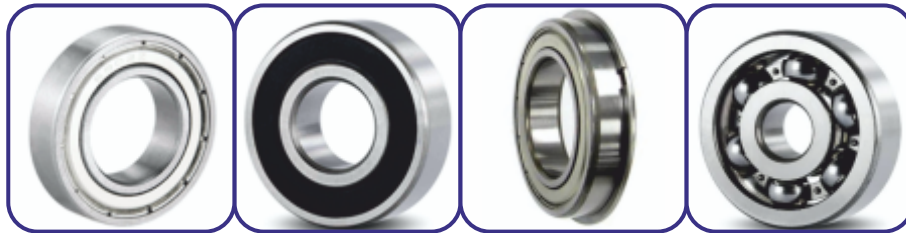
- Depending upon the direction of load to be supported
- Depending upon the type of loading (Steady or fluctuating load)
- Depending upon the type of rolling element (ball or roller)



1.3.1 Single 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

Plain Bearing

NBC offers 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.

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

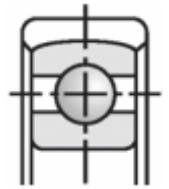


Four Point
bearings



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.



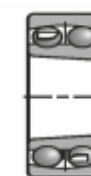
1.3.3 Self-Aligning Ball Bearing

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.

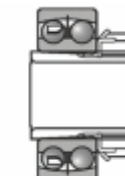
The double row self-aligning ball bearings with tapered clamping sleeve and nut are identical to double row self-aligning ball bearing except that these have a tapered bore. Bearing are mounted on the shaft using a sleeve and nut for clamping.



Cylindrical
Bore



Tapered
Bore



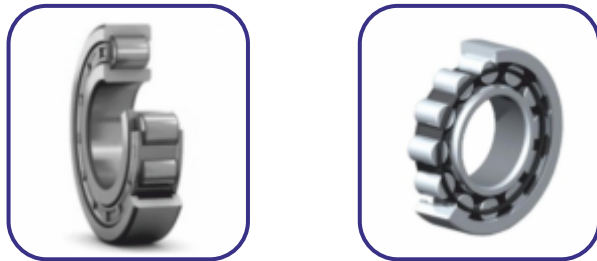
Tapered Clamping
Sleeve and Nut



Self-Aligning
Ball Bearing

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.



Cylindrical Roller Bearing with Brass & Steel Cage



Single Row

Double Row

Four Row

1.3.5 Taper Roller Bearing

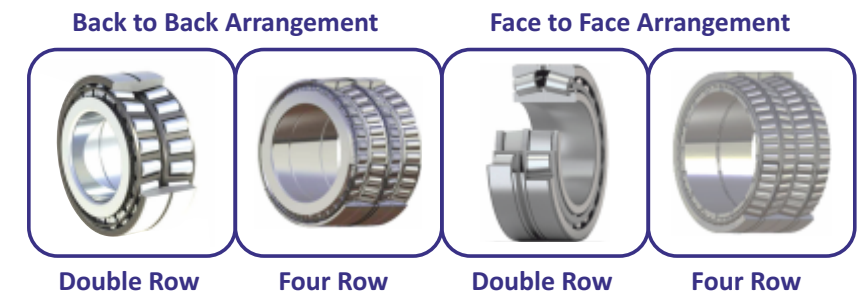
Tapered roller bearings consist of cup, cone, retainer and tapered rollers. Tapered roller bearings are designed in such a way that vertices of the cone for each roller and those for the cone and cup raceways coincide on the bearing axis or extensions of the raceways and rollers converge at a common 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 provides 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.



Double Row

Four Row

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.



Cylindrical bore



Tapered bore



Spherical Roller Bearing

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 the bearing.

- 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.



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 carrying 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

The cage is an important component of a rolling bearing. The functions performed by the cage are:

- It prevents the mutual contact between the rolling elements by keeping it apart.
- Due to the cage, the rolling elements are evenly spaced which ensures even load distribution.
- It guides the rolling elements and prevent them from falling.

There are pressed cages as well as solid cages:

Pressed cages are made from sheet steel, or sometimes from brass sheet. Their main advantages are light weight and low material cost.

Solid cages are made from brass, steel, light metal or textile-laminated phenolic resin. They are manufactured either by machining, by injection molding of plastic materials or by sintering metals.



Stamp Type Cage



Pin Type Cage



Finger Type Cage



Brass Cage



Molded Type Cage

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 to heavy contact type.

The materials used for seals are NBR (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.

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



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-hardened bearings feature 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 the 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.

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:

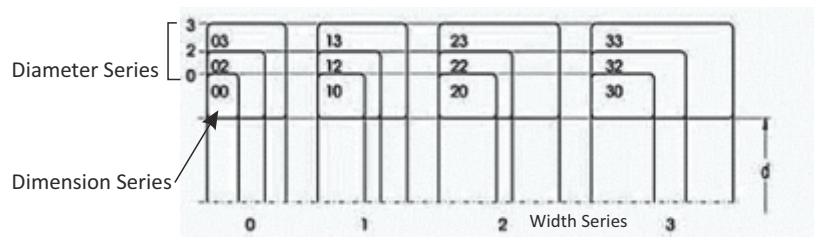
1. Bearings size code for the following bore diameter are:

- 00 = 10 mm
- 01 = 12 mm
- 02 = 15 mm
- 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 = 7 mm) 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=28 mm)

Bearing Series indicates the bearing type and the dimension series.

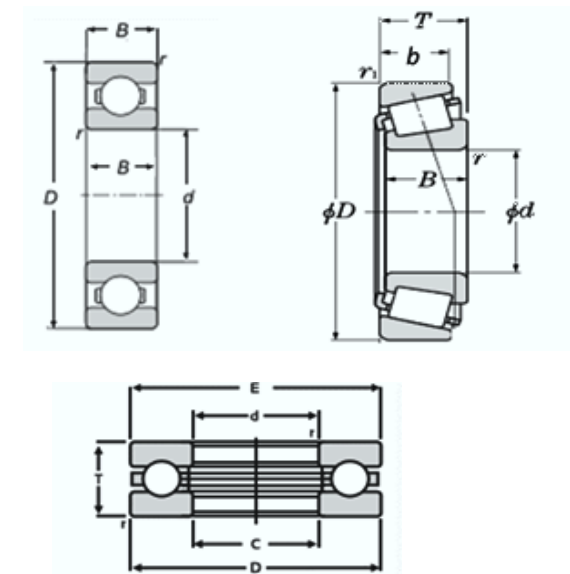


Deep Groove Ball Bearing	160XX, 68XX, 69XX 60XX, 62XX, 63XX, 64XX,
Angular Contact Ball Bearing	32XX, 33XX, 72XX, QJ2XX, QJ3XX
Self – Aligning Ball Bearing	N2XX,, N3XX, N4XX ,NJ2XX, NJ3XX, NJ4XX , NJ22XX,NJ23XX, NU2XX, NU3XX, NU4XX, NU10XX, NU22XX, NU23XX, NUP3XX,NUP4XX, NUP22XX,NUP23XX, NN30XX, NNU49XX
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.

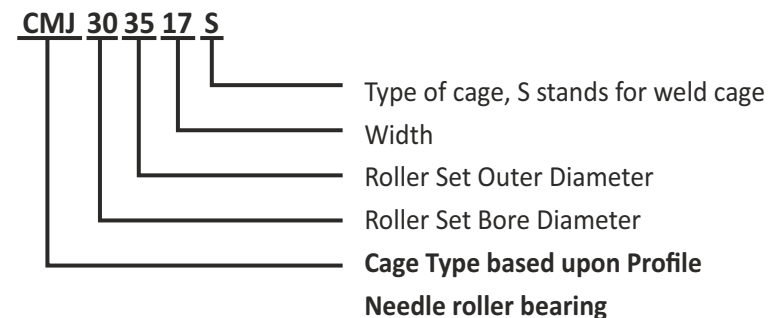
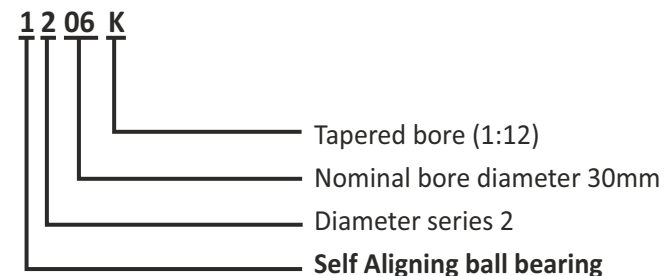
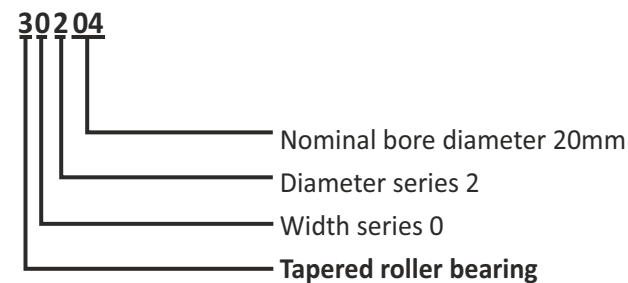
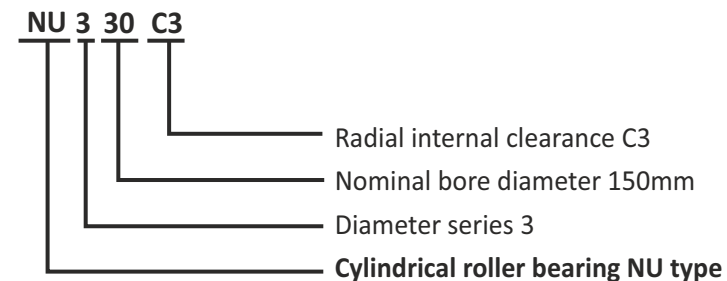
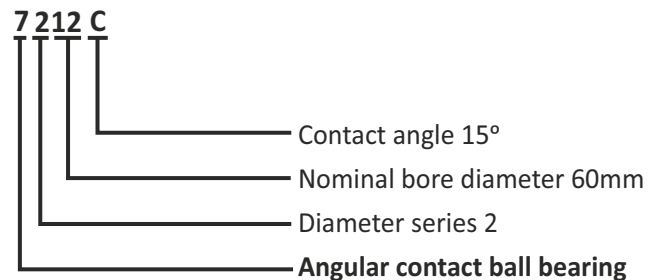
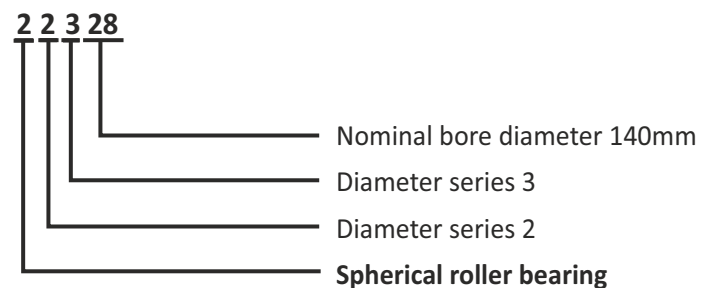
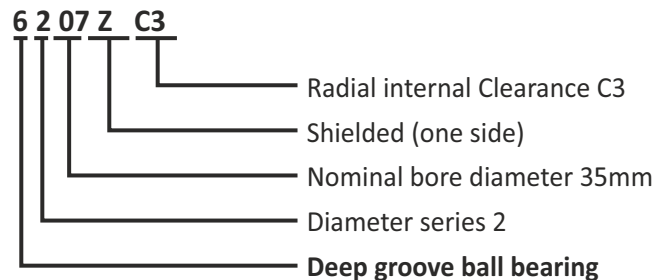
The boundary dimensions for metric bearings based on ISO standards are:

- 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.



2.2 Bearing Nomenclature:

Bearing Basic Number

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

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)
M-	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 & cupsfor taper roller bearing- inch series)
N-	Taper bearing having non-standard boundary dimensions
N-	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

NOMENCLATURE: BEARING SUFFIXES

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 temperture-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-	Polyamide Cage with Flange
G2-	Pin type steel cage
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

P0-	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
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 needle roller bearing
F	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.

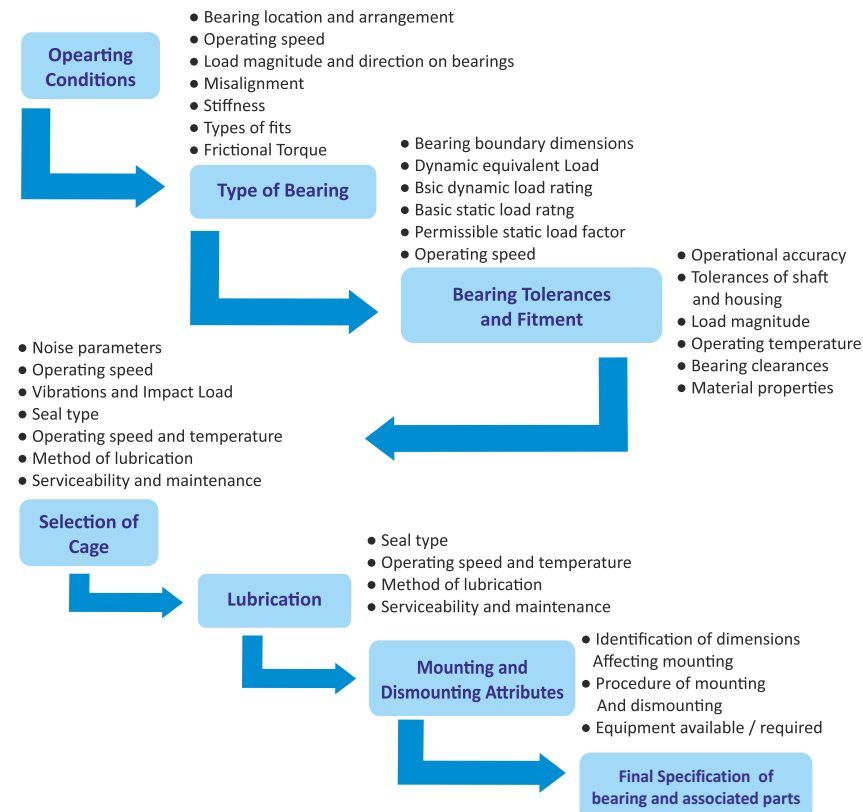


Figure 3.1 Flow Chart for Bearing Selection

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

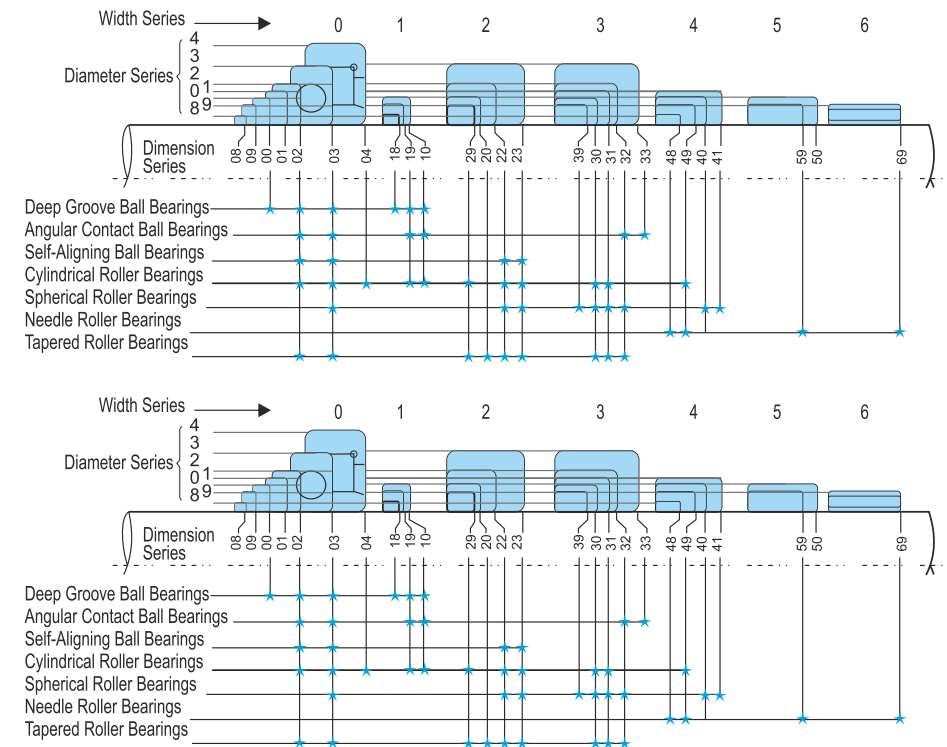


Figure 3.2 Different types of bearing and dimension series of rolling bearing

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.

Bearing Type	Radial Load Capacity				Axial load Capacity			
	1	2	3	4	1	2	3	4
Deep Groove Ball Bearing	1				1			
Angular Contact Ball Bearing	1				1	2		
Cylindrical Roller Bearing	1	2			1			
Taper Roller Bearing	1	2			1	2	3	
Spherical Roller Bearing	1	2	3	4	1			

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.

Deep Groove Ball Bearing	Relative Permissible Speed				
	1	4	8	12	16
Deep Groove Ball Bearing	1	4			
Angular Contact Ball Bearing	1	4	8		
Cylindrical Roller Bearing	1	4			
Needle Roller Bearing	1	4			
Taper Roller Bearing	1	4			
Spherical Roller Bearing	1	4			
Thrust Bearing	1	4			

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

- (a) Location of bearings in arrangement for ease of mounting and dismounting.
- (b) Variations in temperature leading to expansion and contraction of shaft.
- (c) Deflection of shaft as well as errors during mounting (if any) causing misalignment in bearing.
- (d) Bearings ability to sustain loads at their mounting position.

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

Fixed side bearing:

The bearing which prevents axial movement of the shaft relative to housing is fixed bearings. Fixed side bearing is able to support radial and axial loads. A bearing that can fix the axial movement in both 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 spherical roller bearings.

Table 3.2 Some Bearing arrangements and their applications

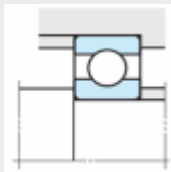
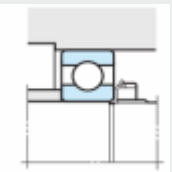
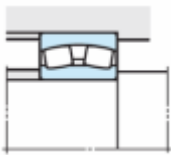
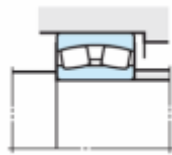
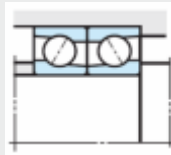
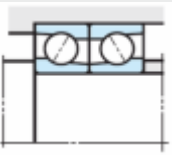
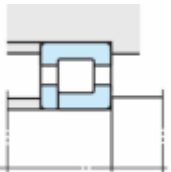
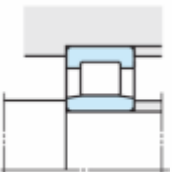
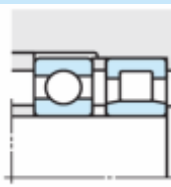
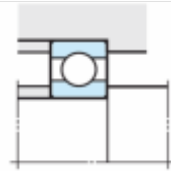
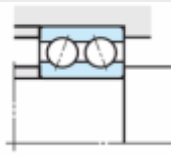
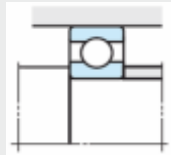
Application	Fixed side	Free Side	Remarks
Transmissions and Pumps			Arrangement capable of accommodating partial radial load as well axial loads.
Overhead crane wheels			Arrangement suitable in cases where there is possibility of errors due to mounting and deflection of shafts.
Machine tool spindles			Arrangement suitable for cases where under the action of light load high speed of rotation and high accuracy is desired.
Traction Motors			Arrangement is suitable for applications involving requirement to withstand heavy loads and shock loads. This arrangement up to some extent can take axial load also. Additionally it helps when interference is desired for both the rings.

Table 3.2 Some Bearing arrangements and their applications

Application	Fixed side	Free Side	Remarks
Diesel Locomotive Transmission			Arrangement is application with high speed and high radial load in presence of axial load.
Blowers and medium sized electric motors			Arrangement is recommended for high speed operating conditions but not suitable in case of shaft deflections.
Worm gear reducers			Arrangement is suitable for high axial load acting in both the directions.

3.3 Input required for bearing selection:

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.

1. 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.
2. Include a brief description of the mechanism if this is not clear from the drawing.
3. Provide the data for the speed, load on each bearing and operating temperature.
4. Indicate any unusual features such as the possibility of shock or vibration, unbalanced load, high temperature, or the presence of dirt, moisture or fumes.
5. 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.
6. 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 technical cell:

- 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 operation bearing fail mainly due to

(I) Human error

- Improper mounting
- Improper bearing selection
- Design inappropriate
- Insufficient maintenance

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

Under load zone as the rolling element rotate to 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 occurs either in the raceway surface or in the rolling elements surfaces.

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 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, L_{10} 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.

Basic dynamic load (C)

Every bearing is designed for a certain load referred as the dynamic load rating C. It 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_{10})

ISO:281 gives the calculation of basic rating life L_{10} with 90 % reliability. It is based on Lundberg and Palmgren fatigue theory which gives a rating life. The fatigue behaviour 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 (as per ISO:281 Standard):

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

Where,

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

C = Basic dynamic rated Load, N

(C_r : radial bearings, C_a : thrust bearings)

P = Equivalent Dynamic Load, N

(P_r : radial bearings, P_a : thrust bearings)

$p=3$For ball bearings

$p=10/3$ For roller bearings

The basic rating life can also be expressed as:

- 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

n , is the speed, rev/min

- The basic rating life 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_{10s} = Basic rating life in kms.

Using life factor(f_h) and speed factor(f_n), basic rating life can be calculated in hours using the following formula

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

$$f_h = f_n \left(\frac{C}{P} \right)$$

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

Where

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

f_h = life factor

f_n = speed factor

n = operating speed, rev./min

The relationship between rotational speed 'n' and speed factor 'f_n' as well as the relation between the basic rating life L_{10h} and the life factor 'f_h' is shown in table 4.1

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 'f_h and f_n' can be taken from table 4.1

$$C = P (f_h / f_n)$$

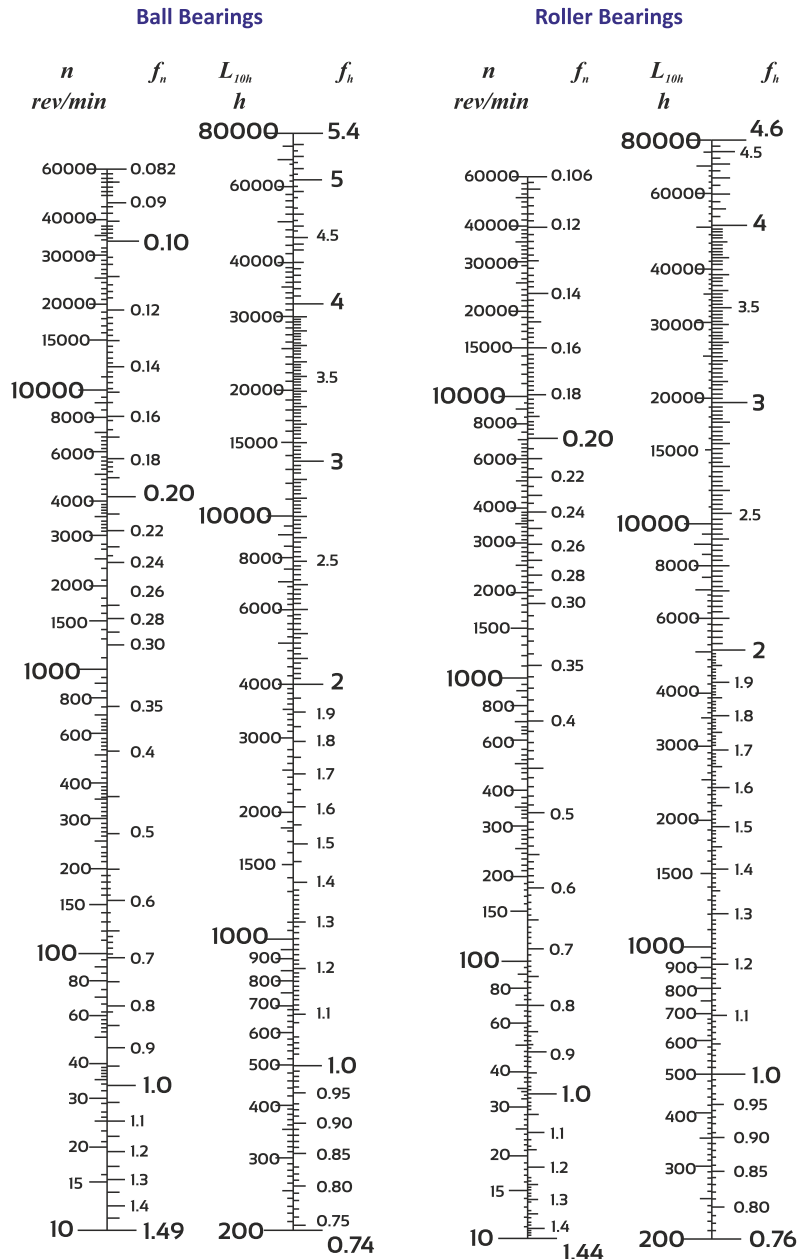
Where,

f_h = life factor

f_n = 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

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

where,

L : Total basic rating life of entire unit, h

$L_1, L_2 \dots L_n$: 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

$$L_m = \left(\frac{\Phi_1}{L_1} + \frac{\Phi_2}{L_2} + \dots + \frac{\Phi_j}{L_j} \right)^{-1}$$

Where,

L_m : Total life of bearing

Φ_j : Frequency of individual load conditions ($\sum \Phi_j = 1$)

L_j : Life under individual conditions

4.2 Life adjustment factor for Reliability, a_1

The values for the reliability adjustment factor, a_1 , 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_1

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

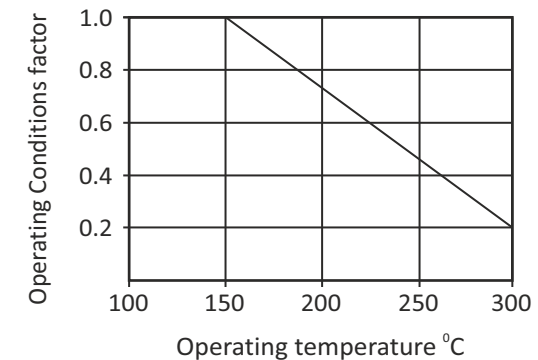
4.3 Thermal stabilization of Rolling bearings at high temperature

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 alters the microstructure which in turn 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

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.

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

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,

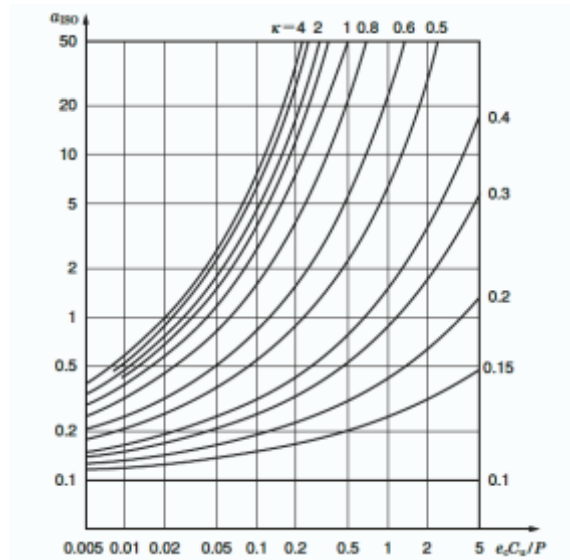
e_c - Contamination factor

C_u - Fatigue load limit in newton

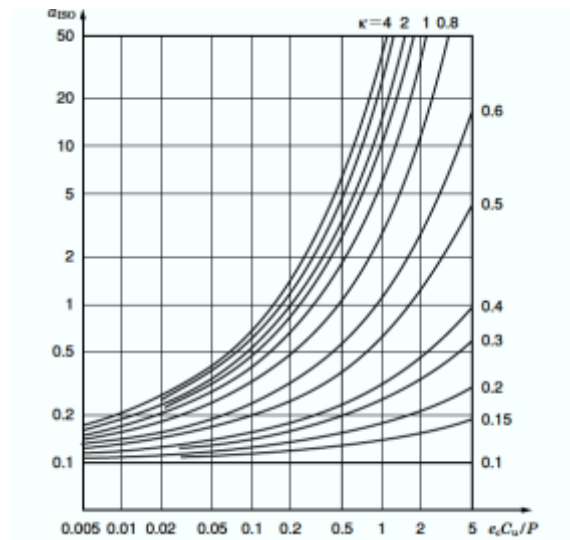
K - Viscosity ratio (kappa)

P - Dynamic Equivalent load in newton

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

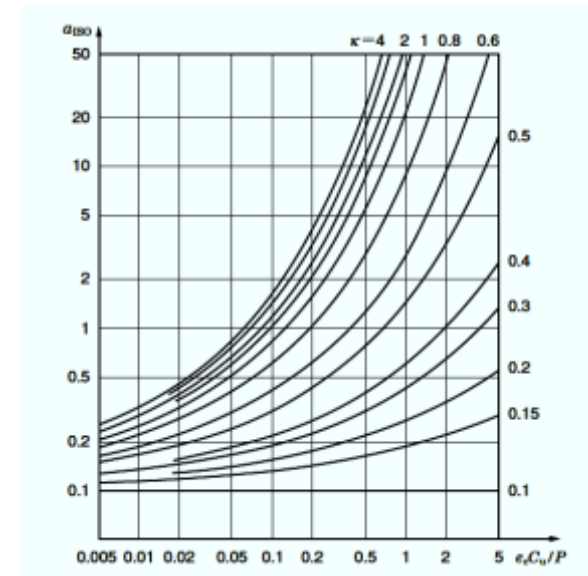


Life modification factor a_{iso} (Radial ball bearings) Fig.4.1

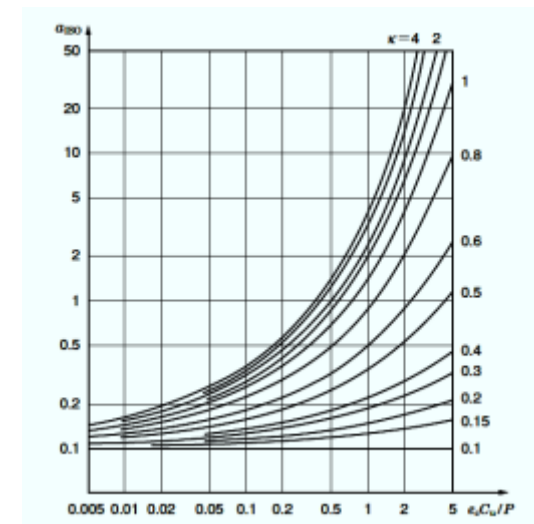


Life modification factor a_{iso} (Radial roller bearings) Fig.4.2

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 Ratio (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 (σ) 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

Λ is used as an indicator of the lubricant regime. With Λ 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, Λ as:

- $\Lambda > 3 \rightarrow$ full film (thick film) lubrication, hydrodynamics
- $1.2 > \Lambda > 3 \rightarrow$ 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.

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

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 achieved
<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 a_{ISO} 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

4.7 Contamination factor (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_c can be taken from the table (ISO281:2007)

Table 4.7 for contamination factor, e_c

Contamination level	e_c	
	$D_{pw} < 100\text{mm}$	$D_{pw} \geq 100\text{mm}$
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	0.6 to 0.5	0.8 to 0.6
Slight contamination	0.5 to 0.3	0.6 to 0.4
Typical contamination Conditions typical of bearings without seals: coarse 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

D_{pw} is the mean pitch diameter of bearing in mm

Note: For advance and detailed method for calculation of e_c factor for different lubrication method in grease and oil (bath or circulation), refer ISO 16889 and ISO 4406 standards.

4.8 Method for checking contamination level in lubricant

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.

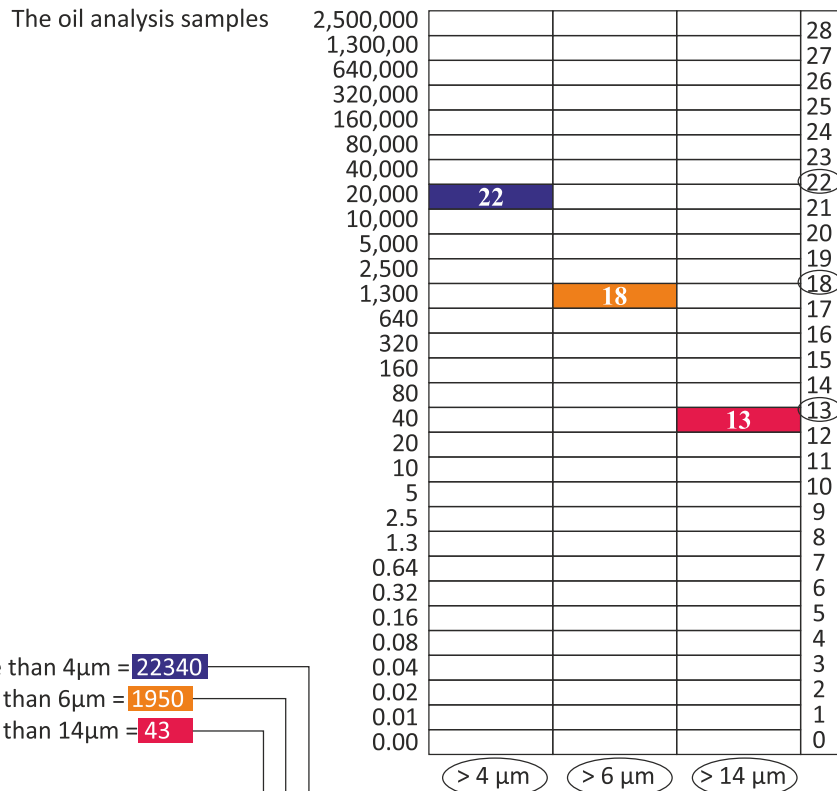
There are two methods for checking contamination level in lubricant.

- Microscopic counting method. This method uses two particle sizes: $\geq 5 \mu\text{m}$ and $\geq 15 \mu\text{m}$.
- Automatic Optical single particle counter in accordance with ISO 11171. It uses three particle sizes: $\geq 4 \mu\text{m}(c)$, $\geq 6 \mu\text{m}(c)$ and $\geq 14 \mu\text{m}(c)$.

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
1	2	1

Example of contamination level classification for lubricating 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 (β). The filter is for the specified particle size. Filter rating β 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

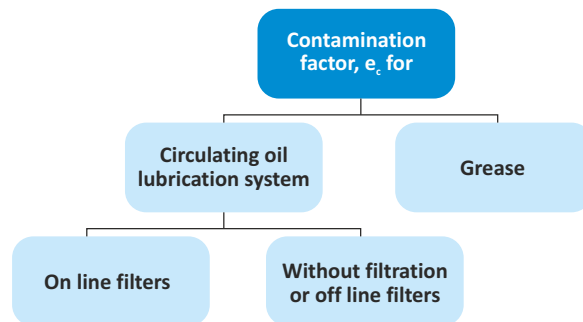
For example, a “ $\beta_{5(c)} = 10$ ” means that only 1 in 10 particles, 5µm or larger, passes through the filter.

4.9 Method for determining 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 $\beta_x(c)$ 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

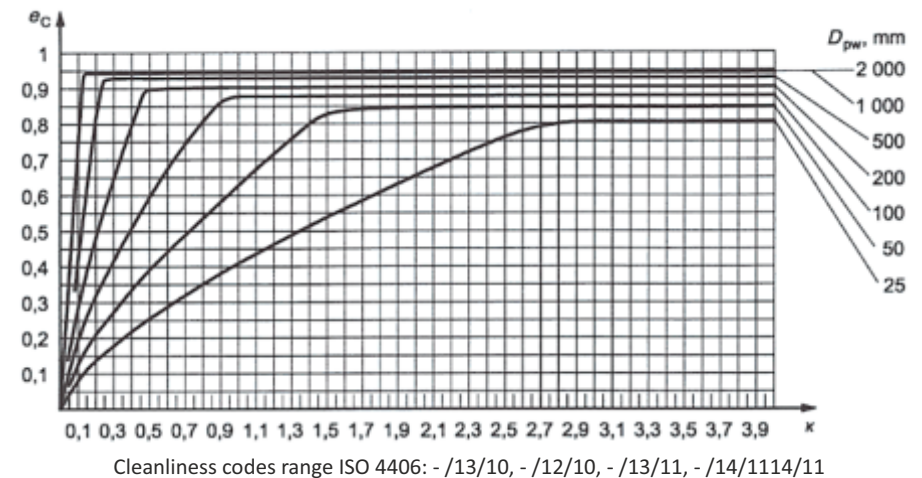
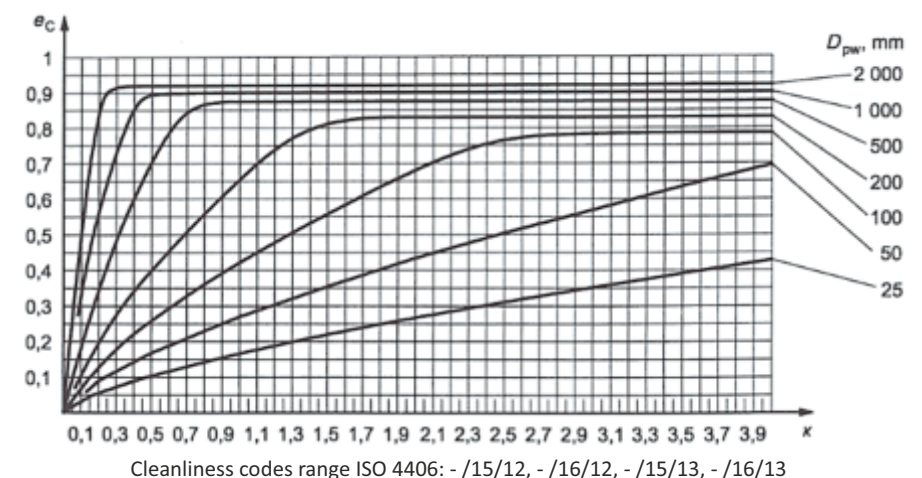
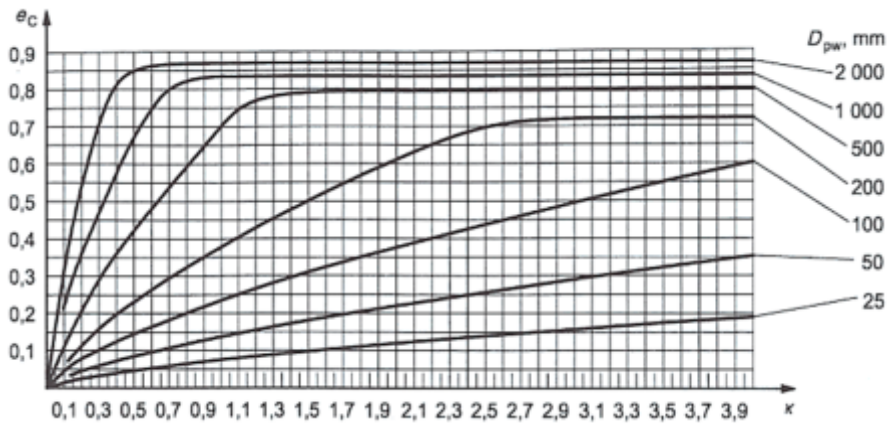


Fig. 2. Contamination coefficient for circulating oil lubrication with on-line filter - filter rating $\beta_{12(c)} = 200$, cleanliness code acc. to ISO 4406 - /15/12



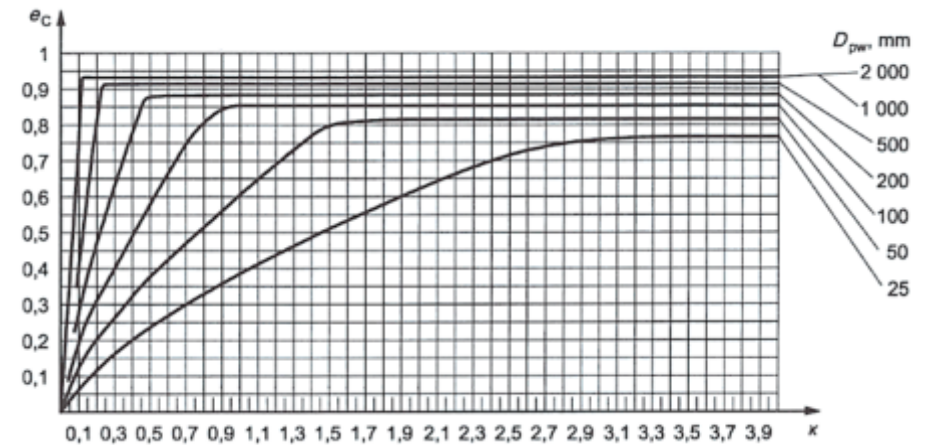
4.9.1.2 Contamination factor, e_c for circulating oil lubrication system without filtration or with off line filters.

Fig. 3. Contamination coefficient for circulating oil lubrication with on-line filter
- filter rating $\beta_{25(C)} = 75$, cleanliness code acc. to ISO 4406 - /17/14



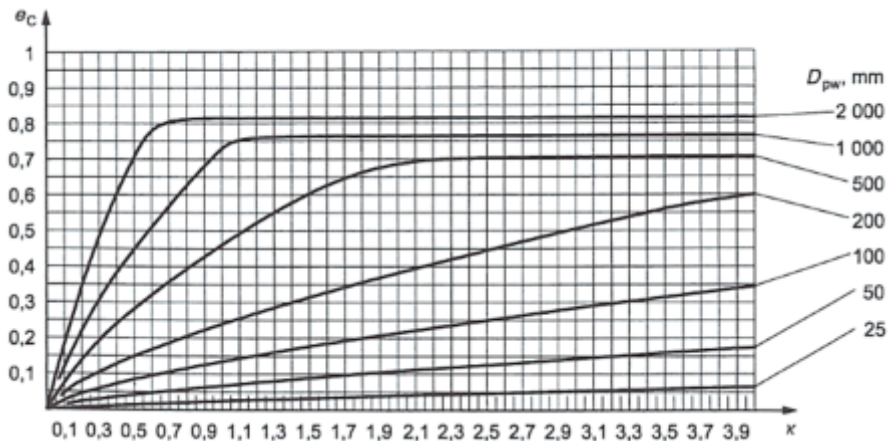
Cleanliness codes range ISO 4406: - /17/14, - /18/14, - /18/15, - /19/15

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



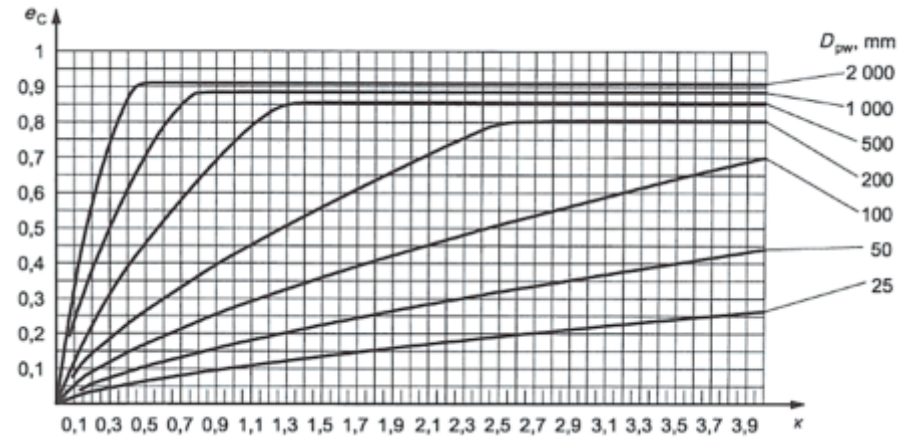
Cleanliness codes range ISO 4406: - /13/10, - /12/10, - /11/9, - /12/9

Fig. 4. Contamination coefficient for circulating oil lubrication with on-line filter
- filter rating $\beta_{40(C)} = 75$, cleanliness code acc. to ISO 4406 - /19/16



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

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

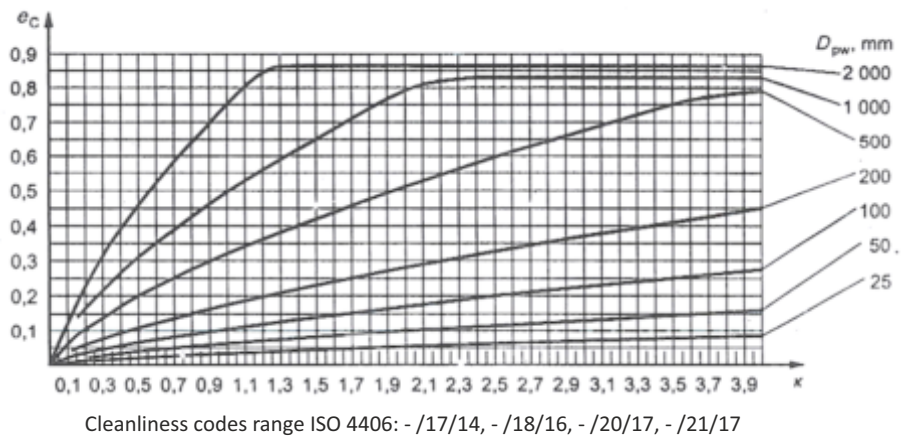


Fig. 8. Contamination coefficient for oil lubrication without filters or with off-line filters - cleanliness code acc. to ISO 4406 -/19/16

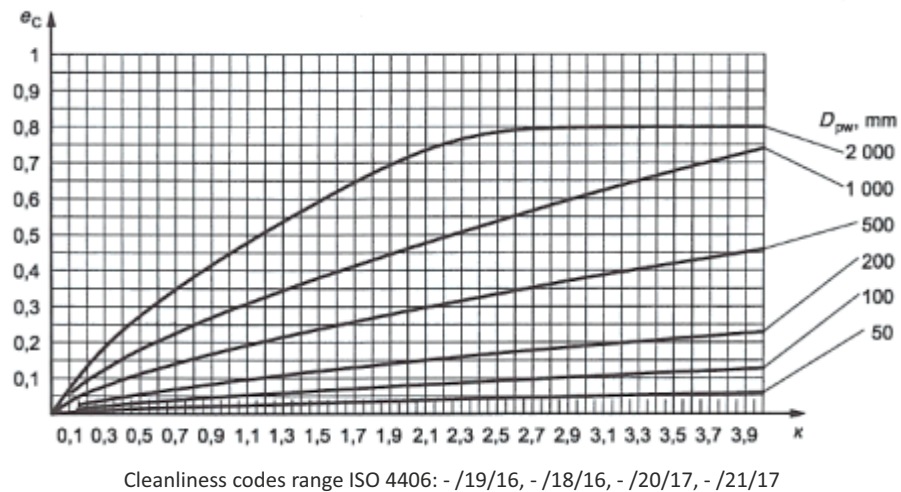
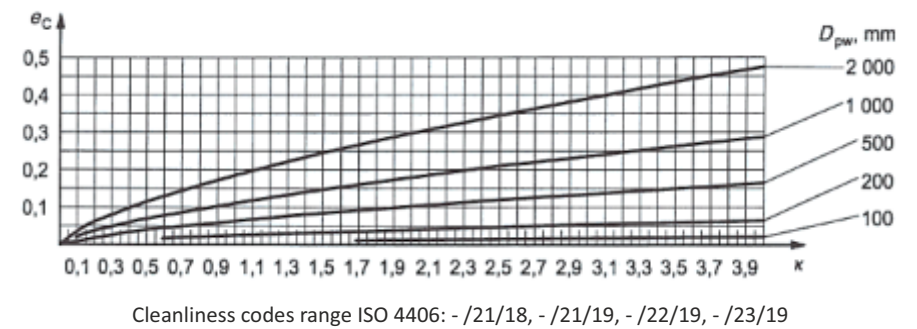


Fig. 9. Contamination coefficient for oil lubrication without filters or with off-line filters - cleanliness code acc. to ISO 4406 -/21/18



4.8.2 Contamination factor, e_c for grease lubrication

Grease lubrication is used when the bearing operates under normal temperature and speeds. Grease has several advantages over oil, including improved protection against moisture & contaminants and has simple application procedure. Grease selection varies with the application and operating conditions of bearings. Contamination effects grease life. The contamination level changes with the type of working conditions (refer table). If the working conditions are very clean, contamination level is low but if the bearing operates in harsh environment then contamination level is high. Contamination value is used in the calculation of bearing life and can be calculated from graph using viscosity ratio (K) and bearing size (D_{pw}).

Working conditions	Contamination level
Very clean assembly with careful washing, rinse; very good sealing regard to working conditions; continuous regreasing 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; regreasing 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; regreasing 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

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

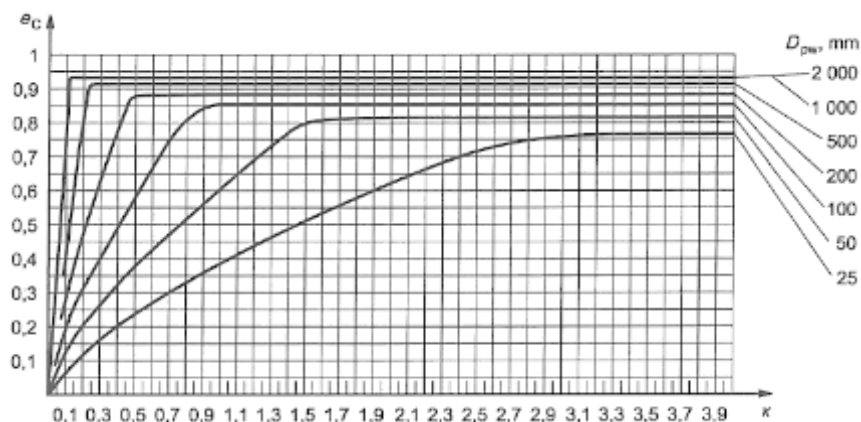


Fig.11. Contamination coefficient for grease lubricant - Normal cleanliness

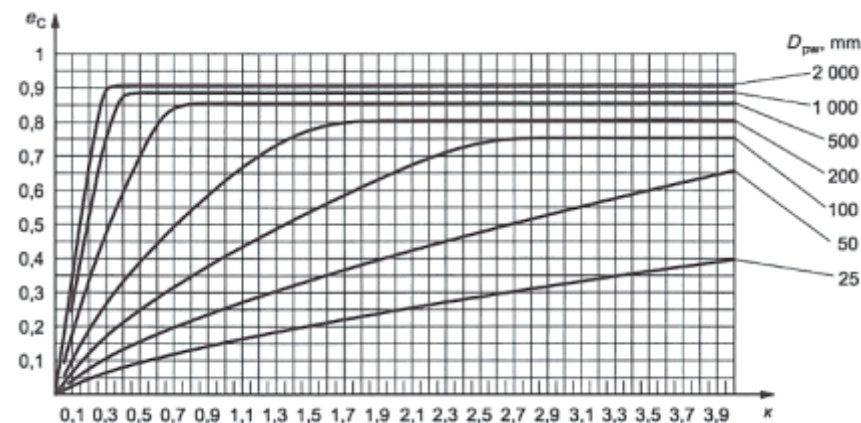


Fig.12. Contamination coefficient for grease lubricant - Slight or typical cleanliness

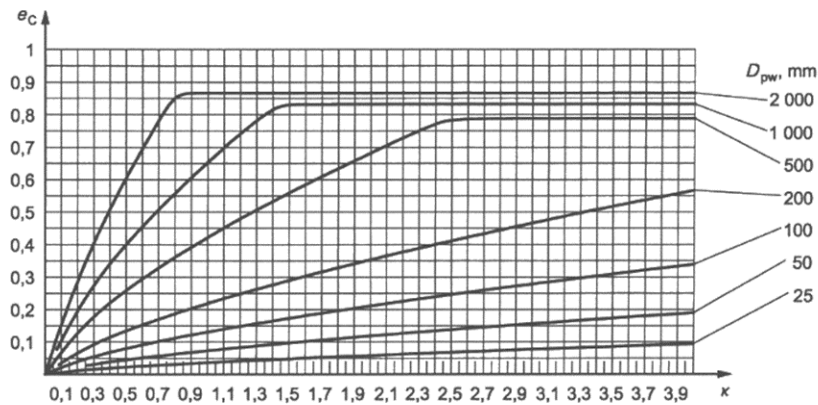


Fig.13. Contamination coefficient for grease lubricant - Severe contamination

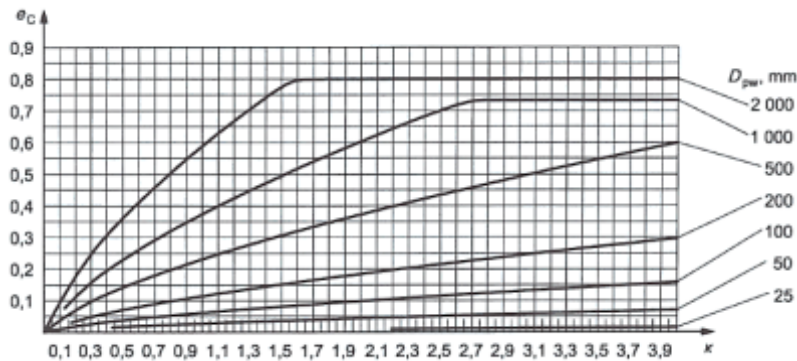
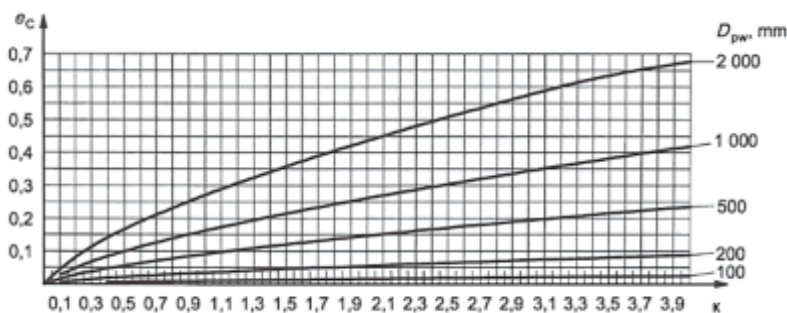


Fig.14. Contamination coefficient for grease lubricant - Very severe contamination



4.10 Basic Static Load Rating (C)

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

Static Equivalent Load (Po)

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.

For radial bearings equivalent static load can be calculated from the formula:

$$P_o = X_0 \cdot F_r + Y_0 \cdot F_a$$

P_o equivalent static load, KN

F_r actual radial load, KN

F_a actual axial load, KN

X_0 bearing radial load factor

Y_0 bearing axial load factor

Note: The equivalent static bearing load (P_o or P_{or}) formula is provided for various types of bearings in data table of the catalogue.

Bearing selection based on static loading conditions:

The static equivalent load which can be permitted on the bearing is limited by the basic static rating. Bearing size must be selected based on static load on the bearing taking into account the possible effects of permanent deformation:

- The bearing is not rotating or rotates under load at low speed ($n < 10 \text{ r/min}$)
- Bearing is subjected to continuous high loads.
- Slow oscillating movements under load.

Static Safety Factor, (S_o)

When bearing service life is affected by permanent deformation depending upon static load and operating requirement such as smooth running or vibration, shock etc. the static safety factor is calculated to assess the load level on the bearing.

The static safety factor is given by

$$S_o = C_o / P_o$$

S_o static safety factor

C_o basic static load rating, KN

P_o equivalent static bearing load, KN

Minimum safety factor values S_o

Operating condition	Ball bearing	Roller bearing
General application	1~2	1.5 ~3

When vibration and/or shock loads are present, a load factor based on the shock load needs to be included in the P_o max value. For more information, please contact NBC Engineering.

4.11 Life factor for application

Life factor f_h

Service Requirements	< 1.0	1.0-2.0	2.0-2.5
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			
Machines used for 8 hours a day but not always in full operation		Automobiles, motor cycles internal grinding spindles, ore tub axles	Buses, Trucks
Machines fully used for 8 hours			Small rolling mill roll necks
Machines continuously used for 24 hours a day			
Machines continuously used for 24 hours a day with maximum reliability pumps			

Life factor f_h

2.5-3.0	3.0-3.5	3.5-4.0	4.0-5.0	> 5.0
Power station auxiliary equipment, construction machines, Crane sheaves elevators, Conveyors, deck cranes, Cranes	Crane Sheaves			
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	
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	
	Loom	Electric motors in shop compressors, pumps	Textile machines, mine winches, iron industry conveyors	Paper making machine, main rolls machines
				Power station equipment, water supply equipment for urban areas, mine drain

Reference life for machine application under operational conditions

Operation classification	L10h life (reference)				$\times 10^3 \text{ h}$	
	~ 4	4 $\sim$ 10	12 $\sim$ 25	25 $\sim$ 50	50 $\sim$	
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 Standard Organization)

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 standard	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 roller bearings (Inch series)
	ISO 1224	Precision instrument bearings
Deutsches Institut für Normung (DIN)	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 for the mean bore and outer diameter tolerances are d_{mp} and D_{mp} .

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 V_{dmp} and V_{Dmp} .

Inner ring form are indicated as:

- Single plane bore diameter variation- V_{dp} (roundness),
- Mean single plane bore diameter variation- V_{dmp} (taper),
- Width variation- V_B (parallelism of side faces),
- Raceway roundness & taper, flatness of faces

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

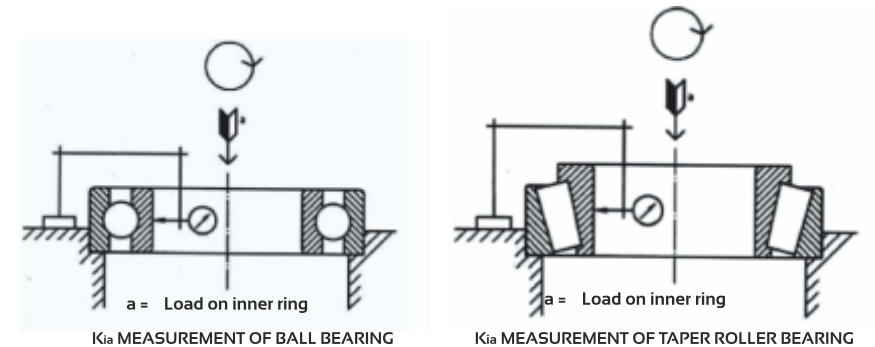
Running accuracies in bearing are:

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

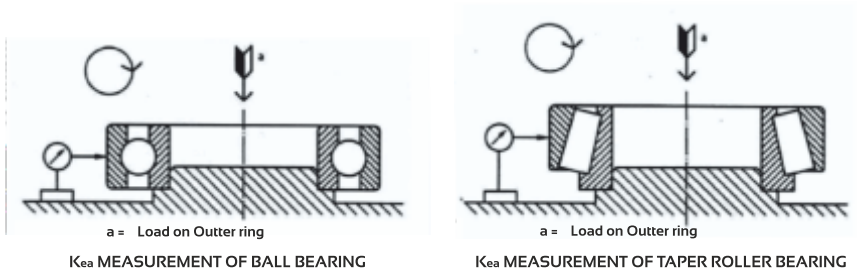
(A) Radial run-out of assembled bearing inner ring, 'Kia' (radial bearing):

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.



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

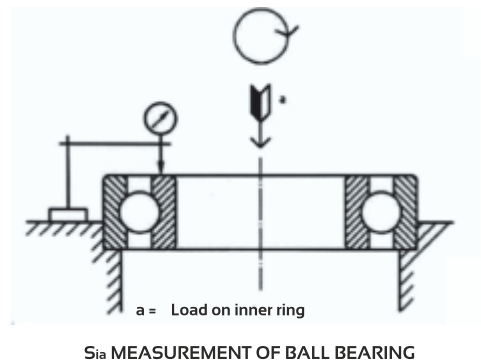
Difference between the largest and the smallest of the radial distance between the outside surface of the outer ring in different angular positions of this ring and a point in a fixed position relative to the inner ring. At the angular position of the point mentioned, or on each side and close to it, 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.



5.2.2 Face run-out with raceway

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

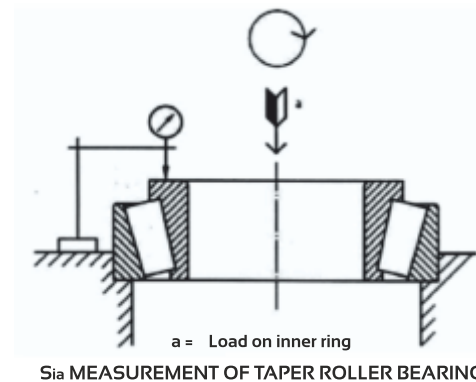
Differences between the largest and the smallest of the axial distances between the reference face of the inner ring, in different relative angular positions of this ring, at a radial distance from the inner ring axis equal to half the inner ring raceway contact diameter, and a point in a fixed position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



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

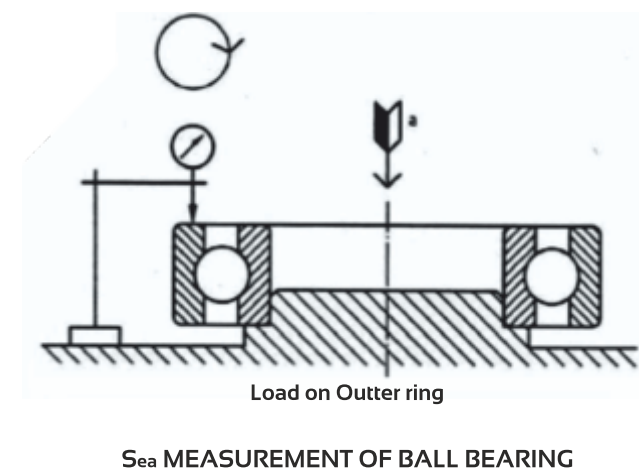
Difference between the largest and the smallest of the axial distances between the cone back face, in different angular positions of the cone, at a radial distance from the cone axis equal to half the cone raceway contact diameter and a point in a fixed position relative to the cup. The cone and cup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



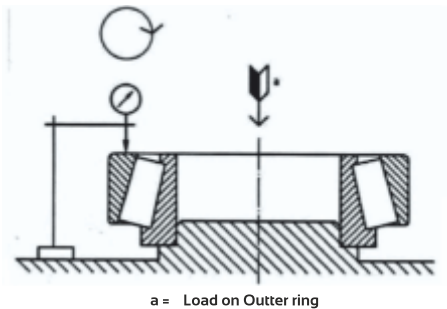
(C) Assembled bearing outer ring face run-out with raceway 'Sea' (Groove type radial ball bearing):

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.



(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.

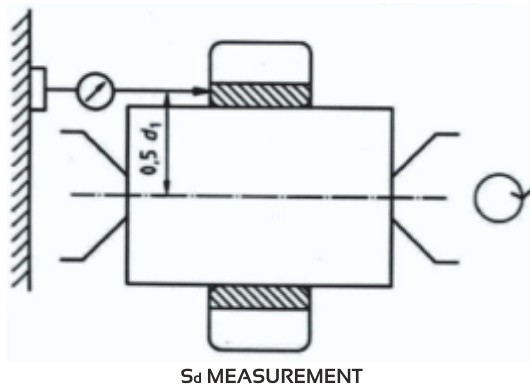


Sea MEASUREMENT OF TAPER ROLLER BEARING

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

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.



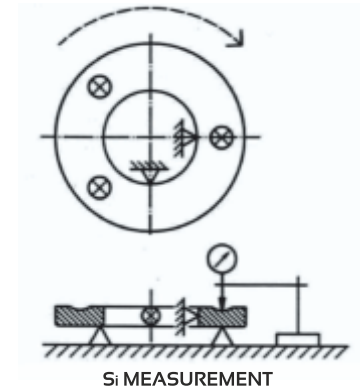
Sd MEASUREMENT

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

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.

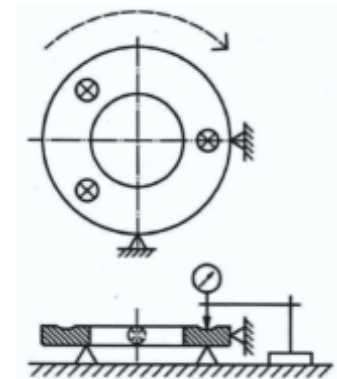


Si MEASUREMENT

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.

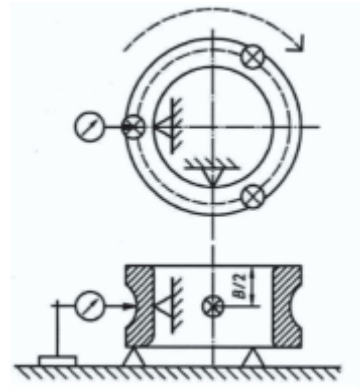


Se MEASUREMENT

5.2.6 Thickness-variation

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

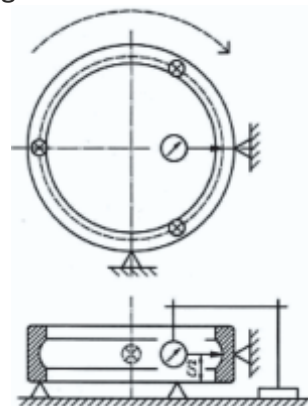
Difference between the largest and the smallest of the radial distances between the bore surface and the middle of a raceway on the outside of the ring.



K_i MEASUREMENT

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

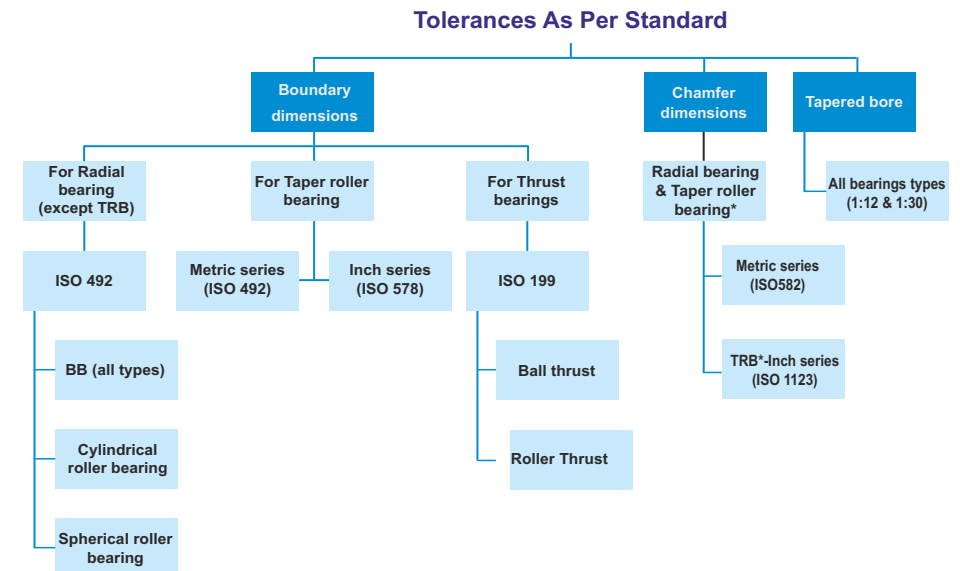
Difference between the largest and the smallest of the radial distances between the outside surface and the middle of a raceway on the inside of the ring.



K_e 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.



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

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 Manufacturers Association

DIN : Deutsches Institut für Normung

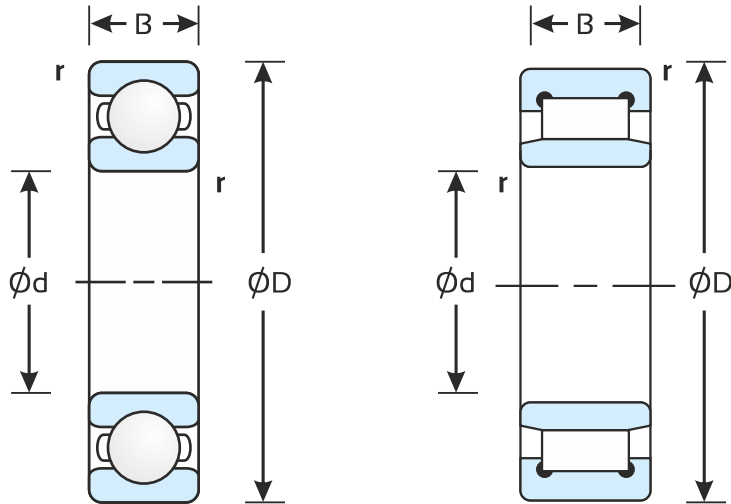
BS : British Standards Institution

F : Association Francaise de Normalisation

(Except Tapered Roller Bearings)

- d** = bearing bore diameter, nominal
- d1** = basic diameter at theoretical large end of a basically tapered bore
- Δds** = deviation of a single bore diameter
- Δdmp** = single plane mean bore diameter deviation
(for a basically tapered bore Δdmp refers only to the theoretical small end of bore)
- Δd1mp** = 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
- ΔDs** = deviation of single outside diameter
- ΔDmp** = 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
- ΔBs** = deviation of single inner ring width
- VBs** = inner ring width variation
- C** = outer ring width, nominal
- C1** = outer ring flange width, nominal
- ΔCs** = deviation of single outer ring width
- ΔC1s** = 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 generatrix inclination with flange back race
- Sia** = assembled bearing inner ring race (back face) runout with raceway
- Sea** = assembled bearing outer ring face (back face) runout with raceway
- Sea1** = assembled bearing outer ring flange (back face) runout with raceway



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

Table 5.3.1: Inner Ring

Values in microns												
d (mm)		Δ dmp		Vdp			Vdmp	Kia	ΔBS			VBS
				Diameter Series					All	Normal	Modified	
				9	0,1	2,3,4						
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

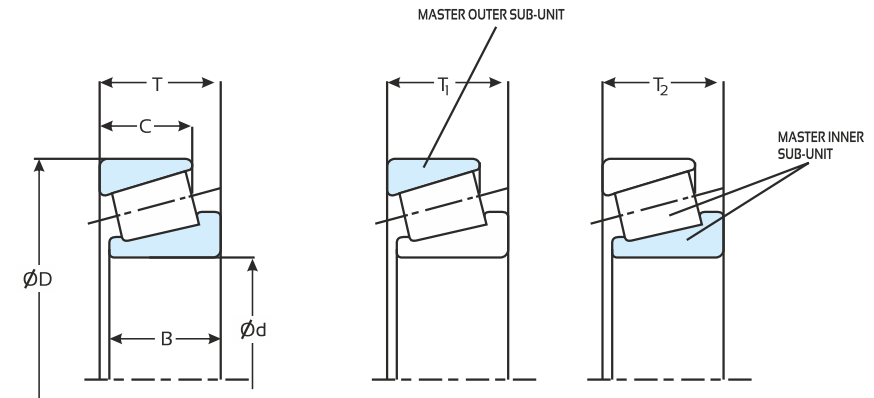
Values in microns												
D (mm)		Δ Dmp		VDP				VDmp	Kea	ΔCS ΔC1S		VCS VC1s
				Open Bearings			Capped Bearing					
				Diameter Series								
				g	0,1	2,3,4	2,3,4					
Over	Including	High	Low	Max			Max	Max	Max	High	Low	Max
6	18	0	-8	10	8	6	10	6	15	Identical to Δ Bs and VBs or Inner ring of same 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			

5.4 Tolerance For Tapered Roller Bearing (Metric Series)

Normal tolerance class

Symbols (Applicable for metric and inch series)

d	=	bearing bore diameter, nominal
Δds	=	deviation of a single bore diameter
Δdmp	=	single plane mean bore diameter deviation (for a basically tapered bore dmp refers only to the theoretical small end of bore)
Vdp	=	bore diameter 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
ΔDs	=	deviation of a single outside diameter
ΔDmp	=	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
ΔTs	=	deviation of the actual bearing width
T1	=	effective width of inner sub-unit, nominal
ΔBs	=	deviation of single inner ring width
C	=	outer ring width, nominal
ΔCs	=	deviation of single outer ring width
Kia	=	radial run out or assembled bearing inner ring
Kea	=	radial run out or assembled bearing outer ring
Sd	=	inner ring reference face (back face, where applicable) run out with bore
SD	=	variation of bearing outside surface generatrix inclination with outer ring reference face (back face)
Sia	=	assemble bearing inner ring face (back face) run out with raceway
Sea	=	assembled bearing outer ring face (back face) run out with raceway
ΔT1s	=	deviation of the actual effective width of inner sub unit
T2	=	effective width of outer sub-unit, nominal
T2s	=	deviation of the actual effective width of 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)		Δ 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)		Δ 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

Unit : 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

Unit : microns

Nominal bore diameter		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)	
(d)															
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 inner and outer rings

Unit : 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 Symbol 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 (d ₁ - 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 r _s , r ₁ , r ₂ , r ₃ ...
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.

5.6 Tolerance for Thrust Ball and Roller Bearings

5.6 Tolerance For Thrust Ball and Roller Bearings (As per ISO 199) Symbols

d	= bore diameter of shaft washer, single-direction bearing
d ₂	= bore diameter of shaft washer, double-direction bearing
Δdmp	= deviation of mean bore diameter in a single plan of shaft, single-direction bearing
Δd2mp	= deviation of mean bore diameter in a single plan of shaft, double-direction bearing
D	= outside diameter of housing washer
ΔDmp	= deviation of mean outside diameter in a single of plan of housing washer
Se	= variation in thickness 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 thickness between shaft washer raceway and back face (Note: Applies only to ball thrust bearings and cylindrical roller thrust bearings with 90° contact angle)
T ₁	= bearing height, single-direction bearing
T ₂	= bearing height, double direction bearing
ΔT _s	= deviation of the actual bearing height, single-direction bearing
ΔT _{1s}	= deviation of the actual bearing height, double-direction bearing
Vdp	= variation of bore diameter in a single plane of shaft washer, single-direction bearing
Vd2p	= variation of bore diameter in a single plane of shaft washer, double-direction bearing
Vdp	= variation of outside diameter in a single radial plane of housing washer

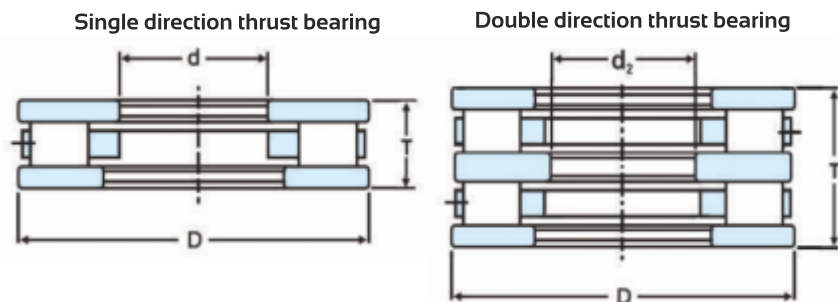


Table 5.6.1 Shaft washer and bearing height
(As per ISO:199/Normal tolerance class)

Tolerance value in microns

d and d2 (mm)		Δd_{mp} , Δd_{2mp}		Vdp, Vd2p	Si	ΔT_s		ΔT_{1s}	
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.

Table 5.6.1 Housing washer and bearing height
(As per ISO199/Normal tolerance class)

Tolerance value in microns

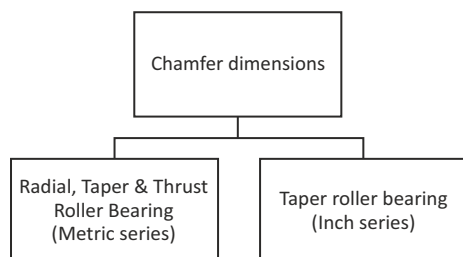
D (mm)		ΔD_{mp}		VDp	Se
Over	Including	high	low	max.	max.
10	18	0	-11	8	Identical to Si of shaft washer of same bearing
18	30	0	-13	10	
30	50	0	-16	12	
50	80	0	-19	14	
80	120	0	-22	17	
120	180	0	-25	19	
180	250	0	-30	23	
250	315	0	-35	26	
315	400	0	-40	30	
400	500	0	-45	34	
500	630	0	-50	38	
630	800	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.

5.7 Chamfer Dimensions Limits For Rolling Bearings

(As per ISO : 582 / I5:5934)

5.7.1 Metric Series Radial Bearings and Tapered Roller Bearings



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

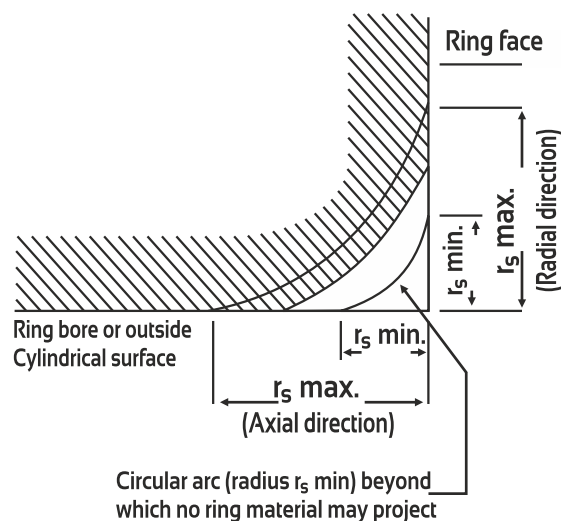


Table 5.7.1 Tapered Roller Bearings (Metric Series)

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

Table 5.7.2 Radial Bearings Except 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 millimetres

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 r_s 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 Millimetres

r nom	Cup back face chamfer		Cup back face chamfer	
	r_s min	r_s min (ISO 582-1972)	r_s min	r_s 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

5.7.2 Chamfer dimensions limits for Tapered roller bearing

(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

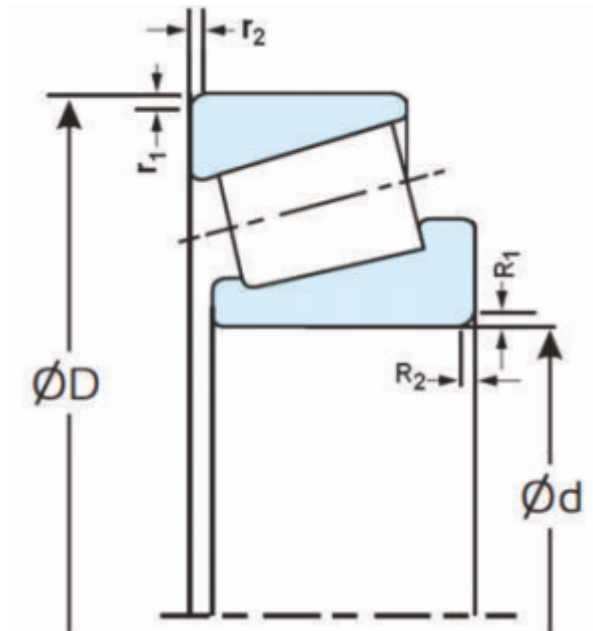
$R1$ = height of inner ring back face chamfer

$R2$ = 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 bearing (inch series)

Table 5.7.6 Inner ring chamfer dimension 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 dimension 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 1.

5.8 Basic Tolerance for Tapered Bore

d - Nominal bore diameter

d_1 - 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: $d_1 = d + 1/12B$
- In case of taper 1/30: The basic diameter at the theoretical large end of the bore: $d_1 = d + 1/30B$

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

- Mean diameter tolerance, given by limits for the actual mean diameter deviation at the theoretical small end of the bore, Δd_{mp}
- Taper tolerance diameter, given by limits for the difference between the actual mean diameter deviations at the two ends of the bore, $\Delta d_{1mp} - \Delta d_{mp}$
- Tolerance for the diameter variation, V_{dp} 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):

$$\alpha = 2^\circ 23' 9.4''$$

$$= 2.38594$$

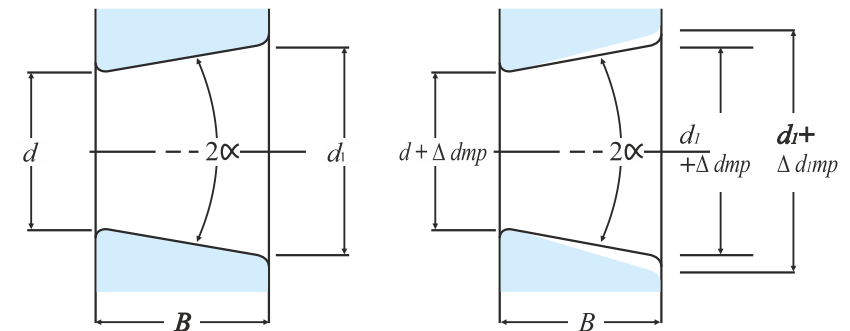
$$= 0.041643 \text{ rad}$$

For taper 1/30, normal taper angle (half the cone angle):

$$\alpha = 0^\circ 57' 17.4''$$

$$= 0.95484$$

$$= 0.016665 \text{ rad}$$



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 taper ratio 1:12)

Unit : μm

d (mm)		Δd_{mp}		$\Delta d_{1mp} - \Delta d_{mp}$		V_{dp}
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	-
1000	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						
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

Unit : μ m

5.9 Selection of accuracy class for specific application

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 torque & 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 Type 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 satisfactory 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:

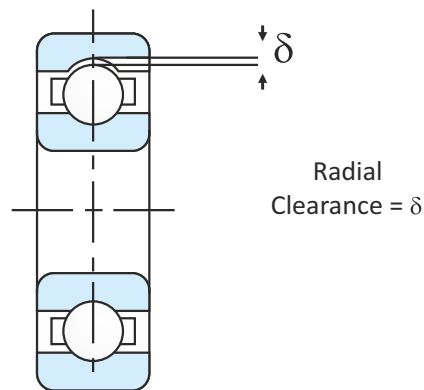
Radial bearings are made with following different ranges of radial internal clearance- C2, Normal, C3 and C4

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.

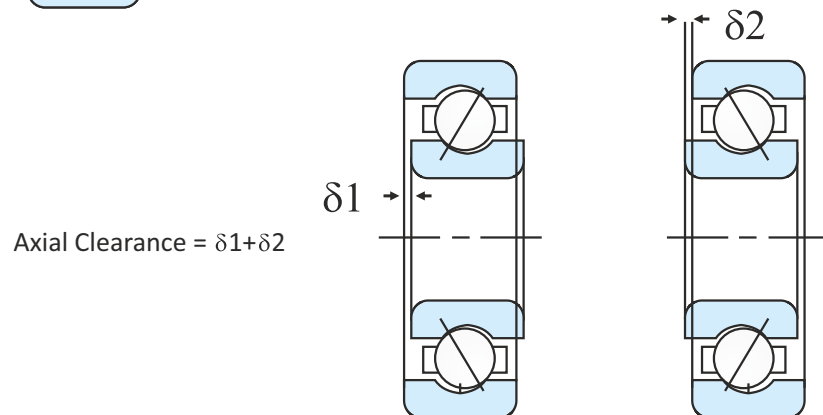
CN: This grade of radial internal clearance is intended for use where only when one ring is made an interference fit and there is no appreciable loss of clearance due to temperature difference. ball and roller bearings for general engineering applications are usually of this clearance.

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 = $\delta_1 + \delta_2$

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:

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

Where,

δ_{eff} : Effective internal clearance, mm

δ_o : Bearing internal clearance, mm

δ_f : 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.

$$\delta_f = (0.70 \sim 0.90) \Delta_{\text{deff}}$$

Where,

δ_f : Reduced amount of clearance due to interference, mm

Δ_{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:

$$\delta t = \alpha \cdot \Delta T \cdot D_o$$

Where,

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

α : Bearing material expansion coefficient $12.5 \times 10^{-6}/^{\circ}\text{C}$

ΔT : Inner/outer ring temperature differential, $^{\circ}\text{C}$

D_o : Outer ring raceway diameter, mm

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

For ball bearings and spherical roller bearings,

$$D_o = 0.20 (d + 4.0D)$$

For roller bearings (except spherical roller bearing),

$$D_o = 0.25 (d + 3.0D)$$

Where,

d : Bearing bore diameter, mm

D : Bearing outside diameter, mm

6.4 Radial Internal Clearance Values

Bearing Internal Clearance Values As Per ISO: 5753 / IS: 5935

6.4.1 Deep 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.
2.5	6		0	7	2	13	8	23	-	-
6	10		0	7	2	13	8	23	14	29
10	18		0	9	3	18	11	25	18	33
18	24		0	10	5	20	13	28	20	36
24	30		1	11	5	20	13	28	23	41
30	40		1	11	6	20	15	33	28	46
40	50		1	11	6	23	18	36	30	51
50	65		1	15	8	28	23	43	38	61
65	80		1	15	10	30	25	51	46	71
80	100		1	18	12	36	30	58	53	84
100	120		2	20	15	41	36	66	61	97
120	140		2	23	18	48	41	81	71	114
140	160		2	23	18	53	46	91	81	130
160	180		2	25	20	61	53	102	91	147
180	200		2	30	25	71	63	117	107	163
200	225		2	35	25	85	75	140	125	195
225	250		2	40	30	95	85	160	145	225
250	280		2	45	35	105	90	170	155	245
280	315		2	55	40	115	100	190	175	270
315	355		3	60	45	125	110	210	195	300
355	400		3	70	55	145	130	240	225	340
400	450		3	80	60	170	150	270	250	380
450	500		3	90	70	190	170	300	280	420
500	560		10	100	80	210	190	330	310	470
560	630		10	110	90	230	210	360	340	520
630	710		20	130	110	260	240	400	380	570
710	800		20	140	120	290	270	450	430	630
800	900		20	160	140	320	300	500	480	700
900	1000		20	170	150	350	330	550	530	770
1000	1120		20	180	160	380	360	600	580	850
1120	1250		20	190	170	410	390	650	630	920

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 ¹		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 Bearings (Non-interchangeable)

Table 6.5 Radial internal clearance for Cylindrical roller bearing (non-interchangeable) with cylindrical 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 C1NA are applied only to precision bearing of class 5 or higher

6.4.3 Double Row Self Aligning Ball Bearing (Cylindrical bore)

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 (Cylindrical bore)

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



Clearance values in microns

Nominal bore diameter d mm over Incl.		Bearing with cylindrical bore									
		C2		CN		C3		C4		C5	
		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

6.4.4 (B) Spherical Roller Bearing (Cylindrical bore)

Table 6.7(B) Spherical Roller Bearing (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)	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Over	Incl.										
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	370	370	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	570	570	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.

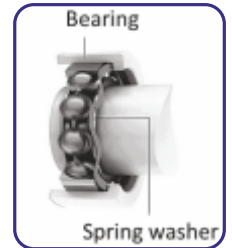
Purpose of preload

- (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

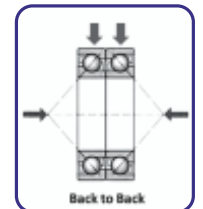
Deep groove ball bearings requiring a preload must be loaded axially. Axial load can be applied to the outer ring or inner ring. The race comes in contact with the ball and translates this load to the raceway of the outer or inner ring. This creates a contact angle, between the race, the ball and the 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



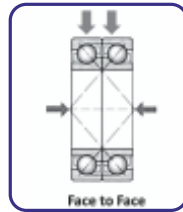
2. Angular contact bearing

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.

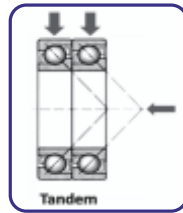
In Back-to-back arrangement, the bearings has a clearance between the inner ring faces. After preloading, the inner rings are clamped together, bringing the inner ring and outer ring faces flush with each other and resulting in contact angles that diverge towards the centerline.



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.

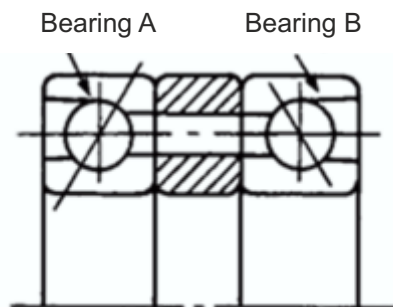


Preload methods

There are two main methods of preloading bearings

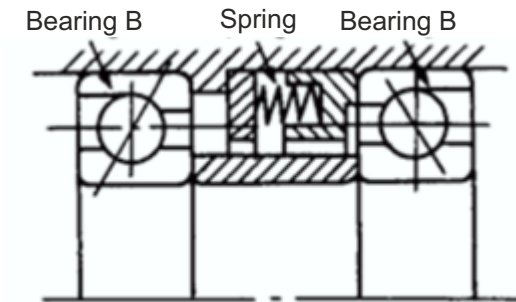
Rigid preloading

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



Spring preload

Also referred as constant pressure preloading. Spring is used for applying an axial force to the non-rotating inner or outer of bearing. The force applied by the spring is relatively constant throughout its compression. Spring preloading can withstand high operating speeds as compared to rigid preloading.



07 Lubrication

7.1 Function of the lubricant

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

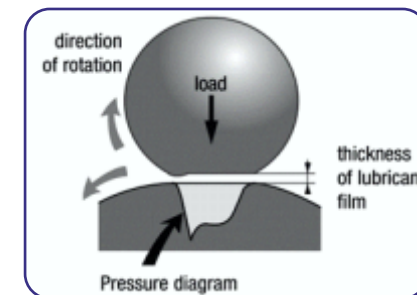
Lubricants improve the rolling fatigue life of bearings greatly by providing a thin film between the rolling contact surfaces.

(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	○	□
Cooling Effect	x	○
Seal Structure	○	△
Power Loss	○	○
Environment	○	△
Contamination	○	△
High speed rotation	x	○

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

Table 7.2 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 $n \cdot dm$

The $dm \cdot N$ 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
2	265~295	☐ For low temperature ☐ 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 7.3 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
Dropping point (°c)	170 to 190	170 to 230	220 to 260	160 to 180
Operating temp. Range (°c)	-30 to +120	-50 to +130	-50 to +180	0 to +110
Rotational range	Medium to high	High	Low to medium	Low to high
Mechanical stability	Excellent	Good to excellent	Good	Good to excellent
Water resistance	Good	Good	Good	Bad
Pressure resistance	Good	Fair	Bad to 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.	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	Fluorine Compounds
Base Oil	Mineral Oil	Mineral Oil	Mineral Oil	Synthetic Oil
Dropping point (°c)	250 or Higher	200 to 280	-	250 or Higher
Operating temp. Range (°c)	-30 to +150	-10 to +130	-10 to +150	-40 to +250
Rotational range	Low to High	Low to Medium	Medium to High	Low to Medium
Mechanical stability	Good to Excellent	Good	Good	Good
Water resistance	Good to Excellent	Good	Good	Good
Pressure resistance	Good	Good	Good	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 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.

Grease quantities for weekly to yearly relubrication [g]:

$$m1 = D \cdot B \cdot X$$

Table: 7.6 Reduction factor

Relubrication	X
weekly	0.002
monthly	0.003
yearly	0.004

Quantity m2 for extremely short relubrication intervals [g]:

$$m2 = (0.5 - 20) \cdot V [\text{kg/h}]$$

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

$$m3 = D \cdot B \cdot 0.01$$

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.

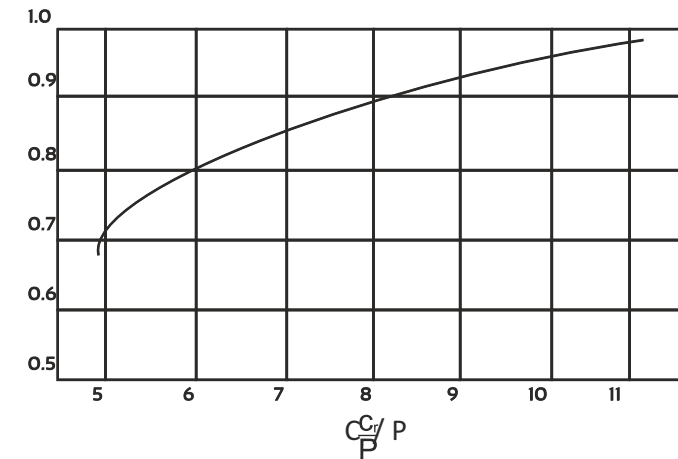


Fig. 7.1 Value of adjustment factor FL depends on bearing load

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 & numbers of revolutions at a radial load of 1.4 kN

$$Cr/Pr = 14 / 1.4 \text{ kN} = 10$$

from fig. 7.1 adjusted load fL is 0.98

$$n0 = 0.98 \times 13000 = 12740 \text{ r/min}$$

$$\text{therefore } n/n0 = 12740/4800 = 2.6$$

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

straight-line from that point (A in example) to a point on the line II which corresponds to the n_0/n value (2.6 in example). Point C, where this line intersects vertical line indicates the lubrication interval 'h' which is approximately 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.

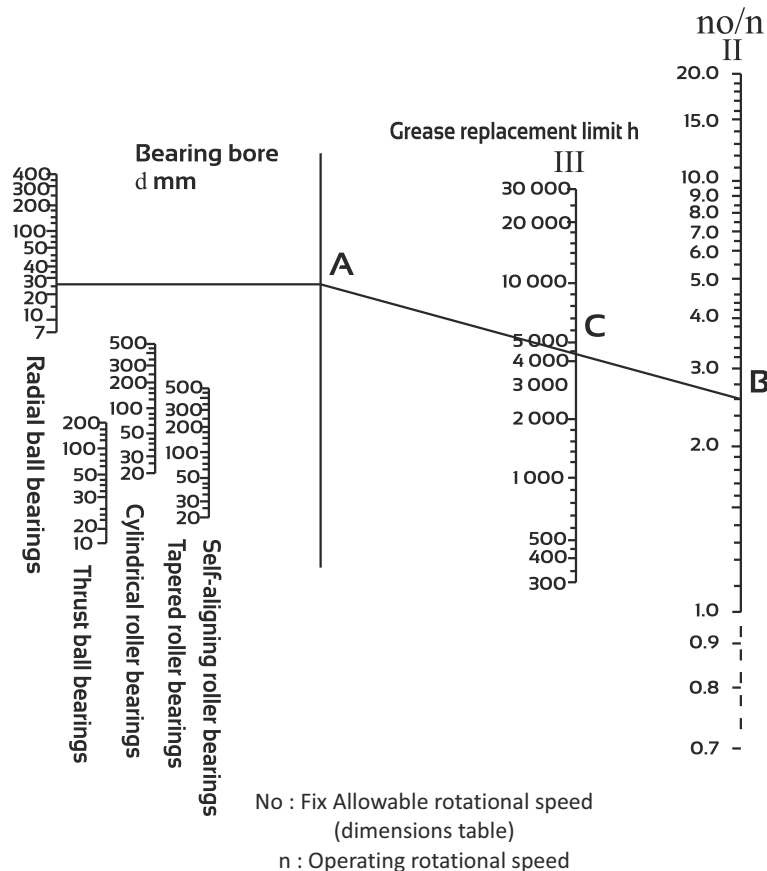


Fig. 7.2 Diagram for grease interval

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:

Table: 6 Speed factor with % filled quantity of grease

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	50
	Machined Retainer	36
N-cylindrical Roller Bearings ⁽³⁾	Pressed Retainer	55
	Machined Retainer	37
Tapered Roller Bearings	Machined Retainer	46
Spherical Roller Bearings	Pressed Retainer	35
	Machined Retainer	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 thickeners 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 1mm^{2/s}=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.

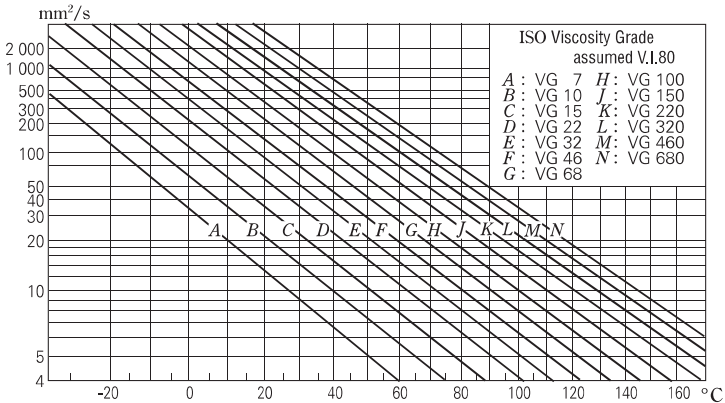
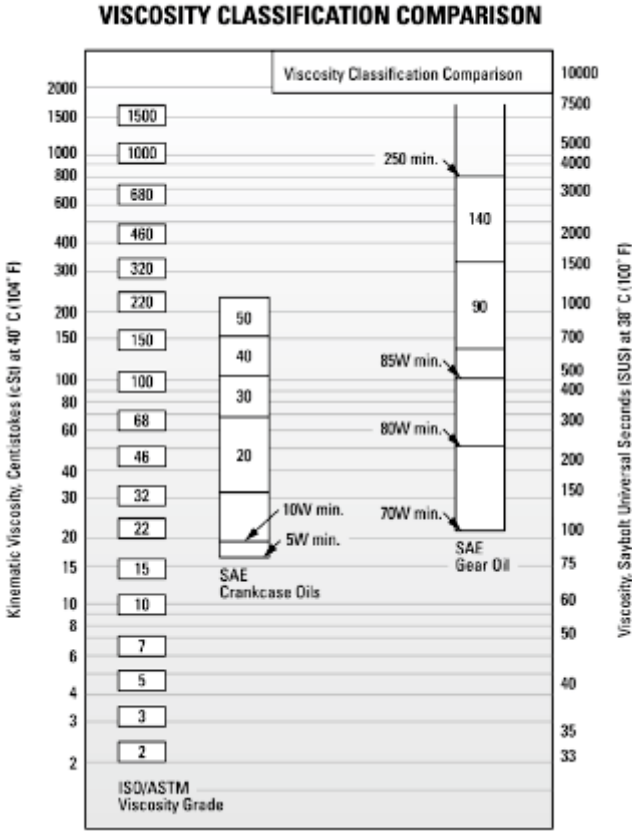
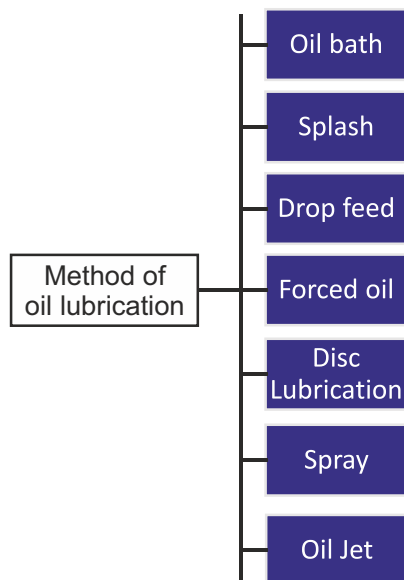


Fig. 11.5 Relation between lubricating oil viscosity and temperature

Table 7.9 Selection standards for lubricating 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 to 150,000	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 to 100	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		-

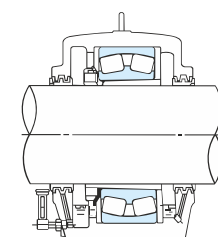
Please consult NEI technical cell in cases where operating conditions fall outside the range covered by this table.



7.4.5 Methods of Oil Lubrication

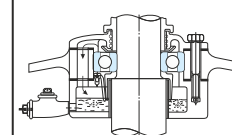
Oil bath lubrication

- 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.



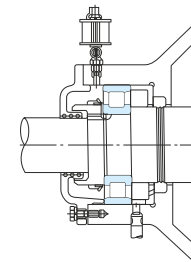
Splash lubrication

- 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.



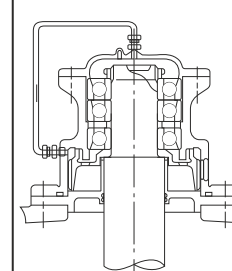
Drop-Feed lubrication

- 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.

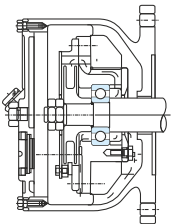
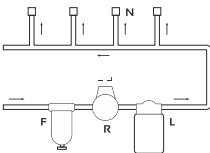
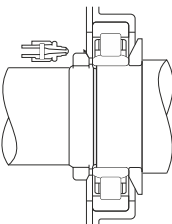


Forced oil circulation

- 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 oil 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.	

7.4.6 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).

For more details, please contact NEI technical cell.

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 NEI technical cell.

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:

$$M = 0.5 \times \mu \times P \times d$$

Where,

M = bearing frictional moment, calculated at the bearing bore radius (N mm)

μ = 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: ^a Apply to unsealed bearing

^b No appreciable axial load ($F_a = 0$)

8.2 Bearing operating 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.

$$Q = 0.105 \times 10^{-6} \times M \times n$$

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 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
- (7) Accuracies of shaft, housing, etc.
- (8) Type of Cage

Because of the many factors involved in determining the speed capabilities of a rolling bearing, it is impossible to develop a simple formula to establish an exact value for the limiting speed. 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. Since each application must be evaluated on its own merits, it is recommended the to

consulted the NBC Application Engineering Department 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.

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 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 ($P \leq 0.09 C_r$, $F_a / F_r \leq 0.3$).

- If load is $P \leq 0.04 C_r$, 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 to NBC engineering for 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 to 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 $Fr \leq 0.3C_{or}$

$$\Delta dp = 0.08 \sqrt{\frac{d \cdot Fr}{B}}$$

When $Fr \geq 0.3C_{or}$

$$\Delta dp = 0.02 (Fr/B)$$

where,

Δdp = Interference decrease of inner ring (μm)

Fr = Radial load (N)

B = Inner ring width (mm)

C_{or} = 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 shaft 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: $\Delta dt = 0.0015 \times d \times \Delta T$

Where Δdt = effective interference for temperature difference (μm)

ΔT = Temperature difference between bearing temperature and 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:

- Operating conditions with large vibrations or shock loads
- Application using hollow shaft of housing with thin walls
- Application using housing made of light alloys or plastic.

Loose interferences are recommended for:

- Application requiring high running accuracy
- Application using small size bearings or thin walled bearings.

Shaft and housing material, geometry, hardness and surface finish must be carefully controlled.

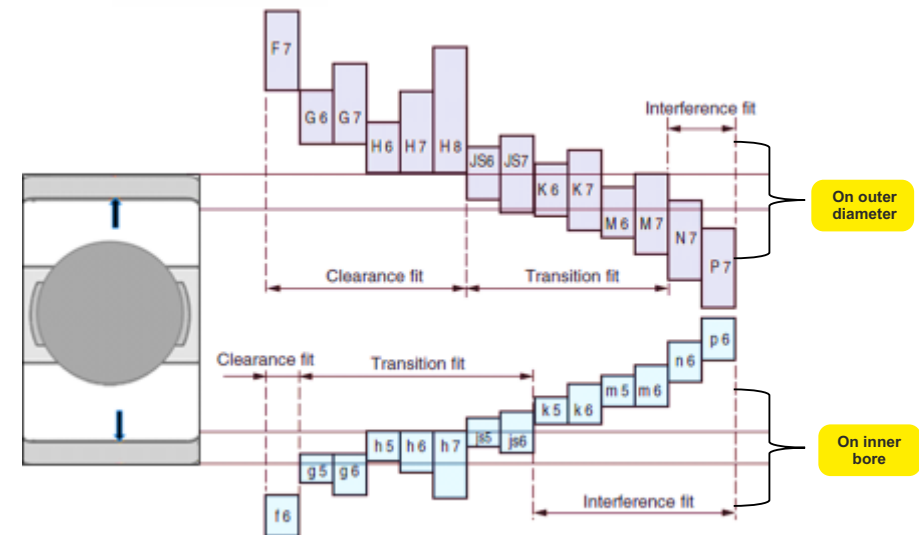
- Ground shafts should be finished to 1.3 micron Ra or better;
- For turned shafts a finish of 2.5 micron Ra or better; and
- Housing bores should be finished to 4 micron Ra or better.

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	Cylindrical, needle and tapered roller bearings	Spherical roller bearings	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, arduous 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
	Radial bearings with cylindrical core		All diameters			g6(f6) h6
Stationary inner ring load	Easy axial displacement of inner ring on shaft desirable	Wheels on non-rotating shafts (free wheels)				
	Axial displacement of inner ring on shaft not necessary	Tension pulleys, sheaves				
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	Outer ring cannot move axially
	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

Table for fit on shaft	Unit μm
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Table for fit on Housing Unit μm

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

Table for fit on shaft	Unit μm
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Table for fit on Housing	Unit μm
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10.3 Taper roller bearing -AFBMA recommended fitting practice

AFBMA limits & fitting guidelines

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 2.5µm 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 considered for contraction of the hollow shaft in order to maintain the desired radial pressure.

The NEI applications engineer should be consulted for proper fitting practice on all special applications. .

AFBMA Automotive Tapered Cone Fitting Practice.

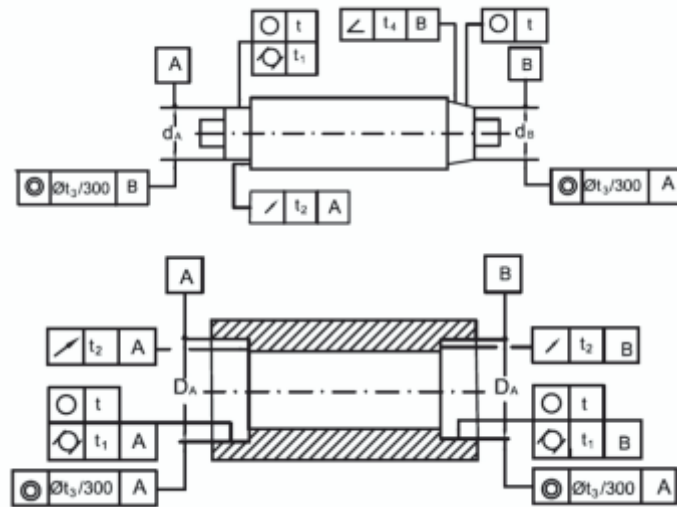
Use	Application	Fit Type	Cone Bore B*	Shaft Diameter B*	Fit	Cone Bore B*	Shaft Diameter B*	Fit
			Upto 3" bore			Above 3" bore		
Automotive Rotating Shafts	Pinion, transmission rear wheels, crossshaft, transfer case	Adjustable cones	+0.0005 -0.0000	+0.0005 +0.0000	0.0005T 0.0005L	+0.0010 -0.0000	+0.0015 +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, differential	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	+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, transmission, 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

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 housing	-	IT6(IT5) IT7(IT6)	IT5 IT6	IT4 IT5	IT4 IT4	IT3 IT4
Tolerance of roundness and cylindricity	shaft	$\bigcirc$ 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	$\bigcirc$ 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	$\nearrow$ t_2	IT4 (IT3)	IT3 (IT2)	IT2	IT1	IT0
	housing	$\nearrow$ t_2	IT5 (IT4)	IT4 (IT3)	IT2	IT2	IT1
Tolerance of concentricity	shaft	$\odot$ t_3	IT5 IT6	IT4 IT5	IT4 IT5	IT3 IT4	IT3 IT3
	housing	$\odot$ t_3	IT5 IT6	IT4 IT5	IT4 IT5	IT3 IT4	IT3 IT3
Tolerance of angularity	shaft	$\angle$ t_4	$\frac{IT7}{2}$	$\frac{IT6}{2}$	$\frac{IT4}{2}$	$\frac{IT3}{2}$	$\frac{IT2}{2}$

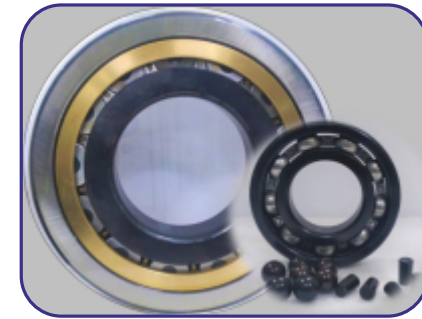
For IT grade values refer table for ISO tolerance grade.

Table: ISO Tolerance grade for dimensions

Nominal Dimension Over incl.		Tolerance Grade													
		IT0	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	
		μm													
mm															
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	1000	-	-	-	-	-	36	56	90	140	230	360	560	900	
1000	1250	-	-	-	-	-	42	66	105	165	260	420	660	1050	
1250	1600	-	-	-	-	-	50	78	125	195	310	500	780	1250	
1600	2000	-	-	-	-	-	60	92	150	230	370	600	920	1500	
2000	2500	-	-	-	-	-	70	110	175	280	440	700	1100	1750	

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

- 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

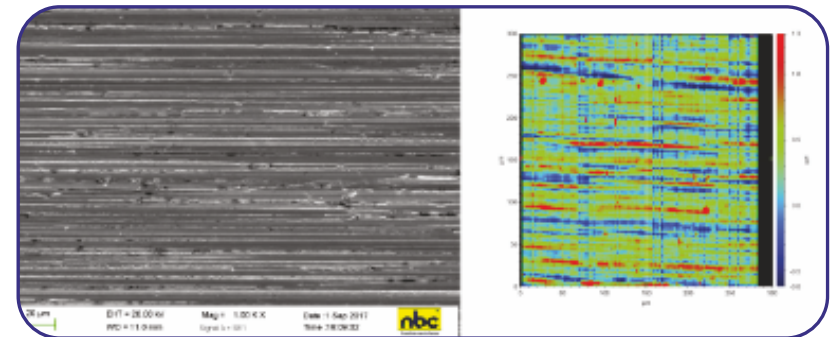
- Surface reduction to mirror like finishes
- Optimum surface roughness
- Increased lubrication retention and heat transfer

- Reduction in lubricant temperature
- Reduced noise

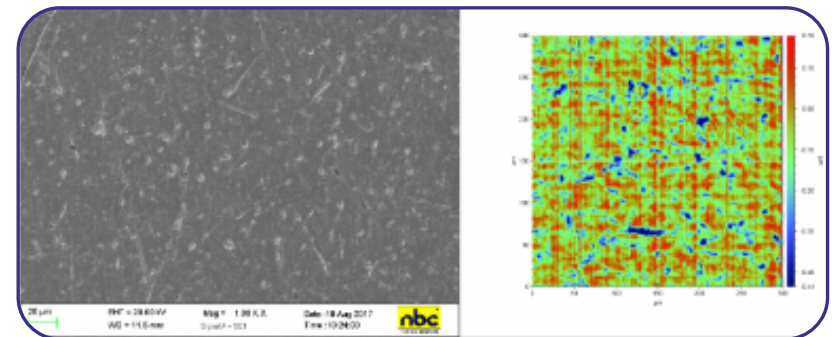
APPLICATIONS / INDUSTRIES

- Transmission bearings

Honing



Isofinishing



11.3 Oil Impregnated Bearing Solutions

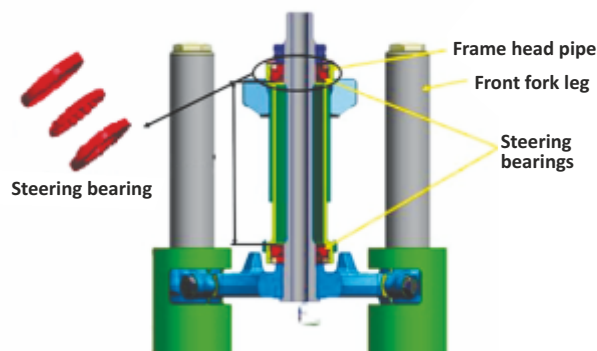
Key features

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.

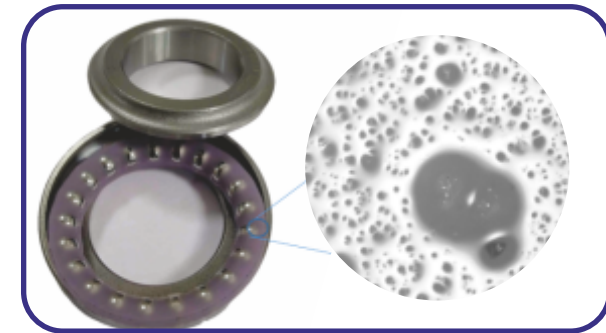
Benefits:

- 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

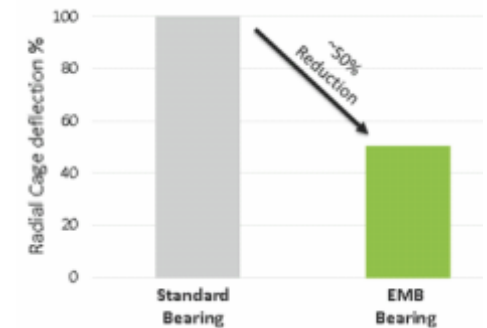
Benefits:

- 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

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 operate within vibration tolerances.

Uncontrolled vibrations create undesirable behavior in machinery, leading 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 predict 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 solutions to industries. We offer field laser alignment, which makes the alignment process fast and accurate by avoiding trial & error methods.

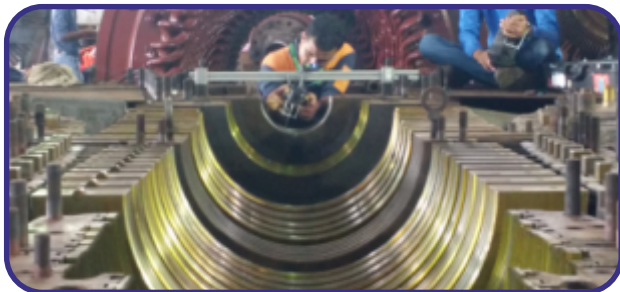
We perform laser alignment for shaft in coupled & Un-coupled condition, torsion shaft alignment, ID&FD fan alignment, cooling tower fan shaft alignment, wind mill alignment, cardon shaft alignment, soft foot correction and thermal growth compensation.



In-Situ Dynamic Balancing

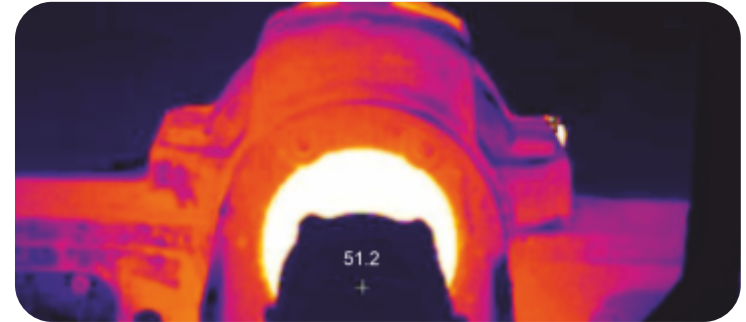
Unbalance Condition of machine is one of the most common contributors to vibrations in rotating machines. If unbalance remains uncorrected, it may lead to severe vibration problems, premature bearing failures, low performance of machines than expected, and more power consumptions.

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 rotation. 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

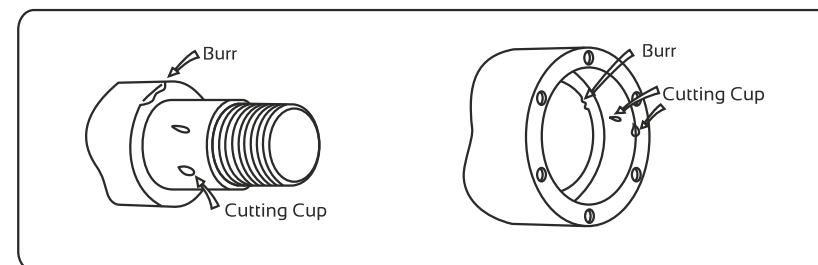
It is crucial that you should not expose bearings to the presence of water for a long time, as it will lead to rust and corrosion. It will also cause the premature failure of the bearings, which can affect the machine performance and productivity. As a result, it will increase your operating costs. Also,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

Proper lubrication

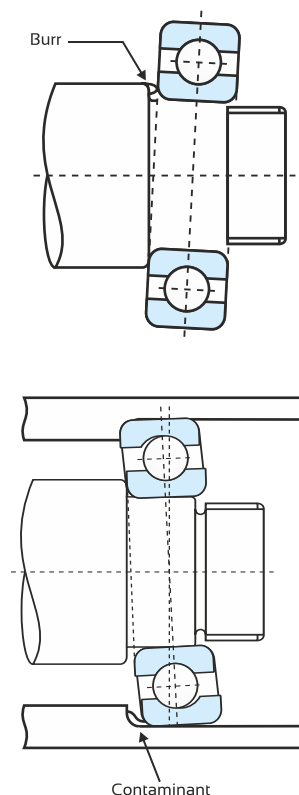
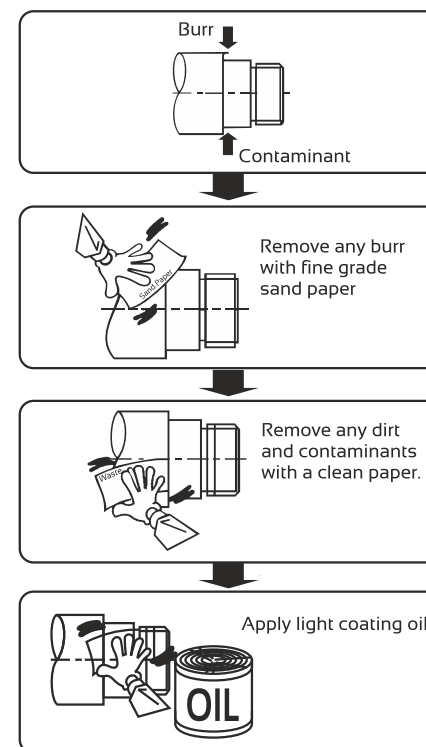
If you want to have a prolonged life of your bearings, it is crucial that they should be properly lubricated. The correct lubricant depends on the environmental conditions, temperature, speed and load. In this case, it is advisable that you should follow your manufacturer's recommendations.

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 gauge. Check the size at two different positions and at four locations

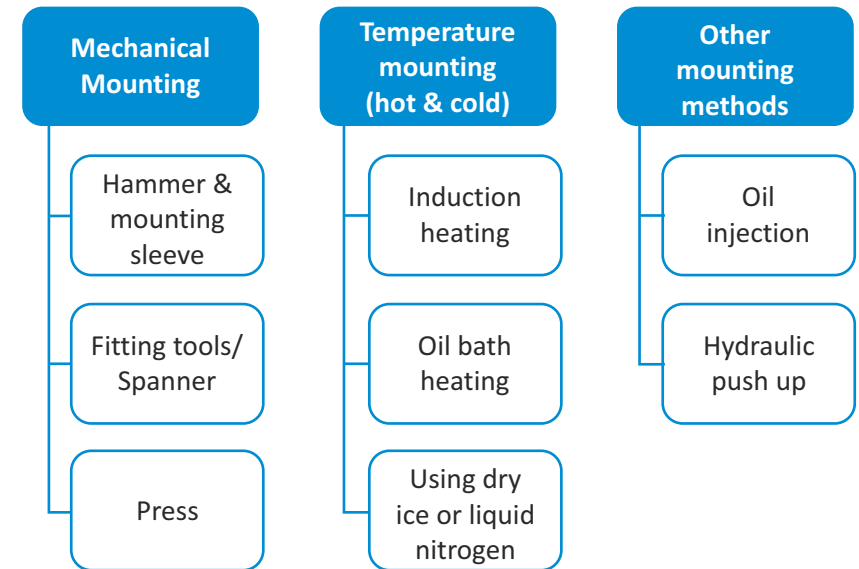


- Check dimensions, shoulder and finishing of shaft and the housing as per the drawing. The shaft diameter and housing bore



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.



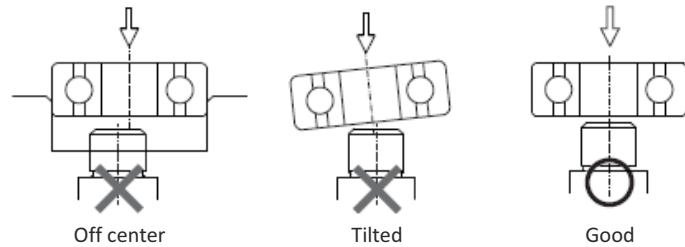
13.3.1 Mechanical method

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

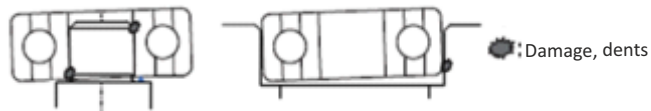
- Non-separable bearing, the component which is tight fit is mounted first in housing or shaft.
- Separable bearing, inner can be mounted independently of outer. During assembly, care must be taken to align the shaft properly with housing.

Alignment

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

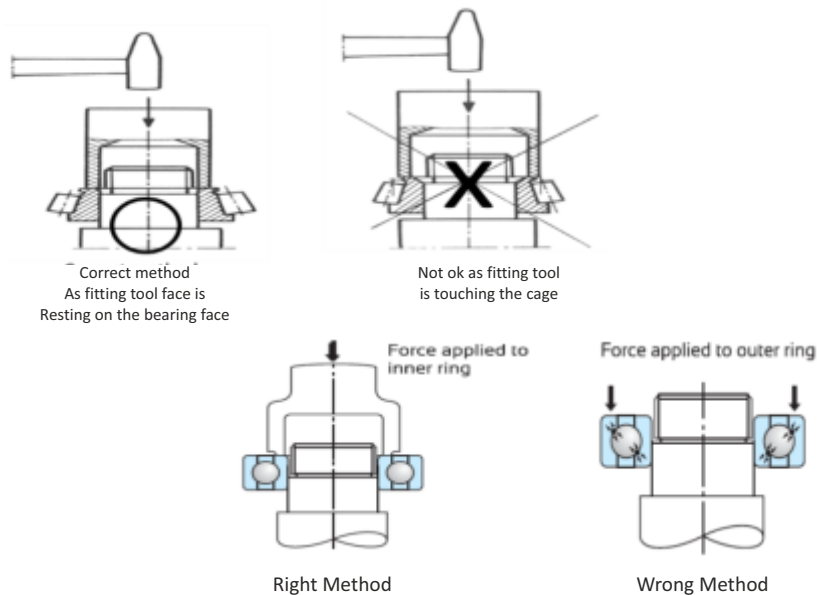


Misalignment Due to Contamination and Damage



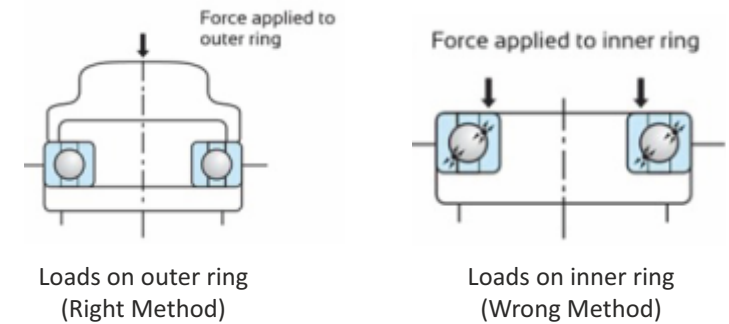
Inner mounting on shaft

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



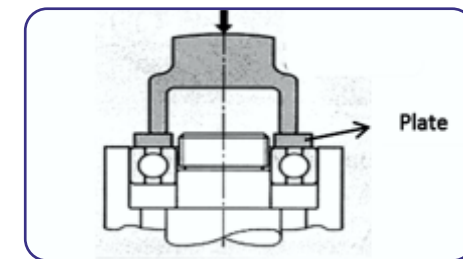
Outer ring mounting in housing

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

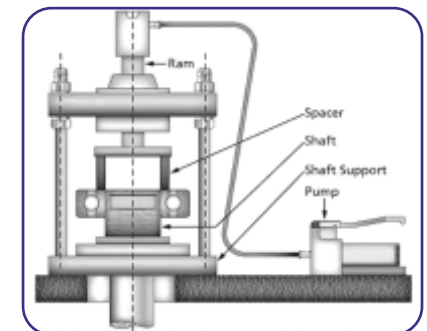


Mounting both housing and shaft together

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



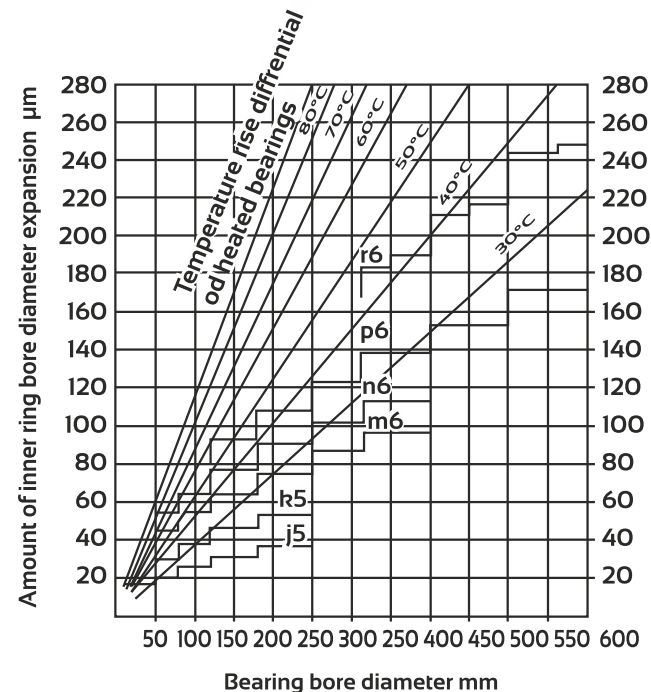
13.3.2 Temperature Mounting

(Heat expansion of inner ring to ease installation)

Oil bath method

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

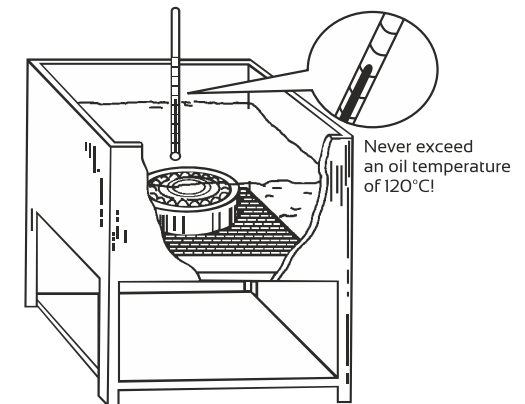
1. Immersion of the bearing in heated oil is the most common method. Use clean oil and suspend the bearing in the oil with a wire or support it underneath using a metal screen in order to avoid uneven heating of bearing elements.
2. The temperature to which the inner ring should be heated depends upon 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.

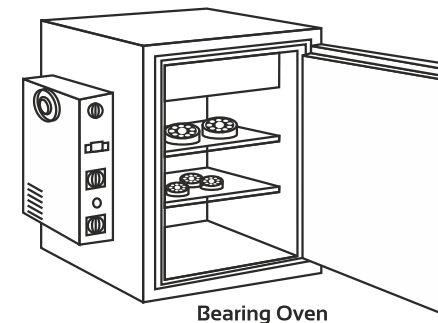
Precautions : Bearings should never be heated over 120°C.

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.

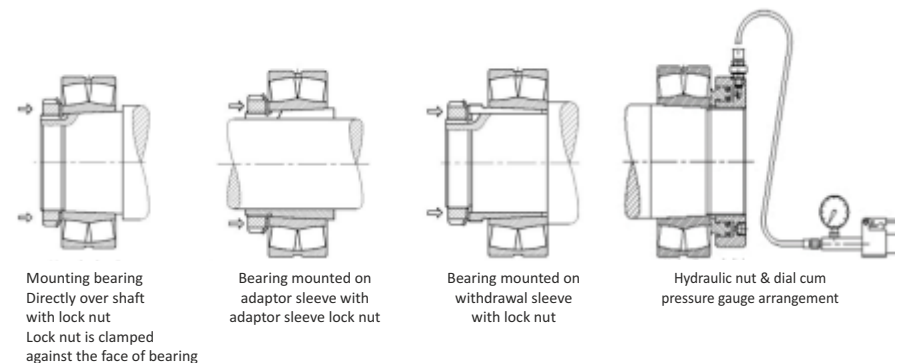
Mounting can be done in the following ways.

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



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.

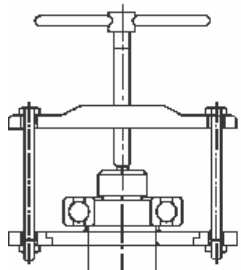
Table for permissible residual clearance

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

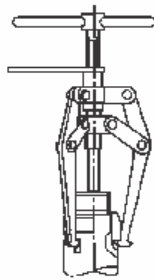
A bearing may be removed for periodic inspection. If the removed bearing is to be used again or it is removed only for inspection, it should be dismantled as carefully as when it was mounted. If the bearing has a tight fit, its removal may be difficult. The means for removal should be considered in the original design of the adjacent parts of the machine. When dismantling, 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 dismantled independent of each other.

Small size bearings can be dismantled 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.

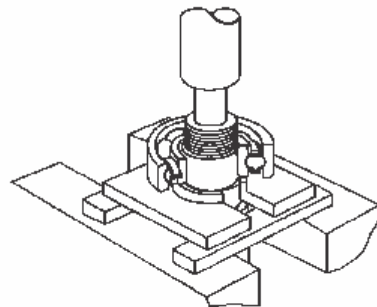


(a)

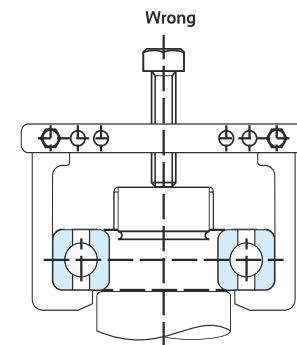
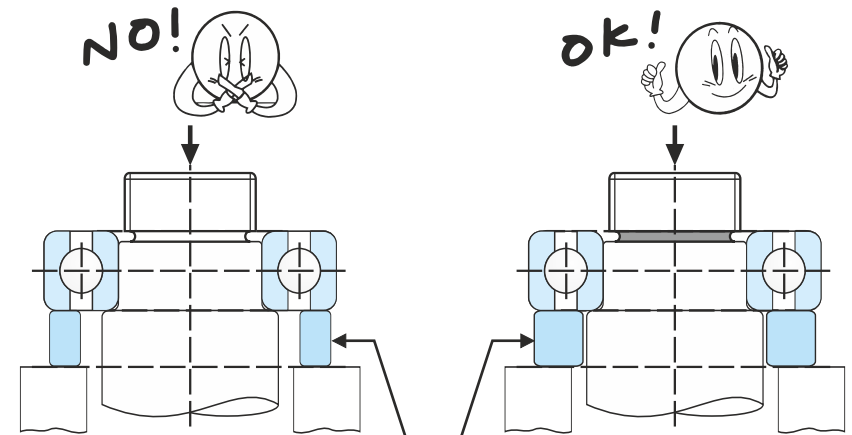
Removal Using a Bearing puller



(b)

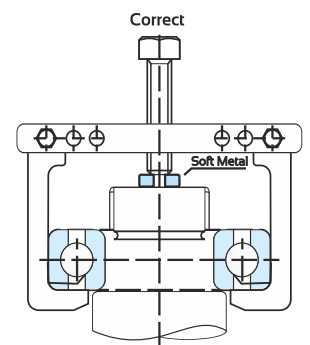


Removal Using a spacer



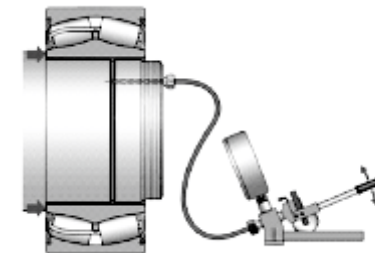
Wrong

Permissible



Correct

Soft Metal



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

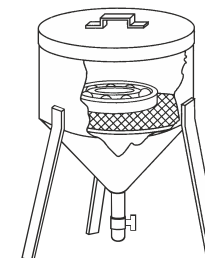
In Rough cleaning a separate container should be used and to support the bearing. A screen is provided in the container. All the cleaning media as mentioned above can be used for cleaning bearing, if bearing is very dirty, Gasoline should be used. Care should be taken to prevent igniting and to prevent 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.

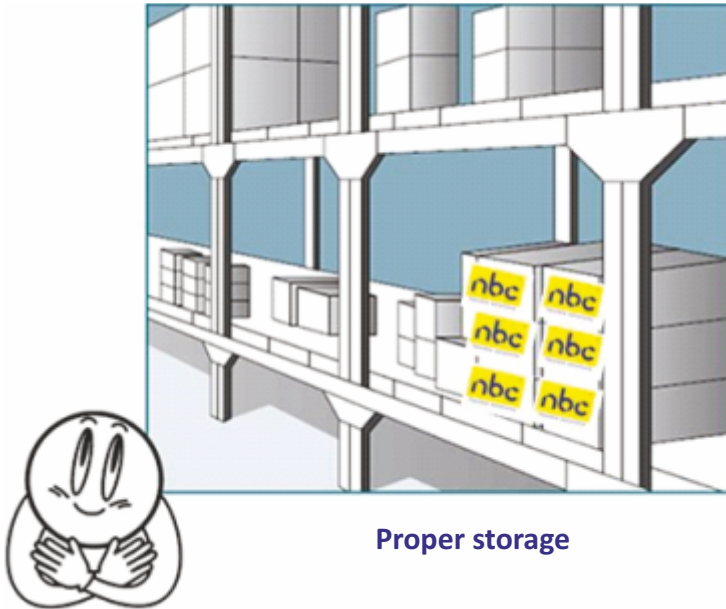
- (e) When there is rust or scoring on the raceway surfaces or rolling elements.
- (f) When there are any significant impact or brinell traces on the raceway surfaces or rolling elements.
- (g) When there is significant evidence of creep on the bore or the periphery of the outer ring.
- (h) When discoloration 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

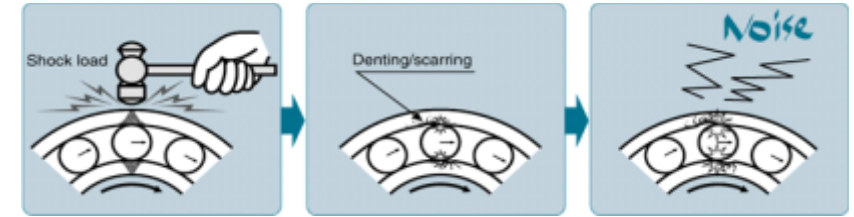


13.9.2 Bearing Handling

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

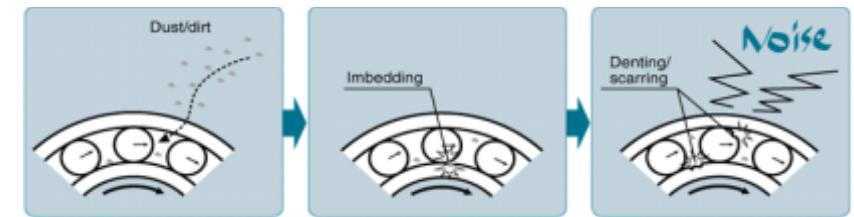
If an excessive load or impact is applied to this narrow area of contact, brinelling and/or scarring will occur. This damage leads to objectionable noise and vibration levels and rough bearing rotation. (Even dropping bearings on the floor will cause this type of damage.)

Bearings are very susceptible to impacts and shock loads!



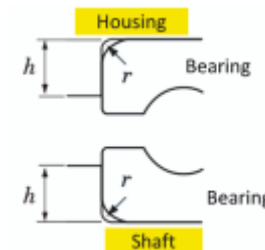
Bearings are very susceptible to foreign particle contamination!

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

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

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:

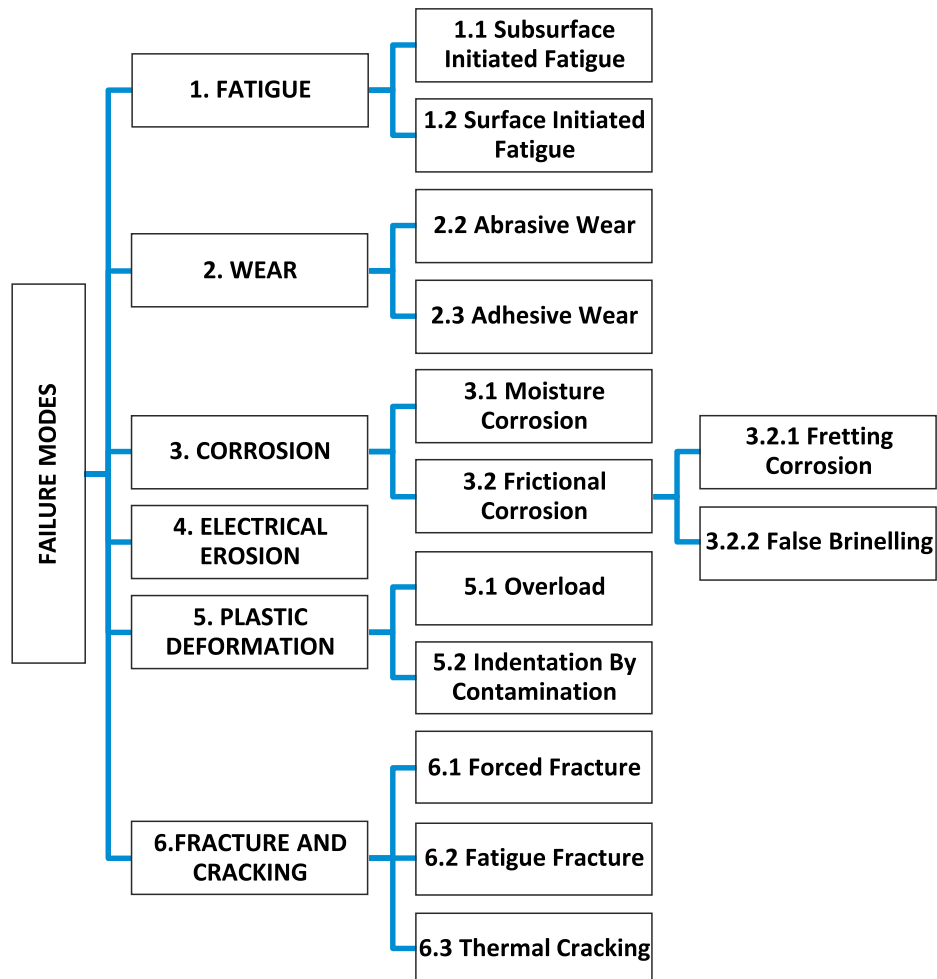
1. Improper mounting/handling practice
2. Wrong bearing selection
3. Inappropriate operating condition
4. Insufficient lubrication
5. Solid or liquid contamination
6. Wrong lubrication selection
7. Material fault/inclusion
8. Deviation/abnormality in manufacturing process

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 repeated 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:

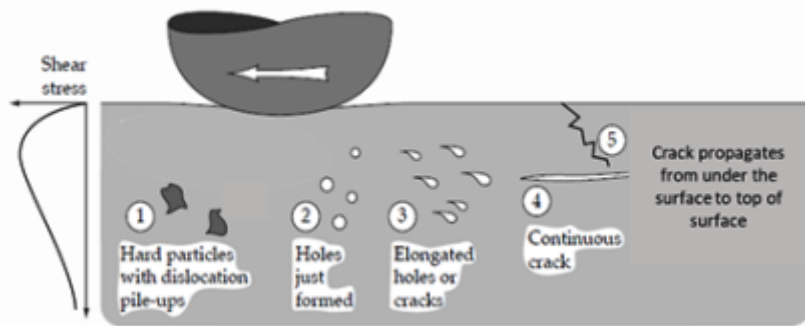
- Subsurface initiated
- Surface initiated

Subsurface Initiated fatigue

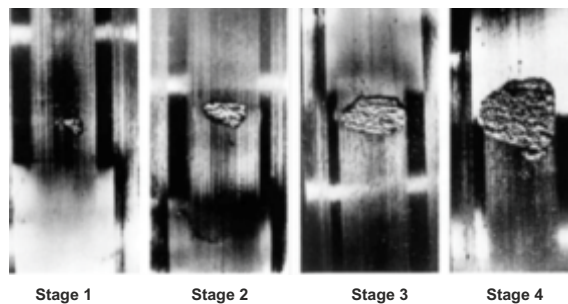
During operation, there are repeated cyclic stress in the rotating part and constant stresses in the stationary part. Under load zone the rolling elements are compressed due to maximum load and as they move out of load zone they expand due to minimum load.

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.

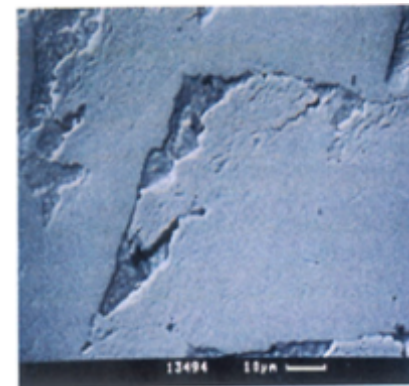


Surface Initiated fatigue

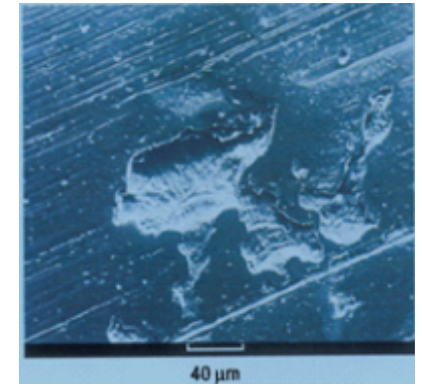
Fatigue initiated from the surface is mainly caused due to surface distress. Surface distress is the damage to the rolling contact surface roughness under the reduced lubrication or wrong lubricant selection. It may also occur when lubrication is contaminated with foreign particles due to poor sealing 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 asperities, 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

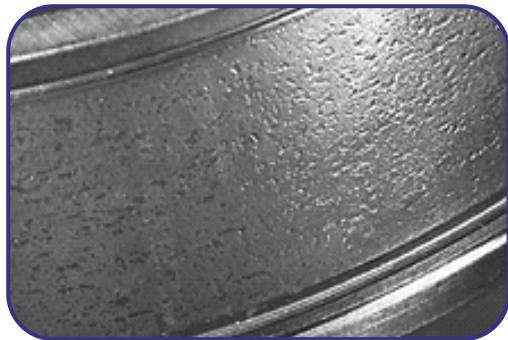
Wear is the progressive removal of the material resulting from interaction of the asperities of two sliding or rolling/sliding contacting surfaces during application. There are two basic mechanism of wear in rolling element bearings:

- 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.



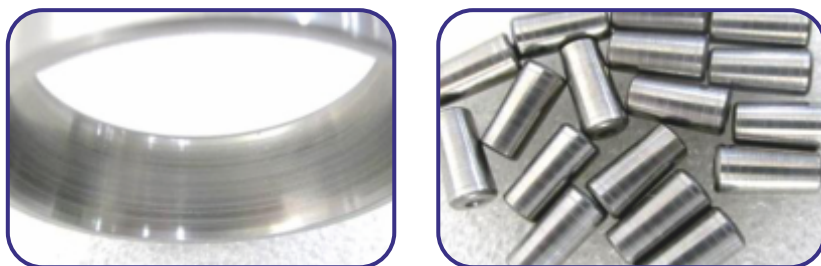
Abrasive wear on the inner ring raceways of a double-row cylindrical roller bearing with central rib

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)

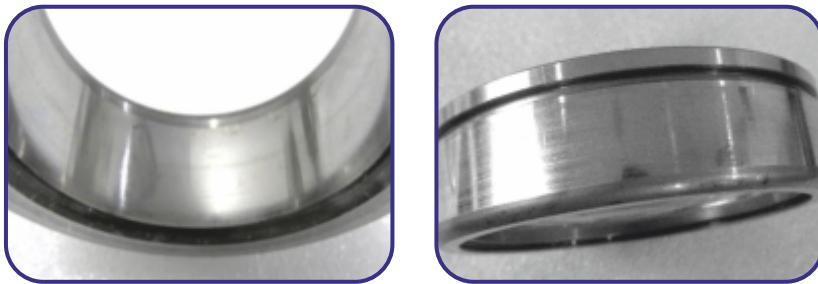
Adhesive wear is a transfer of material from one surface to another with frictional heating and sometimes, tempering or re-hardening of the surface. This produces localized stress concentrations with the potential for cracking or flaking of the contact areas.

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.

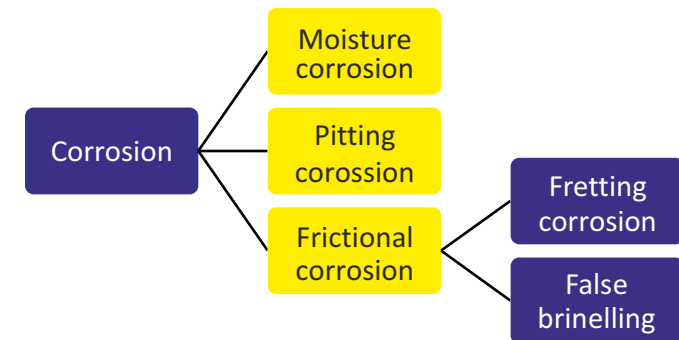


Seizing marks on inner ring bore surface due to loose fits

3. Corrosion

It is the gradual destruction of materials (usually metals) by chemical and/or electrochemical reaction with their environment.

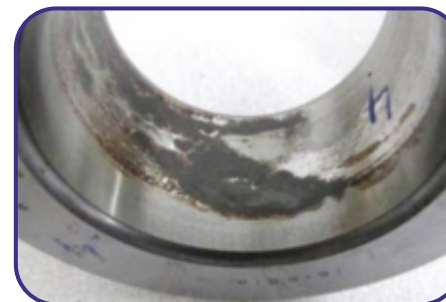
In case bearing is handled or stored improperly which resulted into removal of rust preventive oil film or when water enter through defective or inadequate seals or sometimes from condensation under certain conditions, black oxide commonly called “water etch” will form at respective rolling positions.



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

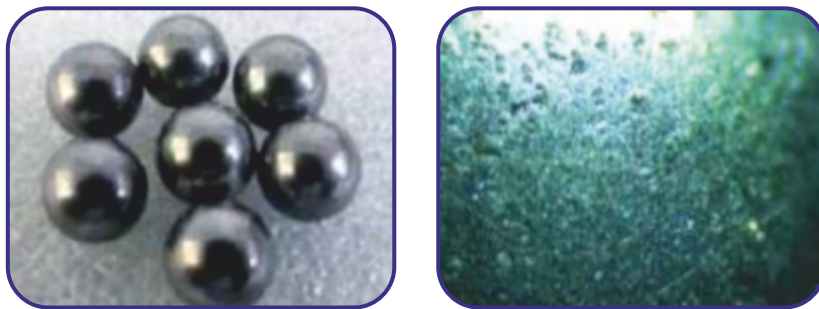


Contact corrosion on cone raceway of Taper Roller Bearing at roller pitch distance

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

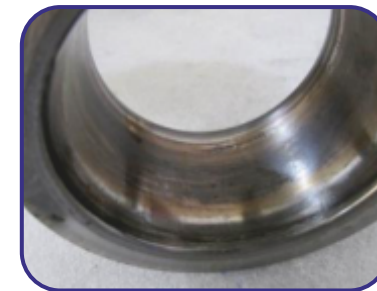
3.3 Frictional Corrosion

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 rigidity to bending



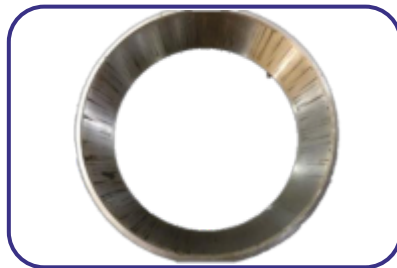
Fretting corrosion on cone bore of Taper Roller Bearing due to micro movement between cone and shaft

3.3.2 False Brinelling

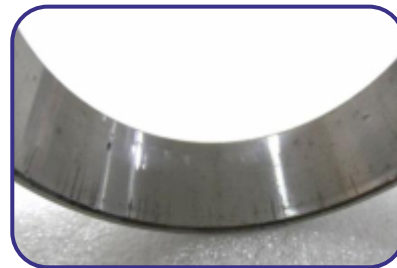
When bearing is stationary, lubrication film between the rolling elements and the raceways is very thin; gives metal to metal contact and the vibration produce small relative movements of rolling elements and rings. As a result of these relative movements, small particles break away from the surfaces 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 shiny. For the case of bearings in running condition (while rotation) false brinelling caused by vibration are visible in the form of closely spaced flutes.

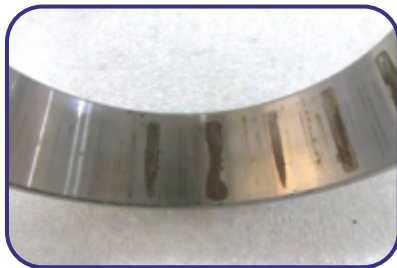
Causes	Countermeasures
• Oscillation or vibration while bearing is stationary e.g. while transportation • Oscillations with small amplitude • Poor lubrication	• Secure shaft & housing while transportation • Radially preload the bearing or provide a vibration damping base • Use oil or high consistency 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



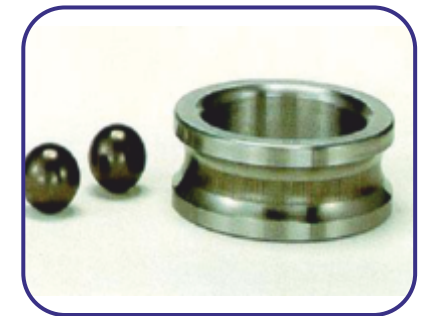
False brinelling and contact corrosion marks on cup raceway of Taper Roller Bearing due to water/moisture entry and vibrations

4. Electric 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

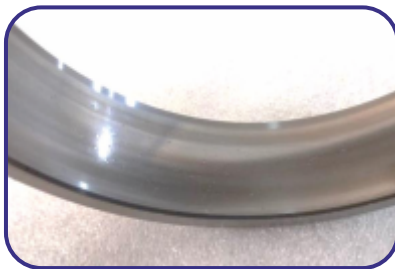
5.2 Indentation

5.2.1 Indentation from foreign particles

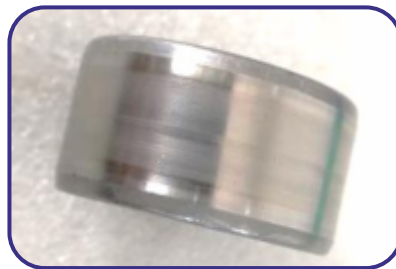
When foreign particles get trapped and over-rolled between the rolling surfaces, indentations are formed on raceways and rolling elements. The size and shape of the indentation depends on the nature of the particles. It can be caused by–

- 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

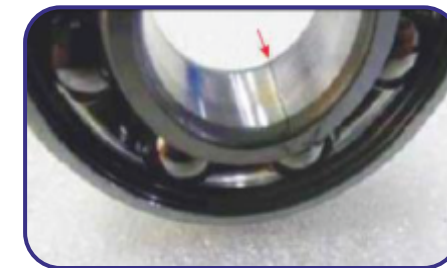
Crack initiates and propagates when the ultimate tensile strength of the material is locally exceeded. Fracture is the result of a crack propagating to the point of complete separation of the component.

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



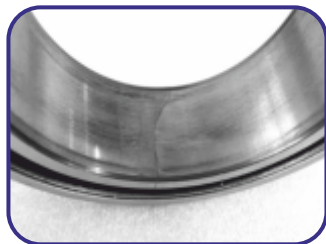
Fatigue fracture of Outer ring caused by insufficient support in the housing



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



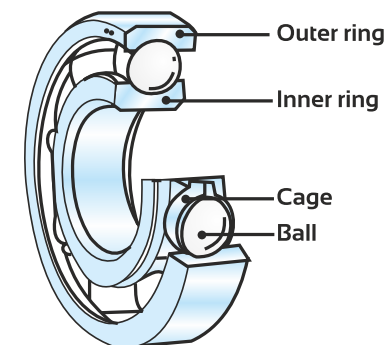
15 Technical Data – Ball Bearing

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 prized 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)

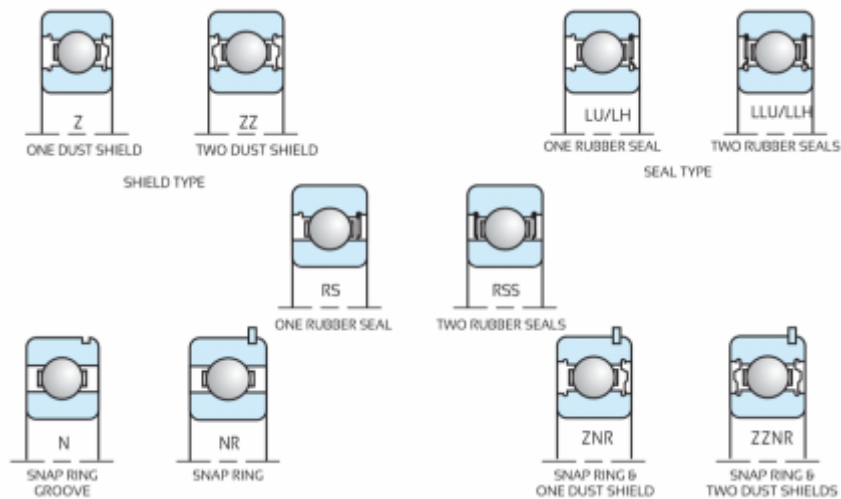
F_a = Axial dynamic bearing load (N)

F_r Radial dynamic bearing load (N)

Single row deep groove ball bearing with shield / seal

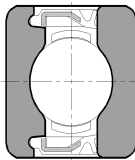
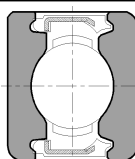
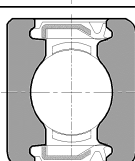
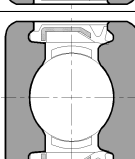
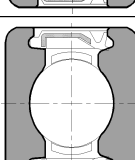
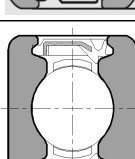
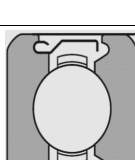
The bearings are with non- contact shield (Z) and contact type of rubber seals (RS, LU, LH). These are most commonly used rubber seals. Apart from these seals new design rubber seals were developed specific to applications. Depending upon the application requirement seals/shield is fixed on one side or both side. The bearings are also available with groove (N) on outer diameter and snap ring (R) for axial locating.

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

Construction	Sealed Type						Shielded Type
	RS	LB	LU	LH	LH1	LV	Z
							
	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 specially designed lip on edge of seal prevents penetration by foreign matter, low torque construction.	Basic construction same as LH type, Additionally vent hole provided to evacuate vacuum 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 temperature.							
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.



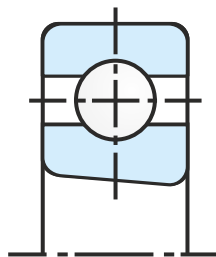
TMB Ball Bearing

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 bearings 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 Bearing with Tapered Bore

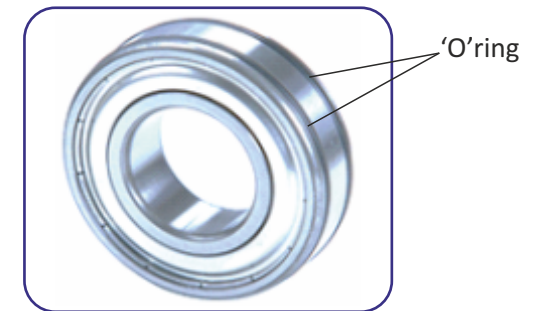
The single row radial ball bearings with tapered bore are identical to single row radial ball bearings except that these have tapered bore which is used for easier mounting and for the adjustment of radial clearance. Dimensions of tapered bore diameter refer to small bore.



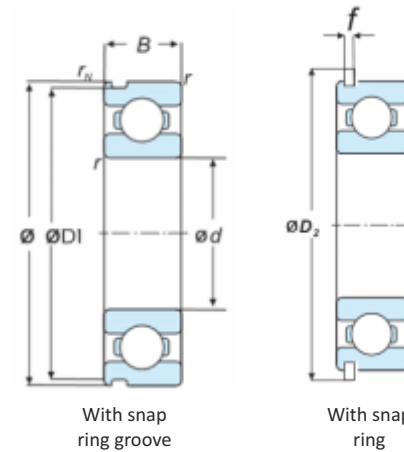
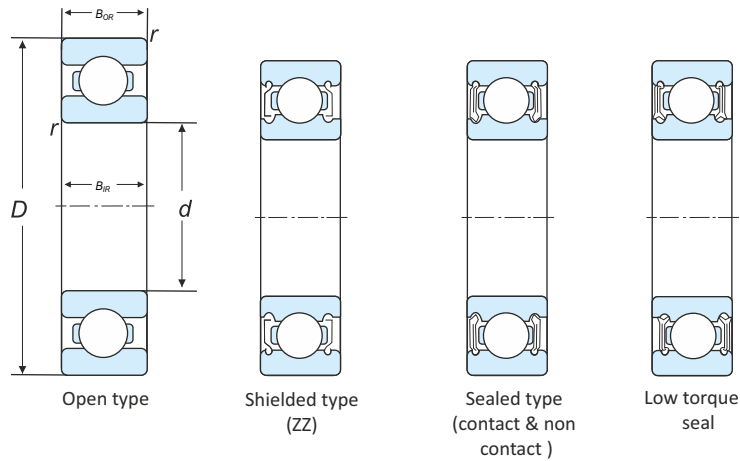
SINGLE ROW RADIAL
BALL BEARING WITH
TAPER BORE

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.



Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

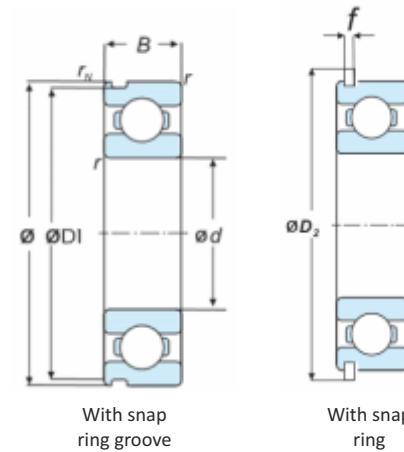
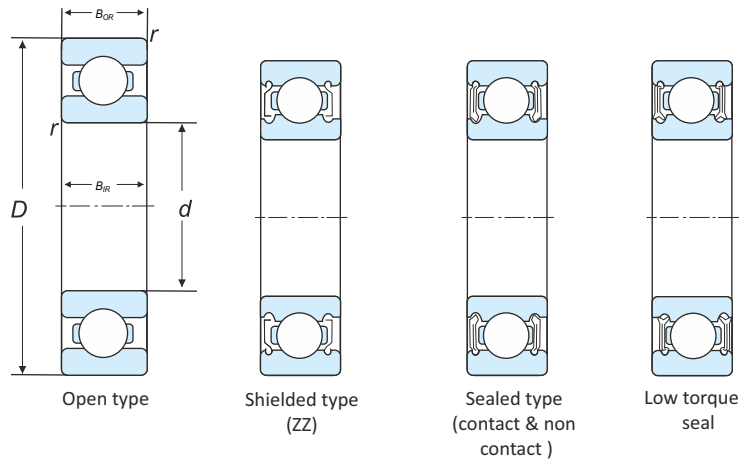
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
10	26	8	8	0.3	4.55	1.96	464	200	0.17	29000	34000	6000	Z	ZZ	-	-	RS	RSS	-	-	0.019
10	30	9	9	0.6	5.98	2.64	610	269	0.22	25000	30000	6200	Z	ZZ	-	LH	RS	RSS	N	NR	0.032
10	28	8	8	0.3	5.1	2.39	520	244	0.19	24000	29000	N1566	-	-	-	-	-	RSS	-	-	0.026
12	35	11	11	0.3	6.78	3.32	691	339	0.26	23000	27000	6300	Z	ZZ	-	LH	LU	LLU	-	-	0.053
12	24	6	6	0.3	2.89	1.46	295	149	0.10	27000	32000	6901	-	-	-	-	RS	RSS	-	-	0.011
12	28	8	8	0.3	5.1	2.39	520	244	0.19	26000	30000	6001	Z	ZZ	-	-	LUAX2	-	-	-	0.021
12	32	10	10	0.6	6.9	3.1	704	316	0.26	22000	26000	6201	Z	ZZ	-	LH	LUAX2	RSS	N1	NR	0.038
12	32	14	14	0.6	62	2.7	6322	275	0.26	22000	26000	62201	Z	-	-	-	-	RSS	-	-	0.05
12	37	12	12	1	9.7	4.2	989	428	0.35	20000	24000	6301	Z	ZZ	-	LH	LU	LLU	-	-	0.061
12	40	12	12	1	11.4	5	1162	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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

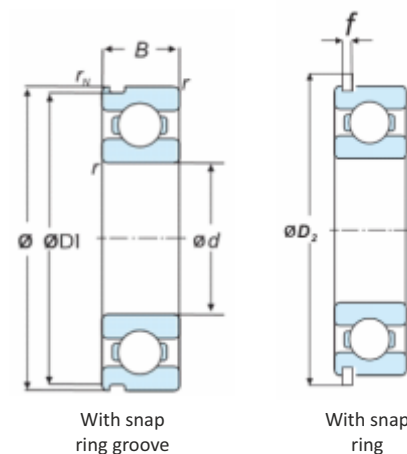
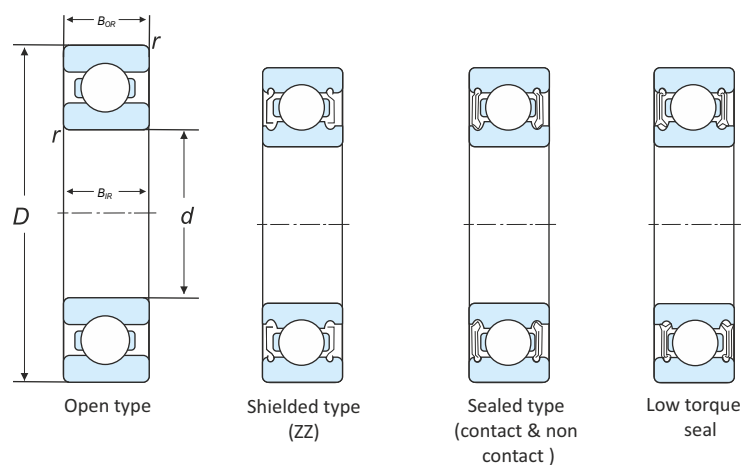
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
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		Sealed Bearings*			Snap Ring Groove	Snap Ring		
		Non Contact Type	Low Torque Type	Contact Type																	
15	28	7	7	0.3	4.1	2.06	418	210	0.13	24000	28000	6902	Z	-	-	-	RS	RSS	-	-	0.018
15	32	9	9	0.3	5.6	2.84	571	290	0.20	22000	26000	6002	Z	ZZ	-	LLH	LU/LUA	LLU	-	-	0.035
15	32	8	8	0.3	5.6	2.84	571	290	0.20	22000	26000	16002	-	-	-	-	-	-	-	-	0.025
15	35	11	11	0.6	7.75	3.6	790	367	0.30	19000	23000	6202	Z	ZZ	-	-	LU	LLUA/LLVA	-	-	0.052
15	35	14	14	0.6	7.7	3.7	785	377	0.30	22000	25000	62202	-	-	-	-	-	RSS	-	-	0.06
15	35	11	11	0.6	7.64	3.72	779	379	0.29	24000	27000	6202C	-	-	-	-	-	LLWA	-	-	0.044
15	42	13	13	1	11.4	5.54	1162	565	0.45	17000	21000	6302	Z	ZZ	-	-	RS	RSS	-	-	0.084
16	42	13	13	1	9.6	4.55	979	464	0.37	17000	21000	BB1002	-	-	-	-	-	-	-	-	0.084

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

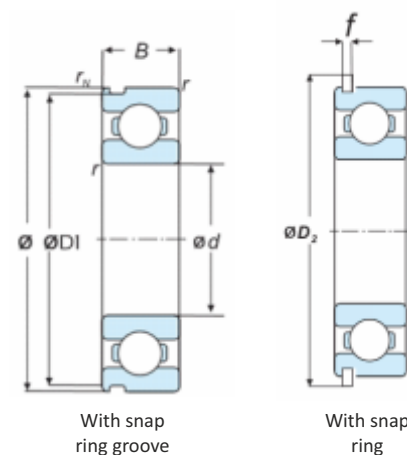
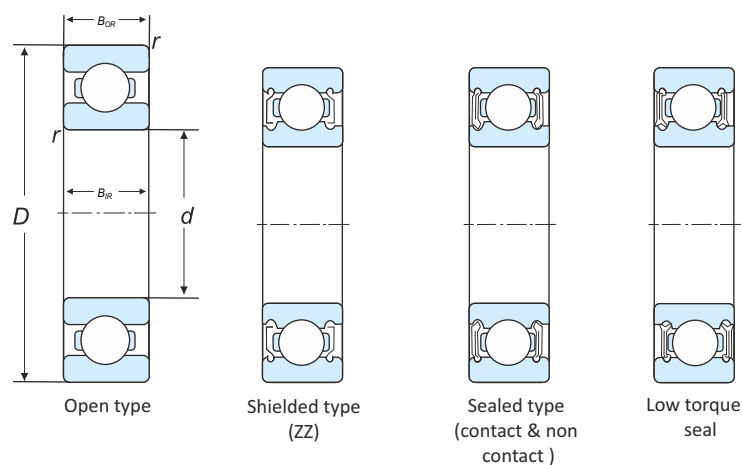
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static												
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	Sealed Bearings*			Snap Ring Groove	Snap Ring		
														Non Contact Type	Low Torque Type	Contact Type				
17	30	7	7	0.3	4.65	2.58	474	263	0.17	20000	24000	6903	-	-	-	-	-	-	-	0.016
17	35	8	8	0.3	6.8	3.35	693	342	0.25	20000	24000	16003	-	-	-	-	-	-	-	0.032
17	35	10	10	0.3	6.8	3.35	693	342	0.25	20000	24000	6003	Z	ZZ	-	LLHA	LU	LLU	-	0.039
17	40	12	12	0.6	9.6	4.6	979	469	0.38	18000	21000	6203	Z	ZZ	-	LLHA	LUAX2	LLU	-	0.065
17	40	12	12	0.6	10.5	5.2	1071	530	0.43	18000	21000	6203C	-	-	-	LLHA	LU	LLVA	N1	0.061
17	40	16	16	0.6	9.6	4.6	979	469	0.43	16000	18000	62203	-	-	-	-	-	RSS	-	0.09
17	42	12	12	0.6	11.6	5.7	1183	581	0.43	18000	21000	6203A/42	-	-	-	LH	LU	-	-	0.078
17	47	14	14	1	13.5	6.55	1377	668	0.55	16000	19000	6303	Z	ZZ	-	LLHA	LU	LLWA/LLVA	-	0.116
17	40	12	12	0.6	9.6	4.6	979	469	0.38	18000	21000	6203SPL	-	-	-	-	-	LLV	-	0.068
17	47	14	14	1	13.5	6.55	1377	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

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

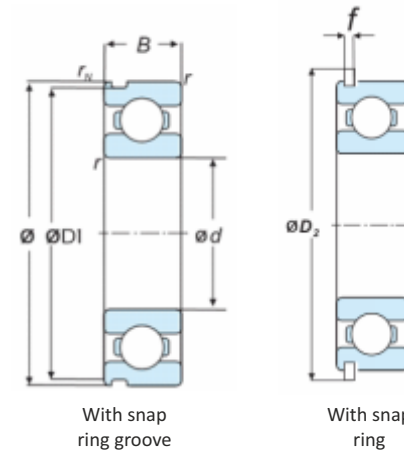
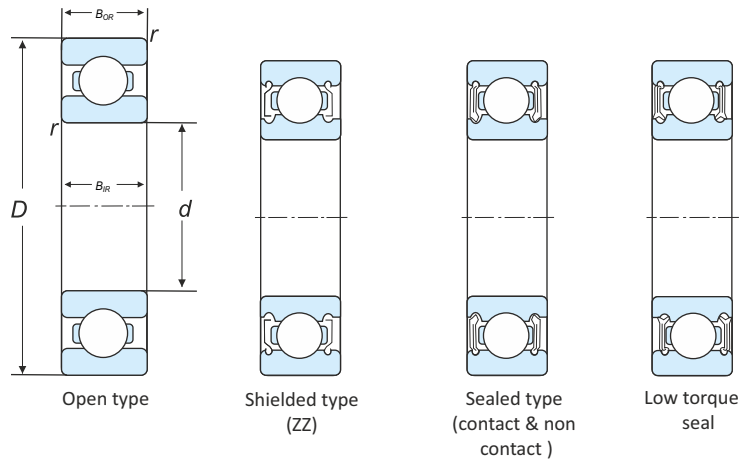
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
18	56	16	16	1.1	20.7	10.4	2111	1060	0.84	13000	15000	63/18	-	-	-	-	-	LLU	-	-	0.196
20	32	9	9	0.3	4	2.47	408	252	0.15	21000	23000	6904/32	-	-	-	LLH	-	RSS	-	-	0.026
20	37	9	9	0.3	6.4	3.7	653	377	0.12	18000	20000	6904	-	-	-	-	-		-	-	0.036
20	42	8	8	0.3	7.4	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	9.4	5.05	959	515	0.36	18000	21000	6004	Z	ZZ	-	LH/LLH	LU	LLU	-	-	0.069
20	47	14	14	1	13.7	6.7	1397	683	0.56	16000	18000	6204	Z	ZZ	-	LLHA	LU/LUA	LLU/RSS	N	-	0.114
20	47	14	14	1	12.8	6.5	1305	663	0.44	16000	18000	6204M	-	-	-	-	-	-	N	-	0.105
20	47	16	16	1	13.7	6.7	1397	683	0.56	16000	18000	6204/2B	Z	ZZ	-	LLHA	-	-	-	-	0.11
20	47	15.88	15.88	0.6	13.7	6.7	1397	683	0.56	16000	18000	BB1003	-	-	-	-	-	-	-	-	0.12

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

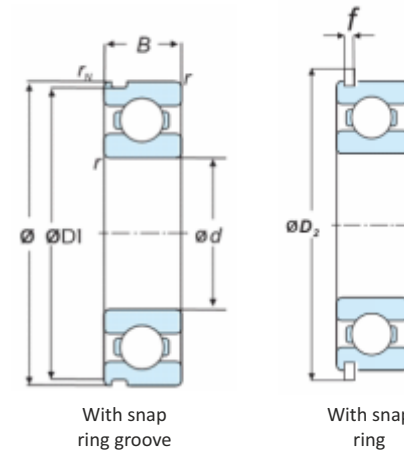
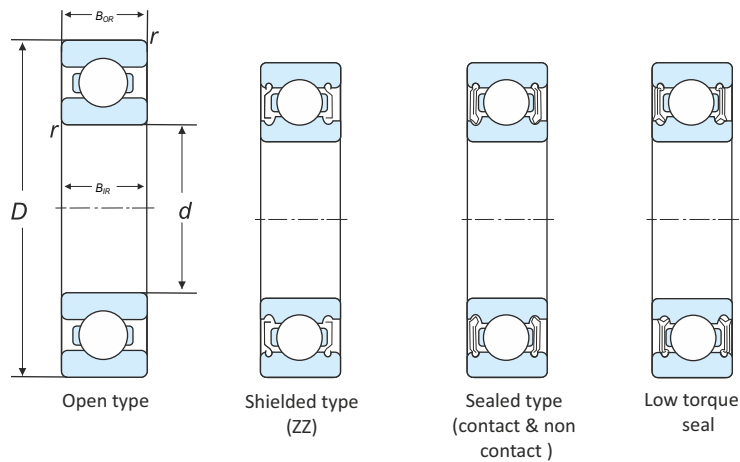
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static												
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	Sealed Bearings*			Snap Ring Groove	Snap Ring		
														Non Contact Type	Low Torque Type	Contact Type				
20	47	18	18	1	12.8	6.7	1305	683	0.56	11000	16000	62204	-	-	-	-	-	-	-	0.14
20	50	14	14	1	13.7	6.7	1397	683	0.56	16000	18000	1838002	-	-	-	-	-	-	-	0.125
20	52	15	15	1.1	15.9	7.85	1621	800	0.66	14000	17000	6304	Z	ZZ	-	-	RS	RSS	N	0.147
20	52	15	15	1.1	18.1	9	1846	918	0.75	14000	17000	6304M	-	-	-	-	-	-	-	0.142
20	55	11	11	1.1	15.9	7.85	1621	800	0.55	14000	17500	20x55x11	-	-	-	-	-	-	-	0.136
20	56	17	17	1.1	20.5	10.2	2090	1040	0.86	13000	15000	20x56x17	-	-	-	-	-	-	N	0.19
20	62	16	16	1	23.4	12.2	2386	1244	1.02	10000	12000	BB1063	-	ZZ	-	-	-	-	-	0.254
20	42	12	12	0.6	9.4	5.05	959	515	0.36	18000	21000	N1344	-	-	-	-	-	-	-	0.067
20	47	16	16	1	14.68	7.16	1497	730	0.60	16000	18000	N1389	-	-	-	-	-	LLUA	-	0.112
20	52	14	14	1	18.1	9	1846	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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

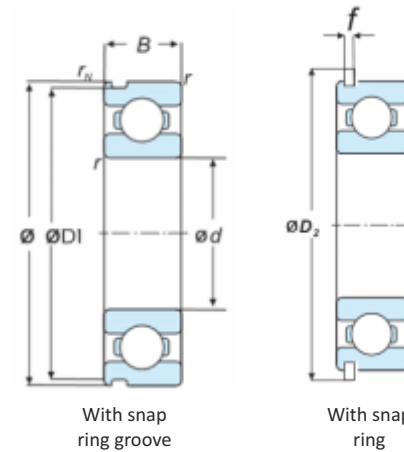
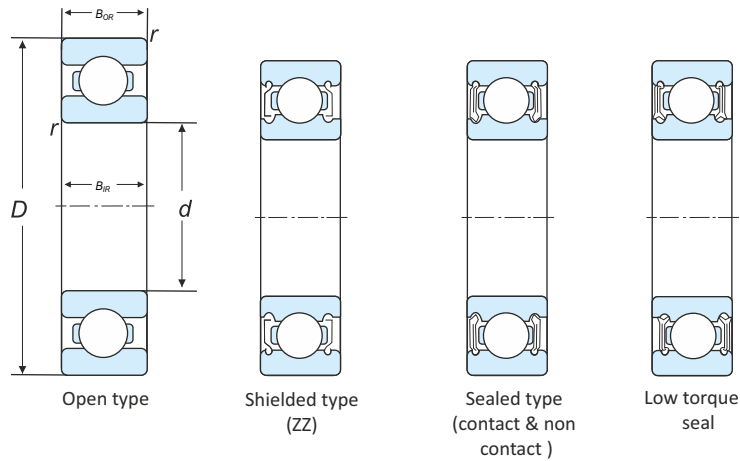
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
20	52	15	15	1.1	18.1	9	1846	918	0.75	14000	17000	G1361	-	-	-	-	-	LLUA	-	-	0.153
20	52	15	15	1.1	18.1	9	1846	918	0.75	14000	17000	N1426	-	-	-	-	-		-	-	0.142
20	52	15	15	1.1	18.1	9	1846	918	0.75	16000	18000	6304MA	-	-	-	-	-	LLUA	-	-	0.11
22	52	15	15	1	15.9	7.85	1621	800	0.76	19000	21000	6304/22	-	-	-	-	-	-	-	-	0.13
22	52	15	15	1	18.2	9	1851	921	0.75	18000	20000	6304/22M	-	-	-	-	-	LLU	-	-	0.141
22	56	16	16	1.1	20.7	10.4	2111	1060	0.87	13000	15000	63/22	-	-	-	-	-	-	-	-	0.164
22	44	12	12	0.6	9.4	5.15	959	525	0.36	17000	20000	60/22	-	-	-	-	-	LLV	-	-	0.074
22	50	14	14	1	15.18	7.95	1548	811	0.51	14000	17000	62/22	-	-	-	-	-		-	-	0.114
22	52	15	15	1.1	18.1	9	1846	918	0.76	18000	20000	G1360	-	-	-	-	-	LLUA	-	-	0.142
22	52	15	15	1.1	18.1	9	1846	918	0.76	18000	20000	N1360	-	-	-	-	-	-	-	-	0.136
22	56	11.5	11.5	1.5/1	16.6	9.5	1693	969	0.70	13000	15000	N1422	-	-	-	-	-	-	-	-	0.135

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

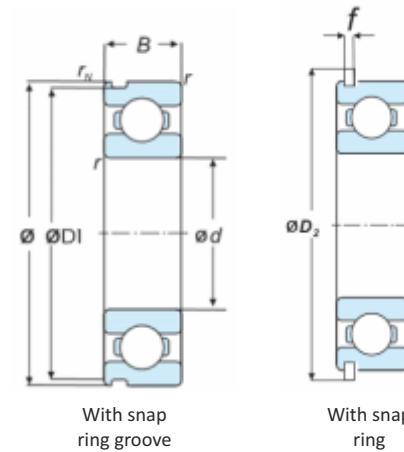
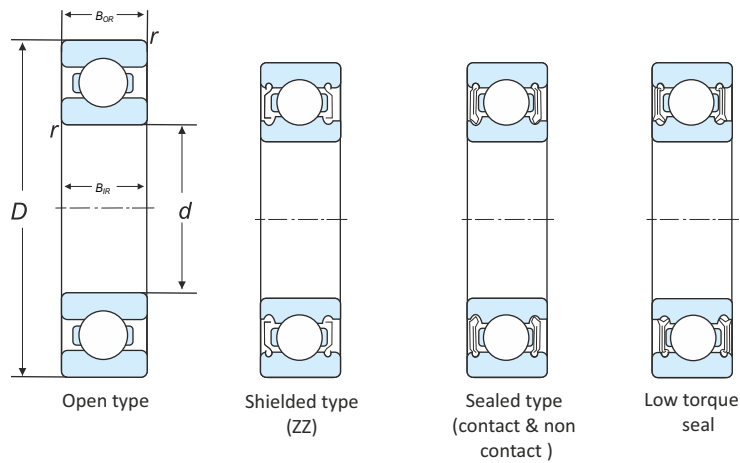
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers									Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
25	42	9	9	0.3	7.05	4.55	719	464	0.28	16000	19000	6905	-	-	-	-	-	-	-	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	10	5.85	1020	597	0.39	15000	18000	6005	Z	ZZ	-	LLH	-	RSS/LLUA1	N	NR	0.088
25	52	9	9	0.6	11.6	6.5	1183	663	0.45	14000	17000	98205	-	-	-	-	-	-	-	0.085	
25	52	15	15	1	14	7.85	1428	800	0.57	13000	15000	6205	Z	ZZ	-	-	LU	LLU/LLUA	N	NR	0.129
25	52	18	18	1	14.1	7.8	1438	795	0.57	13000	15000	62205	-	-	-	-	-	-	-	0.16	
25	52	12	12	0.6	15.2	18.05	1550	1841	0.63	9000	15000	420205	-	-	-	-	-	-	-	0.1	
25	52	15	15	1	17.6	9.3	1795	948	0.76	13000	15000	6205C	Z	-	-	-	-	LLU/LLUA	N	-	0.128
25	56	15	15	1.1	17.7	9.5	1805	969	0.75	16000	18000	25X56X15	Z	-	-	-	-	-	-	0.162	
25	62	12	12	0.6	19.5	11.3	1988	1152	0.83	13500	16000	1838001	-	-	-	-	-	-	-	0.176	

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

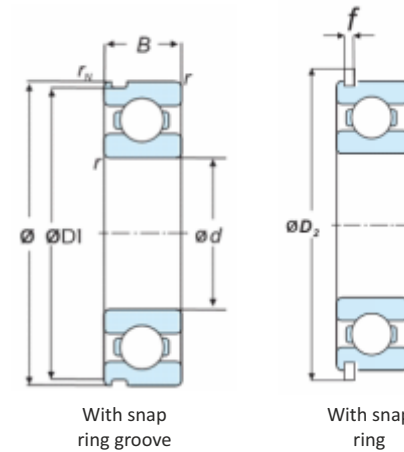
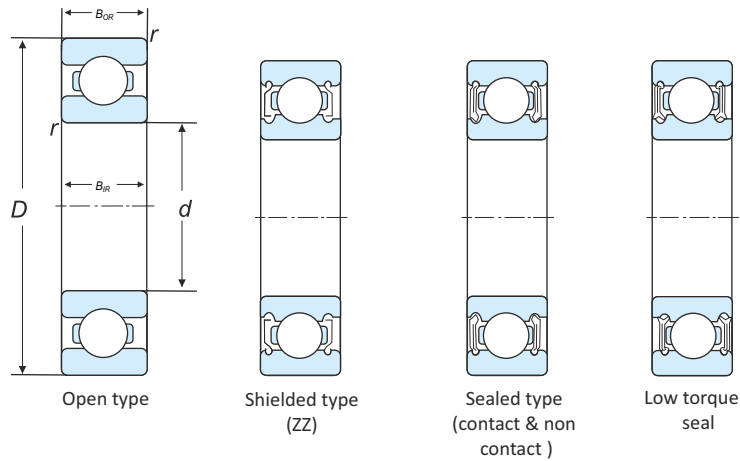
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
25	62	17	17	1.1	21.2	10.9	2162	1111	0.91	12000	14000	6305	Z	ZZ	-	-	LU	LLU	N	NR	0.225
25	62	14	14	0.2	16	10.3	1632	1050	0.68	6700	11400	6007/25	-	-	-	-	-	-	-	-	0.211
25	62	17	17	1.5	23.6	12.1	2406	1234	1.02	16000	18000	6305CS	Z	-	-	-	-	LLU/LLUA	NX	-	0.225
25	68	12	12	0.6	20.4	11.1	2080	1132	0.89	14000	15000	N1287	-	-	-	-	-	-	-	-	0.234
25	72	17	17	1.1	21.2	10.9	2162	1111	0.89	12000	14000	SP72X25X17	-	-	-	-	-	-	-	-	0.37
25	72	19	19	2	27.1	14.5	2763	1479	1.19	7700	13100	6306/25	-	-	-	-	LU	LLU	N	-	0.365
25	52	15	15	1	18.1	9	1846	918	0.76	13000	15000	G1362	-	-	-	-	-	-	-	-	0.128
25	52	20.6	20.6	1	21.3	14.7	2172	1499	1.13	7300	9800	5205	-	-	-	-	-	-	-	-	0.168
25	52	23.6	23.6	1	21.3	14.7	2172	1499	1.13	7300	9800	W5205	-	-	-	-	-	LLU	NX	-	0.21
25	56	15	15	1	17.8	9.5	1815	969	0.75	12500	14500	N1468	-	-	-	-	-	-	-	-	0.152

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

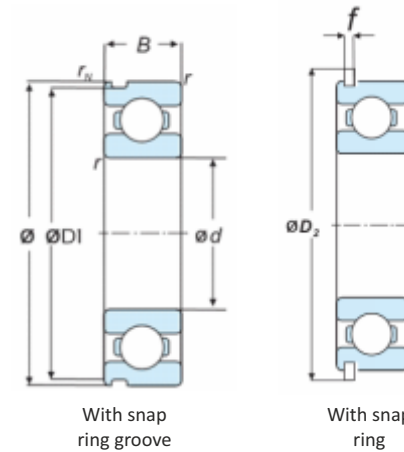
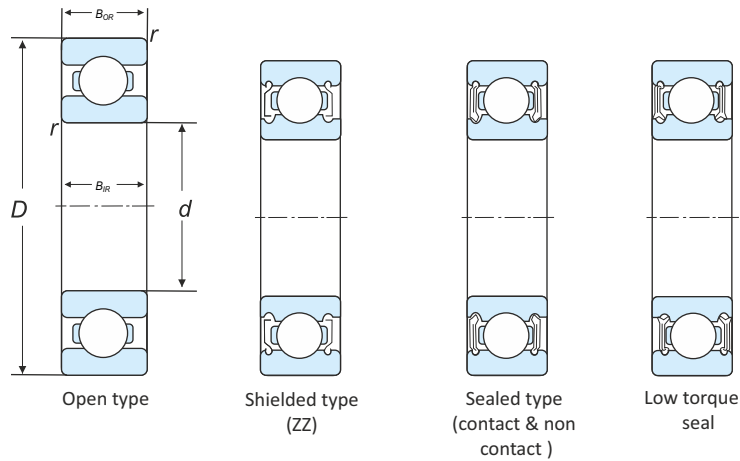
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static												
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	Sealed Bearings*			Snap Ring Groove	Snap Ring		
														Non Contact Type	Low Torque Type	Contact Type				
25	62	17	17	0.3	23.6	12.1	2406	1234	1.02	12000	14000	G1332	-	-	-	-	-	-	-	0.229
25	62	17	17	1.1	26.3	13.5	2682	1377	1.12	12000	14000	N1366	-	-	-	-	-	-	-	0.224
25	62	17	17	1.8	23.6	12.1	2406	1234	1.02	12000	14000	N1332	-	-	-	-	LH1A	LLH1/LLH1A	NX	0.229
25	62	19	19	0.4	23.6	12.1	2406	1234	1.02	12000	14000	N1415	-	-	-	-	-	LLU	NX	0.253
25	64	17	17	0.5	22.3	11.5	2274	1173	0.98	11500	13500	N1464	-	-	-	-	-	-	-	0.26
25	68	18	18	0.3	26.7	14	2723	1428	1.16	11000	13000	G1335	-	-	-	-	-	-	-	0.312
25	68	18	18	0.3	26.7	14	2723	1428	1.16	11000	13000	63/25LLUNX	-	-	-	-	-	LLU	NX	0.302
25	80	21	21	1.5	33	17.6	3365	1795	1.47	10000	12000	6405	-	-	-	-	LU	-	-	0.536
25.5	72	19	19	1.1	27.1	14.5	2763	1479	1.19	10000	12000	872489	-	-	-	-	-	-	-	0.363

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

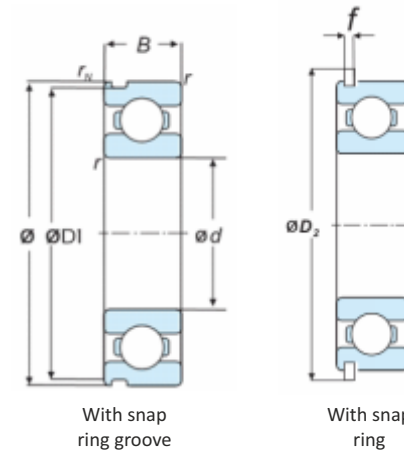
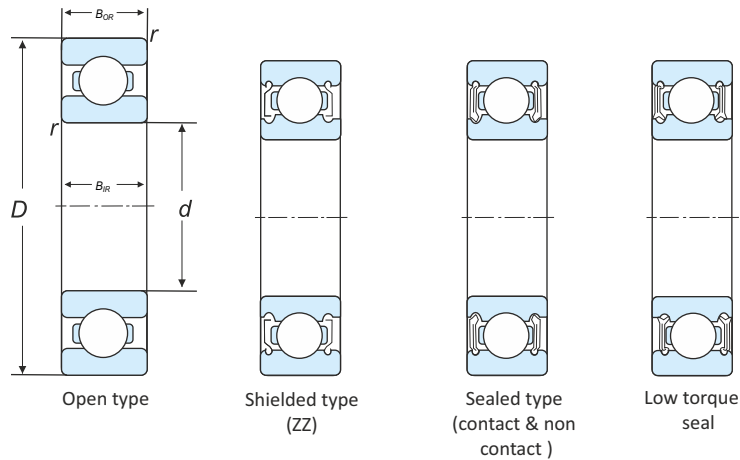
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
28	58	16	16	1	17.9	9.75	1825	994	0.74	12000	14000	62/28	-	-	-	LLH/LLHA	-	LLU	N	NR	0.171
28	68	18	18	1.1	26.7	14	2723	1428	1.18	11000	13000	63/28	-	-	-	-	LU	LLU	N	NR	0.293
28	68	17	17	1.1	26.7	14	2723	1428	1.18	11000	13000	SP63/28	-	-	-	-	-	-	-	-	0.254
28	72	18	18	1.5	25.7	15.4	2621	1570	1.13	9800	11000	72x28x18	-	-	-	-	-	-	-	-	0.35
28	72	18	18		22.2	14.6	2264	1489	0.98	9800	11000	BB1087	-	-	-	-	-	-	-	-	0.36
30	47	9	9	0.3	7.24	4.9	738	500	0.29	14000	17000	6906	-	-	-	-	-	-	-	-	0.05
30	55	13	13	1	13.2	8.3	1346	846	0.54	13000	15000	6006	Z	ZZ	LBRA	LLHA	LU	LLU	N	NR	0.116
30	55	11	11	1	13.2	8.3	1346	846	0.54	13000	15000	SP6006	-	-	-	-	-	-	-	-	0.1
30	55	9	9	0.3	11.2	7.35	1142	749	0.37	13000	15000	16006	-	-	-	-	-	-	-	-	0.091
30	62	16	16	1	19.5	11.3	1988	1152	0.82	11000	13000	6206	Z	ZZ	-	LLH	RS	RSS	N	NR	0.201

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

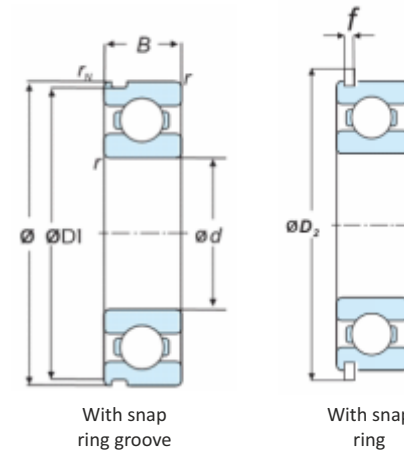
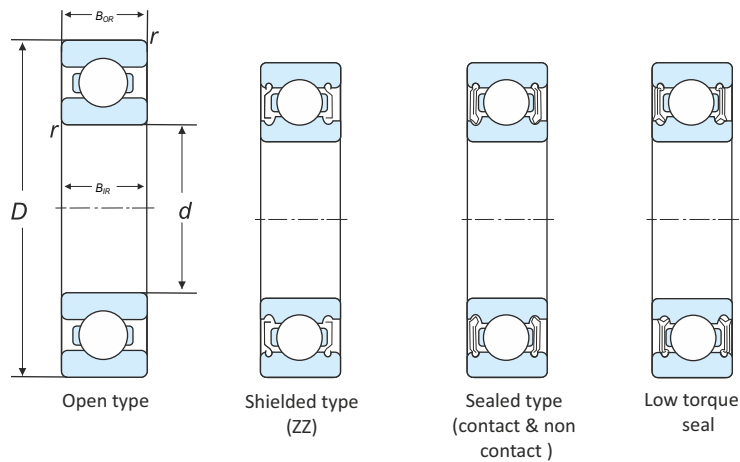
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
30	62	16	16	1	23.4	12.8	2386	1305	1.03	11000	13000	6206C	-	-	-	-	LU	-	-	0.195	
30	62	20	20	1	19.5	11.3	1988	1152	1.03	7500	13000	62206	-	-	-	-	-	-	-	0.25	
30	62	14	14	1	20.6	11.3	2101	1152	0.87	7500	13000	420206	-	-	-	-	-	-	-	0.18	
30	72	19	19	1.1	27.1	14.5	2763	1479	1.19	10000	12000	6306	Z	ZZ	LLBR	LLH	LU	LLU	N	NR	0.334
30	72	19	19	1.1	32.57	17.28	3321	1762	1.45	10000	12000	6306C	-	-	-	-	-	-	-	0.331	
30	72	17	17	1.1	29.7	16.7	3029	1703	1.36	12000	14000	420306	-	-	-	-	-	-	-	0.3	
30	72	21	21	1.1	32.57	17.28	3321	1762	1.45	15000	16000	N1345	-	-	-	-	-	LLU	N	-	0.35
30	90	23	23	1.5	40.6	22.8	4140	2325	1.84	7800	9200	6406	-	-	-	-	-	-	N	NR	0.698
30	56	12	12	1.5/1.0	16.6	9.5	1693	969	0.69	13000	15000	N1530	-	-	-	-	-	-	-	-	0.108
30	56	13.5	13.5	1.5/1.0	16.6	9.5	1693	969	0.69	13000	15000	N1626	-	-	-	-	-	-	-	-	0.12
30	62	15	15	1.5/1.0	17.8	11	1815	1122	0.75	11000	13000	N1424	-	-	-	-	-	-	-	-	0.186

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

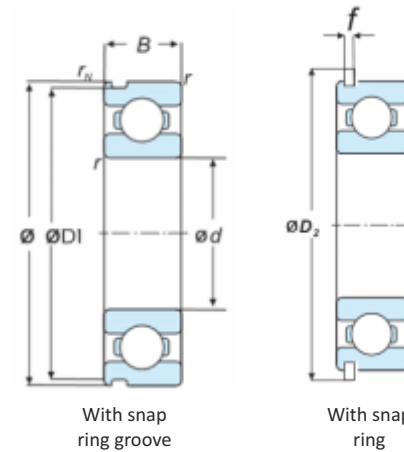
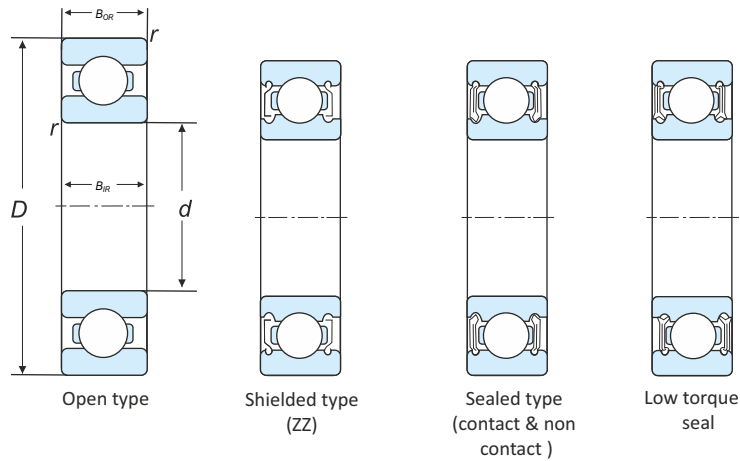
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
30	62	16	16	1	19.5	11.3	1988	1152	0.82	11000	13000	N1624	-	-	-	-	-	LLH1	N	-	0.198
30	72	19	19	1.1	32.57	17.28	3321	1762	1.45	10000	12000	N1392	-	-	-	-	-	LLU	N	-	0.328
34.99	72	15	18.5	1.5	25.7	15.3	2621	1560	1.12	9800	11000	BB1103	-	-	-	-	-	-	-	-	0.3
35	62	9	9	0.3	11.7	8.2	1193	836	0.42	12000	14000	16007	-	-	-	-	-	-	-	-	0.11
35	62	14	14	0.5	16	10.3	1632	1050	0.66	12000	14000	6007	Z	ZZ	-	-	RS	RSS	N	NR	0.154
35	62	14	14	0.5	16	10.3	1632	1050	0.66	12000	14000	6007SPL	-	-	-	-	-	RSS	-	-	0.154
35	72	17	17	1.1	25.7	15.3	2621	1560	1.12	9800	11000	6207	Z	ZZ	-	-	LU	LLU	N	NR	0.28
35	72	17	17	1.5	25.7	15.3	2621	1560	1.12	9800	11000	6207RO	-	-	-	-	-	-	-	-	0.286
35	72	23	23	1.1	25.5	15.2	2600	1550	1.12	6300	11000	62207	-	-	-	-	-	-	-	-	0.39
35	80	21	21	1.5	33.4	19.2	3406	1958	1.51	8800	10000	6307	Z	ZZ	LLBR	LLH/LLH1	LU	LLU	N	NR	0.457

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

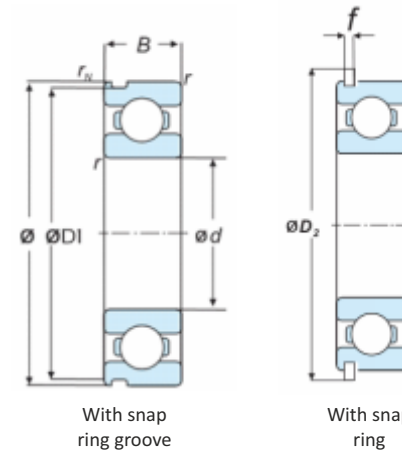
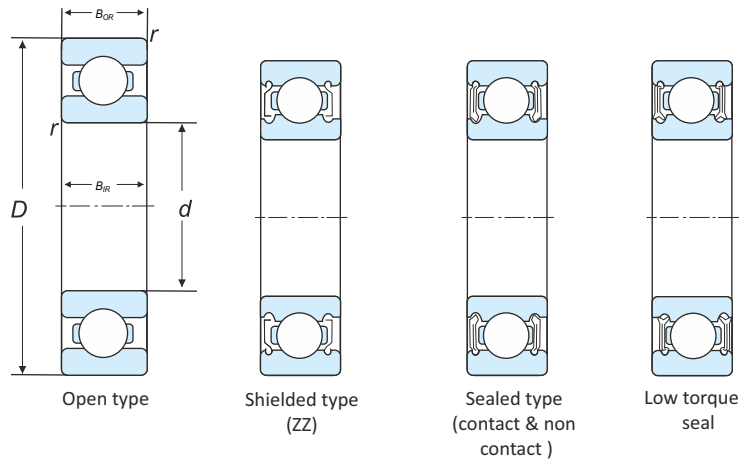
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
35	80	26	21	1.5	33.4	19.2	3406	1958	1.51	8800	10000	SP6307	-	-	-	-	-	LLU	-	-	0.483
35	80	21	21	1.5	33.4	19.2	3406	1958	1.51	8800	10000	CR-6307	-	-	-	-	-	LLU	-	-	0.445
35	100	25	25	1.5	48.3	27.8	4925	2835	2.25	7800	9100	6407	-	-	-	-	-	-	-	-	0.925
35	72	15	15	1.5	20	13.8	2039	1407	0.88	9800	11000	N1201	-	-	-	-	-	-	-	-	0.277
35	72	21	21	1.1	28.3	16	2886	1632	1.25	9800	11000	N1485	-	-	-	-	-	LLH1A	N	-	0.335
35	80	21	21	1.5	33.4	19.2	3406	1958	1.51	8800	10000	CR-6307	-	-	-	-	-	LLU		-	0.46
35	85	23	23	1.5	36.83	21.3	3756	2172	1.70	8500	9800	N1206LLU	-	-	-	-	-	LLU		-	0.623
35	90	25	25	1.5	44.5	26.2	4538	2672	2.13	8300	9500	N1412	-	-	-	-	-	LLU		-	0.697
36	64	12	12	1.5/1.0	17.9	11.1	1825	1132	0.74	12000	14000	N1506	-	-	-	-	-	-	-	-	0.133
40	58	12	12	0.6	10.3	7.91	1049	807	0.45	11000	13000	N1305	-	-	-	-	-	-	-	-	0.084

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

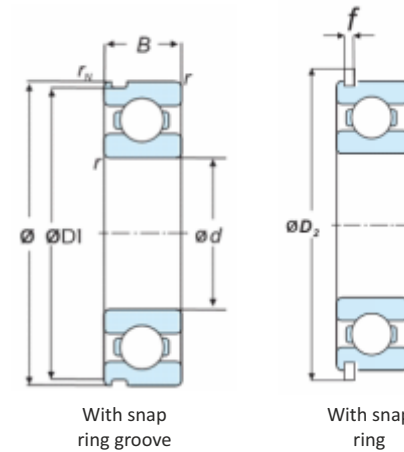
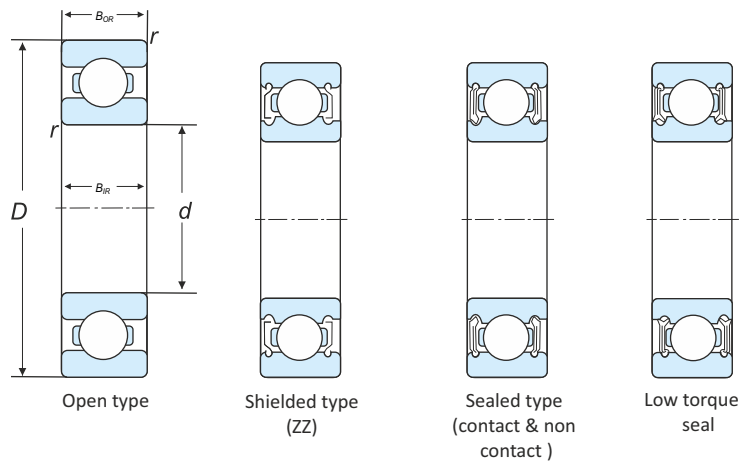
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
40	62	12	12	0.6	13.7	10	1397	1020	0.59	10000	12000	6908	-	-	-	-	-	-	-	-	0.11
40	68	9	9	0.3	11.1	8.55	1132	872	4.60	10000	12000	16008	-	-	-	-	-	-	-	-	0.13
40	68	15	15	1	16.8	11.5	1713	1173	0.71	10000	12000	6008	-	ZZ	-	-	-	LLU	N	NR	0.195
40	80	18	18	1.1	29.1	18	2967	1835	1.27	8700	10000	6208	Z	ZZ	-	LLHA	LU	LLU	N	NR	0.357
40	80	18	18	1.1	29.1	18	2967	1835	1.27	8700	10000	6208K	-	-	-	-	-	-	-	-	0.363
40	85	18	18	1.1	29.1	18	2967	1835	1.26	11000	12000	40X85X18	-	-	-	-	-	-	NX	NXR	0.467
40	90	23	23	1.5	40.6	22.9	4140	2335	1.84	7800	9200	6308	Z	ZZ	-	LLH	RSS/LU	LLU	N	NR	0.599
40	90	23	23	1.5	44.3	26	4517	2651	2.11	7800	9200	6308C	-	-	-	-	-	LLU	-	-	0.62
40	90	23	23	1.5	40.6	22.9	4140	2335	2.11	7800	9200	6308RO	-		-	-	-		-	-	0.665
40	90	23	23	1.5	51	28	5200	2855	2.37	11000	13000	N1334	-	-	-	-	-	-	N	-	0.538

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

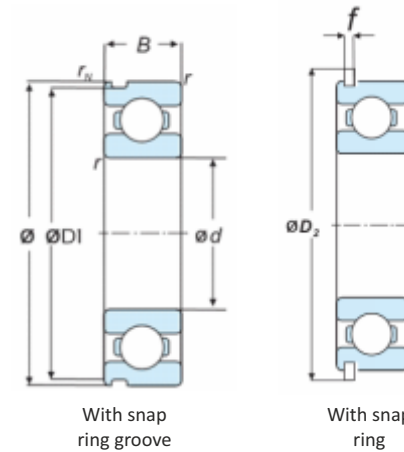
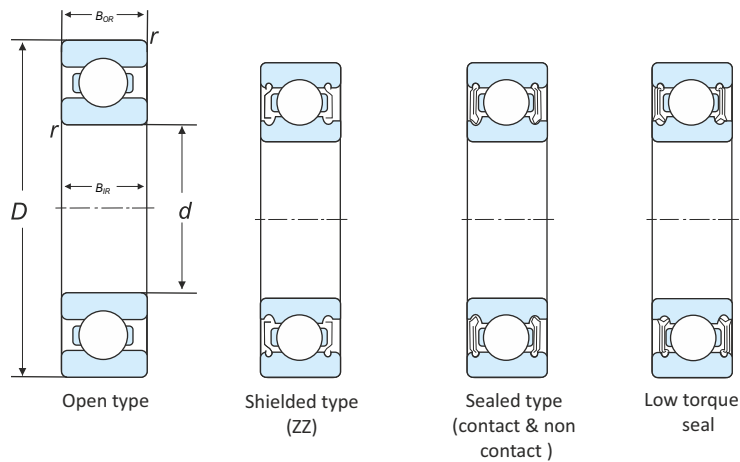
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
40	110	27	27	2	61.9	38	6312	3875	3.07	7000	8200	6408	-	-	-	-	-	N	NR	1.21	
40	100	25	25	1.5	53	32	5404	3263	2.57	7400	8400	N1451	-	-	-	-	-	-	-	0.897	
42.03	90	23	23	0.6/1.5	40.7	24	4150	2447	1.87	7800	9200	N1270	-	-	-	RSS	-	-	N	-	0.548
45	75	16	16	1	21	15.1	2141	1540	0.93	9200	11000	6009	Z	ZZ	-	-	-	LLU/LLUA	N	NR	0.237
45	75	12	12	1	21	15.1	2141	1540	0.93	9200	11000	SP6009	-	-	-	-	-	-	-	-	0.2
45	85	19	19	1.1	32.7	20.5	3334	2090	1.44	7800	9200	6209	Z	ZZ	-	-	LU	LLU	N	NR	0.4
45	85	19	19	1.1	32.7	20.5	3334	2090	1.44	7800	9200	6209K	-	-	-	-	-	-	-	-	0.41
45	100	25	25	15	53	32	5404	3263	2.54	7000	8200	6309	Z	ZZ	-	LLH/LLHA	-	LLU	N	NR	0.825
45	120	29	29	1.1	71.5	44.4	7291	4527	3.58	6300	7400	6409	-	-	-	-	-	-	-	-	1.55
45	68	12	12	0.6	14.11	10.86	1439	1107	0.62	4000	5500	6909	-	-	-	-	LUA	LLUA	-	-	0.126

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

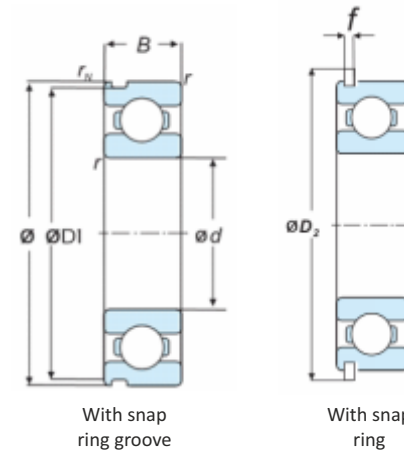
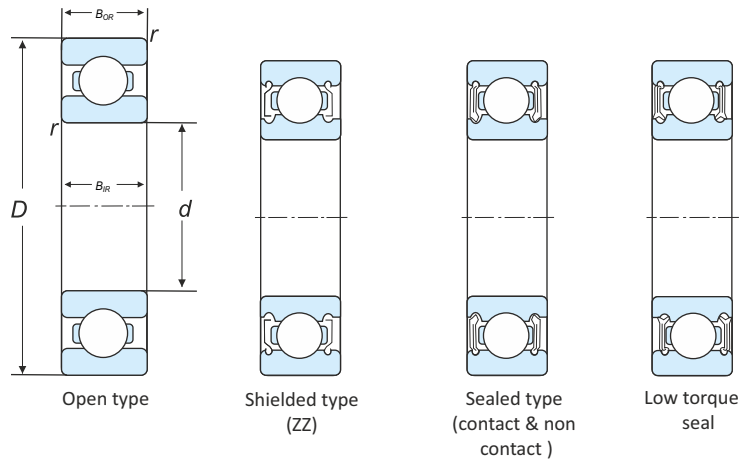
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
50	80	10	10	0.6	132	11.3	13460	1152	0.61	8400	9800	16010	-	-	-	-	-	-	-	0.19	
50	80	16	16	1	21.8	16.6	2223	1693	0.99	8400	9800	6010	Z	-	-	-	LU	LLU/LLUA	N	NR	0.262
50	90	20	20	1.1	35	23.2	3569	2366	1.58	7100	8300	6210	Z	ZZ	-	LLHA	LU	LLU	N	NR	0.457
50	90	20	20	1.1	35	23.2	3569	2366	1.58	7100	8300	6210K	-	-	-	-	-	-	-	-	0.46
50	110	27	27	2	61.9	38	6312	3875	3.02	6400	7500	6310	Z	-	LBRA	-	LU	LLU	N	NR	1.065
50	130	31	31	2.1	92.28	55.13	9410	5622	3.40	5700	6700	6410	-	-	-	-	-	-	-	-	1.9
55	80	13	13	1	15.9	13.3	1621	1356	0.73	8200	9600	6911	-	ZZ	-	-	-	-	-	-	0.19
55	90	18	18	1.1	28.3	21.3	2886	2172	1.29	7700	9000	6011	-	-	-	-	-	LLU	-	-	0.39
55	100	21	21	1.5	43.4	29.3	4425	2988	2.00	6400	7600	6211	Z	ZZ	-	-	LU	LLU	N	NR	0.597
55	100	21	21	1.5	43.4	29.3	4425	2988	2.00	6400	7600	6211RO	-	-	-	-	-	-	-	-	0.607

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

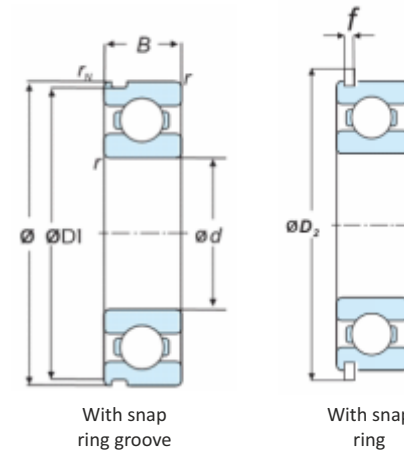
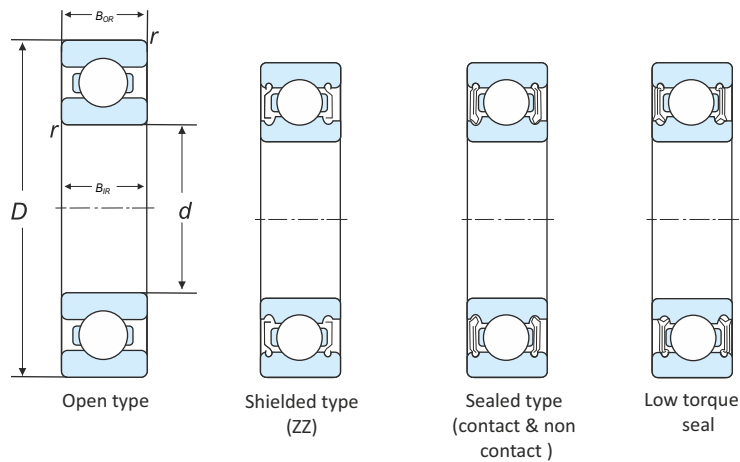
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
Non Contact Type			Low Torque Type	Contact Type																	
55	100	21	21	1.5	43.4	29.3	4425	2988	2.00	6400	7600	6211K	-	ZZ	-	-	-	-	-	-	0.607
55	120	29	29	2	71.5	44.4	7291	4527	3.53	5800	6800	6311	Z	ZZ	-	-	LU	LLU	-	-	1.372
55	130	31	31	1.5	87.8	52.4	8953	5343	4.42	9000	10000	N1336	-	-	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	16.4	14.2	1672	1448	0.70	7600	8900	6912	-	-	-	-	-	RSS	-	-	0.19
60	95	18	18	1.1	31.66	24.22	3228	2470	1.19	7000	8300	6012	-	-	-	-	-	-	-	-	0.414
60	95	11	11	0.6	20	17.5	2039	1784	0.96	6000	7000	16012	-	-	-	-	-	-	-	-	0.285
60	110	22	22	1.5	47.7	32.9	4864	3355	2.21	6000	7000	6212	Z	ZZ	-	-	LU	LLU	N	NR	0.769
60	110	22	22	1.5	47.7	32.9	4864	3355	2.21	6000	7000	6212RO	-	-	-	-	-	-	-	-	0.769
60	110	22	22	1.5	47.7	32.9	4864	3355	2.21	6000	7000	6212K	-	ZZ	-	-	-	-	-	-	0.769

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

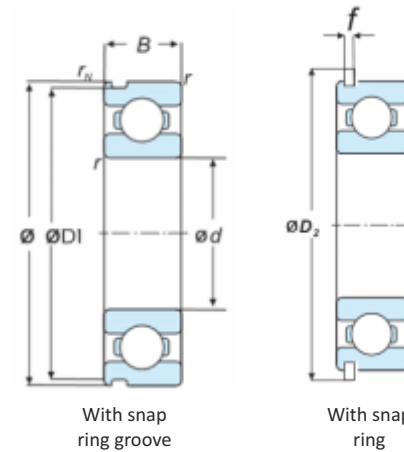
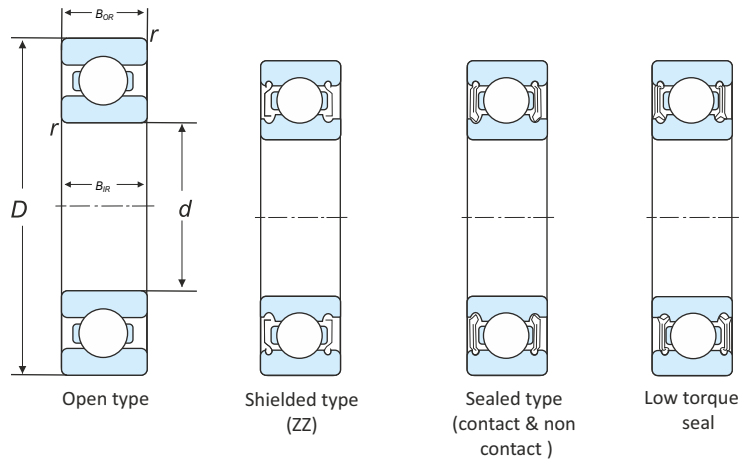
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
60	130	31	31	2.1	81.8	52	8341	5302	4.09	5400	6300	6312	Z	ZZ	-	-	-	-	-	-	1.689
60	150	35	35	2.1	109.2	70.3	11135	7168	4.43	4800	5700	6412	-		-	-	-	-	-	-	2.8
65	90	13	13	1	20	17.5	2039	1784	0.95	5000	6000	6913	-	-	-	-	-	-	-	-	0.216
65	100	18	18	1.5	30.5	25.2	3110	2570	1.46	6500	7700	6013	Z	-	-	LLH	-	LLU/LLUA	-	NR	0.425
65	100	11	11	0.6	20.4	18.6	2080	1897	0.45	5000	6000	16013	-	-	-	-	-	-	-	-	0.297
65	120	23	23	1.5	57.2	40.1	5833	4089	2.71	5500	6500	6213	Z	ZZ	-	-	-	-	N	NR	0.98
65	125	23	23	1.5	57.2	40.1	5833	4089	2.69	5500	6500	6213/125	-	ZZ	-	-	-	RSS/LLU	-	-	1.17
65	140	33	33	2.1	92.1	59.8	9391	6098	4.68	4900	5800	6313	Z	ZZ	-	-	LU	LLU	-	NR	2.091
65	90	13	13	1.6	20	17.5	2039	1784	0.96	5000	6000	N1364	-	-	-	-	-	-	-	-	0.208
65	100	23.7	23.7	1.5	26.8	21.8	2733	2223	1.37	5000	6000	N1264	-	-	-	RSSA1	-	-	-	-	0.625

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

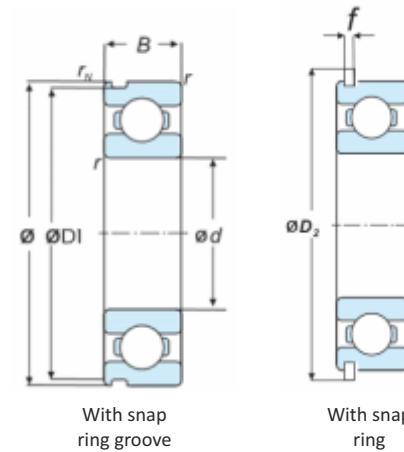
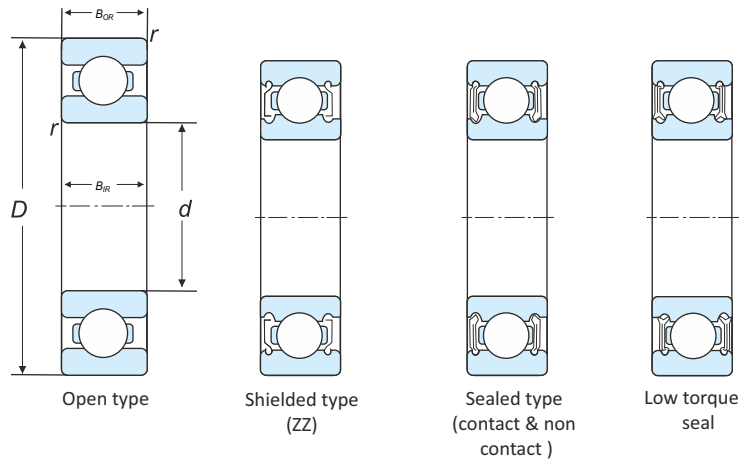
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)	
					Dynamic	Static	Dynamic	Static													
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	Sealed Bearings*			Snap Ring Groove	Snap Ring			
														Non Contact Type	Low Torque Type	Contact Type					
70	100	16	16	1	23.7	21.1	2417	2152	1.16	6500	7700	6914	-	-	-	-	-	-	-	0.334	
70	110	20	20	1.1	38	30.8	3875	3141	1.83	6100	7100	6014	-	-	-	-	-	LLUA	N	NR	0.587
70	125	24	24	1.5	62.2	44.1	6343	4497	2.97	5100	6000	6214	-	-	-	-	-	-	-	-	1.056
70	150	35	35	2.1	104.13	68.04	10618	6938	5.32	4600	5400	6314	-	ZZ	-	-	-	-	-	-	2.61
70	110	13	13	0.6	27.9	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	62.1	44.9	6332	4578	3.19	4800	5600	6215	-	-	-	-	-	-	-	-	1.139
75	130	25	25	1.5	66.1	49.5	6740	5048	3.19	4800	5600	6215K	-	-	-	-	-	-	-	-	1.2
75	160	37	37	2.1	113.21	76.97	11544	7849	6.00	4300	5000	6315	-	-	-	-	-	RSS	-	-	3.13
80	125	22	22	1.1	47.54	39.79	4848	4057	2.35	5300	6200	6016	-	ZZ	-	-	-	-	-	-	0.85

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

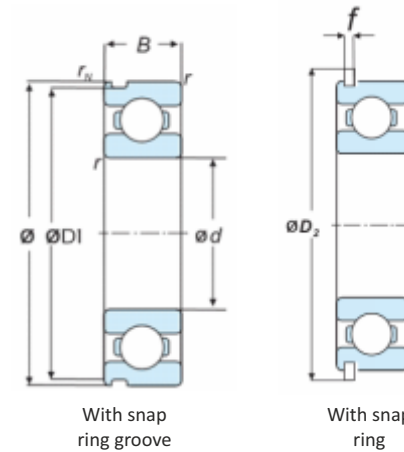
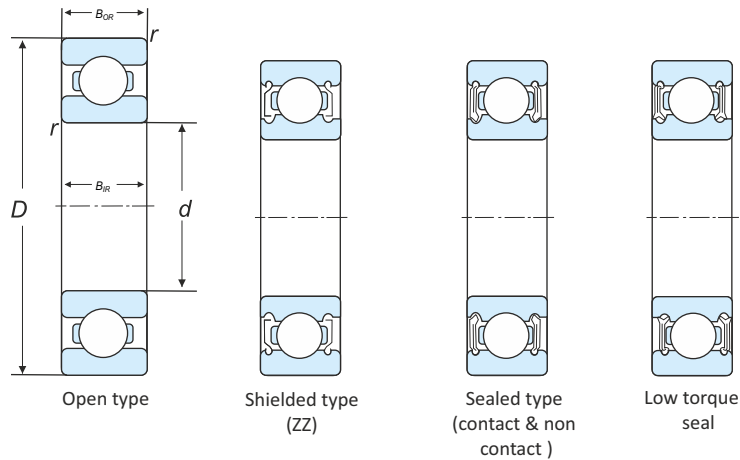
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static												
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	Sealed Bearings*			Snap Ring Groove	Snap Ring		
														Non Contact Type	Low Torque Type	Contact Type				
80	140	26	26	2	71.55	54.3	7296	5537	3.84	4500	5300	6216	-	-	-	-	-	-	1.4	
80	170	39	39	2.1	122.7	86.5	12512	8820	6.72	4000	4700	6316	-	ZZ	-	-	-	RSS	3.59	
80	125	22	22	1.1	47.6	40	4854	4079	2.35	5200	6100	6016	-	-	-	-	-	LLU	0.861	
80	150	28	28	2	83.5	64	8514	6526	4.19	4200	5000	N1390	-	-	-	-	-	-	1.972	
85	130	22	22	2	47.3	40.15	4823	4094	2.34	4200	5000	6017	-	-	-	-	-	-	0.92	
85	150	28	28	2	83.2	64	8484	6526	4.17	4200	5000	6217	-	-	-	-	-	-	1.8	
85	150	28	28	2	83.2	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	49.8	5914	5078	2.94	4700	5600	6018	-	-	-	-	-	-	1.02	
90	160	30	30	2	96.0	71.46	9787	7287	4.25	4000	4700	6218	-	-	-	-	-	-	0	
90	190	43	43	3	142.33	107.23	14513	10934	8.28	3600	4200	6318	-	ZZ	-	-	-	-	4.91	

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

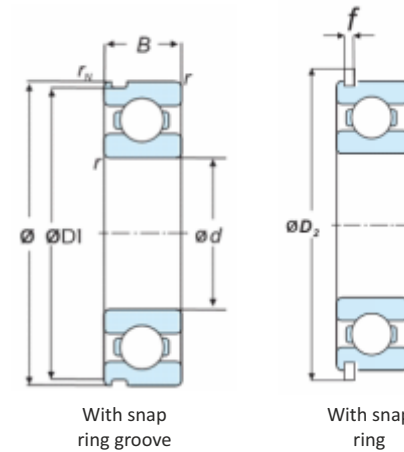
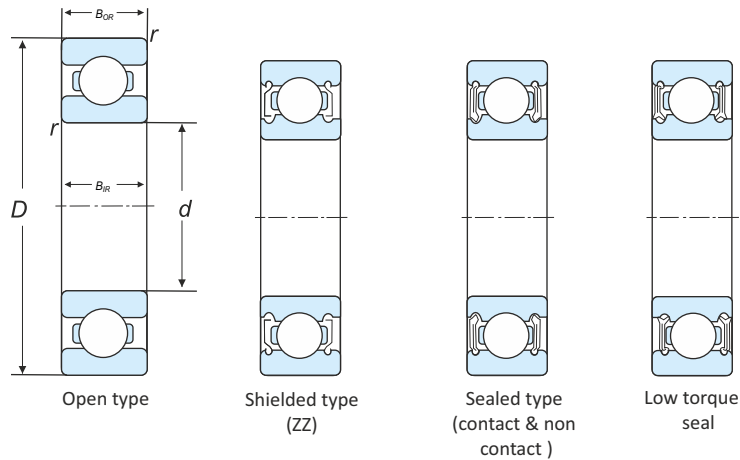
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static												
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	Sealed Bearings*			Snap Ring Groove	Snap Ring		
														Non Contact Type	Low Torque Type	Contact Type				
95	145	24	24	1.5	60	53.8	6118	5486	2.92	4500	5300	6019	-	-	-	-	-	-	-	1.08
95	200	45	45	3	156.36	121.98	15944	12438	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	45	4589	4589	2.00	4000	5000	16020M	-	-	-	-	-	-	-	1
105	160	26	26	2	71.9	63.36	7332	6461	3.57	4000	4700	6021	-	-	-	-	-	-	-	1.59
105	225	49	49	3	240	154	24473	15703	7.70	2900	3500	6321	-	-	-	-	-	-	-	8.05
110	170	28	28	2	81.8	72.8	8341	7423	4.30	3800	4500	6022	-	-	-	-	-	-	-	1.9
110	200	38	38	2.1	110.82	100.43	11300	10241	7.06	3200	3800	6222	-	-	-	-	-	-	-	4.36

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)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

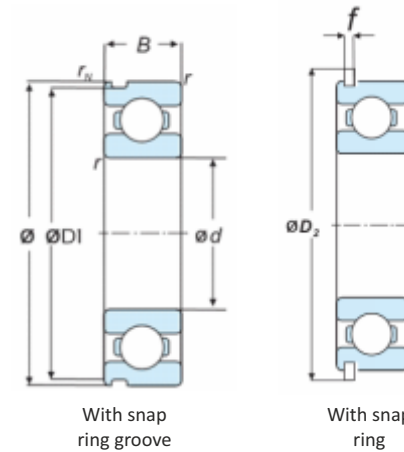
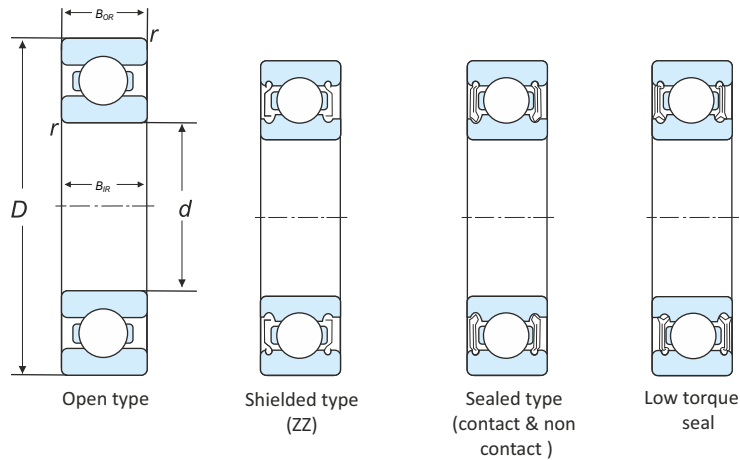
Static equivalent radial load

$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static												
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	Sealed Bearings*			Snap Ring Groove	Snap Ring		
														Non Contact Type	Low Torque Type	Contact Type				
110	240	50	50	3	204.9	178.3	20894	18181	14.13	2900	3400	6322	-	-	-	-	-	-	-	8
120	215	40	40	2.1	155	131	15805	13358	8.87	2900	3400	6224	-	-	-	-	-	-	-	5.3
120	260	55	55	3	207	185	21108	18864	16.35	2600	3100	6324	-	-	-	-	-	-	-	12.4
120	180	19	19	1	63	63.5	6424	6475	3.20	3500	4000	16024M	-	-	-	-	-	-	-	2
130	230	40	40	3	167	146	17029	14888	7.78	2700	3100	6226	-	-	-	-	-	-	-	5.82
130	280	58	58	4	229	214	23351	21822	9.80	2300	2700	6326	-	-	-	-	-	-	-	15.2
140	250	42	42	3	179.1	167	18263	17029	9.64	2500	2900	6228	-	-	-	-	-	-	-	7.68
150	320	65	65	4	278	284	28348	28959	13.1	2000	2300	6330 C3	-	-	-	-	-	-	-	21.4
150	225	35	35	2.1	132	125	13460	12746	5.50	2700	3200	6030M	-	-	-	-	-	-	-	5.5
150	270	45	45	3	182	205	18559	20904	7.90	2200	2600	6230	-	-	-	-	-	-	-	9.67

Single Row Deep Groove Ball Bearing (Metric series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

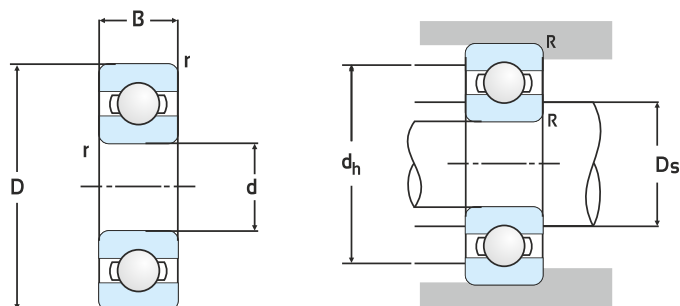
$$P_{or} = 0.6 F_r + 0.5 F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

Boundry Dimensions					Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers								Mass (Kg) (Approx)
					Dynamic	Static	Dynamic	Static												
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	Sealed Bearings*			Snap Ring Groove	Snap Ring		
														Non Contact Type	Low Torque Type	Contact Type				
160	240	38	38	2.1	143	144	14582	14684	5.65	2500	3000	6032M13	-	-	-	-	-	-	-	6
160	240	25	25	1.5	95	105	9687	10707	4.68	2500	3000	16032M	-	-	-	-	-	-	-	4
170	310	52	52	4	228	239	23249	24371	9.60	2000	2300	6234C3	-	-	-	-	-	-	-	15.4
170	260	42	42	2.1	161	160	16417	16315	7.55	2300	2800	6034	-	-	-	-	-	-	-	7.8
180	280	46	46	2.1	189	199	19272	20292	8.31	2300	2700	6036M	-	-	-	-	-	-	-	10.5
190	340	55	55	4	269	300	27430	30591	8.3	1550	2000	6239	-	-	-	-	-	-	-	22.2
200	250	24	24	1.5	76	100	7750	10197	3.37	2300	3000	61840	-	-	-	-	-	-	-	2.75
200	360	58	58	4	250	300	25493	30591	12.6	1650	1900	6240M	-	-	-	-	-	-	-	27
220	400	65	65	4	275	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

Single Row Deep Groove Ball Bearing (Inch series)



Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

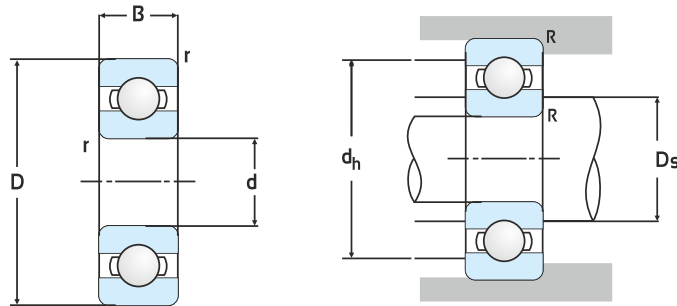
Static equivalent radial load

$$P_{or} = 0.6F_r + 0.5F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

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												

Single Row Deep Groove Ball Bearing (Inch series)



Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

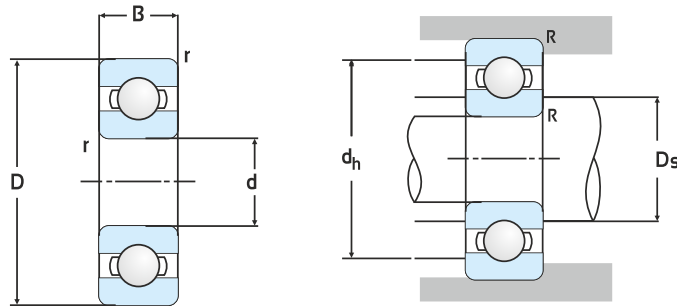
Static equivalent radial load

$$P_{or} = 0.6F_r + 0.5F_a$$

when $P_{or} < F_r$ use $P_{or} = F_r$

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	
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	MS12 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

$$P_r = XF_r + YF_a$$

F_a	e	$\frac{F_a}{F_r} < e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
C_{or}					
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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

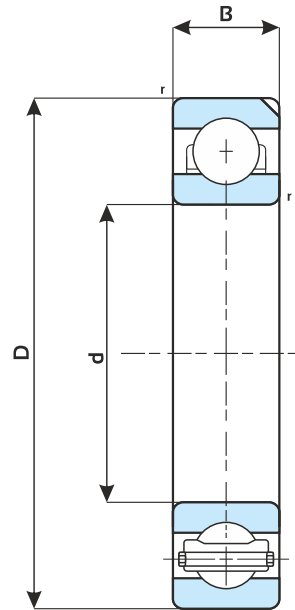
$$P_{or} = 0.6Fr + 0.5Fa$$

when $P_{or} < Fr$ use $P_{or} = Fr$

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
	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

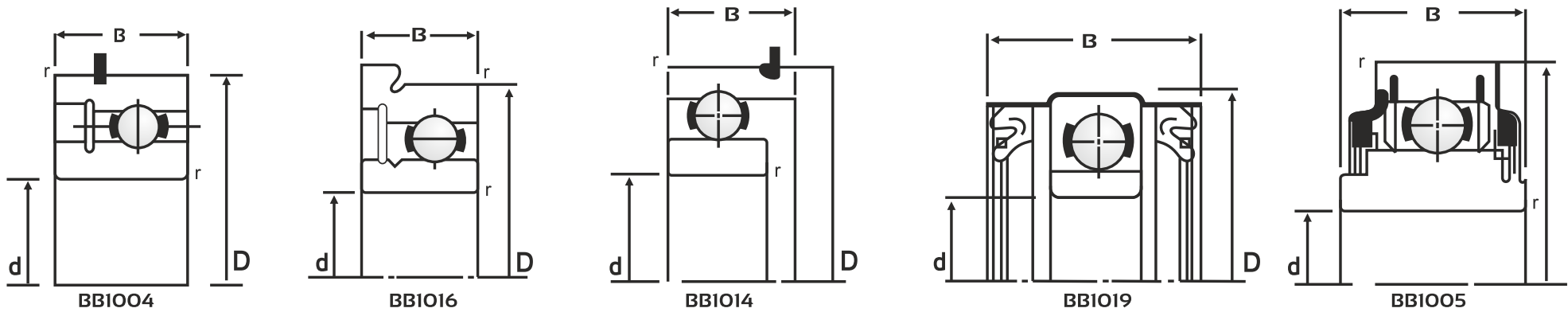
Notch (locating slot) on outer ring side face



Boundary 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		
240	440	72	4	350	465	3840	47416	12	6240M	51
280	380	46	2.1	236	310	2589	31611	16.3	61956	15
320	400	38	2.1	168	240	1843	24473	6	61864M	12
300	420	74	4	370	550	4059	56084	17.1	6064	49
630	920	128	10	816	176	8952	17947	40	60/630	280
670	980	136	7.5	765	1730	8392	176408	45.3	60/670C3	351

Special Bearing

Insert Ball Bearings

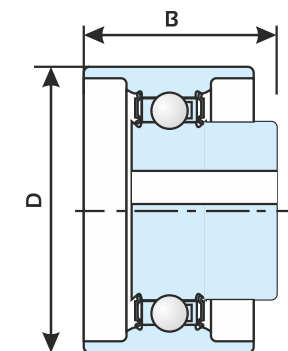


Boundary Dimensions				Basic Load Rating				LimItIng Speed		Bearing Number
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		rpm		
d	D	B	r min	Cr	Co	Cr	Co	Grease	Oil	
25	52	18	1.5	11.5	6.2	1173	632	13000	15000	BB1004
25	52	18	1	11.5	6.2	1173	632	13000	15000	BB1016
25	65	21.5	2	21.3	9.8	2172	999	12000	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

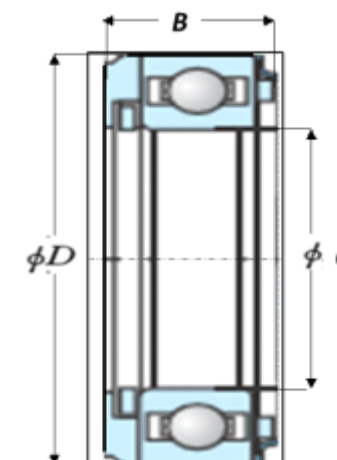
Belt Tensioners

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

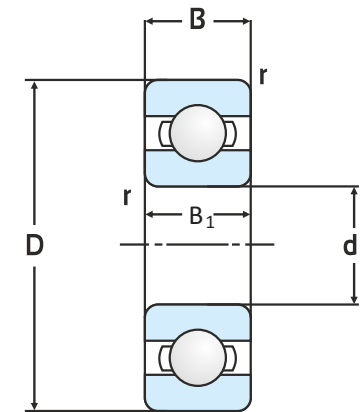
Boundary Dimensions			Basic Load Rating				Bearing Number
			Dynamic	Static	Dynamic	Static	
mm			KN		Kgf		
d	D	B	Cr	Co	Cr	Co	
28.2	55.6	32	-	-	-	-	FCR44-36
28.2	50	32	-	-	-	-	FCR44-36-1
45	86.6	28	32.7	20.5	3334	2090	1888451
50	91.6	29	35	23.2	3569	2366	1888180
50	81.6	25	21.8	16.6	2223	1693	306445C
50	81.6	21	21.8	16.6	2223	1693	SP306445C
65	101.6	27	30.5	25.2	3110	2570	CR1002
65	100	23.7	26.8	21.8	2733	2223	N1264



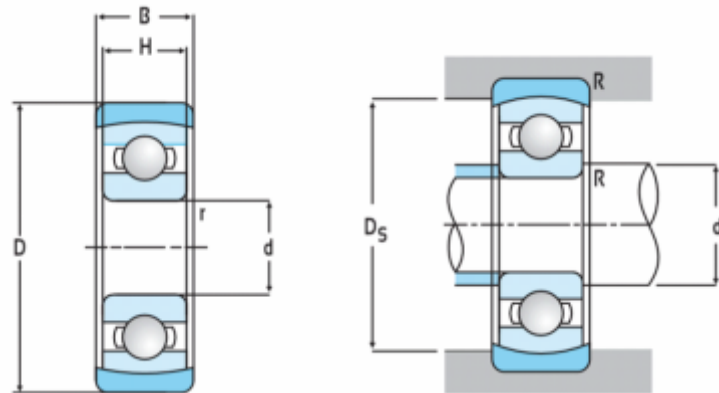
Special Bearing

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	154	2621	15703	1.12	9800	11000	BB1103
22	22	18.5	15	-	207	104	21108	10605	0.88	14000	17000	63/225PL



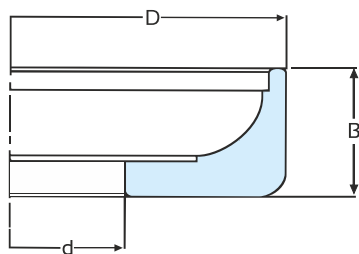
Single Row Externally Aligning Ball Bearing



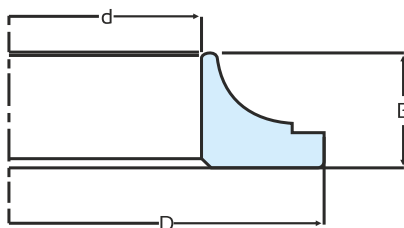
Boundary Dimensions					Basic Load Rating (KN)				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fitment			Mass Kg. (Approx.)
					Dynamic	Static	Dynamic	Static					mm/ inch			
mm / inch					KN		Kgf		KN	rpm			D _s	d _h	R	
d	D	B	H	r	Cr	Co	Cr	Co	Cu	Grease	Oil					
44.45	117.45	28.575	26.988	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

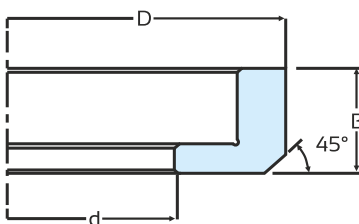
Bearing Races	d	D	B
BB1006	27	45	10.5
BB1030	27.8	46.2	8
BB1031	27.8	47.2	8



Bearing Races	d	D	B
BB1007	24.2	39	8.65
BB1058	25	48	5.5
BB1059	30	48	5.5

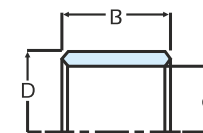


Bearing Races	d	D	B
BB1008	32	42.3	8

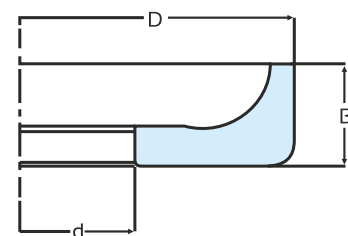


Special Bearing Races

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



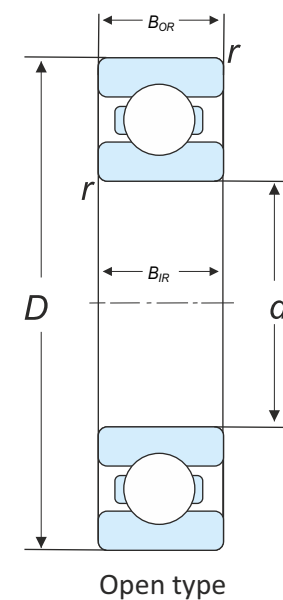
Bearing Races	d	D	B
BB1060	31	48	5.5
BB1061	26	48	5.5



Special Bearing

EMB Bearings for Electric Vehicle

Boundary Dimensions					Dynamic	Static	Dynamic	Static	Limiting Speed (rpm)	Bearing Number	Seals/ Shields	Mass Kg
mm					KN		Kgf				Grease	Non-Contact Type
d	D	B _{IR}	B _{OR}	r _{smin}	C _r	C _{or}	C _r	C _{or}				
30	62	16	16	1	19.5	11.3	1988	1152	14000	EMB 6206	ZZ	0.201
40	68	15	15	1	16.8	11.5	1713	1172	15000	EMB 6008	LLBRA	0.195
	80	18	18	1.1	29.1	18	2966	1835	14000	EMB 6208	ZZ	0.357
45	75	16	16	1	21	15.1	2141	1539	15000	EMB 6009	LLBRA	0.237
	100	25	25	1.5	37.2	26.3	3792	2981	19000	EMB 6309	LBRA	0.825
50	90	20	20	1.1	35	23.2	3568	2365	14000	EMB 6210	--	0.457
60	95	18	18	1.1	20	17.5	2039	1784	15000	EMB 6012	LLBRA	0.414



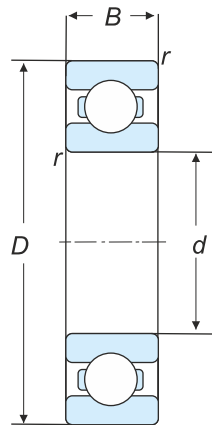
Sensor Integrated Bearings

Boundary Dimensions					Dynamic	Static	Dynamic	Static	Limiting Speed (rpm)	Bearing Number	Mass	Feature
mm					KN		Kgf				Kg	
d	D	B _{IR}	B _{Total}	r _{smin}	C _r	C _{Or}	C _r	C _{Or}			Grease	
30	62	16	25	1	19.5	11.3	1988	1152	14000	SIB 6206	0.201	Speed & Direction
25	62	17	26	1.1	21.2	10.9	2161	1111	12000	SIB 6305	0.225	Temperature Speed & Direction

Note: B (Total) : Width of bearing + sensor unit



Miniature Ball Bearings / Extra Small Ball Bearing



Open type



Shielded type



Contact sealed type

Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

F_a	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	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

$$P_{or} = 0.6Fr + 0.5Fa$$

when $P_{or} < Fr$ use $P_{or} = Fr$

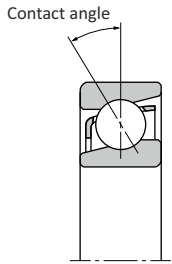
Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Numbers				Mass (Kg) (Approx.)	
				Dynamic	Static	Dynamic	Static		rpm							
mm				KN		Kgf		KN	Grease	Oil	Open Type	Shielded Type	Contact Type			
d	D	B	r	C _r	C _{or}	C _r	C _{or}	C _u								
4	13	5	0.3	1.30	0.49	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

15.2 Angular Contact Ball Bearings

Angular contact ball bearings are non-separable bearings. The design of raceway curvature is such that balls make 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°	40°
Suffix Code	C	-	B



(313)

Single row Angular contact Bearing 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 from 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

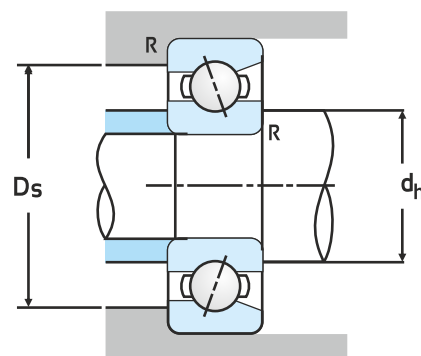
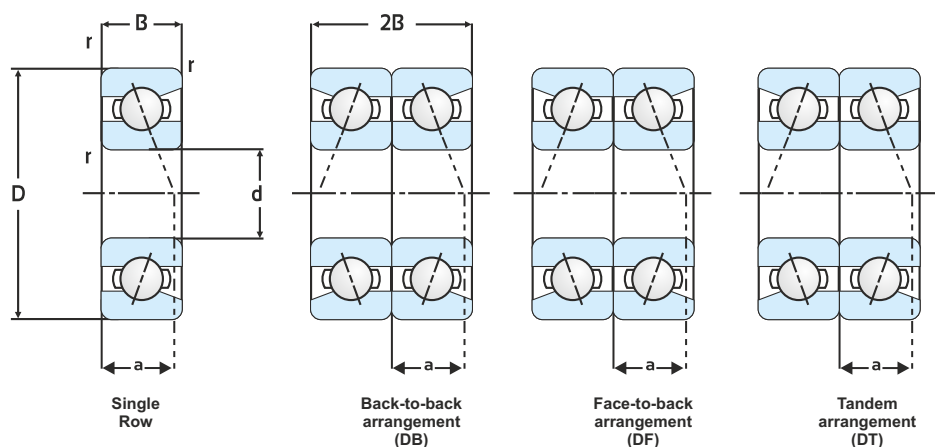
Double row angular contact ball bearings consist of inner, outer rings, ball and cage assemblies with sheet steel or polyamide cage. The bearings are available in open and sealed designs. Bearing can support radial and axial loads in both the directions due to the raceway geometry and the two rows of 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.



(314)

Single Row Angular Contact Ball Bearing (Metric Series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

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
40°	1.14	1	0	0.35	0.57	1	0.55	0.57

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

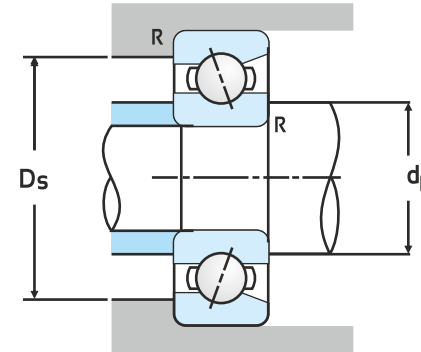
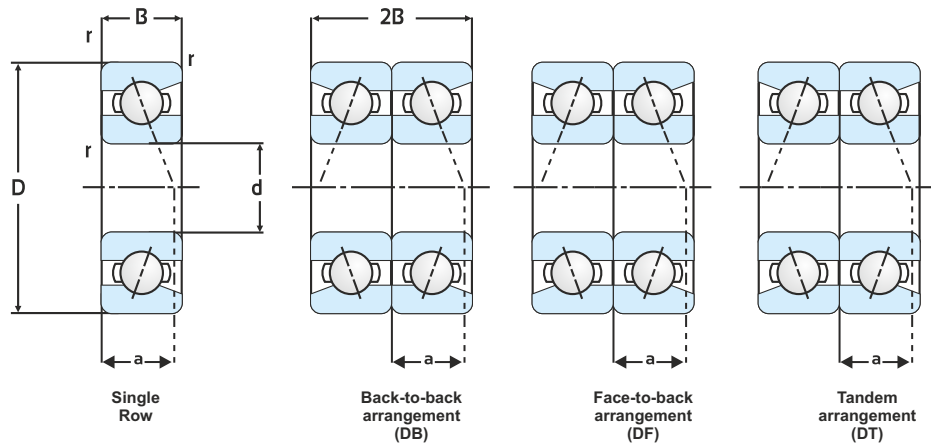
When $P_{or} < F_r$ use $P_{or} = F_r$

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	D _s max.	d _h 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

Single Row Angular Contact Ball Bearing (Metric Series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

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
40°	1.14	1	0	0.35	0.57	1	0.55	0.57

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
40°	0.5	0.26	1	0.52

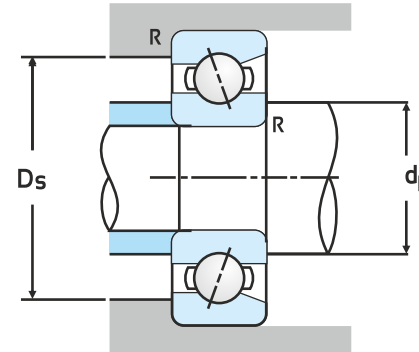
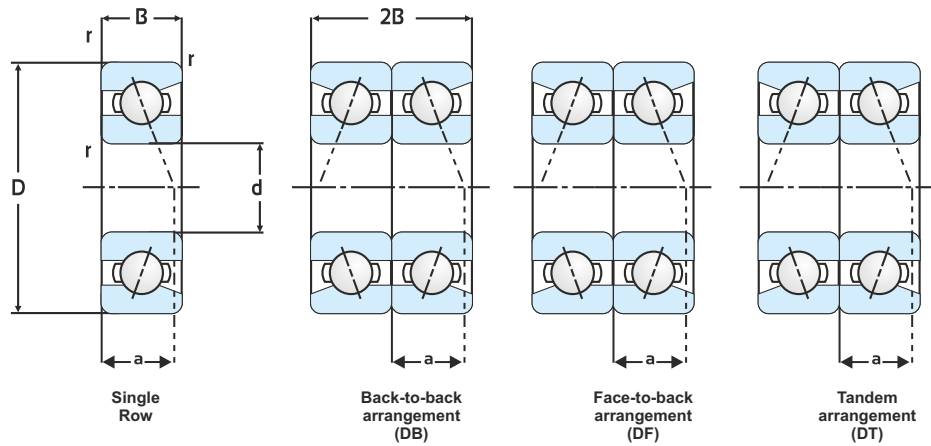
For single and DT arrangement

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	D _s max.	d _h 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	0.84
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

Single Row Angular Contact Ball Bearing (Metric Series)



Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

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
40°	1.14	1	0	0.35	0.57	1	0.55	0.57

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

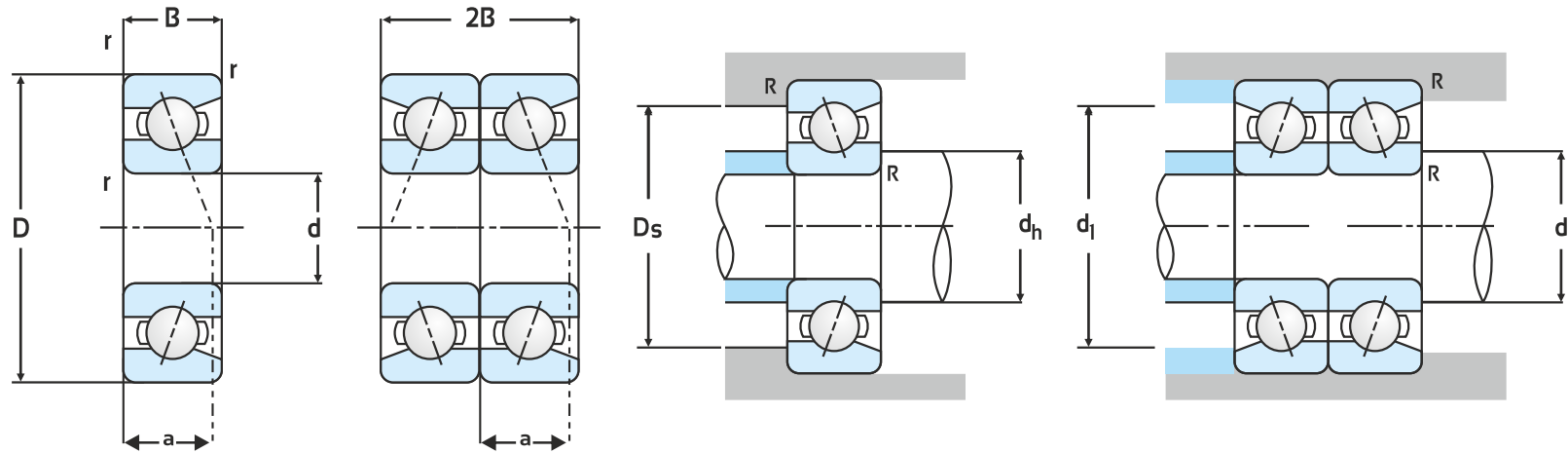
For single and DT arrangement

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	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

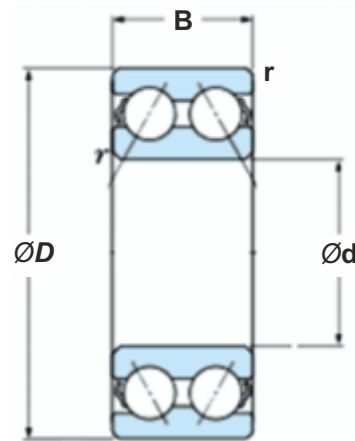
Note: Bearing number with suffix 'B' is for angle 40 Deg. & without suffix is 30 Deg.
Load rating are given for single row, for DB, DF & DT consult NEI engineering

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/ <i>inch</i>				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



**Equivalent radial load
dynamic**

$$P_r = X F_r + Y F_a$$

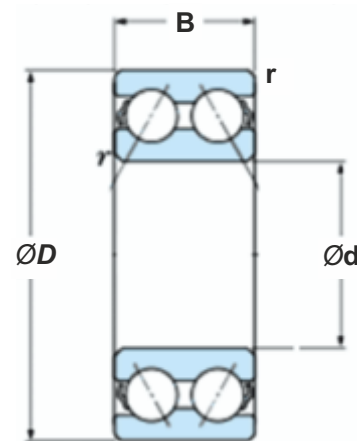
e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
	X	Y	X	Y
0.68	1	0.92	0.67	1.41

**Static equivalent
radial load**

$$P_{or} = F_r + 0.76 F_a$$

Boundary 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	Cor	Cr	Cor	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	22.2	1	21.7	17.1	2213	1744	0.52	3303	0.15
	40	17.5	0.6	14.9	9.2	1519	9381	0.39	3203	0.09
	40	17.5	0.6	14.9	9.2	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	22.2	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

Double Row Angular Contact Bearing



**Equivalent radial load
dynamic**

$$P_r = X F_r + Y F_a$$

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**

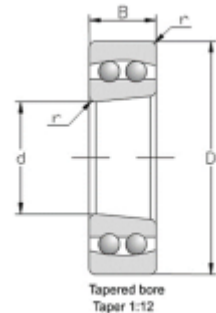
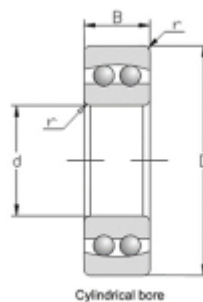
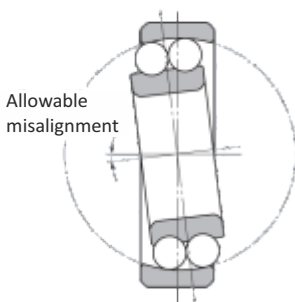
$$P_{or} = F_r + 0.76 F_a$$

Boundary 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	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

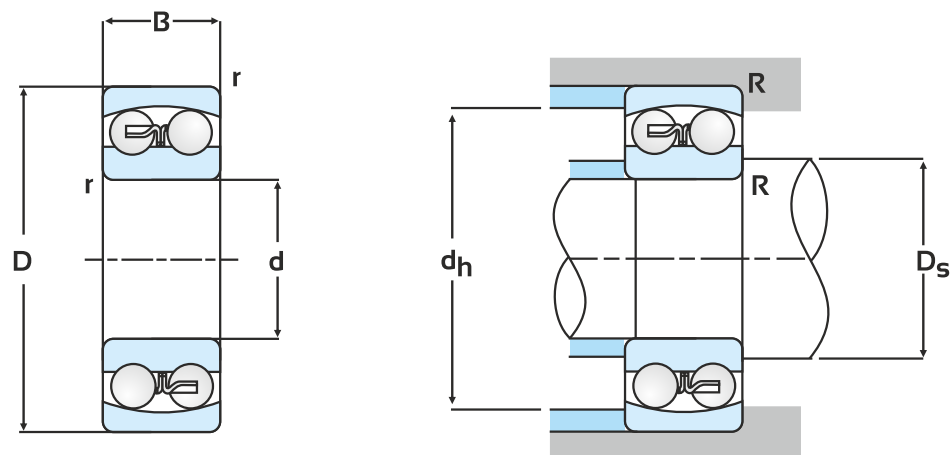
15.3 Self - Aligning Ball Bearing



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 straight bore and tapered bore. In some cases the ball slightly protrude from the bearing face. For more details contact NEI engineering.

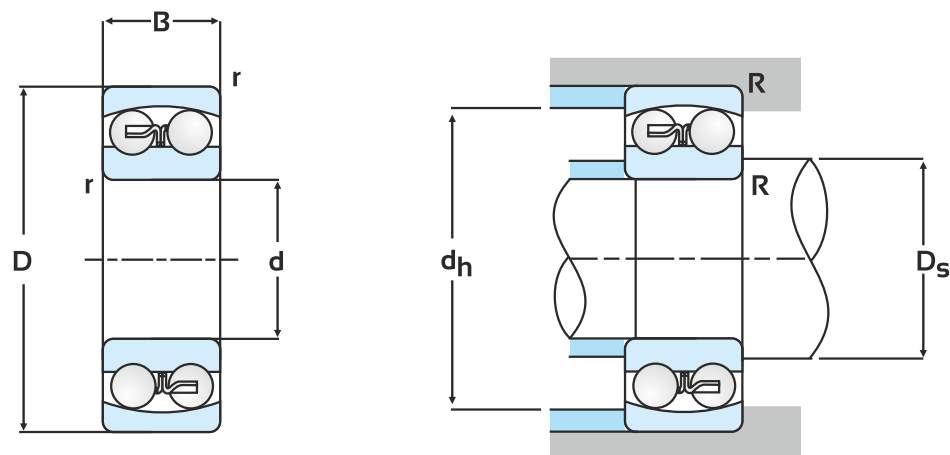


Self Aligning Ball Bearing



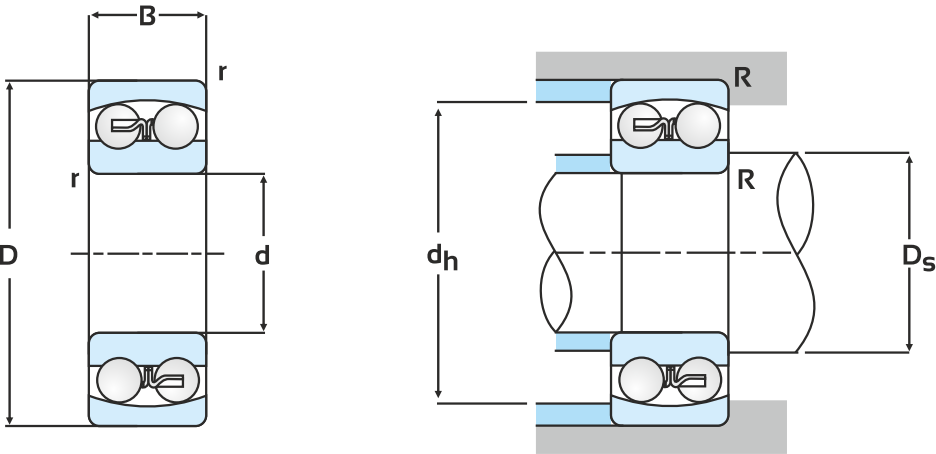
Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions			Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static								
mm				KN		Kgf		KN	rpm						
d	D	B	r min	Cr	Co	Cr	Co	Cu	Grease	Oil		d _h min.	Ds max.	R max.	
12	32	14	0.6	5.55	1.25	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	1	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	1	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

Self Aligning Ball Bearing



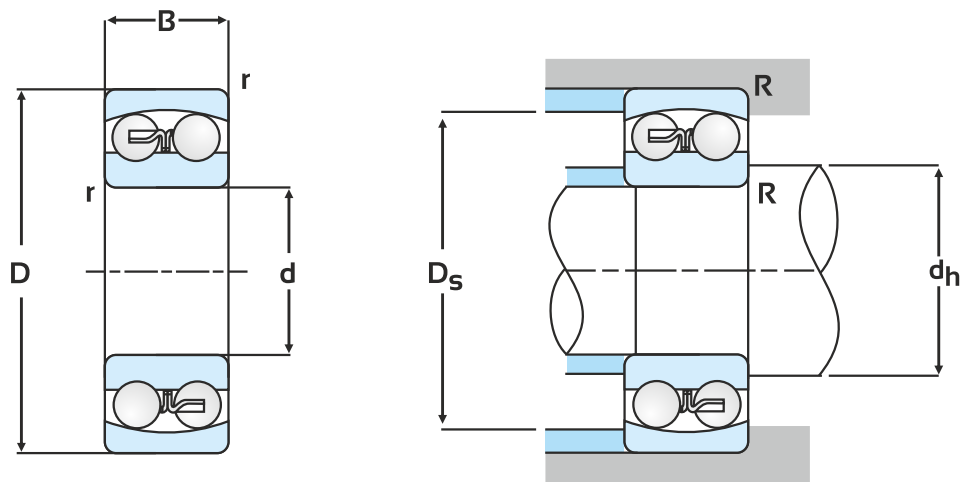
Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions			Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static					mm			
mm				KN		Kgf		KN	rpm						
d	D	B	r min	Cr	Co	Cr	Co	Cu	Grease	Oil		d _h min.	Ds max.	R max.	
40	80	18	1.1	19.7	6.7	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	1	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.	Ds 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

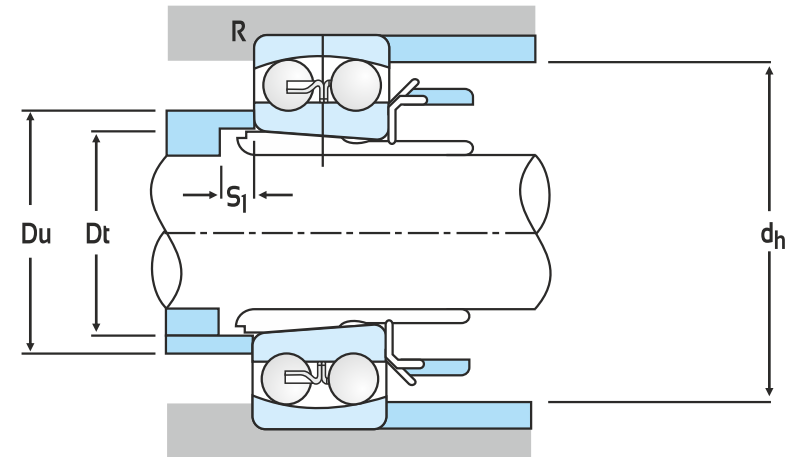
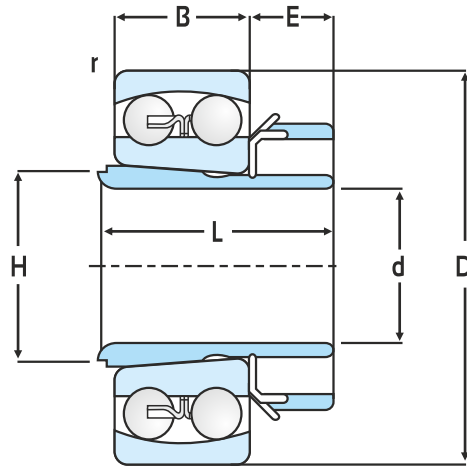
Self Aligning Ball Bearing (Inch Series)



Boundry Dimensions				Basic Load Rating				Fatigue Load Limit	Limiting Speed		Bearing Number	Abutment and Fillet Dimensions			Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static								
mm / inch				KN		Kgf		KN	rpm			mm			
d	D	B	r min	Cr	Co	Cr	Co	Cu	Grease	Oil		d _h min.	Ds 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	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 _{or}	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 Units 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



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:

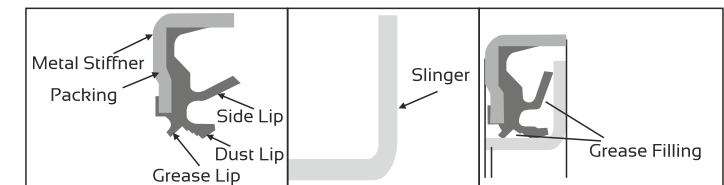
1. Reduces friction and wear.
2. Extends Bearing life.
3. Prevents rusting.
4. Prevents penetration of foreign matter.

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.

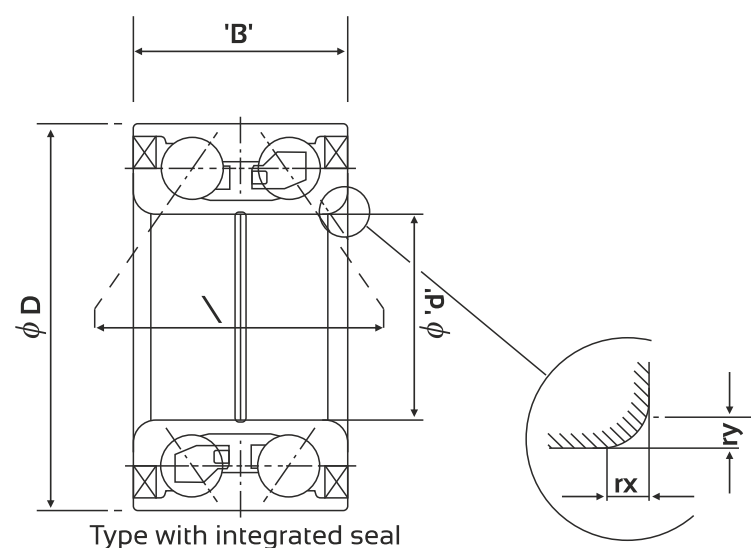
Characteristics	Resists fretting, enhances protection against rust
Maker	Nippon Oil Japan
Name	PYRONOC Universal N6B/N6C
Thickener	Urea
Base Oil	Mineral Oil
Working Temperature	-30 to 150 C
Colour	Cream
Remarks	Fretting Resistance Excellent Recommended grease for Passenger Cars

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



GEN 1 ball type



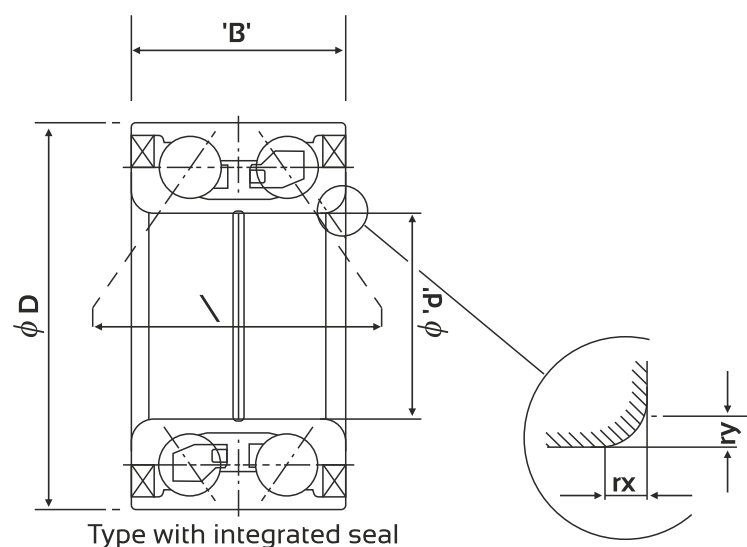
GEN 1



GEN1 Hub mounted

Boundary 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	Cor	Cr	Cor	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



GEN 1 ball type



GEN 1

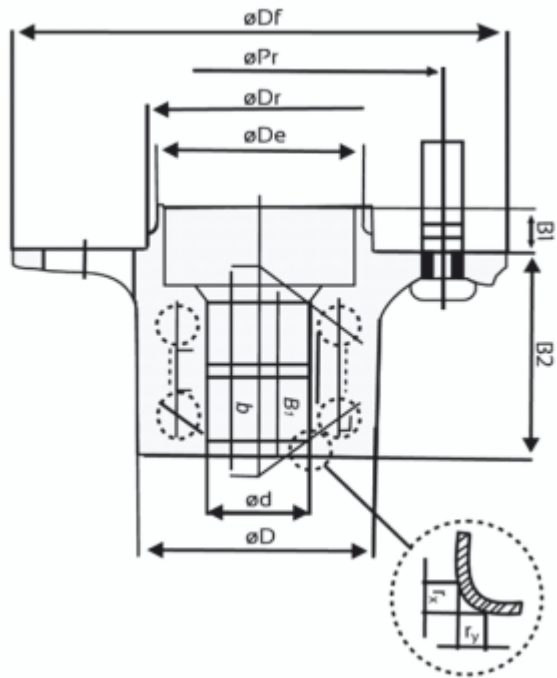


GEN1 Hub mounted

Boundary 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	Cor	Cr	Cor	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	AU1107-2LLX2	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.

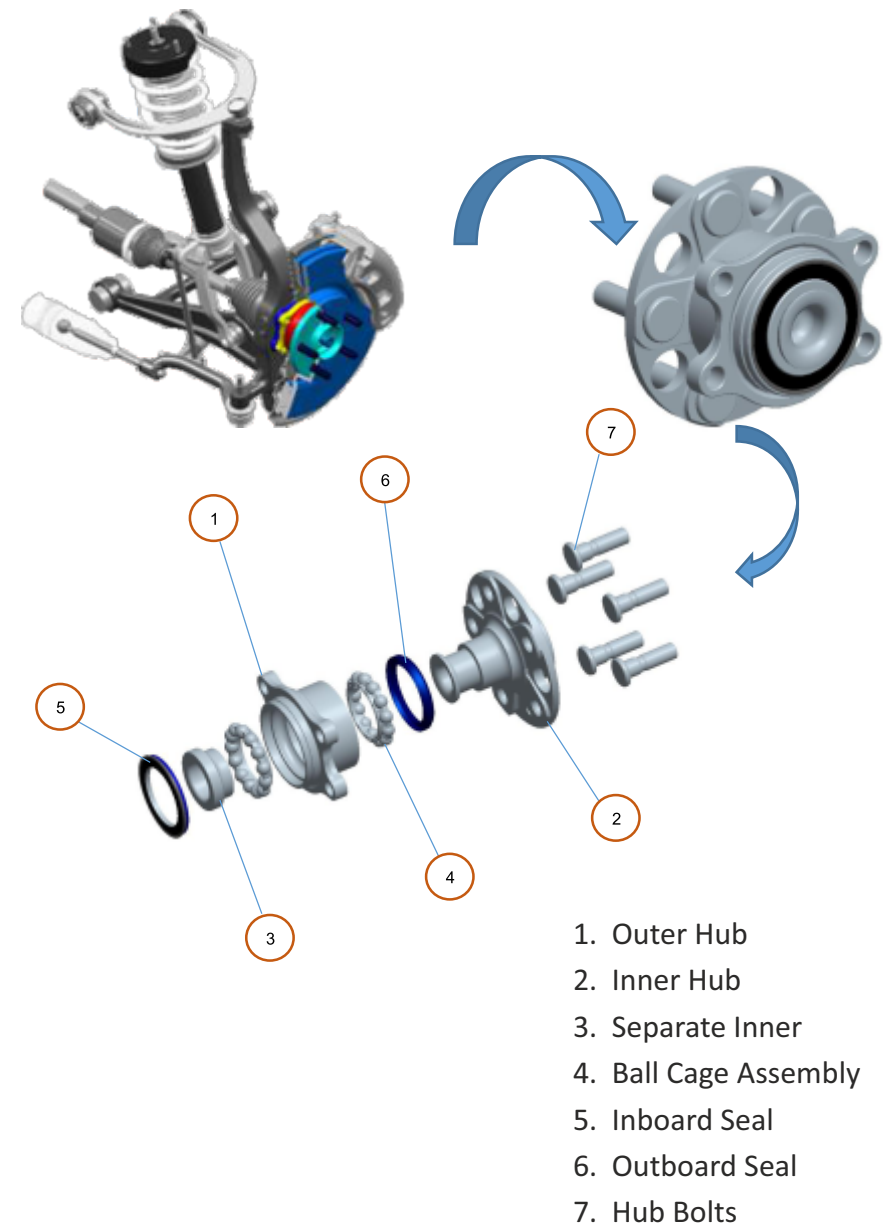
Double flange design and integrated approach reduces total cost of mounting the assembly in the vehicle. Reduced function and overall bearing life caused by incorrect mounting influences are finally eliminated with this Gen 3 bearing development.

It is also possible to provide integrated speed sensors required for signal of ABS/ESP suspension control.

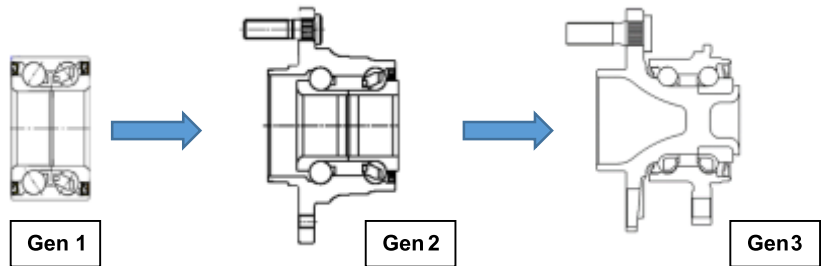
Benefits:-

1. Integrated wheel speed sensor control e.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



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

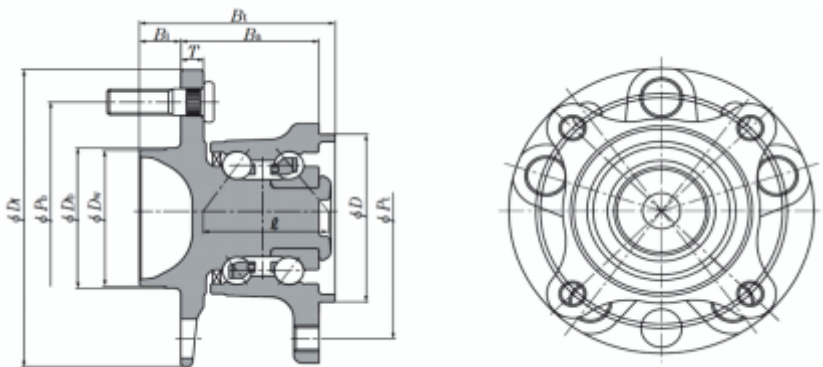
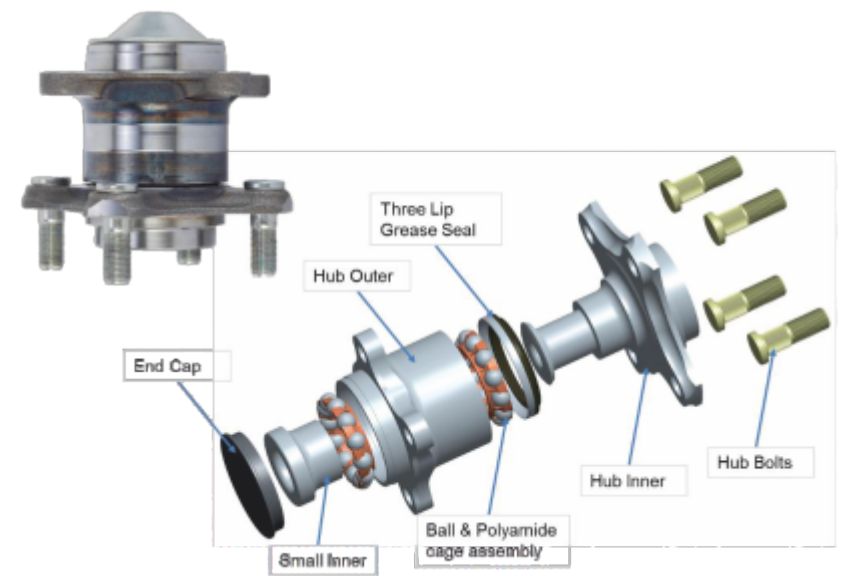
Why Gen 3 Bearings?

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	With Seals	+++	+++	+++
	Preload range under motion	+	++	+++
	Reliability in service	+	++	+++
Maintenance	Preload Management	+	++	+++
	Mounting & Serviceability	+	++	+++
	Knuckle material applicability	+	++ (Light alloys)	++ (Light alloys)

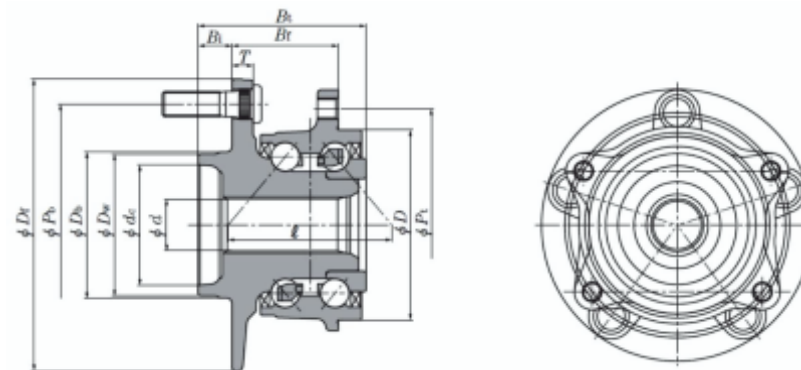
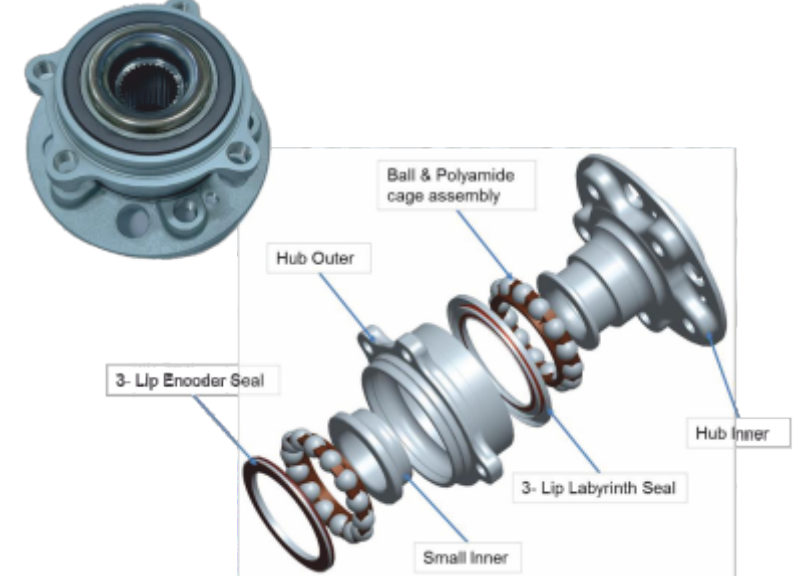
Note: Superiority Ranking order +++ > ++ > +

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

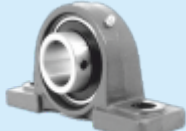
16 Pillow Block



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
	P 	UCP 
	T 	UCT 
	F 	UCF 
	FL 	UCFL 

UC	Housing type	Dimension series
• Insert bearing with set screw	• P- Pillow block unit • F- Flanged unit, 4-bolt (square) • FL- Flanged unit, 2-bolt (oval) • T- Take-up unit	• 2 – Normal series • 3 – Heavy series
Bore diameter	Design variant	
• 01 • 02 • 03 • 04 or higher = (bore dia. Code x 5)	• Mounting • Type of threads • Cage.....	

Example UCP205

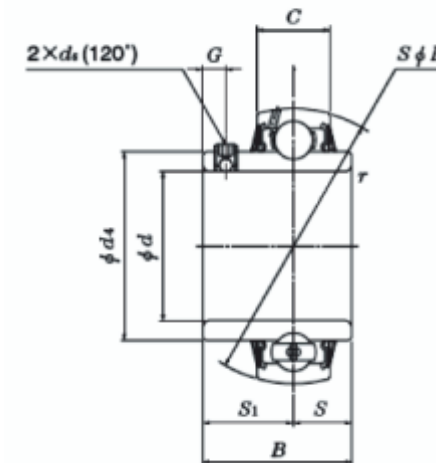
UC : Insert bearing with set screw
P : Pillow block housing
205 : 2- Normal series
05 : Bore diameter (Bore size 25 mm)

Example UCP305-16

UC : Insert bearing with set screw
F : Flange unit 4-bolt (square)
305-16 : 3 - Heavy duty series
05-16 : 16/16 or 1 inch bore diameter

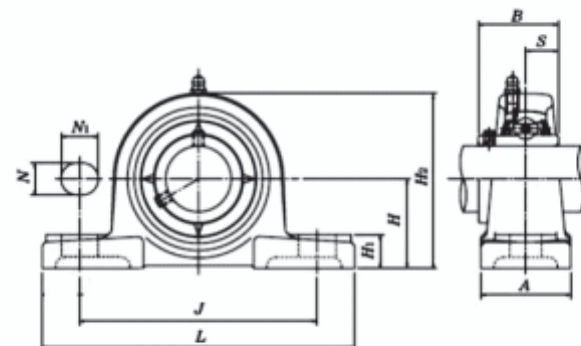
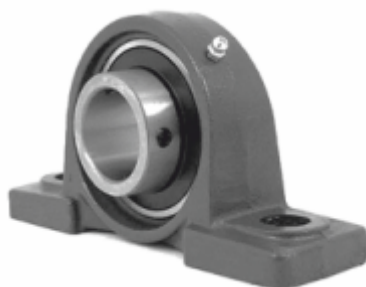
After bearing size two-digit number separated by a hyphen, gives the bore size in inch. It is the number of sixteenths (1/16) of an inch.

UC Ball Bearing Set Screw Type



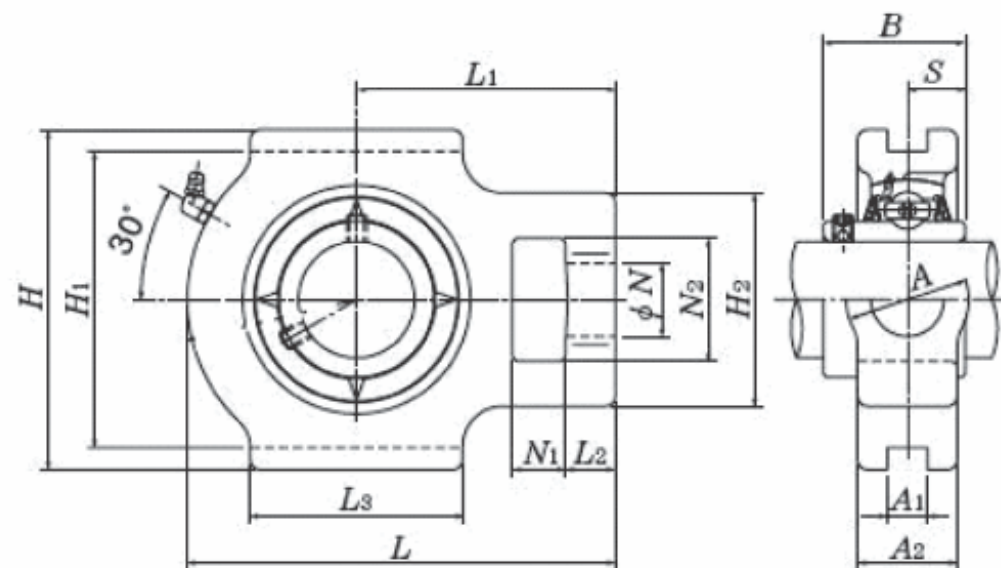
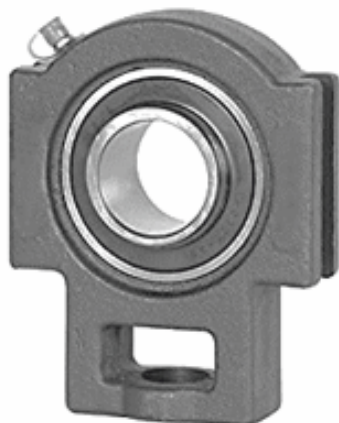
Shaft Dia	Unit no.	d	D	B	C	r _s Min.	S	S ₁	G	d _s	Basic Load Rating		Mass (Kg.)
											Dynamic C _r (KN)	Static C _{or} (KN)	
19.05	UC204-12	19.05	47	31	16	1	12.7	18.3	5	2-1/4-28	12.8	6.65	0.16
20	UC204	20	47	31	16	1	12.7	18.3	5	2-M6 X 1	12.8	6.65	0.16
25	UC205	25	52	34	17	1	14.3	19.7	5.5	2-M6 X 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)



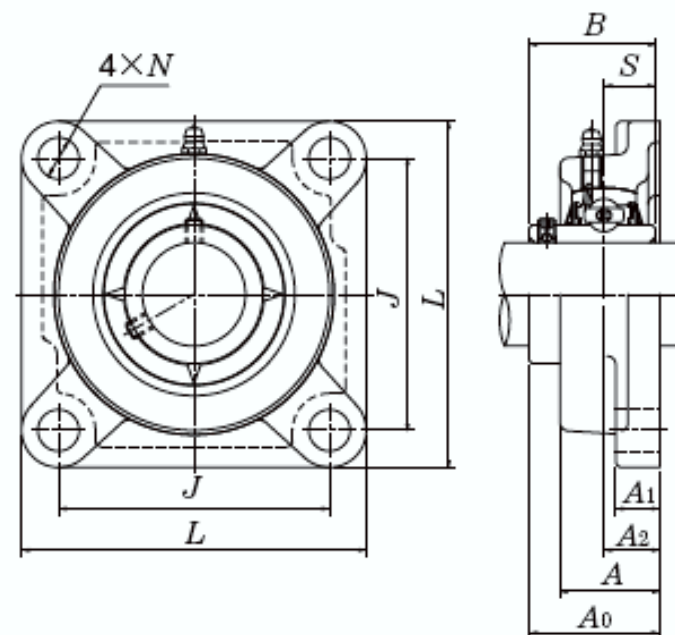
Shaft Dia	Unit no.	H	L	J	A	N	N ₁	H ₁	H ₂	B	S	Bearing No.	Mass (Kg.)
19.05	UCP204-12	33.3	127	95	38	13	16	14	64	31	12.7	UC204-12	0.7
20	UCP204	33.3	127	95	38	13	16	14	64	31	12.7	UC204	0.7
25	UCP205DI	36.5	140	105	38	13	16	15	71	34.1	14.3	UC 205 D ₁	0.8
25	UCP205	36.5	140	105	38	13	19	15	69.5	34	14.3	UC205	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

UCT Take-up units (Cast housing & Set screw type)



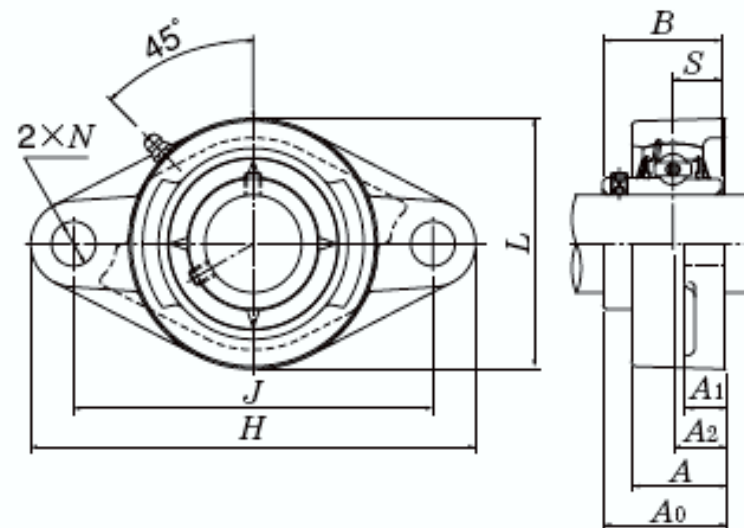
Shaft Dia	Unit no.	N_1	L_2	H_2	N_2	N	L_3	A_1	H_1	H	L	A_2	A	L_1	B	S	Mass (Kg.)
28.575	UCT206-18	16	10	56	37	22	57	12	89	102	113	27	37	70	38.1	15.9	1.05
30	UCT206	16	10	56	37	22	57	12	89	102	113	27	37	70	38.1	15.9	1.05
31.75	UCT206-20	16	10	56	37	22	57	12	89	102	113	27	37	70	38.1	15.9	1.05
	UCT207-20	16	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 Flanged units (Cast housing & Set screw type)



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

UCP 2 Bolt Flanged units (Cast housing & Set 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 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.

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.



2. Needle roller and cage assembly for connecting rod bearings

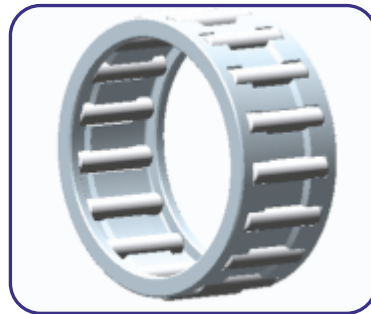
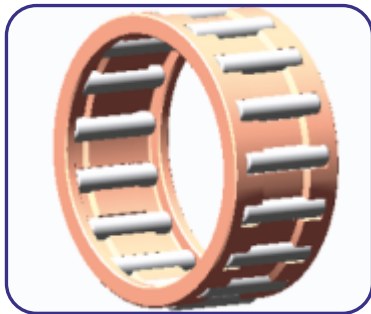
A Needle roller and cage assembly for connecting rod bearings comprises of needle rollers and a cage that guides and hold the rollers on its position.

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

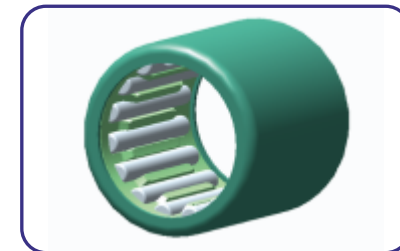
The small end bearing is designed to withstand high impact loads and high-speed oscillation. Cage is designed for inner diameter guide and guide surface is designed to minimize surface pressure.

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 housing 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. 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:

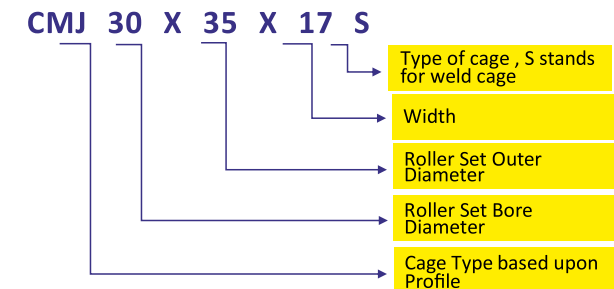
As diameter of rolling element is small so can be arranged in small spacing pitch, and this is ideal for oscillation motion

Needle Bearing Nomenclature

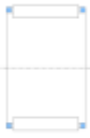
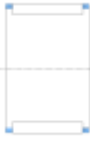
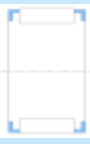
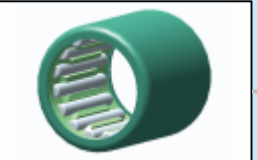
Bearing Type Code	Details
C	Needle roller and machined cage assembly
CBC	Needle roller and machined cage assembly for piston pins
PC	Needle roller and machined cage assembly for crank pins
CJ••S	Needle roller and weld cage assembly
CMJ••S	Needle roller and weld cage assembly
CV••S	Needle roller and weld cage assembly
HC	Drawn-cup needle roller bearing
HMC	Drawn-cup needle roller bearing for heavy loading
HC-F	Speical Type Drawn-cup needle roller bearing
F	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

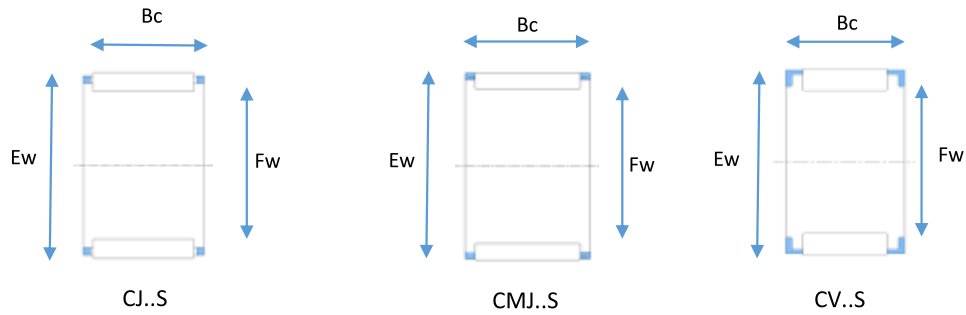


Needle Bearing Classification

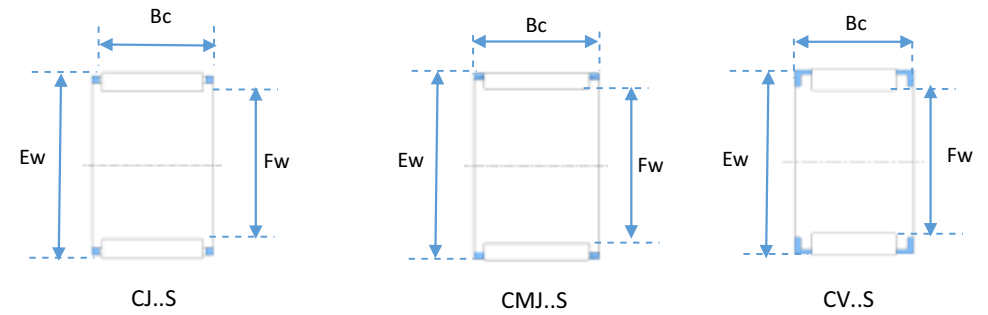
Weld Cage Assembly	 Needle roller and cage assembly	 CJ..S  CMJ..S  CV..S
Machine Cage Assembly	 Needle Roller and Cage Assembly for Connecting Rod Bearings	 C CBC  PC
Shell Type Bearing	 Shell Type Needle Roller Bearings	 HC  HMC

Needle Roller and Cage Assembly

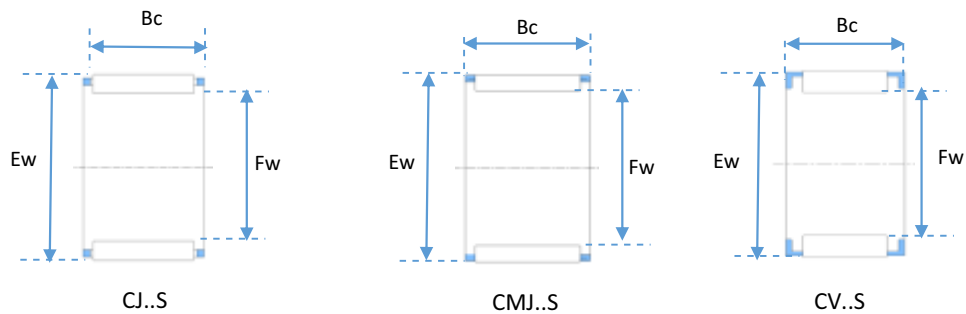




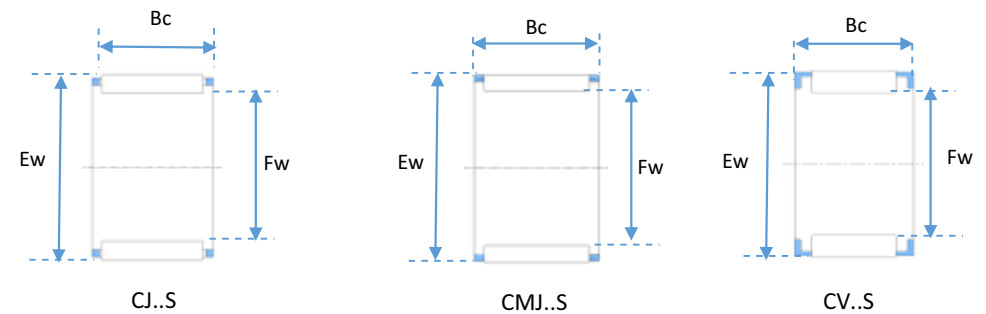
Boundary dimensions (mm)			Basic load rating					
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	Mass (Kg) Approx.
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
15	18	14	7 850	11 600	800	1 190	C15x18x14	0.006
15	19	8	5 350	5 850	545	600	CV15x19x7.8XS	0.0033
15	19	10	6 850	8 050	700	820	C15x19x10	0.0055
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



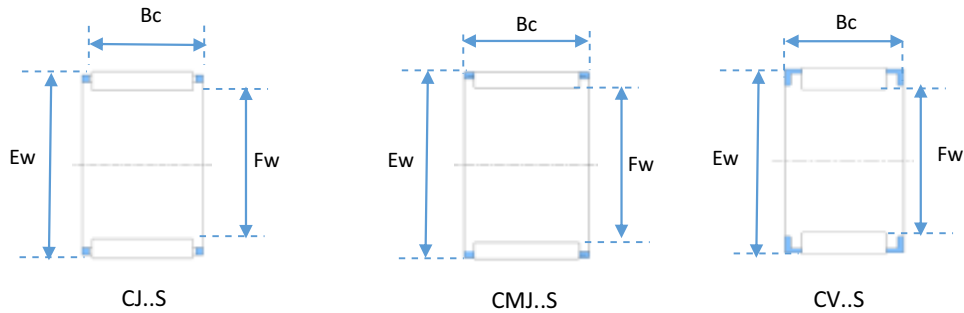
Boundary dimensions (mm)			Basic load rating					
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	Mass (Kg) Approx.
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
18	24	12	12 300	13 800	1 250	1 410	C18x24x12	0.012
18	24	13	11 600	12 800	1 180	1 300	C18x24x13	0.013
18	24	17	16 000	19 300	1 630	1 970	CMJ18X24X17SV1	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	19 600	1 610	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



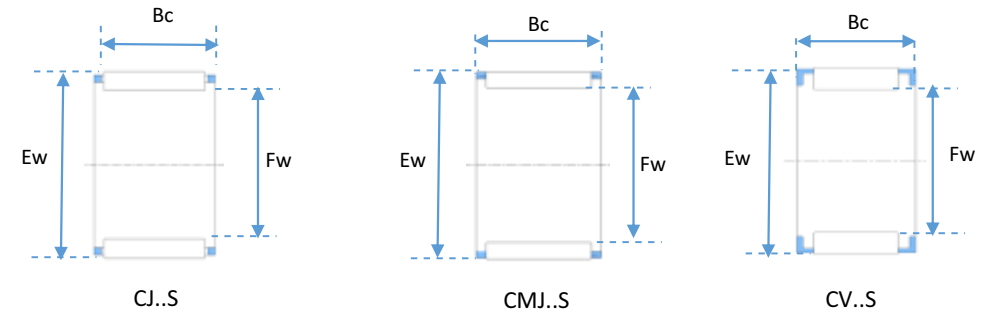
Boundary dimensions (mm)			Basic load rating					
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kg)	Bearing Number	Mass (Kg) Approx.
			Cr	Cor	Cr	Cor		
22	30	17.5	23 200	2 7500	2 370	2 800	CMJ22X30X17.3X2S	0.024
22	30	24	31 000	4 0000	3 150	4 100	CMJ22X30X23.8X3S	0.0348
23	27	13	11 400	1 7700	1 160	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



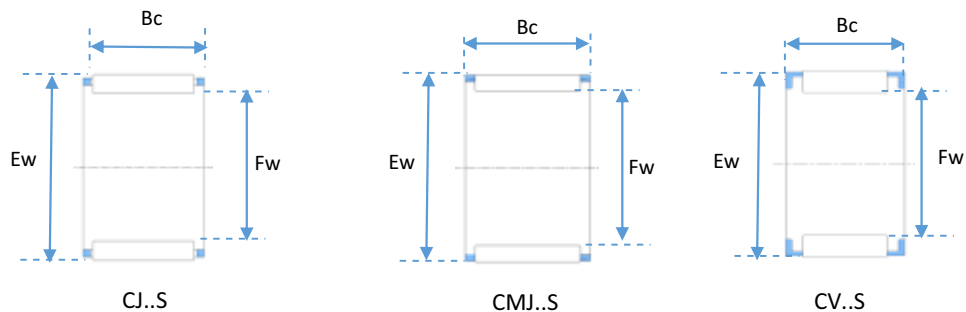
Boundary dimensions (mm)			Basic load rating					
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kg)	Bearing Number	Mass (Kg) Approx.
			Cr	Cor	Cr	Cor		
28	32	17	15 300	27 500	1 560	2 810	C28x32x17	0.017
28	32	21	18 700	35 500	1 910	3 650	C28x32x21	0.02
28	33	13	13 900	20 900	1 420	2 130	C28x33x13	0.015
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



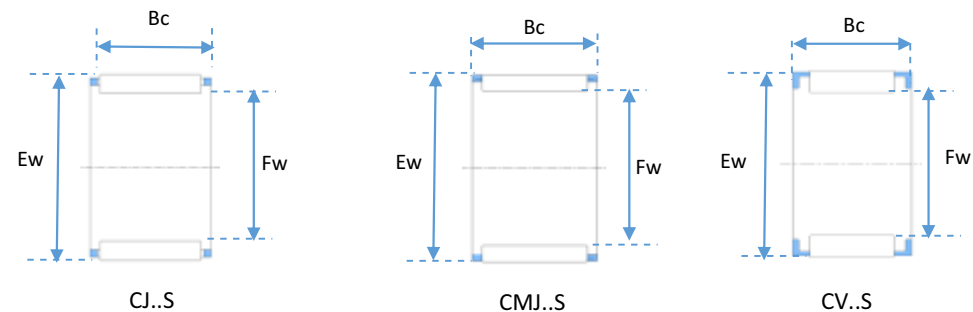
Boundary dimensions (mm)			Basic load rating					Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
32	38	20	25 100	41 000	2 560	4 150	CJ32x38x20S	0.031
32	38	26	31 500	54 000	3 200	5 550	C32x38x26	0.041
32	39	16	22 600	32 000	2 310	3 300	C32x39x16V1	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	CV34x40x39.3X1ZW5	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



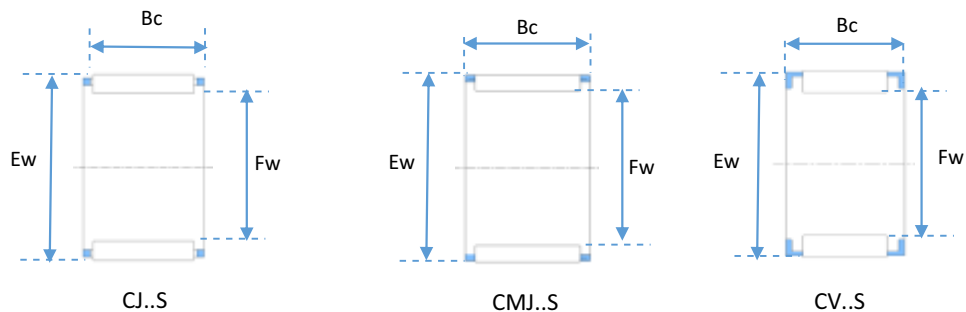
Boundary dimensions (mm)			Basic load rating					Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)	Bearing Number	
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
38	43	17	20 900	38 500	2 130	3 950	C38X43X17	0.027
38	43	27	32 000	67 500	3 300	6 900	C38x43x27	0.043
38	43	29	32 500	68 000	3 300	6 950	C38x43x28.8X	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



Boundary dimensions (mm)			Basic load rating					Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kg)	Bearing Number	
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



Boundary dimensions (mm)			Basic load rating					Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kg)	Bearing Number	
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



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 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 obtainable by various selection and combination

Table 1 Recommended clearance value

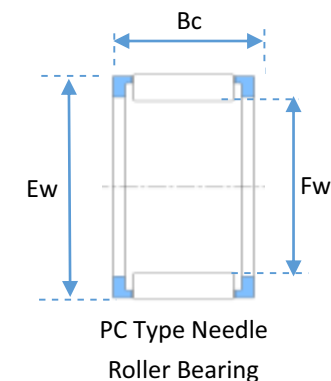
Pin diameter mm		Large end side	Small end side
Over	incl.		
6	10	9~23	5~17
10	18	10~24	5~17
18	30	10~24	5~17
30	40	18~33	--

Table 2 Radial clearance values obtainable by selection and combination

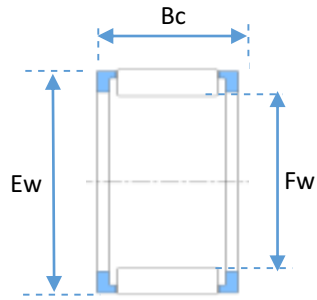
Hole diameter tolerance range	0~+4	+4~+8	+8~+13
Tolerance range of needle roller used	-4~-6	-2~-4	0~-2
Pin diameter tolerance range			
0~-3	10~17	10~17	10~18
-3~-6	13~20	13~20	13~21
-6~-8	16~22	16~22	16~23

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
	Cylindricity (max)	2	3	3	4	4
Pin	Roundness (max)	2	2	3	3	4
	Cylindricity (max)	1	1	2	2	3

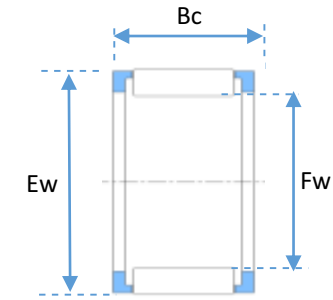


Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
			Cr	Cor	Cr	Cor		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
10	14	9.8	5 050	4 900	515	500	PC10x14x9.8X14	0.0037
12	16	10	5 450	5 600	555	570	PC12x16x10.2	0.0044
12	17	9.8	6 800	6 550	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



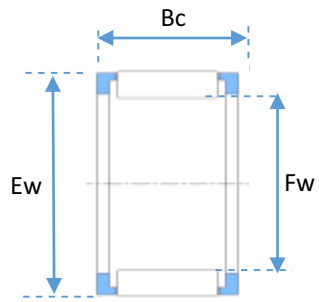
PC Type Needle
Roller Bearing

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
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				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kgf)		
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	CBC9x12x11.7V2	0.003
10	14	9.8	4 500	4 200	460	430	CBC10x14x 9.8x	0.0042
10	14	12.5	6 100	6 200	620	635	CBC10x14x12.5x1	0.0053
10	14	14.8	6 100	6 200	620	635	CBC10x14x14.8x	0.0064
11	14	13.5	5 850	7 250	595	740	CBC11x14x13.5x1	0.0044
11	15	12.3	7 050	7 700	720	785	CBC11x15x12.3x5	0.0049
11	15	15.8	7 050	7 650	720	780	CBC11x15x15.8x2	0.0069
12	15	16.4	7 500	10200	765	1040	CBC12x15x16.6V	0.0056
12	16	14.8	7 600	8 600	775	875	CBC12x16x14.8x1	0.0062
12	16	15.4	7 000	7 800	715	795	CBC12x16x15.6	0.0079
12	16	15.8	8 100	9 350	825	955	CBC12x16x16	0.0073
12	17	14.8	8 400	8 550	855	875	CBC12x17x14.8x	0.0094
14	18	16.8	9 750	12 400	995	1 260	CBC14x18x17	0.0089
14	18	19.8	9 150	11 300	930	1 160	CBC14x18x20	0.013
14	19	17.1	11 100	12 700	1 130	1 300	CBC14x19x17.1x	0.012
15	19	17.3	10 900	14 600	1 110	1 490	CBC15x19x17.3x	0.01
16	20	16.8	10 800	14 700	1 100	1 500	CBC16x20x17	0.01
16	20	19.6	10 200	13 600	1 040	1 390	CBC16x20x19.8	0.013
16	20	23.8	13 600	19 700	1 390	2 010	CBC16x20x23.8x	0.015
16	21	19.6	13 900	17 600	1 420	1 790	CBC16x21x19.6x	0.016
17	21	23	13 200	19 400	1 340	1 980	CBC17x21x23.2	0.016
17	21	25	13 100	19 200	1 340	1 960	CBC17x21x25x	0.017
17	22	22	16 900	22 900	1 720	2 340	CBC17x22x22x1	0.017
18	22	21.8	12 500	18 300	1 270	1 870	CBC18x22x21.8x3	0.015
18	22	23.8	13 000	19 300	1 330	1 970	CBC18x22x23.8x1	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	Housing				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
Cylindricity (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 inscribed circle diameter

(Type HC)

Units: mm

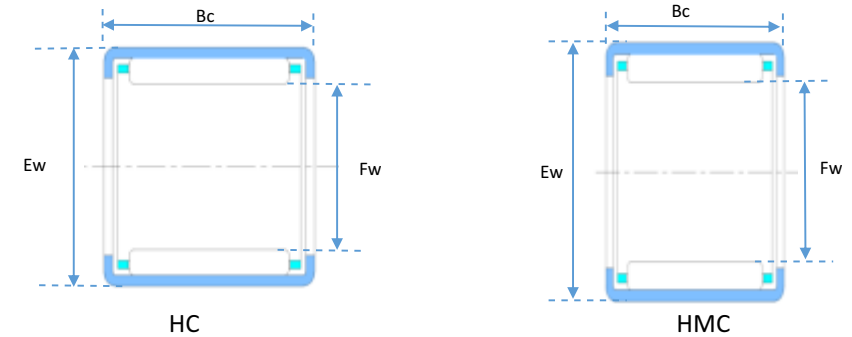
Nominal inscribed circle dia.	Nominal outer ring outer dia.	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
			High	Low
Fw	D			
3	6.5	6.484	3.016	3.006
4	8	7.984	4.022	4.01
5	9	8.984	5.022	5.01
6	10	9.984	6.022	6.01
7	11	10.98	7.028	7.013
8	12	11.98	8.028	8.013
9	13	12.98	9.028	9.013
10	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 inscribed circle diameter

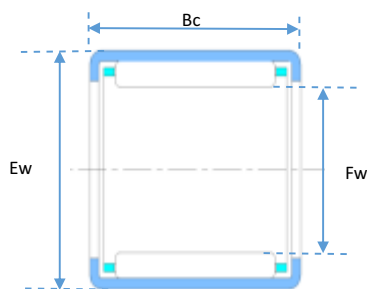
(Type HMC)

Units: mm

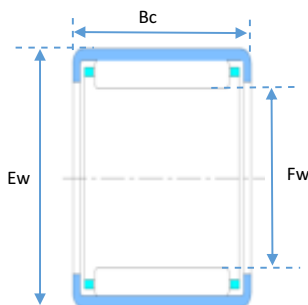
Nominal inscribed circle dia.	Nominal outer ring outer dia.	Ring gauge bore dia.	Tolerance for inscribed circle diameter	
Fw	D		High	Low
8	15	14.995	8.028	8.013
9	16	15.995	9.028	9.013
10	17	16.995	10.028	10.013
12	19	18.995	12.034	12.016
14	22	21.995	14.034	14.016
15	22	21.995	15.034	15.016
16	24	23.995	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



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

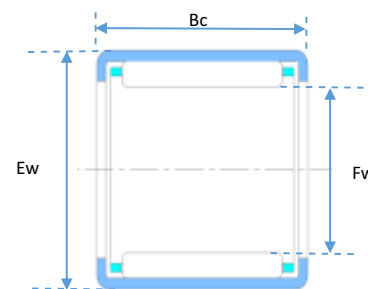


HC

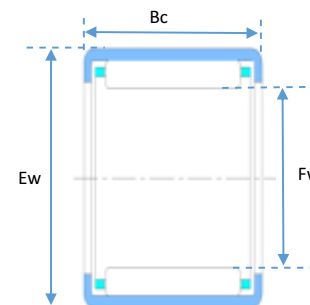


HMC

Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kg)		
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



HC



HMC

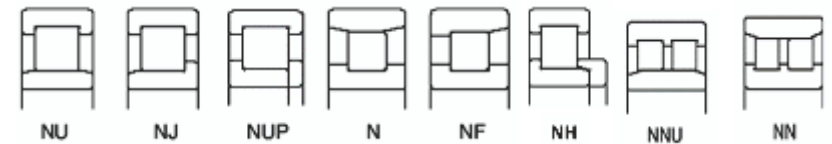
Boundary dimensions (mm)			Basic load rating				Bearing Number	Mass (Kg) Approx.
			Dynamic (N)	Static (N)	Dynamic (Kgf)	Static (Kg)		
Fw	Ew	Bc	Cr	Cor	Cr	Cor		
24	31	28	26 000	44 500	2 650	4 500	HMC2428	0.045
25	32	12	11 100	15 200	1 140	1 550	HC2512F	0.021
25	32	16	15 900	24 000	1 620	2 450	HC2516F	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

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:



Design	Description
 NU type	- Outer ring has flange on both sides. Inner ring is without flange - The bearings can take radial load and no axial load. They are used as floating bearings. - The outer along with rollers and cage forms outer assembly. - The outer assembly and inner are separable and can be mounted independently.
 NJ type	- Inner ring has flange on both sides. outer ring is without flange - The bearings can take radial load and no axial load. They are used as floating bearings. - The inner along with rollers and cage forms inner assembly. - The inner assembly and outer are separable and can be mounted independently.
 N type	- Outer ring has flange on both sides. Inner has flange on one side only. - Along with radial load can take axial load in one direction only. Can be used on floating side and as well as on fixed side.
 NF type	- Inner ring has flange on both sides. Outer has flange on one side only. - Along with radial load can take axial load in one direction only. can be used on floating side and as well as on fixed side.
 NH type (NJ+NH)	- Outer ring has flange on both sides. Inner ring has flange on one side. - L-shape collar rests on the inner outer diameter. - The bearings can take radial load and axial load in either direction. - Widely used as fixed side bearing.
 NUP type	- Outer ring has flange on both sides. Inner ring has flange on one side. - Collar is fixed on the inner ring flange less side - The bearings can take radial load and axial load in either direction. - Widely used as fixed side bearing.

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

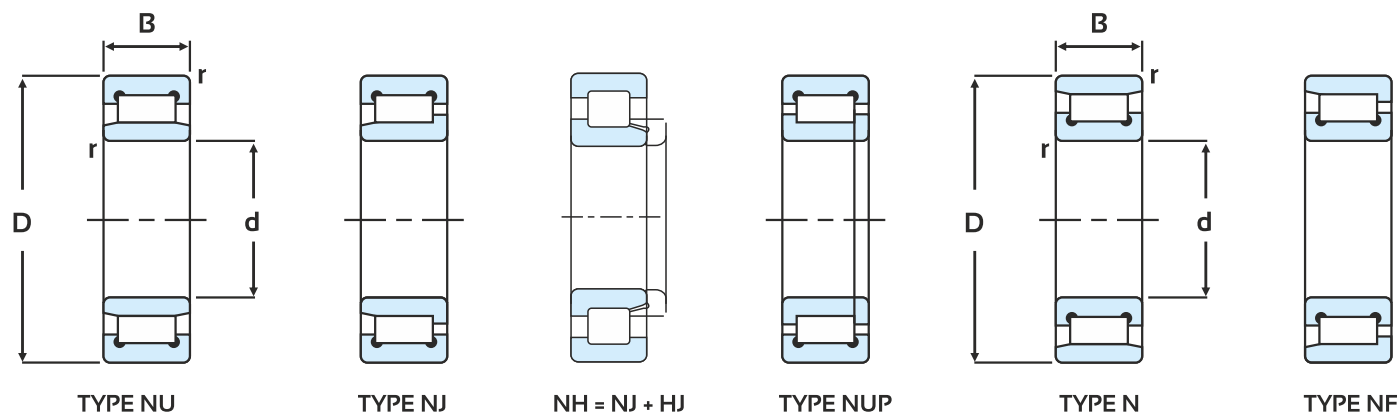


Double Row



Four Row

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

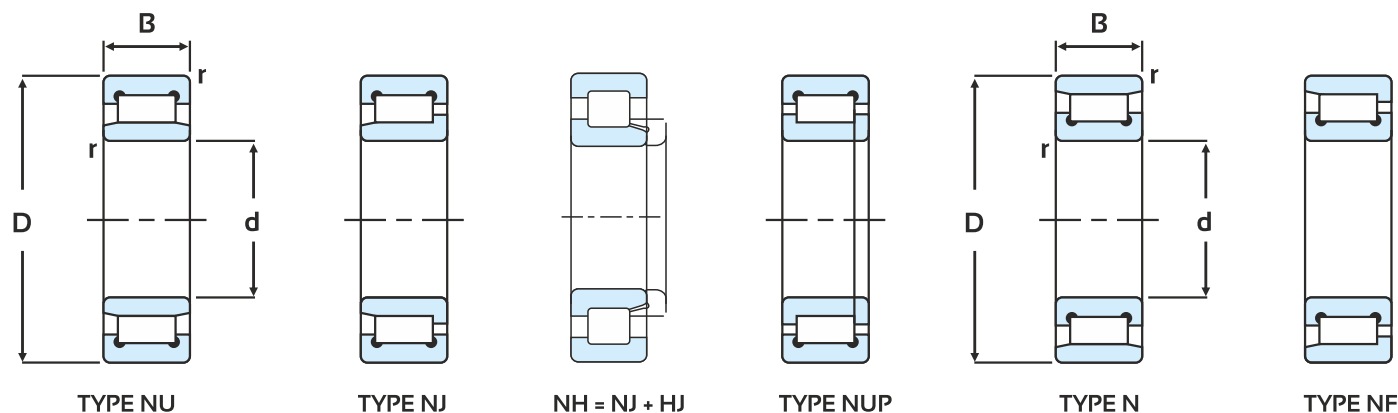
$$P_r = F_r$$

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	28.5	22.8	2906	2325	2.8	NJ204ECP	0.11
20	52	15	2	34.2	27.1	3487	2763	3.3	NJ304E	0.17
22	58	17	1.5	32.3	37.7	3294	3844	4.6	22X58X17	0.240
25	52	15	1.0	29.3	27.7	2988	2825	3.4	NU205E	0.130
25	52	15	1.0	29.3	27.7	2988	2825	3.4	NJ205	0.137
25	52	15	1.0	32.2	26.8	3283	2733	3.3	NJ205E	0.140
25	52	15	0.6	29.09	28.4	2966	2896	3.5	N205E	0.210
25	52	15	0.6	29.3	27.7	2988	2825	3.4	NUP205E	0.140
25	52	18	1.0	32.2	29.6	3283	3018	3.6	NJ2205E	0.200
25	52	18	1.0	34.8	34.6	3549	3528	4.2	NJ2205ET2X	0.154
25	62	17	1.1	41.5	37.5	4232	3824	4.6	NJ305E	0.245
25	62	17	1.1	29.2	25.2	2978	2570	3.1	NU305	0.230
25	62	17	1.5	49.8	47.9	5078	4884	5.8	NJK305	0.245
25	62	17	1.1	29.2	25.2	2978	2570	3.1	NJ305	0.240
25	62	17	1.1	29.2	25.2	2978	2570	3.1	N305	0.230
25	62	17	1.1	41.5	37.5	4232	3824	4.6	NU305E	0.386
25	62	24	1.1	56.9	56.1	5802	5721	6.8	NJ2305E	0.424
25	62	24	1.1	59.84	59.9	6102	6108	7.3	NU2305E	0.350

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

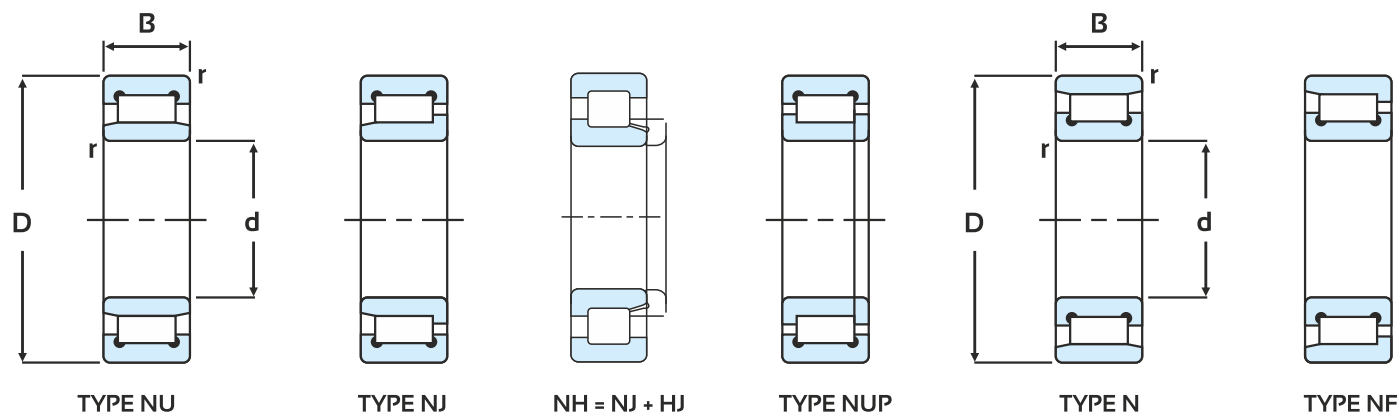
$$P_r = F_r$$

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	19.6	19.5	1999	1988	2.4	NUP1006	0.137
30	58	17	1.5	32.3	37.7	3294	3844	4.6	30X58X17	0.190
30	61.935	19.05	3.17/1.5	51.3	57.7	5231	5884	7.0	CR30	0.300
30	62	20	1.0	43.3	38.2	4415	3895	4.7	NJ2206EF	0.300
30	62	16	0.8	39	37.2	3977	3793	4.5	ASTN206E/TS1N206ET2X	0.203
30	62	16	1.0	39.2	37.5	3997	3824	4.6	NJ206EC3	0.210
30	62	16	1.0	40.4	39	4120	3977	4.8	NJ206ECPC3	0.240
30	72	19	1.1	69	68	7036	6934	8.3	NUP306EN	0.360
30	72	19	2.0	51.7	48.4	5272	4935	5.9	N306EF	0.350
30	72	19	2.0	54.6	52	5568	5302	6.3	NU306E	0.400
30	72	19	2.0	54.6	52	5568	5302	6.3	NJ306E	0.400
30	80	22	4.0	71.6	68.1	7301	6944	8.3	NI274	0.720
30	80	26	1.5	92	108	9381	11013	13.2	N1302	0.780
35	62	14	0.6	22.6	23.1	2305	2356	2.8	NU1007T2X	0.16
35	72	17	1.1	60.2	63.2	6139	6445	7.7	NJ207EF	0.300
35	72	23	1.1	61.4	65.6	6261	6689	8.0	NJ2207E	0.460
35	72	17	1.1	50.2	50.1	5119	5109	6.1	TS1N1522EJ2	0.327
35	72	17	1.0	54.2	55.1	5527	5619	6.7	NU207E	0.320

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

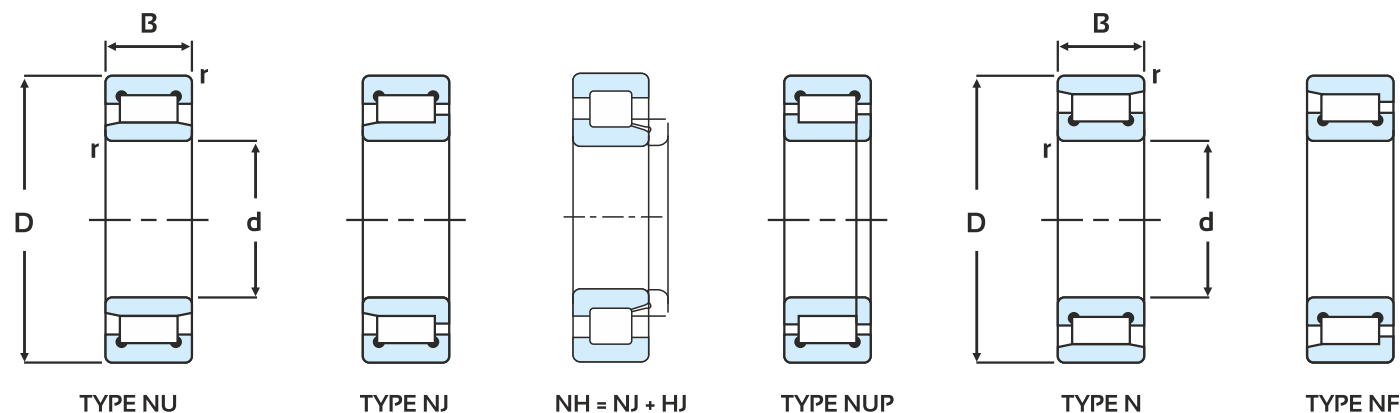
$$P_r = F_r$$

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	46.4	43	4731	4385	5.2	N307	0.464
35	80	21	1.1/1.5	16.4	43	1672	4385	5.2	NJ307/J	0.487
35	80	21	1.5	66.6	65.3	6791	6659	8.0	NJ307EJ	0.500
35	80	21	1.5/4	72.9	80.3	7434	8188	9.8	N1076	0.530
35	80	21	1.5	69	68	7036	6934	8.3	NJ307EF	0.480
35	80	23	1.0	72.3	77.6	7372	7913	9.5	NU307ENS	0.570
35	80	26	1.5	94.6	112.3	9646	11451	13.7	MUB7307	0.674
35	90	23	2.0	102.2	104.9	10421	10697	12.8	N1242	0.781
40	68	15	1	28.3	30.5	2886	3110	3.7	TS1RNU1008N	0.13
40	68	15	0.6	25	26	2549	2651	3.2	NU1008EMN	0.23
40	68	15	0.6	25	26	2549	2651	3.2	NU1008EM	0.23
40	74	21.5	1	30.2	34.2	3079	3487	4.2	ASTN1551/TS1N1551NT2X	0.347
40	80	18	1.1	43.7	42.9	4456	4375	5.2	N208	0.372
40	80	18	1.1	55.6	55.4	5670	5649	6.8	NUP208E	0.384
40	80	18	1.1	55.6	55.4	5670	5649	6.8	NUP208EN	0.380
40	80	18	1.1	55.6	55.4	5670	5649	6.8	NJ208	0.386
40	80	18	1.1	55.6	55.4	5670	5649	6.8	NU208E	0.377
40	80	18	1.1	43.7	42.9	4456	4375	5.2	NH208/J	0.380

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

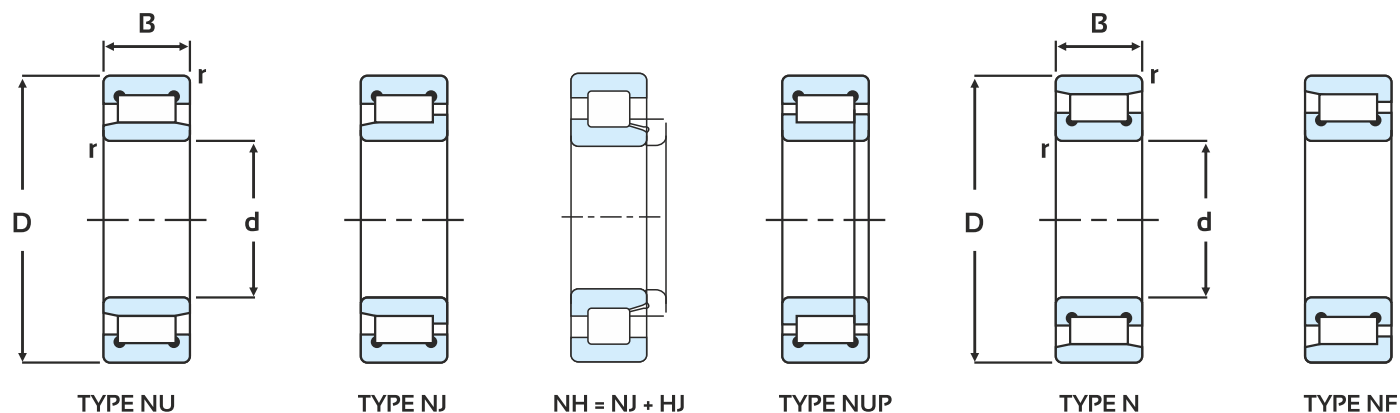
$$P_r = F_r$$

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		
40	80	18	1.1	43.7	42.9	4456	4375	5.2	NUP208/J	0.340
40	80	23	1.1	72.3	77.6	7372	7913	9.5	NU2208E	0.538
40	80	23	1.1	76.3	83.2	7780	8484	10.1	NU2208E	0.480
40	80	23	1.1	76.3	83.2	7780	8484	10.1	NJ2208E	0.480
40	80	23	1.1	76.3	83.2	7780	8484	10.1	NJ2208ECP	0.480
40	90	23	1.5	68.3	66	6965	6730	8.0	N308	0.643
40	90	23	1.5	93	78	9483	7954	9.5	N308EC3	0.650
40	90	23	1.5	84	82.7	8565	8433	10.1	NU308EC3	0.750
40	90	23	4.0	102.2	104.9	10421	10697	12.8	WUB61308UM	0.730
40	90	23	1.5	82.8	81.3	8443	8290	9.9	NJ308E	0.760
40	90	23	2.5	80.4	78	8198	7954	9.5	NF308E/C3	0.760
40	90	33	1.5	114.2	122.1	11645	12451	15.0	NJ2308E	1.060
45	85	19	1.1	63	66.5	6424	6781	8.1	NUP209E	0.504
45	85	19	1.1	63	66.5	6424	6781	8.1	NJ209E	0.493
45	85	23	1.1	79.8	90.2	8137	9198	11.0	NU2209EN	0.540
45	85	19	1.1	66.1	70.8	6740	7219	8.6	NUP209EJ2N	0.470
45	95	32	2.1	87	101	8871	10299	12.3	N8025FC	1.080
45	100	25	1.5	73.8	71	7525	7240	8.7	NU309	0.857

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

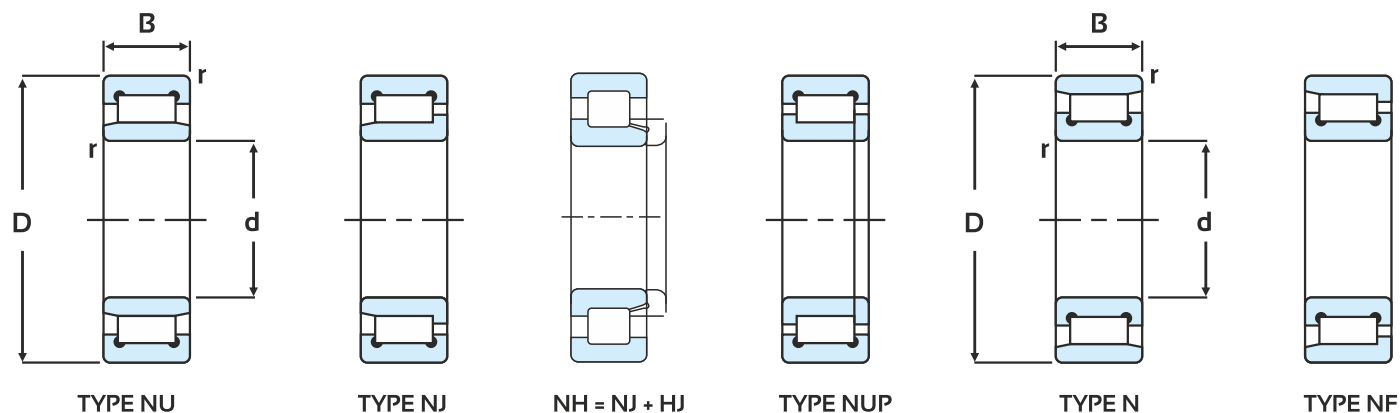
$$P_r = F_r$$

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		
45	100	25	1.5	73.8	71	7525	7240	8.7	NU309N	0.845
45	100	25	1.5	73.8	71	7525	7240	8.7	NF309	0.870
45	100	25	1.5	73.8	71	7525	7240	8.7	NJ309	0.886
45	100	25	1.5	73.8	71	7525	7240	8.7	NUP309N	0.898
45	100	25	1.5	73.8	71	7525	7240	8.7	NJ309VN	0.919
45	100	25	1.5	100.5	102.4	10248	10442	12.5	NU309E	0.890
45	100	25	1.5	100.5	102.4	10248	10442	12.5	NU309EN	0.890
45	100	25	1.0	100.5	102.4	10248	10442	12.5	NUP309E	0.888
45	100	25	2.5	102.4	105.1	10442	10717	12.8	NUP309V	0.948
45	100	25	1.5	97.4	98.3	9932	10024	12.0	NUP309EM	0.940
45	100	36	2.0	157.9	176.3	16101	17977	21.5	WUB1304	1.350
45	100	36	4.5	157.9	176.3	16101	17977	21.5	MLGR-WUBN1304UM	1.354
45	100	36	2.0	157.9	176.4	16101	17988	21.5	MLGR-NJK2309	1.343
45	100	36	2.0	157	176	16009	17947	21.5	NJK2309N	1.330
49.93	80	15	0.6	45.1	53.9	4599	5496	6.6	CR50	0.280
50	90	20	1.1	48.1	50.9	4905	5190	6.2	NJ210E	0.560
50	90	23	1.1	64.1	73.6	6536	7505	9.0	NH2210	0.648
50	110	27	2.0	86.9	86.2	8861	8790	10.5	N310	1.116

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

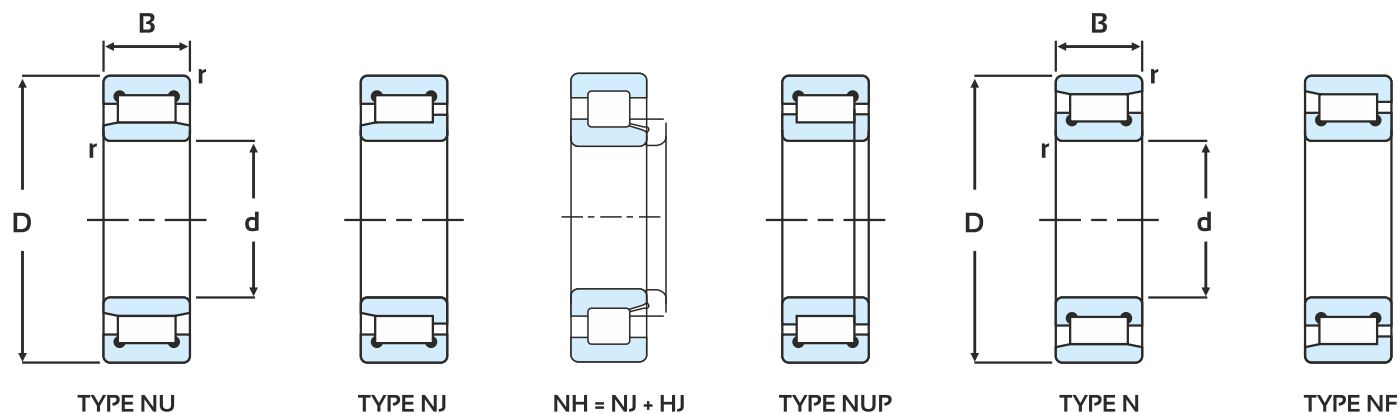
$$P_r = F_r$$

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		
50	110	27	2.0	86.9	86.2	8861	8790	10.5	NUP310N	1.186
50	110	27	2.0	86.9	86.2	8861	8790	10.5	NU310	1.190
50	110	27	2.0	113.4	117.5	11563	11981	14.3	NU310E	1.100
50	110	27	2.0	86.9	86.2	8861	8790	10.5	NJ310	1.140
50	110	27	2.0	86.9	86.2	8861	8790	10.5	NUP310N	1.195
55	100	21	1.5	57.9	62.2	5904	6343	7.6	NU211	0.638
55	100	21	1.5	57.9	62.2	5904	6343	7.6	NJ211	0.652
55	120	29	2.0	136	141	13868	14378	17.2	NJ311EF	1.500
60	110	22	1.5	85.7	82.3	8739	8392	10.0	NUP212E	0.966
60	110	26	1.0	117.8	136.9	12012	13960	16.7	N1072	1.140
60	110	22	1.5	85.7	82.3	8739	8392	10.0	NUP212EJ	0.897
60	130	31	2.1	150.7	158.6	15367	16172	19.3	N312EM	1.800
60	130	31	2.1	150.7	158.6	15367	16172	19.3	N312EC3	1.800
60	130	31	3.5	158.7	150.6	16183	15357	18.4	N312EF(2312)	1.800
60	130	31	2.1	155	165	15805	16825	20.1	NU312EJ2	1.865
65	140	33	2.1	181.8	193.4	18538	19721	23.4	NUP313E	2.370
65	140	33	2.1	180.5	193.4	18406	19721	23.4	NJ313EMC3	2.230
65	140	33	2.1	181.8	193.4	18538	19721	23.4	N313EM	2.300

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

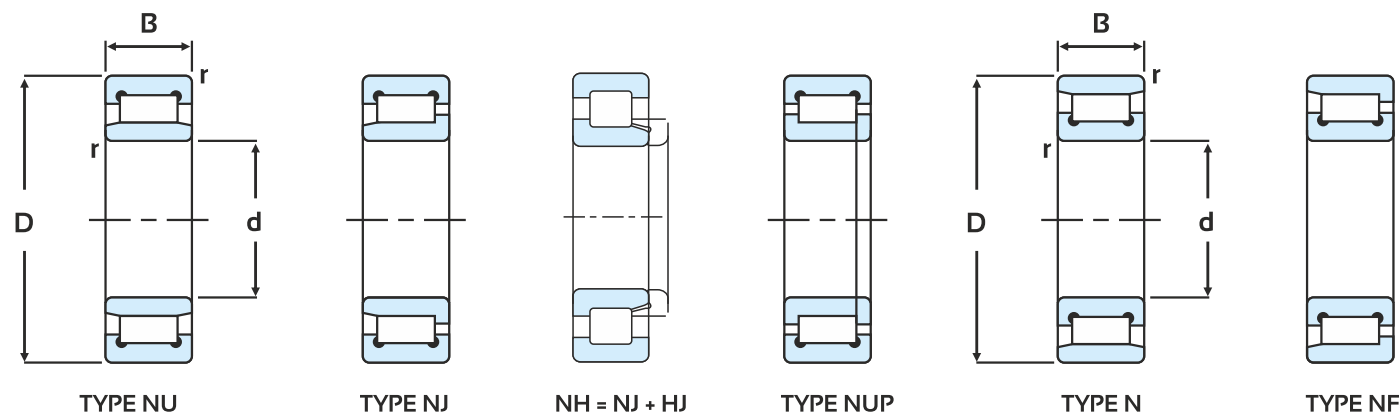
$$P_r = F_r$$

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		
70	150	35	2.1	158	168	16111	17131	19.9	N314	2.150
70	150	35	2.1	184.7	171.6	18834	17498	20.3	N314EF	2.150
70	150	35	2.1	218.8	241.6	22311	24636	28.6	NU314EM	2.700
75	160	37	2.1	238.5	260.8	24320	26594	30.3	NUP315E	3.450
75	160	37	2.1	247.9	273.9	25278	27930	31.8	NU315EC3	3.520
80	170	39	2.1	257	283.9	26206	28949	32.4	NU316EM	4.000
85	180	41	3.0	292.9	333	29867	33956	37.3	NU317EMC3	4.200
90	190	43	3.0	311.9	349.4	31804	35628	38.5	N318EC3	5.200
90	190	43	3.0	315	355	32121	36199	39.1	NU318EM	6.500
90	190	64	3.0	450	530	45887	54044	58.4	N2318E	8.000
95	200	45	3.0	331	381	33752	38851	41.3	NU319EMC3	7.500
95	200	45	3.0	340	390	34670	39768	42.3	NU319EM	8.000
100	180	34	2.1	247.4	302.8	25227	30877	33.4	NU220E	3.500
100	215	47	3.0	315	395	32121	40278	42.0	NU320M	8.750
100	215	47	3.0	320	397	32630	40482	42.2	N320MC3	8.500
100	215	73	3.0	670	735	68320	74948	78.2	NJ2320EMC4	11.9
105	225	49	3.0	364	423	37117	43133	44.4	N321M	9.810
105	225	49	3.0	364	423	37117	43133	44.4	NU321M	9.910

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

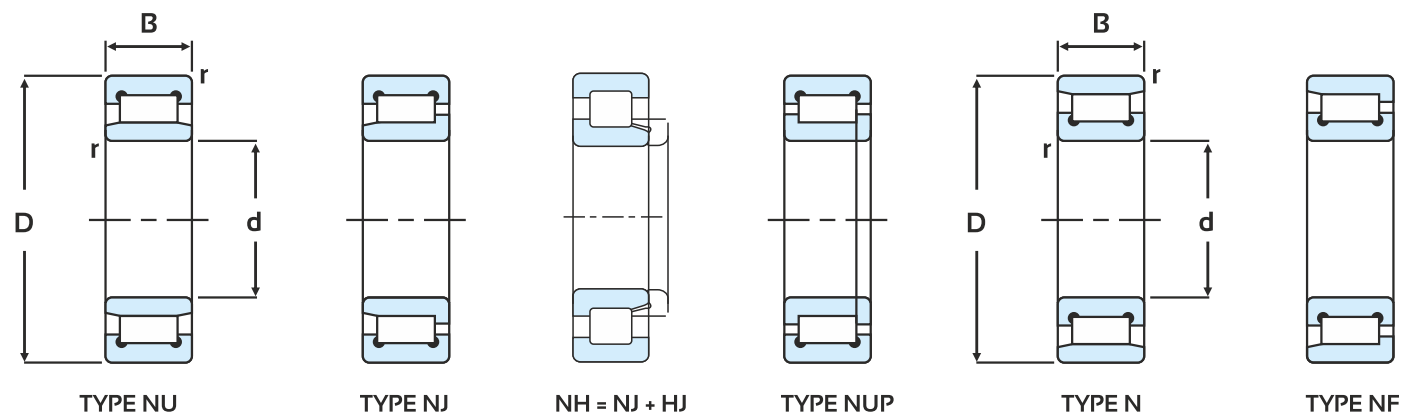
$$P_r = F_r$$

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		
110	200	38	2.1	255	315	26002	32121	33.7	NU222M	5.500
110	200	38	2.1	296	371	30183	37831	39.7	NU222EM	5.400
110	240	50	3.0	380	420	38749	42827	43.3	NU322M	11.600
120	180	28	1.1	173	259	17641	26410	28.0	NU1024MC3	2.600
120	215	40	2.1	288	365	29367	37219	38.1	NU224MC3	6.300
120	215	40	2.1	327	430	33344	43847	44.9	NU224EMC3	6.300
120	260	55	3.0	490	645	49965	65771	64.9	NU324M	15.500
120	260	55	3.0	540	620	55064	63221	62.4	NJ324E	15.000
130	230	40	3.0	295	385	30081	39258	39.4	NU226M	7.300
130	230	40	3.0	376.2	474.7	38361	48405	48.5	NU226EMC3	7.400
130	230	40	3.0	415	455	42318	46396	47.0	NUP226	7.500
130	230	79.4	5.0	525.4	776.1	53575	79139	79.3	NU5226M	14.000
130	230	64	3.0	530	735	54044	74948	75.1	NU2226E	12.200
130	230	64	3.0	520	730	53024	74438	74.6	NU2226EM	11.500
130	280	58	4.0	561	671	57205	68422	66.0	NU326M	17.000
140	250	42	3.0	345	450	35180	45887	44.9	NU228M	9.300
140	250	42	3.0	412.8	547.8	42093	55859	54.7	NU228EMC3	9.400
140	250	68	3.0	510	750	52005	76478	74.9	NU2228MC3	14.400

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

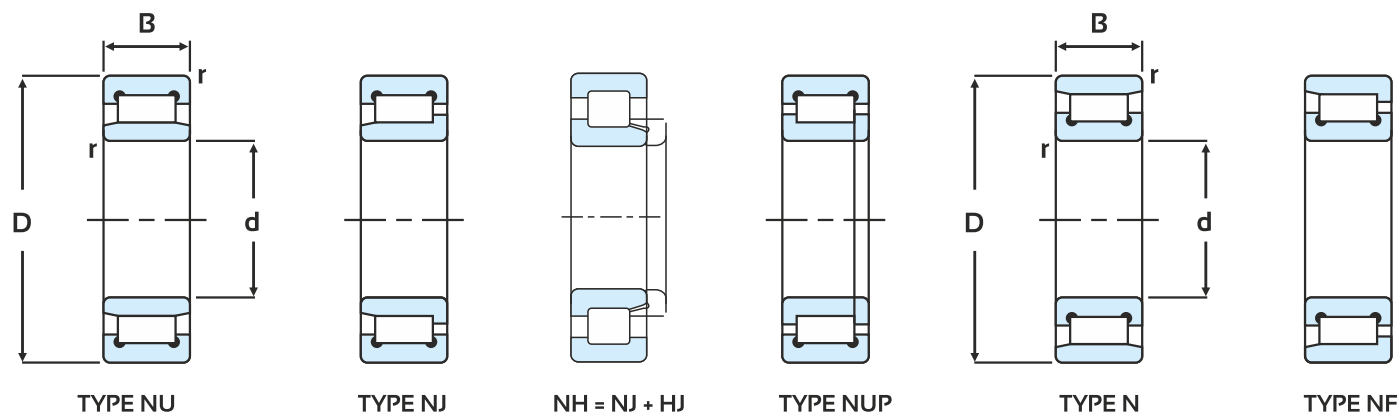
$$P_r = F_r$$

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		
150	270	45	3.0	405	550	41298	56084	53.7	NU230M	11.800
150	270	88.9	6.0	728.8	1103.9	74316	112565	107.8	NU5230M	22.000
150	280	93	3.0	790	1180	80556	120325	114.4	72727 (With Sleeve AHX3228)	32.000
150	320	65	4.0	800	985	81576	100440	93.0	NU330	25.600
160	290	196.8	2.0	1600	3000	163152	305910	286.8	NU160X290X197	36.560
160	340	68	4.0	685	970	69849	98911	89.9	NU332MC3	31.000
160	340	114	4.0	1330	1840	135620	187625	170.5	NU2332E	53.000
160	290	80	3.0	940	1170	95852	119305	111.9	NU2232E	24.000
160	240	38	2.1	235	335	23963	34160	33.2	NU1032C3	6.200
160	340	68	4.0	710	950	72399	96872	88.0	N332M	30.400
160	290	48	3.0	500	664	50985	67708	63.5	NU232M	14.400
170	360	72	5.0	800	1020	81576	104009	92.9	N334	38.700
170	310	52	4.0	600	790	61182	80556	74.1	N234M	18.000
170	310	52	4.0	610	850	62202	86675	79.7	NU234MC3	19.500
170	310	52	4.0	615	825	62712	84125	77.4	NU234EM	17.900

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

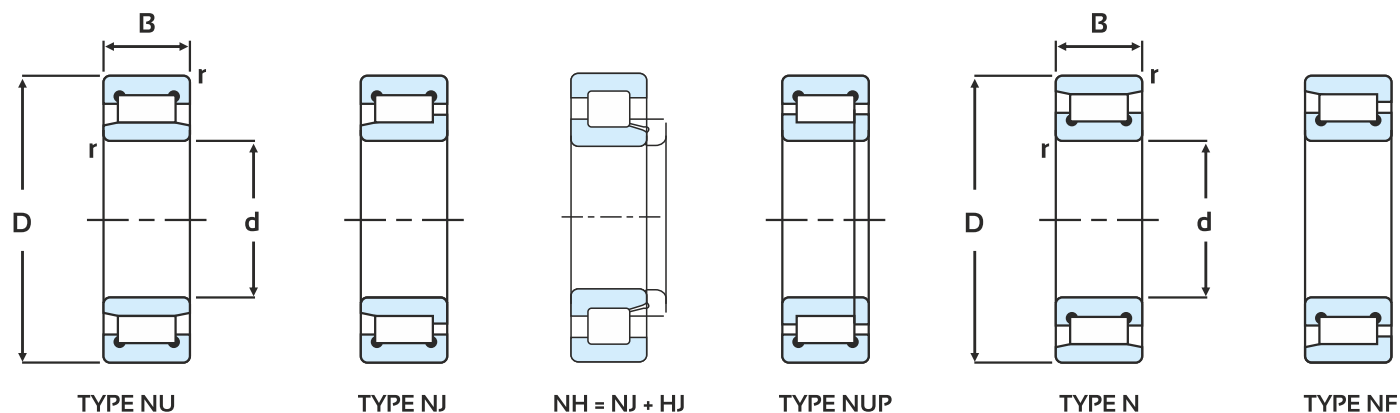
$$P_r = F_r$$

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		
180	320	108	3.0	987.9	1552.6	100736	158319	143.8	NU5236M	37.000
180	320	52	4.0	525	735	53534	74948	68.1	NU236M	18.500
180	380	75	4.0	917	117.5	93506	11981	10.5	NJ336E	43.500
180	280	46	2.1	340	465	34670	47416	44.2	NU1036	11.000
180	380	75	4.0	917	1175	93506	119815	105.2	NU336	43.000
190	400	78	5.0	975	1290	99421	131541	113.7	NU338M	50.400
200	360	120.65	6.0	1337	2229	136334	227291	199.6	NU5240	53.700
200	360	120.65	6.0	1409	2391	143676	243810	214.1	NU5240M	57.250
200	310	51	2.1	400	590	40788	60162	54.3	NU1040M	13.800
200	360	58	4.0	630	880	64241	89734	78.8	NU240	28.000
200	360	58	4.0	765	1060	78007	108088	94.9	NJ240M	26.900
200	420	138	5.0	1900	2620	193743	267161	227.6	NU2340EM	93.300
210	340	95.2	6.0	955	1835	97381	187115	165.2	NU5044M	31.000
220	350	98.4	2.5	953.5	1649	97228	168149	146.9	N1263	35.000
220	400	65	4.0	799	1150	81474	117266	99.9	NU244M	38.000
220	400	65	4.0	1038	1264	105845	128890	109.8	NUP244	38.500
220	460	88	5.0	1223	1392	124709	141942	117.6	N1134	70.770

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

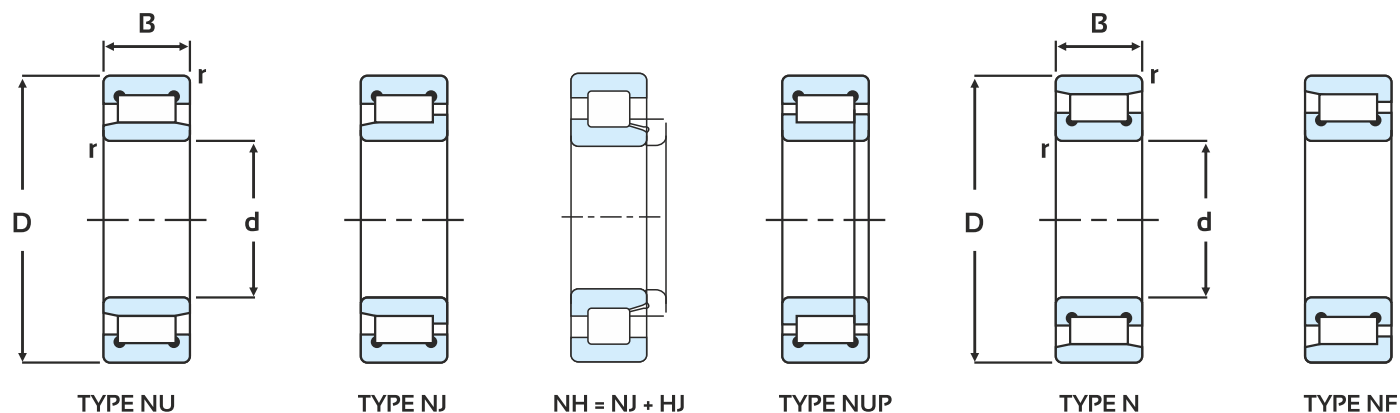
$$P_r = F_r$$

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		
240	440	146.05	4.0	2617	4298	266855	438267	363.1	NU5248	100.000
240	360	56	3.0	534	832	54452	84839	73.0	NU1048M	19.700
240	390	108	3.0	1446	2180	147449	222295	188	N1133	50.290
240	440	72	3.0	952	1370	97075	139699	116	NU248M	51.400
260	400	65	4.0	655	1090	66790	111147	93	NU1052M	30.200
260	360	46	2.1	370.2	598.3	37749	61009	52.0	NF1952	14.050
280	500	165.1	4.0	2915.5	5238.8	297294	534200	424.7	NU5256	139.000
280	380	46	2.1	384.6	642.9	39218	65557	54.8	NU1956	14.960
280	380	46	2.1	384.6	642.9	39218	65557	54.8	NF1956	14.960
280	500	165.1	4.0	2970	5353	302851	545845	434	N1112	144.740
300	460	74	4.0	850	1350	86675	137660	110	NU1060E	44.500
320	440	56	3.0	625	1100	63731	112167	90	NU1964	25.310
320	670	200	7.5	3740	5920	381368	603662	447	NU2364M	341.000
340	620	165	6.0	2880	4650	293674	474161	354	NU2268	28.560
340	710	212	7.5	4710	7250	480279	739283	538	NU2368EM	415.000
380	680	240	6.0	4300	7650	438471	780071	566	NU3276	376.100
380	680	175	6.0	3332	5790	339764	590406	428	NU2276	274.240
380	680	177	6.0	3350	5800	341600	591426	429	N1205	281.750

Single Row Cylindrical Roller Bearing (Metric series)



Dynamic equivalent
radial load

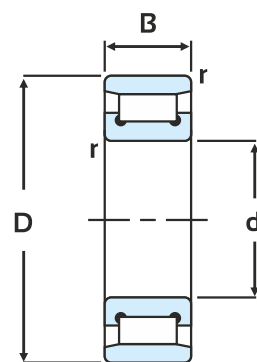
$$P_r = F_r$$

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	139699	236570	175	NU1080	91.000
440	540	40	2.1	330	720	33650	73418	55	N1888MW33C3	18.800
460	580	56	3.0	550	1100	56084	112167	82	N1892MW33C3	32.400
460	760	240	7.5	5600	10400	571032	1060488	737	NU3192M	467.000
460	680	100	6.0	1850	3360	188645	342619	243	NU1092M	124.700
480	790	248	7.5	5900	11000	601623	1121670	770	NU3196M	507.800
530	710	180	6.0	3244	8129.2	330791	828935	573	42629/530	220.000
600	730	60	3.0	560	1290	57103	131541	89	N18/600MW33C3	44.200
600	830	150	6.0	2820	6147	287555	626810	415	327/600	245.000
670	980	308	10.0	7120	10000	726026	1019700	648	N1009	780.000
700	930	160	8.0	2972.8	6902.5	303136	703848	449	327/700	300.000
720	880	62	4	860	2000	87694	203940	131	N18/720MW33C3	77.000

Single Row Cylindrical Roller Bearing (Inch series)



TYPE N

**Dynamic equivalent
radial load**

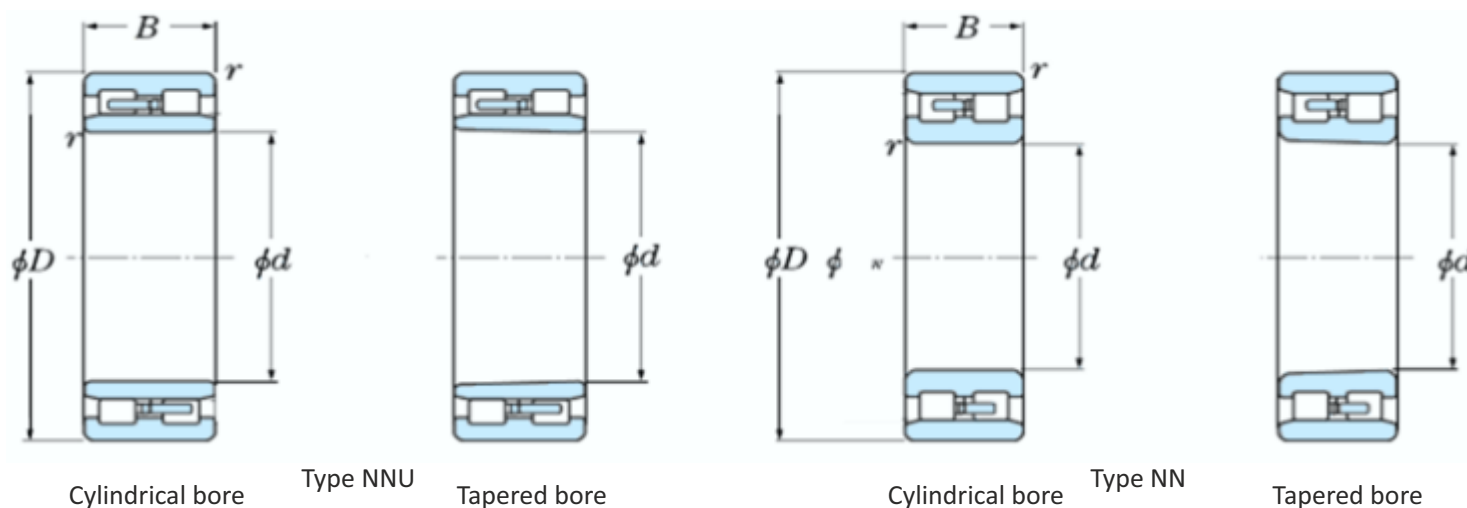
$$P_r = F_r$$

**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		
101.6	184.15	31.75	3.2	225	270	22943	27532	30	CRL32	3.8
101.60	215.9	44.4	4.0	390	450	39768	45887	49	CRM32	8.2
107.95	190.5	31.75	3.2	235	285	23963	29061	31	CRL34	4.0
114.30	203.2	33.337	3.2	255	315	26002	32121	35	CRL36	4.6
114.30	238.125	50.8	4.8	440	505	44867	51495	55	CRM36	11.0
127.00	228.6	34.925	3.2	288	370	29367	37729	41	CRL40	6.5
127.00	254	50.8	4.8	465	550	47416	56084	60	CRM40	12.0
139.70	241.3	34.925	3.0	296	390	30183	39768	43	CRL44	7.2
390.53	579.973	190.5	4.0	3572	6107	364237	622731	669	N1113	207.3
469.90	698.5	139.7	6.0	3300	6180	336501	630175	677	N1050	190.0

Two Row Cylindrical Roller Bearing



Dynamic equivalent
radial load

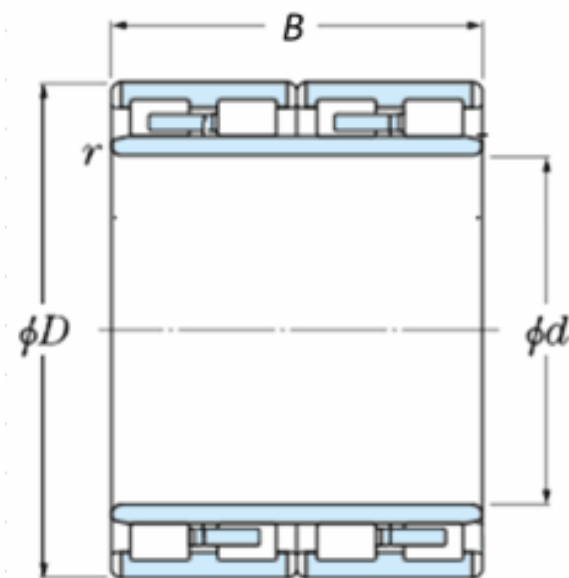
$$P_r = F_r$$

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		
120	180	46	2	225	375	22943	38239	40.5	NN3024K	4
120	260	103	4	826	1452	84227	148060	146.1	N1081	31.9
130	200	52	2	305	530	31101	54044	55.6	NN3026K	5.3
130.06	300.02	171.6	3	1403	2394	143064	244075	232	549722	70
149	249	173	2	1108	2996	112983	305502	297.2	6675125	39.3
220	370	150	4	1600	2800	163152	285516	246.8	NNU4144MW33	66
280	380	100	3.5	697.8	908	71155	92589	77.4	NNU4956	33.3
280	440	135	4	1770	3360	180487	342619	279	132756	99.5
320	480	160	4	2050	4150	209039	423176	333.9	NNU4064MW33	103
370	520	220	1.5	2650	6500	270221	662805	506.5	NNU319961	136
460	680	218	9	3750	8560	382388	872863	619.3	4202192	240
710	950	243	6	5734	15165	584696	1546375	980.2	42629/710	495

Four 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	51291	58	N1105	3.6
120	165	90	1.5	519	813	52922	82902	89	N1106	5.6
150	230	156	2.5	865	1550	88204	158054	156	4R3040 (313891)	24.5
160	230	168	2	890	2150	90753	219236	215	315189	24
200	290	192	2.1	1500	3200	152955	326304	298	313811	41
230	330	206	2.1	1870	4000	190684	407880	358	313824	58
280	390	220	3	2200	5000	224334	509850	424	313822	81.5
340	480	350	1.5	4570	11200	466003	1142064	894	314485	207
480	680	500	12.5	9240	23530	942203	2399354	1693	N1452	598
530	780	570	6	12500	32500	1274625	3314025	2255	4R10602	1010
650	900	650	7.5	17205	41510	1754394	4232775	2739	N1210	1246

Special Cylindrical Roller Bearing

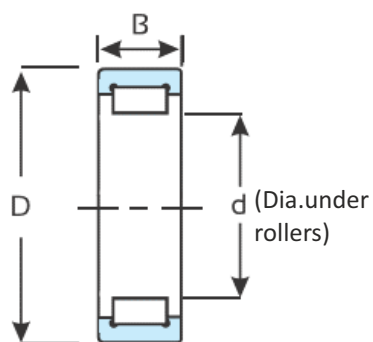


Fig 1

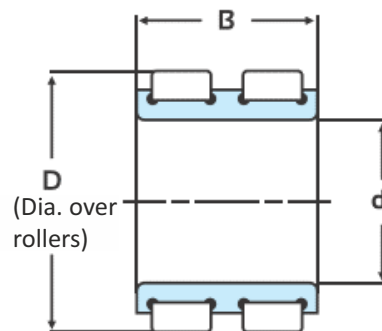


Fig 2

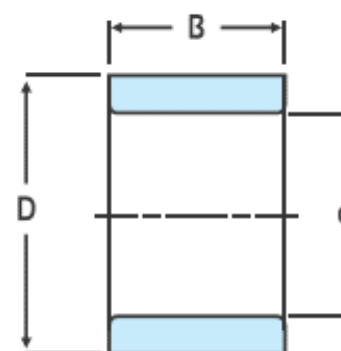


Fig 3

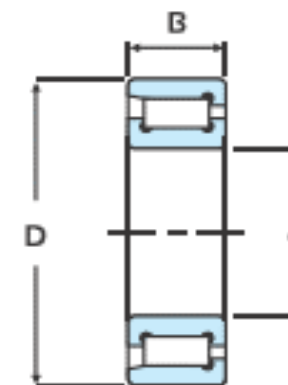


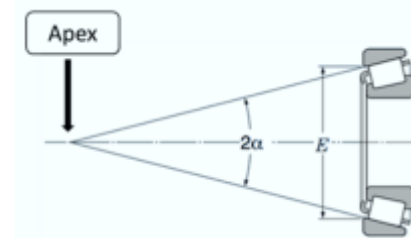
Fig 4

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	0.66	1
35	62	17	1.1	41.5	37.5	4232	3824	-	RNU305	0.187	1
58.5	100	25	2.4	73.8	71	7525	7240	-	RNU309	0.66	1
66.5	100	21	1.1	58	62.5	5914	6373	-	RNU211	0.45	1
120	260	103	4	826	1452	84227	148060	-	N1081	31.85	1
25.4	53.962	28.575	1.1	60	61.8	6118	6302	-	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	57.5	53.6	5863	5466	6.5	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 diameter of outer ring
 α : Nominal contact angle

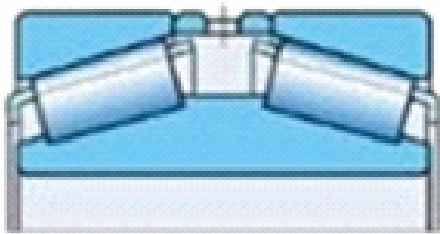


Depending upon the application requirement the taper roller bearings are available in double row and four row combinations. These bearings are preset assemblies ready to mount.

Double Row Taper Roller Bearing

When the bearings are matched face-to-face,

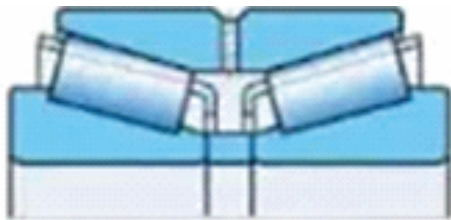
- An intermediate spacer is positioned between the two cups.
- The load lines converge towards the bearing axis.
- Axial loads acting in both directions can be accommodated by each bearing. Face-to-face arrangement (TDI)



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

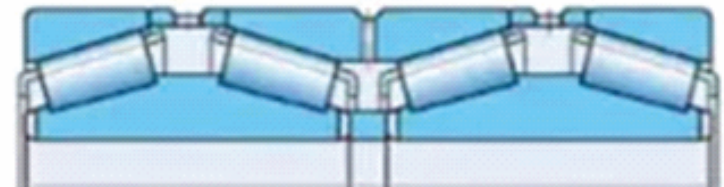


Four-row tapered roller bearings

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):

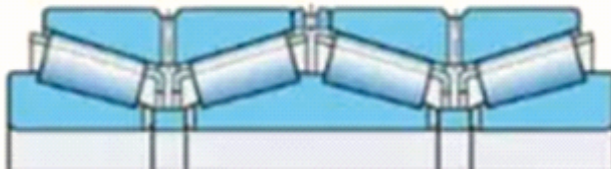
- Two double cones with cone spacer, two single cups
- Two single cups on sides and a Double cup in middle.
- Two cup spacers separating single cup and double cup.
- Spacers have holes for lubrication.
- Cone spacers are hardened to reduce face wear.



NBC also provides set of 2X TDI. It consists of two double row taper roller bearings, separated individual by spacers between two inside cups and two cones.

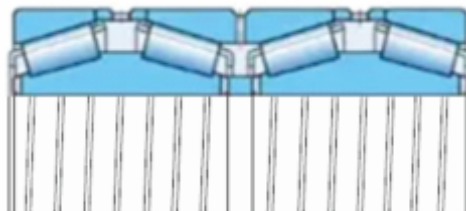
TQIT (Tapered Bore Four-Row Arrangement)

- One double cone & two single cones, all with tapered bore matched through all the cones and four single cups and three cup spacers.
- Lubrication holes in three cup spacers.
- Faces of single cones and both faces of double cone contact each other.

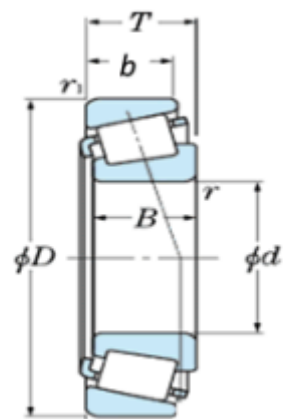


TQI bearings are available in straight tapered bore and tapered bore.

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 and cones and BEP value. The bearings are mostly used in steel plants on roll neck.



Single Row Taper Roller Bearing (Inch series)



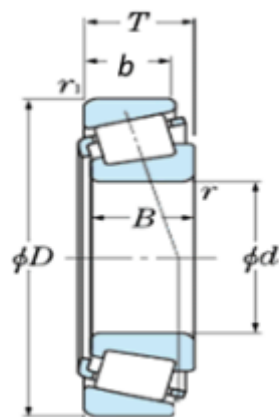
Equivalent radial load
dynamic
 $P_r = X F_r + Y F_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static
 $P_{or} = 0.5 F_r + Y_o F_a$
When $P_{or} < F_r$ use $P_{or} = F_r$
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. (Apporox.)
							Dynamic	Static	Dynamic	Static		e		Y_2	Y_o		
mm							KN		Kgf		KN						
d	D	T	B	b	r	r ₁	Cr	Cor	Cr	Cor	Cu						
15.875	42.862	14.288	14.288	9.525	1.5	1.5	18	18	1835	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	22.4	23	2284	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	29.3	29.9	2988	3049	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	41	42.2	4130	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	41	42.4	4140	4324	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	73.6	78.6	7505	8015	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	40	46	4099	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	42	49	4283	4997	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	42.2	47.8	4303	4874	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	47.8	52	4874	5302	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	27.8	32.2	2835	3283	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	46.7	53.4	4762	5445	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	42.2	47.8	4303	4874	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	60	74.2	6159	7566	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	42.2	47.8	4303	4874	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	51.5	61.4	5251	6261	7.5	0.55	1.09	0.60		M86649/M86610	0.336

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

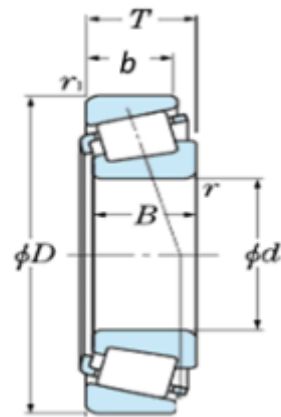
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ and Y₀
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		e		Y ₂	Y ₀		
mm							KN		Kgf		KN						
d	D	T	B	b	r	r ₁	Cr	Cor	Cr	Cor	Cu						
31.75	59.131	15.875	16.764	11.811	3.56	1.3	34.5	41.5	3518	4232	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	42.2	47.8	4303	4874	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	42.2	47.8	4303	4874	5.8	0.35	1.71	0.94		15125/15245	0.239
31.75	68.263	22.225	22.225	17.463	3.5	1.5	51	57.1	5160	5822	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	45.9	54.8	4680	5588	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	78.5	88.7	8005	9045	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	57	72	5812	7342	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	45.9	54.8	4680	5588	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	78.5	106	8005	10839	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	78.5	106	8005	10839	13.0	0.55	1.10	0.60		HM89446/HM89410	0.641
34.925	65.088	18.034	18.288	13.97	3.5	1.3	50	61	5099	6220	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	45.9	54.8	4680	5588	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	65	84.5	6628	8616	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	71.4	85.5	7281	8718	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	71.4	85.5	7281	8718	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	81	96.9	8229	9881	11.8	0.40	1.49	0.82		31594/31520	0.619
34.989	79.375	29.37	29.771	23.812	3.5	3.3	87	105	8871	10666	12.8	0.37	1.64	0.90		3490/3420	0.679
34.989	79.985	32.751	30.925	25	2.5	2.5	87	104	8871	10635	12.7	0.37	1.64	0.90		3478X/3424S	0.765

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$P_r = X F_r + Y F_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

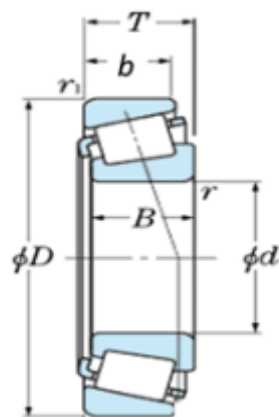
static

$P_{or} = 0.5 F_r + Y_o F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ and Y_o
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			e	Y ₂		
mm							KN		Kgf		KN					
d	D	T	B	b	r	r ₁	Cr	Cor	Cr	Cor	Cu					
34.989	82.931	23.812	25.4	19.05	0.8	0.8	76.7	98.4	7821	10034	12.0	0.33	1.79	0.99	25572/25520	0.645
37.966	63	17	17	13.5	2	1.3	39.1	53.4	3987	5445	6.5	0.42	1.43	0.79	N1504XA/JL69310	0.195
38.1	65.088	18.034	18.288	13.97	3.5	1.3	42.6	55.7	4344	5680	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	91	111.2	9279	11339	13.6	0.37	1.64	0.90	3490/3420	0.675
38.1	65.107	19.812	20	15.748	2.3	1.3	46.6	68.3	4752	6965	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	46.6	68.3	4752	6965	8.3	0.43	1.40	0.77	TS1N1261FPX1X1	0.267
38.1	65.107	19.812	20	15.748	2.3	1.3	46.6	68.3	4752	6965	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	98.2	111.7	10012	11388	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	77	97	7852	9891	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	73	92	7444	9381	11.2	0.30	2.00	1.10	2789/2729	0.477
40	80	21	22.403	17.826	3.5	1.3	69	76.3	7036	7780	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	45.3	61.4	4619	6261	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	58.2	73.2	5938	7460	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	66.3	83.3	6762	8497	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	84	111.5	8565	11370	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	80	106	8198	10758	12.9	0.55	1.09	0.60	ASTM802048XA/11F	0.628
41.275	87.312	30.162	30.886	23.812	1.5	3.5	97	122.9	9891	12532	15.0	0.31	1.96	1.08	3585/3525	0.834

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

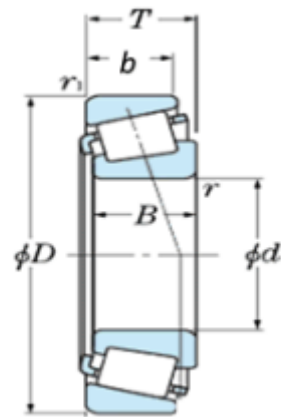
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ and Y₀
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			e	Y ₂	Y ₀	
mm							KN		Kgf		KN	e	Y ₂	Y ₀	Bearing Number	Mass Kg. (Apporox.)
d	D	T	B	b	r	r ₁	Cr	Cor	Cr	Cor	Cu					
41.275	88.9	30.162	29.37	23.02	3.5	3.3	94.6	119	9646	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	97.8	118.3	9973	12063	14.4	0.74	0.81	0.45	HM903245XA/HM903210	1.036
42.07	91	39.688	40.386	33.338	3.5	-	146	186	14888	18966	-	-	-	-	4T4395XA CONE ASSLY.	0.771
42.875	82.931	26.988	25.4	22.225	3.5	2.3	76.8	98.2	7831	10013	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	109	141.6	11105	14439	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	99	125	10095	12746	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	102	134	10401	13664	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	98.4	11.9	10034	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	143.3	181	14612	18406	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	107	141	10860	14327	17.1	0.88	0.68	0.37	55176C/55443	1.500
44.987	79.975	23.75	26	18	2.5	1.5	71.7	86.4	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	56.9	72.6	5802	7403	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	56.9	72.7	5802	7413	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	56.7	72.4	5782	7383	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	56.7	72.4	5782	7383	8.8	0.43	1.40	0.77	ASTLM603049T2X/TS1LM603011F	0.360
45.618	82.931	23.812	25.4	19.05	3.5	2.3	76.7	98.4	7821	10034	12.0	0.33	1.79	0.99	25590/25520	0.543
45.618	83.058	23.876	25.4	19.114	3.58	2	76.7	98.4	7821	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	77.8	93.8	7933	9565	11.4	0.32	1.88	1.03	369S/362A	0.548

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$P_r = X F_r + Y F_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

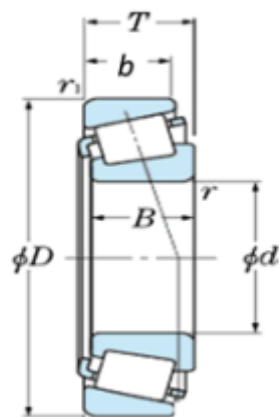
static

$P_{or} = 0.5 F_r + Y_o F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ and Y_o
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			e	Y ₂	Y ₀		
mm							KN		Kgf		KN						
d	D	T	B	b	r	r ₁	Cr	Cor	Cr	Cor	Cu						
45.618	95.25	30.162	29.37	23.02	3.5	3.3	110	148.7	11166	15163	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	174	232	17743	23657	28.3	0.30	2.02	1.11	5395/5335	0.773	
49.987	112.713	30.1875	26.909	20.638	3.5	3.3	107	141	10860	14327	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	104	139.1	10605	14184	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	102	134	10401	13664	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	84.6	116.4	8627	11869	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	102	134	10401	13664	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	109	141.6	11105	14439	17.3	0.33	1.82	1.00	4TB33889XA/22F	0.853	
50.8	104.775	30.163	30.958	23.812	0.8	3.18	130	169	13256	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	111	149	11319	15194	18.2	0.88	0.68	0.37	55200C/55437	1.340	
50.8	116.8	36.512	36.512	28.575	0.8	0.8	149.3	209	15224	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	11319	15194	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	143.3	181	14612	18416	22.0	0.30	2.02	1.11	539/532X	1.450	
53.975	114.981	65.085	26.909	44.445	2.3	3.3	178.6	286.9	18212	29255	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	157.7	193	16081	19680	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	117	155	11930	15805	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	151.6	218.7	15459	22301	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	117.4	171.6	11971	17498	20.9	0.40	1.50	0.83	3977X/3922X (X32212)	1.200	

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

static

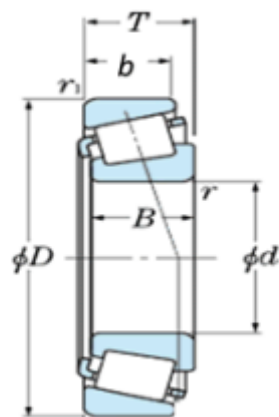
$$P_{or} = 0.5 F_r + Y_o F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$

For values of e, Y₂ and Y_o 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			e	Y ₂	Y _o		
mm							KN		Kgf		KN	e	Y ₂	Y _o			
d	D	T	B	b	r	r ₁	Cr	Cor	Cr	Cor	Cu						
59.985	134.983	35.862	30.925	21.948	3.5	3.5	144.9	169.4	14775	17274	20.7	0.82	0.73	0.40		HM911244/HM911216	2.423
60	112.712	30.162	30.162	23.812	0.8	3	151.6	218.7	15459	22301	-	-	-	-		N1258 CONE ASSLY.	1.368
60.325	100	25.4	25.4	19.845	3.6	3.3	95	141	9687	14378	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	117.4	171.6	11971	17498	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	117.4	171.6	11971	17498	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	14786	20700	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	151.7	218.5	15469	22280	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	190	249.2	19374	25411	30.4	0.34	1.78	0.98		HM212047/HM212010	1.933
63.5	130	36.937	33.937	28	6.5	3.5	171.5	211.6	17488	21577	25.8	0.38	1.57	0.86		JHM513640/JHM513615	2.126
65	105	24	23	18.5	3.0	1.0	94	128	9585	13052	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	265	355.9	27022	36291	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	265	356	27022	36291	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	161	221	16417	22535	27.0	0.35	1.71	0.94		559/552A	1.900
66.675	110.00	22.00	21.996	18.824	3.6	1.3	86	114	8769	11625	13.9	0.40	1.50	0.83		3955/394A	0.784
66.675	112.712	30.162	30.048	23.813	3.5	3.3	117.4	171.5	11971	17488	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	123.1	183	12553	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	151.6	218.7	15459	22301	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	187	244	19068	24881	29.8	0.34	1.76	0.97		HM212049/HM212011	1.860

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

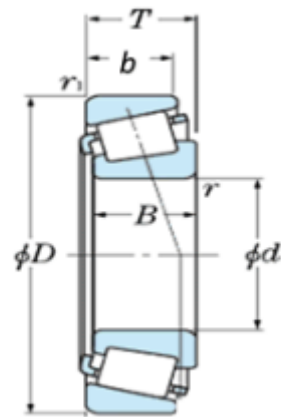
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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		e		Y_2	Y_0		
mm							KN		Kgf		KN						
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu						
68.262	110	22	21.996	18.824	2.3	1.3	86	114	8769	11625	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	247	282.9	25187	28847	33.6	0.66	0.91	0.50		AST9185XA/9121F	3.688
69.85	120	29.794	29.007	24.237	3.5	2.0	134.1	190	13674	19374	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	165.3	232.9	16856	23749	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	24779	25493	30	0.78	0.77	0.42		H913849/10	2.870
69.865	120	32.545	32.545	26.195	3.6	3.3	149.7	219.2	15267	22351	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	150	219	15296	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	165.3	232.9	16856	23749	28.4	0.36	1.65	0.91		567A/563	1.85
73.025	139.992	36.512	36.098	28.575	3.5	-	175.4	26.9	17886	2743	3.2	-	-	-		576 CONE ASSLY.	1.705
73.025	112.712	25.4	25.4	19.05	3.56	3.3	95.5	151	9738	15397	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	165.3	232.9	16856	23749	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	288.2	411	29388	41859	48.5	0.36	1.66	0.91		6461A/6420	4.240
76.2	127	30.162	31	22.225	3.5	3.3	137.3	198.4	14000	20231	24.1	0.42	1.43	0.79		42687/42620	1.460
77.788	127	30.162	31	22.225	3.5	3.3	136.9	197.8	13960	20170	24.0	0.42	1.43	0.79		42690XA/42620F	1.376
80	140	35.25	33	28	3.0	3.0	186.1	282.2	18977	28776	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	173.9	258	17733	26308	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	13	191.9	1326	19568	22.8	0.44	1.35	0.74		495/493	2.020
82.55	139.7	36.512	36.098	28.575	3.5	3.3	174.3	258.7	17773	26380	30.7	0.40	1.49	0.82		580/572X	2.138

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$P_r = X F_r + Y F_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

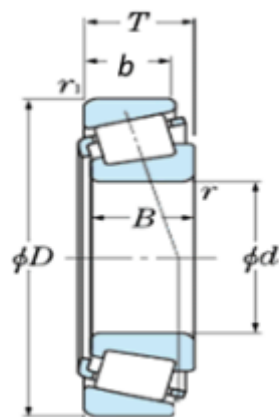
static

$P_{or} = 0.5 F_r + Y_o F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$
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. (Apporox.)
							Dynamic	Static	Dynamic	Static		e		Y_2	Y_o		
mm							KN		Kgf		KN						
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu						
82.55	139.992	36.512	36.098	28.575	3.5	3.3	174.3	258.7	17773	26380	30.7	0.40	1.49	0.82		580/572	2.138
82.57	150	38.5	36	30	6.5	2	227	306	23147	31233	35.7	0.42	1.43	0.79		N1573/32217F	2.770
85	130	30	29	24	3.0	2.5	140	223	14276	22739	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	129.1	190	13164	19415	22.6	0.44	1.35	0.74		497/493	1.525
95	135	20	20	14	5.0	2.5	82.4	146.2	8402	14905	17	0.58	1.03	0.57		JL819349/JL819310	0.862
95.25	168.275	41.275	41.275	30.162	3.5	3.2	225.1	347.8	22953	35465	39.0	0.47	1.28	0.70		683/672	3.650
95.25	152.4	39.688	36.322	30.162	5.0	3.3	181	281.1	18457	28664	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	224	347	22841	35384	38.9	0.47	1.28	0.70		683/672	2.680
99.975	156.975	42	42	34	3.0	3.5	251	381	25594	38820	43.2	0.33	1.82	1.00		HM220149/HM220110	2.797
101.6	190.05	57.15	57.3	44.45	8.0	3.3	382.9	562.2	39044	57328	61	0.33	1.82	1.00		861/854	7.000
101.6	200	52.761	49.212	34.25	3.5	3.3	352	481	35893	49048	52	0.63	0.95	0.52		98400/98788	6.850
107.95	158.75	23.02	21.438	15.875	3.56	3.3	115.4	196.8	11767	20068	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	113.4	191	11563	19435	21.4	0.61	0.98	0.54		4TB37425/37625F	1.385
127	182.56	39.69	38.1	33.34	3.5	3.3	240	430	24473	43847	46	0.31	1.94	1.06		48290/48220	3.320
127	228.6	53.975	49.428	38.1	3.4	3.3	414.4	592.5	42256	60417	61	0.74	0.81	0.45		HM926747/HM926710	8.830
127	304.8	88.9	82.55	57.15	6.4	6.4	991.3	1281	101083	130664	124	0.73	0.82	0.45		HH932132/HH932110	30.100
127	234.95	63.5	63.5	49.212	6.4	3.3	525	827	53534	84329	84	0.63	0.95	0.52		95500/95925	11.800

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

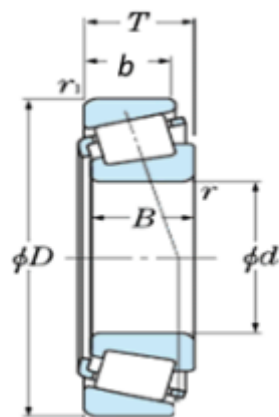
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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			e	Y_2	Y_0		
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	814.6	50169	83065	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	49761	80964	80	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	79333	112269	106	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	101970	137660	128	0.33	1.82	1.00		HH234048/HH234010	30.000
155.575	336.55	85.725	79.375	53.975	6.4	6.0	921.8	1358	93996	138434	126.2	0.81	0.74	0.41		H936340/H936313	36.600
159.951	244.475	47.625	46.83	33.338	3.5	3.3	354	585	36097	59652	58	0.35	1.71	0.94		81630/81962	7.210
165.1	336.55	92.07	95.25	69.85	3.3	6.4	1173	1730	119601	176388	160.4	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	58633	57	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	101970	163152	150	0.33	1.82	1.00		H238148/H238110	27.500
174.625	247.65	47.62	47.62	38.1	3.5	3.3	341.5	693.5	34823	70716	67.5	0.44	1.36	0.75		67787/67720	1.230
190.5	266.7	47.63	46.83	38.1	3.5	3.3	347.1	727.7	35394	74204	69	0.48	1.25	0.69		67885/67820	8.000
190.5	428.625	106.362	95.25	61.912	6.4	6.4	1166	1522	118907	155147	133.3	0.76	0.79	0.43		EE350750/EE351687	63.100
203.2	482.6	117.475	95.25	73.025	6.4	6.4	1400	2000	142758	203940	169	0.87	0.69	0.38		EE380080/EE380190	96.000
206.38	336.55	98.25	100.01	77.79	3.3	3.3	1119.7	2049	114176	208947	185.6	0.33	1.82	1.00		H242649/H242610	34.280
220.662	314.325	61.912	66.675	49.212	1.6	5.0	625	1239	63731	126341	113	0.33	1.82	1.00		M244249A/N1060	15.000
221.17	314.325	61.91	66.675	49.212	1.6	5.0	625	1239	63731	126341	113	0.33	1.82	1.00		M244210/N1059	14.000
228.6	320.68	50.8	49.21	33.34	6.4	3.3	402	742.8	40992	75743	67	0.49	1.22	0.67		88900/88126	12.660
234.95	384.175	112.712	112.712	90.488	6.4	6.4	1460	2730	148876	278378	238	0.33	1.82	1.00		H247549/H247510	50.500

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

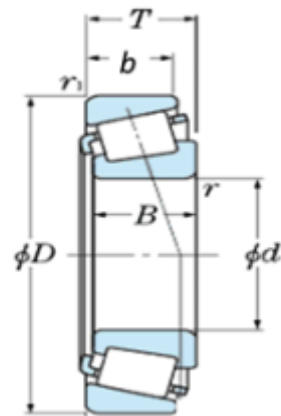
static

$$P_{or} = 0.5 F_r + Y_o F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ and Y_o
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			e	Y ₂		
mm							KN		Kgf		KN					
d	D	T	B	b	r	r ₁	Cr	Cor	Cr	Cor	Cu					
247.65	346.075	63.5	63.5	50.8	6.4	6.4	750	1600	76478	163152	141	0.34	1.76	0.97	M348449/10	17.5
247.65	406.4	115.89	117.475	93.662	6.4	3.3	3393	6315	345981	643890	541	0.38	1.58	0.87	HH249949/H249910 (N1053)	60.200
254	533.4	133.35	120.65	77.78	6.4	6.4	2024	2870	206387	292654	232	0.87	0.69	0.38	HH953749/HH953710	135.000
255.6	342.9	57.15	63.5	44.45	1.5	3.3	614.1	1282	62620	130766	113	0.35	1.71	0.94	M349547/M349510	13.795
257.175	358.775	71.438	76.2	53.975	1.5	3.3	818.5	1664	83462	169637	145	0.33	1.82	1.00	M249747/M249710	20.650
266.7	444.5	121.031	117.475	88.9	6.4	6.4	1788.6	3410	182384	347738	286	0.58	1.03	0.57	H852849/H852810	72.000
317.5	635	165.1	146.015	114.3	19.0	12.7	2910	4960	296733	505771	379	0.94	0.64	0.35	NP340527/NP360214	233.100
317.5	622.3	147.638	131.762	82.55	14.2	12.7	2561.7	3723	261217	379604	286	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	76478	132561	106	0.38	1.58	0.87	EE291250/EE291750	26.500
368.3	609.6	142.875	139.7	111.125	8.0	6.4	2750	5060	280418	515968	383	0.35	1.71	0.94	EE321145/EE321240	156.000
371.475	501.65	74.612	66.675	50.8	6.4	3.3	910	1820	92793	185585	143	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	134600	296733	226	0.39	1.54	0.85	LM565949/565910	50.700
385.762	514.35	82.55	82.55	63.5	6.4	3.3	1300	3200	132561	326304	249	0.42	1.43	0.79	LM665949/LM665910	50.000
425.45	685.698	142.875	142.8	104.775	12.7	6.4	3050	5810	311009	592446	424	0.40	1.50	0.83	EE328167/328269	188.000
479.425	679.45	128.588	128.588	101.6	6.4	6.4	3000	7000	305910	713790	504	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	146837	365053	260	0.34	1.76	0.97	EE243192/243250	62.500
571.5	812.8	155.58	155.575	120.65	6.4	6.4	4440	10600	452747	1080882	723	0.33	1.82	1.00	M278749/M278710	227.000
630	850	108	100	78	6.0	6.0	2500	5680	254925	579190	380	0.41	1.46	0.80	10079/630	164.000

Single Row Taper Roller Bearing (Inch series)



Equivalent radial load
dynamic

$P_r = X F_r + Y F_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

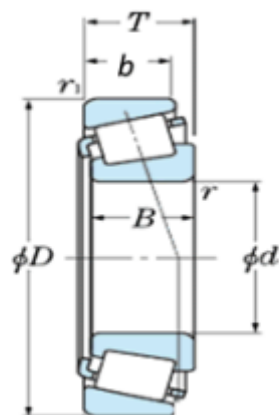
static

$P_{or} = 0.5 F_r + Y_0 F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r	r_1	Cr	Cor	Cr	Cor	Cu					
660.4	939.8	136.525	127	98.425	6.4	6.4	3490	7800	355875	795366	510	0.41	1.46	0.80	EE538260/EE538370	293.730
710	950	114	106	80	6.0	6.0	2800	6500	285516	662805	420	0.46	1.30	0.72	10079/710	211.000
900	1180	124	122	87	8.0	8.0	4140	9740	422156	993188	588	0.40	1.49	0.82	10079/900	330.000
900	1280	190	170	135	7.5	7.5	6450	14500	657707	1478565	864	0.54	1.11	0.61	71/900	703.000
1320	1600	176	165	142	6.0	6.0	6350	20550	647510	2095484	1121	0.36	1.67	0.92	20078/1320	719.000

19.2 Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

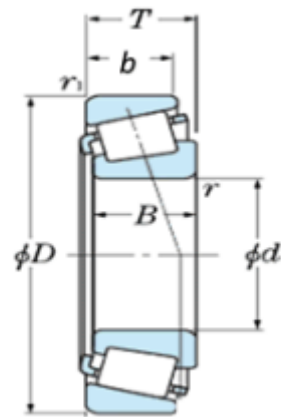
static

$$P_{or} = 0.5 F_r + Y_o F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ 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			e	Y ₂	Y _o	
mm							KN		Kgf		KN	e	Y ₂	Y _o	Bearing Number	Mass Kg. (Approx.)
d	D	T	B	b	r ₁	r	Cr	Cor	Cr	Cor	Cu					
15	35	11.75	11	10	0.6	0.6	16.1	14.8	1642	1509	1.8	0.32	1.88	1.03	30202	0.05
15	42	14.25	13	11	1.5	1.5	22.7	20.3	2315	2070	2.5	0.29	2.11	1.16	30302	0.096
17	40	13.25	12	11	1.0	1.0	21.7	21.9	2214	2235	2.7	0.35	1.74	0.96	30203	0.080
20	42	15	15	12	0.6	0.6	26.1	29.7	2661	3029	3.6	0.37	1.60	0.88	32004X	0.097
20	47	15.25	14	12	1.5	1.5	29.3	30.1	2988	3069	3.7	0.35	1.74	0.96	30204	0.121
20	52	16.25	15	13	1.5	1.5	34.7	33.2	3538	3385	4.0	0.30	2.00	1.10	30304	0.160
20	52.055	14.9	15	11	0.5	1.1	30.5	32.7	3110	3334	4.0	0.50	1.20	0.66	MLN1518FXA	0.159
21.5	47	16.5	16.5	13	1.0	1.0	35.1	39.9	3579	4069	4.9	0.37	1.60	0.88	N1061	0.136
22	52.055	14.9	15	12	1.1	1.1	29.4	31.2	2998	3181	3.8	0.35	1.70	0.93	MLN1519FXA	0.153
25	52	19.25	18	16	1.0	1.0	41.9	47.9	4273	4884	5.8	0.36	1.67	0.92	32205 (Low Carbon Steel)	0.184
25	47	15	15	11.5	3.3	0.6	27.8	34	2835	3447	4.1	0.43	1.39	0.77	32005	0.120
25	47	15	15	11.5	3.3	0.6	27.8	34	2835	3447	4.1	0.43	1.40	0.77	32005F	0.120
25	47	15	15	11.5	3.3	0.6	27.8	33.8	2835	3447	4.1	0.43	1.39	0.77	32005x1N	0.130
25	47	15	15	11.5	0.6	1.0	27.7	33.7	2825	3436	4.1	0.43	1.40	0.77	ML32005X1XAT2X	0.110
25	47	17	17	14	0.6	0.6	32.2	40.2	3283	4099	4.9	0.29	2.07	1.14	33005	0.130
25	47	17	17	14	0.6	0.6	32.2	40.2	3283	4099	4.9	0.29	2.07	1.14	ML33005	0.129

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

static

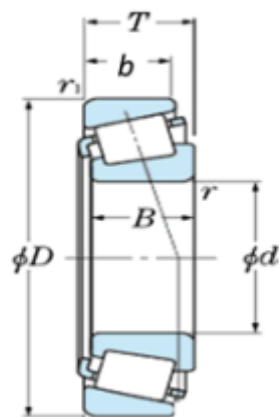
$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$

For values of e, Y_2 and Y_0 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_1	r	Cr	Cor	Cr	Cor	Cu					
25	52	16.25	15	13	1.0	1.0	36	40.1	3661	4085	4.9	0.37	1.60	0.88	30205	0.148
25	52	16.25	15	13	1.0	1.0	36.6	41	3732	4181	5.0	0.37	1.62	0.89	30205F	0.148
25	52	19.25	18	16	1.0	1.0	41	45	4181	4589	5.5	0.36	1.67	0.92	32205	0.184
25	52	22	22	18	1.0	1.0	47.5	57.5	4844	5863	7.0	0.35	1.71	0.94	33205	0.219
25	52	14.5	15	11	1.0	1.0	31.1	33.2	3171	3385	4.0	0.38	1.59	0.88	MLN1466XA	0.136
25	62	18.25	17	15	2.0	2.0	46	45.9	4691	4680	5.6	0.30	2.00	1.10	30305	0.260
25	62	18.25	17	14	1.5	2.2	42	42.3	4283	4313	5.2	0.55	1.10	0.60	30305C	0.264
25	62	25.25	24	20	2.0	2.0	63	66.5	6424	6781	8.1	0.30	2.00	1.10	32305	0.381
28	67	30.5	32	24	2.5	1.0	84.3	90.8	8596	9259	11.1	0.24	2.53	1.39	N1114	0.513
30	55	17	17	13	1.0	1.0	38	47.5	3875	4844	5.8	0.43	1.40	0.77	32006X (Low Carbon steel)	0.172
30	55	17	17	13	1.0	1.0	38	47.5	3875	4844	5.8	0.43	1.39	0.77	32006X	0.172
30	62	17.25	16	14	1.0	1.0	44.3	49	4517	4997	6.0	0.37	1.60	0.88	30206	0.241
30	62	21.25	20	17	1.0	1.0	55.5	65.5	5659	6679	8.0	0.37	1.60	0.88	32206	0.299
30	62	25	25	19.5	1.0	1.0	63.8	75.4	6506	7689	9.2	0.34	1.76	0.97	33206	0.340
30	72	20.75	19	16	2.0	2.0	62.14	63.6	6336	6486	7.8	0.31	1.90	1.05	30306	0.387
30	72	20.75	19	14	1.5	2.2	58.6	579	5975	59041	70.6	0.55	1.10	0.60	30306C	0.381
30	72	20.75	19	14	1.5	1.5	48.5	51.5	4946	5251	6.3	0.83	0.72	0.40	30306D	0.398

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

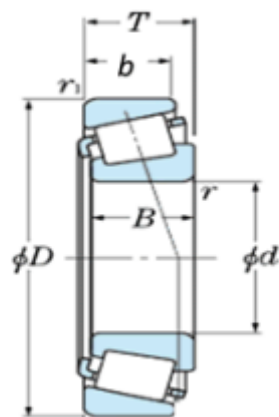
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r_1	r	Cr	Cor	Cr	Cor	Cu					
32	58	17	17	13	1.0	1.0	37.7	47	3844	4793	5.7	0.45	1.32	0.73	320/32X	0.188
35	62	18	18	14	1.5	0.5	42.7	54.4	4354	5547	6.6	0.45	1.32	0.73	32007X	0.224
35	72	18.25	17	15	2.0	2.0	53.1	58.1	5415	5924	7.1	0.37	1.60	0.88	30207	0.315
35	72	24.25	23	19	1.5	1.5	74.21	89.5	7567	9125	10.9	0.37	1.60	0.88	32207	0.447
35	72	24.25	23	19	2.0	2.0	63	77.6	6424	7913	9.5	0.58	1.03	0.57	32207B	0.457
35	72	28	28	22	1.5	1.5	87.5	109	8922	11115	13.3	0.35	1.70	0.93	33207	0.539
35	80	22.75	21	18	2.0	2.0	60.7	73.9	6190	7536	9.0	0.31	1.90	1.05	30307	0.520
35	80	22.75	21	15	2.0	1.5	63.4	71.5	6465	7291	8.7	0.83	0.73	0.40	30307DFXA	0.513
35	80	32.75	31	25	2.5	2.5	97.7	109.3	9962	11145	13.3	0.31	1.90	1.05	32307	0.737
36	62	17	17	13	1.5	1.5	40	50	4079	5099	6.1	0.45	1.32	0.73	TS2N1126	0.197
38	63	17	17	13.5	1.3	1.3	39.1	53.4	3987	5445	6.5	0.41	1.46	0.80	MLJL69349X1XA/10F	0.190
40	80	21	22.4	17.83	3.5	1.3	68	75	6934	7648	9.1	0.27	2.20	1.21	TMB344A/332	0.482
40	68	19	19	14.5	1.0	1.0	51.1	66.8	5211	6812	8.1	0.38	1.58	0.87	32008X	0.273
40	80	19.75	18	16	2.0	2.0	62.6	69.2	6383	7056	8.4	0.37	1.60	0.88	30208	0.435
40	80	24.75	23	19	1.5	1.5	79.1	93.6	8066	9544	11.4	0.37	1.60	0.88	32208	0.523
40	80	32	32	25	1.5	1.5	79.7	94	8127	9585	11.5	0.36	1.68	0.92	4TB33208XA	0.721

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

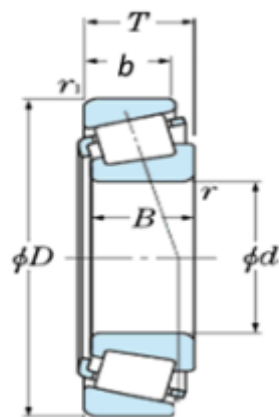
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ and Y₀
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			e	Y ₂	Y ₀	
mm							KN		Kgf		KN	e	Y ₂	Y ₀	Bearing Number	Mass Kg. (Apporox.)
d	D	T	B	b	r ₁	r	Cr	Cor	Cr	Cor	Cu					
40	80	34	34	27	2.0	2.0	103	145	10503	14786	17.7	0.43	1.39	0.77	N1090	0.788
40	85	18.5	18.25	17	1.5	0.3	57.7	64	5884	6526	7.8	0.37	1.60	0.88	N1062	0.547
40	85	33	32.5	28	2.5	2.0	115.6	140.7	11788	14347	17.2	0.34	1.74	0.96	TS2T2EE040XA	0.870
40	90	25.25	23	20	2.0	1.5	84.2	91.4	8586	9320	11.1	0.35	1.74	0.96	30308	0.769
40	90	25.25	23	17	2.0	1.5	85	96	8667	9789	11.7	0.82	0.73	0.40	31308	0.725
40	90	35.25	33	27	2.5	2.5	117.8	141.9	12012	14470	17.3	0.35	1.74	0.96	32308	1.016
40	90	35.25	33	27	2.5	2.5	117.8	141.9	12012	14470	17.3	0.35	1.71	0.94	32308F	1.016
40	95	27.5	25	19	2.0	1.5	91.2	101.8	9300	10381	12.4	0.79	0.76	0.42	331257	0.895
45	100	27.25	25	18	2.0	1.5	98.5	112.1	10044	11431	13.7	0.83	0.73	0.40	31309X1	0.957
45	100	38.25	36	30	2.5	2.5	144.5	176.7	14735	18018	21.5	0.35	1.71	0.94	32309XA (32309)	1.372
45	100	38.25	36	30	2.5	2.5	144.1	176.1	14694	17957	21.5	0.35	1.71	0.94	32309 (32309F)	1.373
45	100	38.25	36	30	2.5	2.5	82.4	100.7	8402	10268	12.3	0.35	1.74	0.96	ASTB32309	1.373
45	75	20	20	15.5	1.3	2.0	58.5	78.4	5965	7994	9.6	0.39	1.53	0.84	32009X	0.347
45	85	20.75	19	16	2.0	2.0	60.8	67.9	6200	6924	8.3	0.40	1.48	0.81	30209	0.451
45	85	24.75	23	19	1.5	1.5	84.4	103.7	8606	10574	12.6	0.40	1.48	0.81	32209	0.582
45	100	27.25	25	22	2.0	1.5	113.4	129.1	11563	13164	15.7	0.35	1.74	0.96	30309	1.009

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

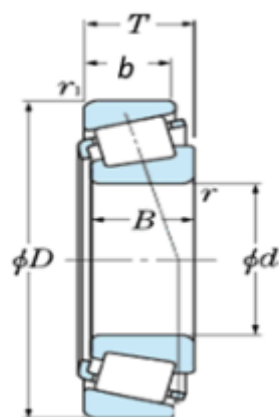
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y₂ and Y₀
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			e	Y ₂	Y ₀		
mm							KN		Kgf		KN						
d	D	T	B	b	r ₁	r	Cr	Cor	Cr	Cor	Cu						
45	100	27.25	25	18	2.5	2.5	99.4	113.5	10136	11574	13.8	0.83	0.73	0.40	31309	0.960	
45	100	28.35	36	30	2.5	2.5	144.5	176.7	14735	18018	21.5	0.35	1.74	0.96	32309	1.360	
45	100	38.25	36	30	2.5	2.5	144.5	176.7	14735	18018	21.5	0.35	1.74	0.96	ASTB32309	1.360	
50	80	20	20	15.5	1.3	2.0	63.7	90.1	6495	9187	11.0	0.42	1.42	0.78	32010X	0.373	
50	80	24	24	19	1.5	1.0	70.4	104.3	7179	10635	12.7	0.32	1.90	1.04	33010	0.433	
50	80	20	20	15.5	3.0	1.0	63.5	89.9	6475	9167	11.0	0.42	1.43	0.79	32010X1	0.366	
50	80	24	24	19	1.8	1.0	70.7	104.7	7209	10676	12.8	0.32	1.90	1.04	ASTBN1569XA	0.440	
50	90	21.75	20	17	1.5	1.5	78.7	95.3	8025	9718	11.6	0.42	1.43	0.79	30210	0.552	
50	90	24.75	23	19	1.5	1.5	84.7	104.3	8637	10635	12.7	0.42	1.43	0.79	32210	0.648	
50	90	32	32	24.5	1.5	1.5	115	158	11727	16111	19.3	0.41	1.45	0.80	33210	0.860	
50	90	21.75	20	17	3.5	1.5	78.4	94.8	7994	9667	11.6	0.42	1.43	0.79	ASTB30210X1	0.548	
50	110	29.25	27	23	2.5	2.0	135	155	13766	15805	18.9	0.35	1.71	0.94	30310	1.280	
50	110	29.25	27	19	2.5	2.0	111	126	11319	12848	15.4	0.83	0.72	0.40	31310	1.210	
50	110	42.25	40	33	2.5	2.0	184.1	218.1	18773	22240	26.6	0.35	1.71	0.94	AST32310 (AST32310PX1)	1.819	
50	110	42.25	40	33	2.5	2.0	111	126	11319	12848	15.4	0.35	1.74	0.96	32310	1.210	

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

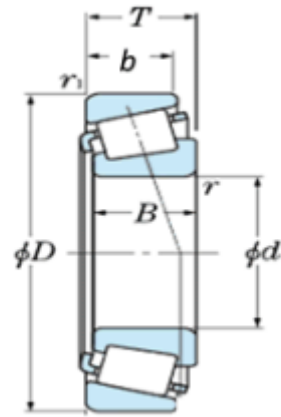
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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_1	r	Cr	Cor	Cr	Cor	Cu					
55	90	23	23	17.5	1.5	1.5	80	118	8158	12032	14.4	0.41	1.48	0.81	32011	0.557
55	95	30	30	23	2.0	2.0	113	159.5	11523	16264	19.5	0.37	1.60	0.88	33111	0.846
55	100	22.75	21	18	2.0	1.5	93	111	9483	11319	13.5	0.40	1.48	0.81	30211	0.740
55	100	26.75	25	21	2.5	2.5	107.9	133.6	11003	13623	16.3	0.40	1.48	0.81	32211	0.824
55	100	35	35	27	2.0	1.5	142	192	14480	19578	23.4	0.40	1.50	0.83	33211	1.160
55	105	36	36	28.5	2.5	2.5	149	192.7	15194	19650	23.5	0.35	1.70	0.93	ASTBN1091XA	1.326
55	105	36	36	25.5	2.5	2.5	142.2	128.5	14500	13103	15.7	0.35	1.70	0.93	N1091	1.324
55	120	31.5	29	25	2.5	2.0	158	184	16111	18762	22.4	0.35	1.74	0.96	30311	1.610
55	120	31.5	29	21	2.5	2.0	135.6	157.8	13827	16091	19.2	0.82	0.73	0.40	31311	1.560
55	120	45.5	43	35	2.5	2.0	211	269	21516	27430	32.8	0.55	1.10	0.60	32311C	2.370
55	120	45.5	43	35	2.5	2.0	184.6	275.2	18824	28062	33.6	0.55	1.10	0.60	32311C	2.489
55	130	33.45	31.2	22	2.0	1.5	141.6	180.1	14439	18365	22.0	0.44	1.36	0.75	TMBSPN1099	1.850
55	140	45	40	33	2.5	2.0	202.6	275.9	20659	28134	33.6	0.65	0.92	0.51	4TN1243	3.427
60	110	23.75	22	19	3.0	2.0	106.9	128.2	10901	13073	15.6	0.40	1.48	0.81	30212X1	0.902
60	95	27	27	21	1.5	1.5	96.7	151.1	9860	15408	18.4	0.33	1.82	1.00	33012	0.691
60	100	30	30	23	1.5	1.5	117.9	172.1	12022	17549	21.0	0.40	1.51	0.83	33112	0.907
60	110	23.75	22	19	2.0	1.5	108	129	11013	13154	15.7	0.40	1.48	0.81	30212	0.902
60	110	29.75	28	24	2.0	1.5	139	179	14174	18253	21.8	0.40	1.50	0.83	32212	1.160

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y ₂

static

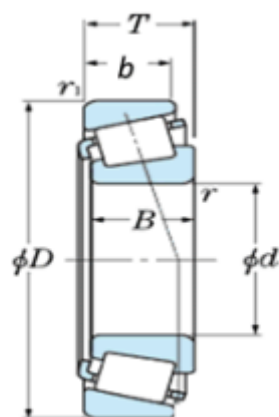
$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$

For values of e, Y₂ and Y₀ 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		e	Y ₂	Y ₀		
mm							KN		Kgf		KN					
d	D	T	B	b	r ₁	r	Cr	Cor	Cr	Cor	Cu					
60	130	33.5	31	26	3.5	3.5	171.2	197	17457	20088	24.0	0.35	1.74	0.96	30312	1.930
60	130	48.5	46	37	3.0	2.5	244	315	24881	32121	38.4	0.35	1.74	0.96	32312	2.990
60	135	33.5	30.95	22	3.5	3.3	154.6	182.1	15765	18569	22.2	0.83	0.73	0.40	330632C	2.079
60	130	33.5	31	22	3.0	2.5	151.2	180.8	15418	18436	22.0	0.83	0.73	0.40	MLB30312DXA	1.925
60	130	48.5	46	37	3.0	2.5	244	315	24881	32121	38.4	0.35	1.74	0.96	ASTB32312	2.990
65	100	23	23	17.5	1.5	1.5	83	128	8464	13052	15.6	0.46	1.31	0.72	32013X	0.629
65	100	27	21	21	1.5	1.5	98	158	9993	16111	19.3	0.35	1.71	0.94	33013	0.736
65	110	28	28	22.5	3.0	2.5	123.1	183	12553	18661	22.3	0.40	1.50	0.83	JM511946/JM511910	1.055
65	120	24.75	23	20	2.0	1.5	125	151	12746	15397	18.4	0.40	1.48	0.81	30213	1.180
65	120	32.75	31	27	2.0	1.5	155.2	198.7	15826	20261	24.2	0.40	1.48	0.81	32213	1.574
65	120	41	41	32	2.0	1.5	197	266	20088	27124	32.4	0.39	1.54	0.85	33213	1.980
65	120	41	41	32	2.0	1.5	197	266	20088	27124	32.4	0.39	1.54	0.85	33213F	1.980
65	140	36	33	28	3.0	2.5	204	239	20802	24371	28.8	0.34	1.76	0.97	30313	2.430
65	140	36	33	23	3.0	2.5	173	204	17641	20802	24.7	0.82	0.73	0.40	31313	2.370
65	140	51	48	39	3.0	2.5	271	347	27634	35384	42.0	0.34	1.76	0.97	32313	3.660
65	145	39.75	36.5	26.5	3.5	3.3	186	223	18946	22699	26.8	0.81	0.74	0.41	77213L	2.955
65	145	87.25	36.5	26.5	3.5	3.3	315	487.7	32121	49731	58.6	0.81	0.74	0.41	477213LXA	6.350

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

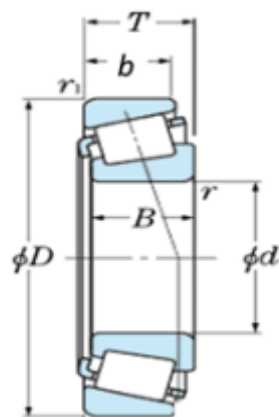
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r_1	r	Cr	Cor	Cr	Cor	Cu					
70	150	38	35	25	3.0	2.5	187	231	19058	23555	27.4	0.82	0.73	0.40	31314	2.860
70	165	51	51	34	3.0	2.5	260	366	26512	37321	42.1	0.75	0.80	0.44	4TN1244	5.177
70	125	26.25	24	21	4.0	1.5	137.4	171.8	14011	17518	21.0	0.42	1.43	0.79	30214X1	1.242
70	150	64	61	42	6.0	2.5	307	363.3	31305	37046	43.4	0.35	1.71	0.94	N1257 (32314)	4.676
70	110	25	25	19	1.5	1.5	104	160	10605	16315	19.5	0.43	1.40	0.77	32014	0.864
70	125	26.25	24	21	2.5	2.5	125.5	152.7	12797	15571	18.6	0.42	1.43	0.79	30214	1.240
70	125	33.25	31	27	2.0	1.5	161	210.7	16417	21485	25.7	0.42	1.43	0.79	32214	1.585
70	125	41	41	32	2.5	2.5	201	282	20496	28756	34.4	0.41	1.47	0.81	33214	2.100
70	125	26.25	24	21	2.5	2.5	137.4	171.8	14011	17518	21.0	0.42	1.43	0.79	MLB30214X2XA	1.231
70	125	26.25	24	21	2.5	2.5	137.4	171.8	14011	17518	21.0	0.42	1.43	0.79	30214X2XA	1.231
70	150	38	35	30	3.0	2.5	228	269	23249	27430	31.9	0.35	1.71	0.94	30314	2.990
70	150	54	51	42	3.0	2.5	312	406	31815	41400	48.5	0.34	1.76	0.97	32314	4.330
75	160	45	45	30	3.0	2.5	248.5	328.3	25340	33477	37.9	0.75	0.80	0.44	4TN1247FP5	4.070
75	115	25	25	19	3.2	2.5	107.5	169.8	10962	17315	20.7	0.46	1.30	0.72	32015X1F	0.888
75	115	25	25	19	3.2	2.5	107.3	169.3	10941	17264	20.6	0.46	1.31	0.72	32015X1XA	0.888
75	125	37	37	29	2.0	1.5	186	280	18966	28552	34.1	0.40	1.50	0.83	33115	1.780
75	130	27.25	25	22	2.5	2.5	14.2	181.1	1448	18467	21.9	0.44	1.38	0.76	30215	1.410

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

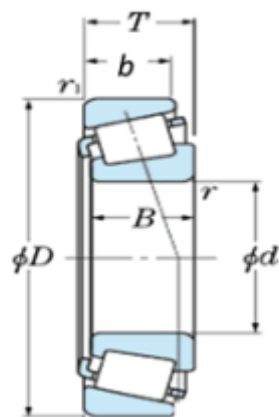
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r_1	r	Cr	Cor	Cr	Cor	Cu					
75	130	33.25	31	27	2.0	1.5	177.3	240	18074	24479	29.0	0.44	1.38	0.76	32215	1.740
75	130	41	41	31	2.5	3.0	210.1	302.6	21424	30856	36.7	0.43	1.40	0.77	33215	2.225
75	160	40	37	26	3.0	2.5	216	256	22026	26104	29.7	0.82	0.73	0.40	31315	3.380
75	160	58	55	45	3.0	2.5	346	452	35282	46090	52.5	0.34	1.76	0.97	32315	5.280
80	170	61.5	58	48	3.0	2.5	397	543	40482	55370	61.9	0.34	1.76	0.97	32316	6.370
80	125	29	29	22	1.5	1.5	141.6	220.8	14439	22515	26.7	0.42	1.42	0.78	32016X	1.284
80	125	29	29	22	1.5	1.5	138	217	14072	22127	26.3	0.42	1.43	0.79	32016	1.270
80	130	37	37	29	2.0	1.5	180.3	277	18385	28246	33.3	0.42	1.44	0.79	33116	1.839
80	140	28.25	26	22	3.0	3.0	141	169.2	14378	17253	20.1	0.42	1.43	0.79	30216	1.720
80	140	35.25	33	28	2.5	2.0	206	277	21011	28235	32.8	0.42	1.43	0.79	32216	2.180
80	140	46	46	35	2.5	2.0	246	362	25054	36893	42.9	0.42	1.43	0.79	332016	2.830
85	180	44.5	41	28	4.0	3.0	195	242	19884	24677	27.1	0.42	1.43	0.79	31317	4.600
85	192	64	64	45	4.0	3.0	393	538	40023	54829	59.1	0.75	0.80	0.44	4TN1248FP5	8.665
85	150	49	49	37	2.5	2.0	280	418	28572	42593	48.5	0.42	1.43	0.79	33217	3.536
85	150	30.5	28	24	0.4	0.3	183	232	18661	23657	27.0	0.42	1.43	0.79	30217X	0.172
85	150	38.5	36	30	2.5	2.0	224	300	22841	30591	34.9	0.42	1.43	0.79	32217	2.745
85	150	46	46	38	3.0	2.5	272	387	27736	39462	45.0	0.33	1.82	1.00	JH217249/JH217210	3.080

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

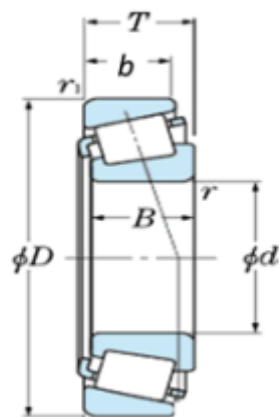
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r_1	r	Cr	Cor	Cr	Cor	Cu					
85	150	49	49	37	2.5	2.0	284	420	28959	42827	48.8	0.42	1.43	0.79	33217	3.600
85	180	44.5	41	34	4.0	3.0	306	363	31203	37015	40.7	0.34	1.76	0.97	30317	4.970
85	180	63.5	60	49	4.0	3.0	438	587	44663	59856	65.8	0.34	1.76	0.97	32317	7.300
85	150	38.5	36	30	2.5	2.0	224	300	22841	30591	34.9	0.42	1.43	0.79	ASTB32217	2.745
85	150	30.5	28	24	2.5	2.1	184.9	235.7	18854	24034	27.5	0.42	1.43	0.79	MLB30217XA	2.095
90	140	32	32	24	2.0	1.5	169	271	17233	27634	31.7	0.42	1.43	0.79	32018	1.790
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	269.8	395.5	27512	40329	45.2	0.42	1.43	0.79	32218	3.439
90	190	46.5	43	36	4.0	3.0	354	434	36097	44255	47.8	0.34	1.76	0.97	30318	5.800
90	190	67.5	64	53	4.0	3.0	497	677	50679	69034	74.6	0.35	1.71	0.94	32318	8.780
95	200	49	45	32	4.0	3.0	292	355	29775	36199	38.5	0.82	0.73	0.40	31319	6.950
95	145	39	39	32.5	2.5	2.5	219	365	22372	37250	42.2	0.28	2.14	1.18	33019 (33019F)	2.277
95	170	34.5	32	27	3.0	2.5	242	318	24687	32396	35.6	0.42	1.43	0.79	30219	3.040
95	170	45.5	43	37	3.0	2.5	315	445	32121	45377	49.9	0.42	1.43	0.79	32219	4.240
95	170	45.5	43	37	3.5	3.5	299	418	30479	42583	46.9	0.42	1.43	0.79	32219X1XA	4.129
95	200	49.5	45	38	4.0	3.0	369	478	37627	48742	51.9	0.34	1.76	0.97	30319	6.800

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

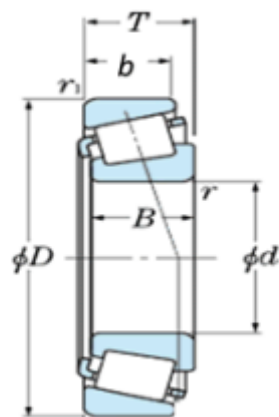
static

$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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			e	Y_2	Y_0		
mm							KN		Kgf		KN	Cu	e	Y_2	Y_0		
d	D	T	B	b	r_1	r	Cr	Cor	Cr	Cor	Cu						
100	215	77.5	73	60	4.0	3.0	580	861	59143	87796	91.6	0.34	1.76	0.97		32320	12.700
100	150	32	32	24	2.0	1.5	171.9	286	17529	29163	32.6	0.46	1.31	0.72		32020XF	1.904
100	150	32	32	24	2.5	3.0	172.2	286.7	17559	29235	32.7	0.46	1.31	0.72		32020X	1.912
100	150	39	39	32.5	2.0	1.5	224	390	22841	39768	44.6	0.29	2.09	1.15		33020	2.370
100	155	36	35	28	3.0	2.5	193	312	19670	31825	35.4	0.47	1.28	0.70		JM720249/10F	2.343
100	180	37	34	29	3.0	2.5	258	335	26349	34170	36.9	0.42	1.43	0.79		30220	3.780
105	225	81.5	77	63	4.0	3.0	659	911	67198	92895	95.6	0.34	1.76	0.97		32321	14.500
105	160	35	35	26	2.5	2.0	205	336	20945	34242	37.6	0.44	1.36	0.75		32021	2.400
105	190	39	36	30	3.0	25.0	283	382	28878	38942	41.4	0.42	1.43	0.79		30221F	4.377
105	190	53	50	43	3.0	2.5	381	579	38851	59041	62.8	0.42	1.43	0.79		32221	6.300
110	200	41	38	32	3.0	2.5	327	440	33344	44867	47.0	0.42	1.43	0.79		30222	5.210
110	200	56	53	46	3.0	2.5	439	642	44765	65465	68.7	0.42	1.43	0.79		32222	7.430
110	240	54.5	50	42	4.0	3.0	430	580	43847	59143	59.9	0.34	1.76	0.97		30322	11.100
110	240	63	57	38	4.0	3.0	425	590	43337	60162	60.8	0.82	0.73	0.40		31322	12.500
110	240	84.5	80	65	4.0	3.0	816	1132	83167	115430	116.7	0.34	1.76	0.97		32322	18.000

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

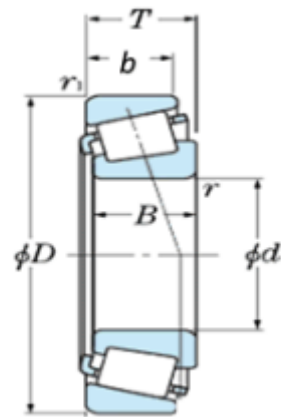
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$$P_{or} = 0.5 F_r + Y_0 F_a$$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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			e	Y_2	Y_0	
mm							KN		Kgf		KN	e	Y_2	Y_0	Bearing Number	Mass Kg. (Apporox.)
d	D	T	B	b	r_1	r	Cr	Cor	Cr	Cor	Cu					
110	170	47	47	37	2.5	2.0	288	500	29367	50985	55.1	0.29	2.07	1.14	33022	3.800
110	170	38	38	29	2.5	2.0	231	381	23586	38810	41.9	0.43	1.40	0.77	32022XF	3.000
110	170	38	38	29	2.5	2.0	231.3	380.6	23586	38810	41.9	0.43	1.40	0.77	ASTB32022X	3.003
120	215	61.5	58	50	3.0	2.5	497	751	50679	76579	78.5	0.44	1.36	0.75	32224	9.260
120	180	38	38	29	2.5	2.0	245	420	24983	42827	45.3	0.46	1.30	0.72	32024	3.250
120	260	59.5	55	46	4.0	3.0	589	746	60060	76070	75.0	0.34	1.76	0.97	30324	14.200
120	260	68	62	42	4.0	3.0	533	676	54350	68932	68.0	0.82	0.73	0.40	31324	15.200
120	260	90.5	86	69	4.0	3.0	864	1230	88102	125423	123.7	0.34	1.76	0.97	32324	15.200
120	215	43.5	40	34	3.0	2.5	345	470	35180	47926	49.1	0.44	1.36	0.75	30224	6.500
130	230	43.75	40	34	3	4	379	514	38647	52413	54	0.43	1.4	0.8	30226	6.84
130	230	67.75	64	54	4.0	3.0	530	820	54044	83615	83.8	0.44	1.36	0.75	32226	11.500
130	280	98.75	93	78	5.0	4.0	895	1263	91263	128788	124.2	0.34	1.76	0.97	32326	27.600
140	250	71.75	68	58	4.0	3.0	610	980	62202	99931	97.8	0.44	1.36	0.75	32228	14.700
140	210	45	45	34	2.5	2.0	333	589	33966	60081	60.7	0.46	1.30	0.72	32028XF	5.280
150	225	48	48	36	3.0	2.5	365	670	37219	68320	67.7	0.46	1.30	0.72	32030	6.400
150	270	77	73	60	4.0	3.0	700	1130	71379	115226	110.3	0.43	1.40	0.77	32230	18.400

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = X F_r + Y F_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

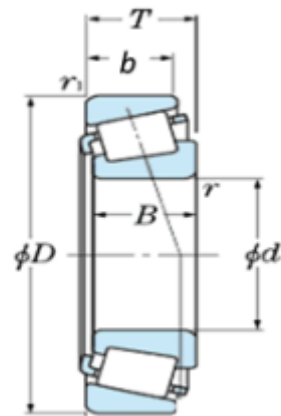
static

$P_{or} = 0.5 F_r + Y_0 F_a$

When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e, Y_2 and Y_0
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_1	r	Cr	Cor	Cr	Cor	Cu					
160	240	51	51	38	3.0	2.5	415	730	42318	74438	72.3	0.46	1.30	0.72	32032	7.700
160	375	86.55	79.4	50	4.7	4.7	880	1090	89734	111147	98.9	0.66	0.91	0.50	7832	39.400
160	290	84	80	67	4.0	3.0	897	1430	91467	145817	136.7	0.43	1.40	0.77	32232	23.400
170	260	57	57	43	3.0	2.5	519	920	52922	93812	89.2	0.44	1.36	0.75	32034	10.600
170	260	57	57	43	3.0	2.5	519	920	52922	93812	89.2	0.44	1.36	0.75	32034X	10.600
170	360	127	120	100	5.0	4.0	1430	2120	145817	216176	193.0	0.36	1.67	0.92	32334	57.900
170	230	38	38	30	2.0	2.5	286	590	29163	60162	58.4	0.38	1.58	0.87	32934	4.500
170	230	39	38	31	3.1	2.5	335	590	34160	60162	58.4	0.38	1.58	0.87	JHM534149/110	4.510
180	320	91	86	71	5.0	4.0	950	1650	96872	168251	153	0.46	1.30	0.72	32236	29.800
180	380	98	88	60	5.0	5.0	1090	1491	111127	152027	133.5	0.36	1.67	0.92	27336	46.000
190	290	64	64	48	3.0	2.5	655	1210	66790	123384	113.5	0.44	1.36	0.75	32038X	14.700
190	340	97	92	75	5.0	4.0	1150	1850	117266	188645	168.4	0.43	1.40	0.77	32238	35.200
200	360	104	98	82	5.0	4.0	1300	2200	132561	224334	197.0	0.41	1.46	0.80	32240	43.2
200	420	108	100.01	66	6.0	6.0	1293	1864	131868	190041	161.9	0.36	1.67	0.92	27340	63.000
220	340	76.5	66.675	62	4.0	4.0	858	14401	87490	1468470	1295	0.35	1.71	0.94	2007144	22.300
220	400	72	65	54	5.0	4.0	1000	1460	101970	148876	126.8	0.43	1.40	0.77	7244(30244)	35.200

Single Row Taper Roller Bearing (Metric series)



Equivalent radial load
dynamic

$P_r = X F_r + Y F_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	0	0.4	Y_2

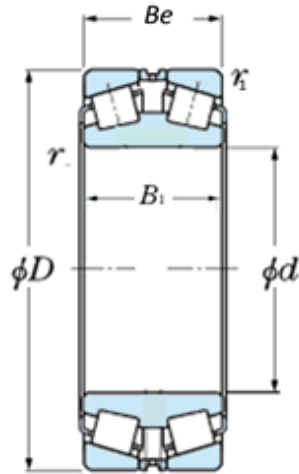
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$P_{or} = 0.5 F_r + Y_0 F_a$

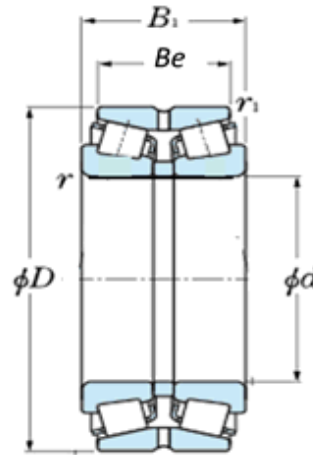
When $P_{or} < F_r$ use $P_{or} = F_r$
For values of e , Y_2 and Y_0
see the table below.

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial load factors		Bearing Number	Mass Kg. (Apporox.)
							Dynamic	Static	Dynamic	Static		e	Y_2	Y_0		
mm							KN		Kgf		KN					
d	D	T	B	b	r_1	r	Cr	Cor	Cr	Cor	Cu					
240	320	51	48	41	3.0	2.5	470	990	47926	100950	88.6	0.46	1.30	0.72	32948	11.000
240	360	76	72	62	4.0	3.0	900	1750	91773	178448	153.5	0.46	1.30	0.72	32048	27.300
255	560	123.05	104.8	70	6.0	6.0	1780	2490	181507	253905	199.2	0.87	0.69	0.38	30651	120.000
260	360	64.5	60	52	3.5	3.5	696	1323	70930	134927	114.9	0.37	1.62	0.89	2007952	17.700
280	420	87	82	71	5.0	4.0	1110	2040	113187	208019	170.8	0.37	1.62	0.89	2007156	39.300
300	460	100.7	95	82	5.0	5.0	1478	2610	150661	266111	213.2	0.31	1.94	1.06	2007160	55.900
300	460	100	100	74	5.0	4.0	1484	2980	151323	303871	243.5	0.43	1.40	0.77	32060	58.000
320	480	100	100	74	5.0	4.0	1520	2940	154994	299792	236.5	0.42	1.43	0.79	32064	59.000
320	670	210	200	170	7.5	7.5	4570	8040	466003	819839	606.8	0.37	1.62	0.89	32364	331.200
500	670	85	78	60	6.0	5.0	1470	3100	149896	316107	222.5	0.43	1.40	0.77	10079/500	74.100

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load

$$P_r = XF_r + YF_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

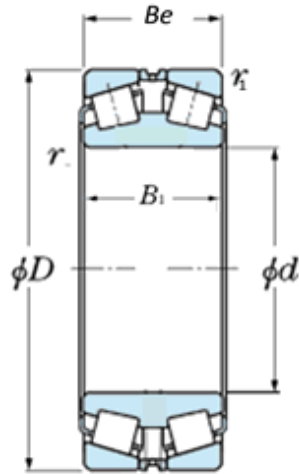
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$$P_{or} = F_r + Y_o F_a$$

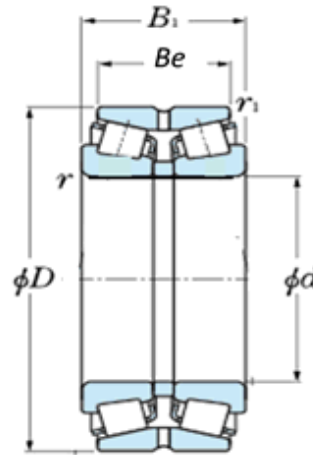
For values of e , Y_2 and Y_o see the table below.

Boundary Dimension						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor				Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static			Y ₁	Y ₂	Y ₀				
mm						KN		Kgf		KN	e	Y ₁	Y ₂	Y ₀				
d	D	Bi	Be	r	r ₁	Cr	Cor	Cr	Cor	Cu								
101.6	146.05	49.212	39.688	1.5	0.8	182	331	18559	33752	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	60264	95444	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	62202	112167	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	65465	72	0.40	1.69	2.51	1.65	LM522549/LM522510D	TDO	4.600	
120	260	136	124	1.5	3.0	1050	1426	107069	145409	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	74234	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	56084	117266	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	91467	168658	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	58123	122364	123	0.73	0.92	1.38	0.90	HM926749/HM926710D	TDI	19.000	
130	230	150	120	4.0	2.0	945	1645	96362	167741	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	56084	122364	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	55064	116042	119	0.34	1.99	2.96	1.94	67390/67326D	TDO	10.530	
140	300	140	154	1.5	4.0	1200	1830	122364	186605	176	0.82	0.82	1.23	0.80	31328X/DF	TDI	51.500	
150	250	137.25	112	2.5	1.0	785	1560	80046	159073	155	0.25	2.70	4.02	2.64	2097730	TDI	25.800	
150	270	172	138	4.0	1.5	1351	2388	137751	243504	233	0.42	1.61	2.39	1.57	97530	TDO	39.100	
150	320	164	150	1.5	4.0	1360	2250	138679	229433	212	0.82	0.82	1.23	0.80	31330XDF	TDI	58.500	

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load dynamic

$$P_r = XF_r + YF_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

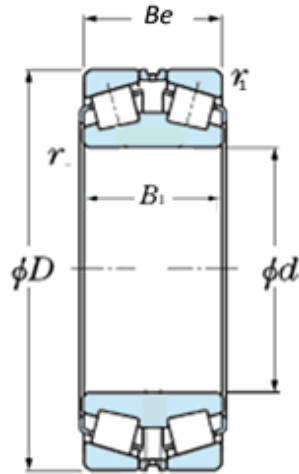
static

$$P_{or} = F_r + Y_o F_a$$

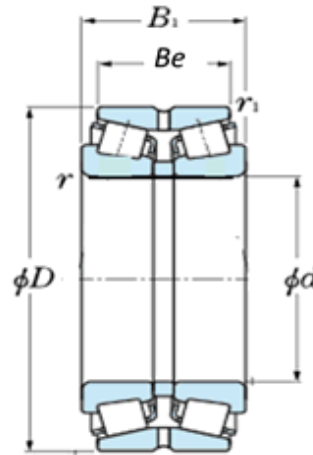
For values of e , Y_2 and Y_o
see the table below.

Boundary Dimension						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor				Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static			Y ₁	Y ₂	Y ₀				
mm						KN		Kg _f		KN	e				Y ₁			
d	D	Bi	Be	r	r ₁	Cr	Cor	Cr	Cor	Cu								
152.4	254	142.876	111.125	7.9	3.5	996	1930	101562	196802	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	589	1069	60071	109006	106	0.35	1.93	2.87	1.89	81630/81963D	TDO	18.180	
160	270	150	120	2.5	1.0	1070	1890	109108	192723	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	1160	2140	118285	218216	204	0.32	2.11	3.14	2.06	HM237535/HM237510D	TDO	36.500	
170	260	114	114	1.0	2.5	1050	1915	107069	195273	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	88000	190888	178	0.53	1.27	1.90	1.25	82680X/82620D	TDO	29.000	
	288.925	123.825	123.825	1.5	3.3	1090	1980	111147	201901	176	0.32	2.11	3.14	2.06	HM237546D/HM237510	TDI	31.000	
180	280	128	128	1.0	2.5	1100	2320	112167	236570	220	0.42	1.61	2.39	1.57	32036X/DF	TDI	29.500	
180	300	163.25	134	3.0	1.0	1220	2360	124403	240649	207	0.26	2.60	3.87	2.54	2097736	TDO	43.500	
180	280	133.25	108	3.0	1.0	940	1810	95852	184566	162	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	63731	157034	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	172329	326304	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	183546	336501	296	0.40	1.69	2.51	1.65	EE420751/421451	TDO	87.000	
200	310	151	123	3.0	1.0	995	2080	101460	212098	192	0.37	1.82	2.72	1.78	2097140	TDI	38.300	
200	340	183	150	4.0	1.5	1650	3400	168251	346698	308	0.24	2.81	4.19	2.75	2097740	TDO	65.500	
200.025	317.5	146.05	111.125	4.3	1.5	1257	2337	128176	238304	214	0.52	1.30	1.93	1.27	93787/93127CD	TDO	40.800	

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

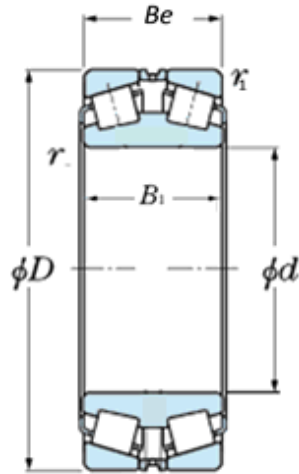
static

$$P_{or} = F_r + Y_o F_a$$

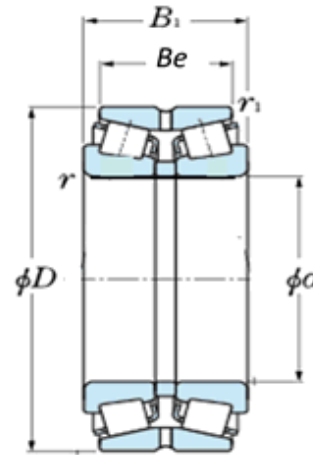
For values of e , Y_2 and Y_o
see the table below.

Boundary Dimension						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static			Y ₁	Y ₂	Y ₀			
mm						KN		Kgf		KN	e						
d	D	Bi	Be	r	r ₁	Cr	Cor	Cr	Cor	Cu							
203.2	276.225	95.25	73.025	3.5	0.8	706	1467	71991	149590	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	2216	4072	225986	415201	368	0.33	2.05	3.05	2.00	H242649D/H242610	TDI	63.750
220	340	163	130	4.0	1.5	1530	2980	156014	303871	267	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	109108	249827	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	1479	2512	150854	256138	214	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	122364	254925	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	254925	555737	474	0.33	2.05	3.05	2.00	H247549/H247510D	TDO	105.000
240	320	109	90	3.0	1.1	690	1610	70359	164172	144	0.36	1.88	2.79	1.83	2097948	TDI	22.000
240	360	165	130	4.0	1.0	1360	2940	138679	299792	258	0.31	2.18	3.24	2.13	2097148	TDI	46.000
240	400	209	168	5.0	2.0	1870	4050	190684	412979	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	78007	177428	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	3393	6315	345981	643890	540	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	273280	591426	496	0.33	2.05	3.05	2.00	NP985601/NP490062	TDO	122.000
260	360	133	109	3.5	1.2	1200	2652	122364	270424	230	0.37	1.82	2.72	1.78	2097952	TDO	36.800
260	400	185	146	1.3	3.7	1760	3790	179467	386466	323	0.29	2.33	3.47	2.28	2097152	TDO	74.300
260	420	170	170	5.0	5.0	2080	4047	212057	412693	342	0.40	1.69	2.51	1.65	47752	TDI	88.500
260	440	225	180	4.0	1.3	2440	4750	248807	484358	398	0.24	2.81	4.19	2.75	2097752	TDI	124.000

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load dynamic

$$P_r = XF_r + YF_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

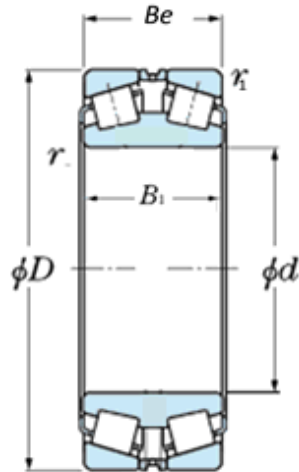
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$$P_{or} = F_r + Y_o F_a$$

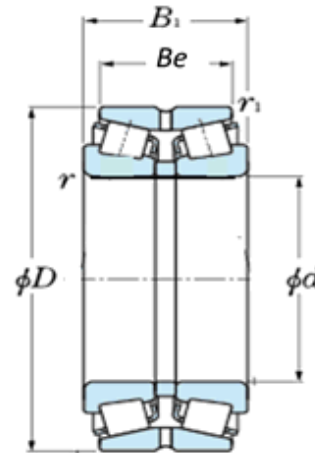
For values of e , Y_2 and Y_o
see the table below.

Boundary Dimension						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor				Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static			Y ₁	Y ₂	Y ₀				
mm						KN		Kgf		KN	e				Y ₁			
d	D	Bi	Be	r	r ₁	Cr	Cor	Cr	Cor	Cu								
279.4	457.2	244.475	244.475	1.5	6.4	3490	7685	355845	783639	634	0.33	2.05	3.05	2.00	HH255149D/HH255110	TDI	163.600	
280	420	188	154	5.0	2.0	1910	4080	194763	416038	342	0.37	1.82	2.72	1.78	2097156	TDO	85.000	
300	420	160	128	4.0	1.0	1510	3630	153975	370151	301	0.36	1.88	2.79	1.83	2097960	TDO	62.900	
300	500	204	152	1.8	4.7	2510	4910	255945	500673	395	0.32	2.11	3.14	2.06	1097760	TDO	148.000	
300	440	105	105	4.0	4.0	980	2050	99931	209039	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	426235	960557	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	147857	346698	280	0.42	1.61	2.39	1.57	EE129120X/EE129172DF	TDO	71.000	
305	510	200	200	5.0	5.0	1650	6000	168251	611820	480	0.74	0.91	1.36	0.89	N1326	TDI	163.000	
305.08	500	200	200	5.0	4.0	2228	4692	227189	478443	377	0.87	0.78	1.16	0.76	N1021	TDI	154.600	
305.08	500	200	200	5.0	5.0	2375	5095	242158	519496	409	0.87	0.78	1.16	0.76	N1021M	TDI	154.600	
320	620	250	282.75	6.0	2.5	3759	6431	383315	655810	493	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	236570	560835	442	0.33	2.05	3.05	2.00	HM261049/HM261010D	TDO	97.000	
340	460	159	128	4.0	1.0	1700	4190	173349	427254	337	0.36	1.88	2.79	1.83	2097968	TDO	71.000	
340	580	241	170	1.8	5.0	3200	6080	326304	619978	469	0.42	1.61	2.39	1.57	1097768	TDO	235.000	
360	480	159	128	4.0	1.0	1760	4380	179467	446629	347	0.32	2.11	3.14	2.06	2097972	TDO	73.700	
379	681.5	307	307	6.0	6.0	6450	14300	657707	1458171	1057	0.40	1.69	2.51	1.65	N1208	TDI	522.550	

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

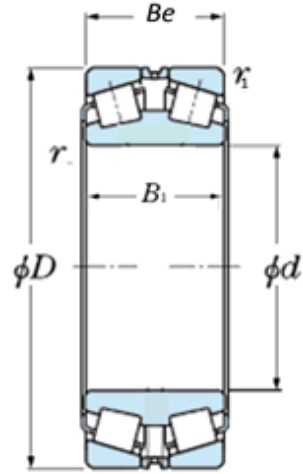
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$$P_{or} = F_r + Y_o F_a$$

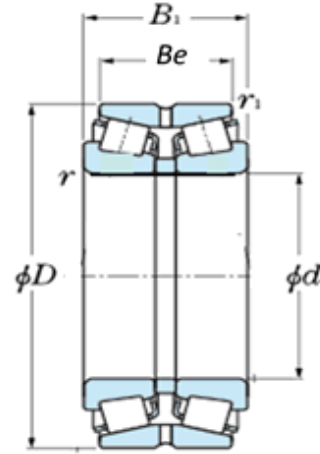
For values of e , Y_2 and Y_o
see the table below.

Boundary Dimension						Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor				Bearing Number	Type	Mass Kg. (Apporox.)
						Dynamic	Static	Dynamic	Static			Y ₁	Y ₂	Y ₀				
mm						KN		Kgf		KN	e				Y ₁			
d	D	Bi	Be	r	r ₁	Cr	Cor	Cr	Cor	Cu								
380	620	240	170	6.0	2.5	3100	6850	316107	698495	516	0.46	1.47	2.18	1.43	1097776	TDO	250.000	
384.18	546.1	222.25	177.8	6.4	1.6	3703	8207	377595	836868	631	0.33	2.05	3.05	2.00	HM266449/HM266410D	TDO	165.000	
390	590	200	200	2.5	7.0	2677	6821	272974	695537	520	0.73	0.92	1.38	0.90	JM966747DW/JM966718W	TDI	190.157	
440	650	211	152	6.0	2.5	2860	6900	291634	703593	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	212098	556960	405	0.40	1.69	2.51	1.65	EE244180/244236D	TDO	109.000	
480	650	179	130	6.0	2.5	2251	5510	229524	561855	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	290615	831056	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	275319	795366	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	356895	927927	657	0.31	2.18	3.24	2.13	EE640192/EE640261D	TDO	200.000	
510	800	285	285	6.0	6.0	6644	12679	677489	1292878	876	0.87	0.78	1.16	0.76	N1219	TDI	518.335	
530	710	190	136	5.0	1.5	2780	6720	283477	685238	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	420116	1160419	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	420116	1160419	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	234531	634253	433	0.51	1.32	1.97	1.29	EE542220/542291D	TDO	171.000	

Double Row Taper Roller Bearing



TDI (X-Arrangement)



TDO (O-Arrangement))

Equivalent radial load
dynamic

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

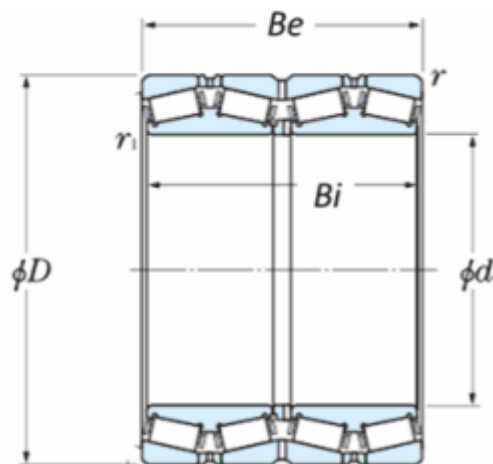
static

$P_{or} = F_r + Y_o F_a$

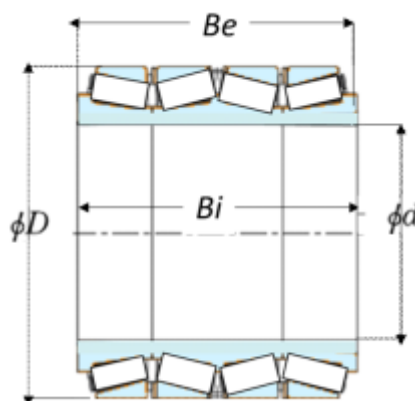
For values of e , Y_2 and Y_o
see the table below.

Boundary Dimension						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			
mm						KN		Kgf		KN							
d	D	Bi	Be	r	r ₁	Cr	Cor	Cr	Cor	Cu							
560	750	213	156	6.0	2.5	3163	8060	322501	821858	561	0.34	1.99	2.96	1.94	10979/560	TDO	235.000
560	820	242	242	8.0	11.0	4390	11557	447648	1178467	789	0.83	0.81	1.21	0.80	8471/560	TDI	427.000
600	800	210	160	6.0	2.5	3462	9846	353020	1004017	670	0.37	1.82	2.72	1.78	10979/600	TDO	242.000
710	950	240	175	6.0	2.5	4110	11000	419097	1121670	712	0.46	1.47	2.18	1.43	10979/710	TDO	440.000
850	1120	268	188	6.0	2.5	6860	18700	699514	1906839	1148	0.46	1.47	2.18	1.43	10979/850	TDO	647.000

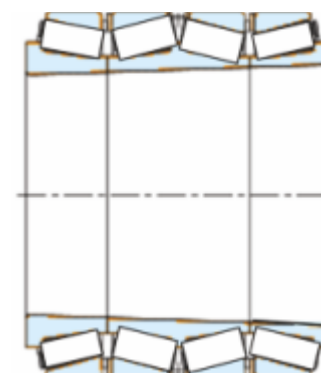
Four Row Taper Roller Bearing



TQO(X- Arrangement)



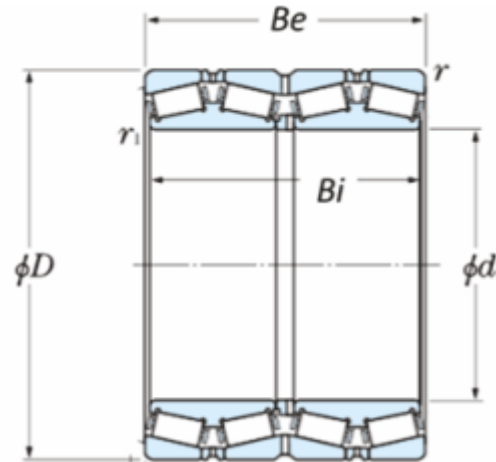
TQIT (O- Arrangement with Straight bore)



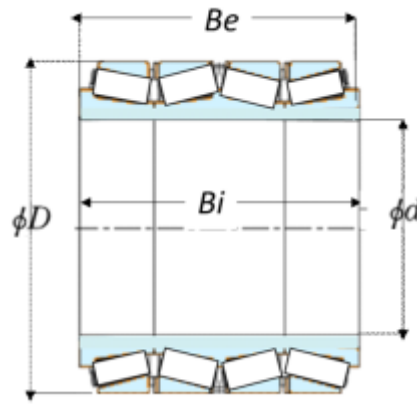
TQIT (O- Arrangement with tapered bore)

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type*	Mass Kg. (Apporox.)
mm							Dynamic	Static	Dynamic	Static								
d	D	C	Be	Bi	r ₁	r	KN		Kgf		KN							
							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	57001	68	0.43	1.57	2.34	1.53	28985D/28921/29921D	TQO	3.30
127	182.526	158.75	158.75	158.75	3.3	3.3	660	1730	67300	176408	185	0.31	2.18	3.24	2.13	48290DGW/20/20D	TQO	13.800
136.525	190.5	161.925	161.925	161.925	1.6	3.3	807	1890	82290	192723	199	0.32	2.11	3.14	2.06	48393DW/20/20D	TQO	14.000
177.8	247.65	192.088	192.088	192.088	1.5	3.2	1372	2768	139903	282284	270	0.44	1.53	2.28	1.50	67790DW/20/21D	TQO	28.130
180.843	284.162	101.6	239.715	239.715	3.3	1.5	1473	3663	150222	373486	341	0.33	2.05	3.05	2.00	M240631T/44TD/47T/44D	TQIT	60.000
187.325	269.875	211.138	211.138	211.138	3.3	1.5	1240	3400	126443	346698	324	0.33	2.05	3.05	2.00	M238849D/10/10D	TQO	41.800
190.5	266.7	188.912	187.325	187.325	1.5	3.3	1313	3185	133887	324774	303	0.48	1.41	2.09	1.38	67885DW/20/20D	TQO	33.400
200	340	305	305	305	4.0	4.0	2522	5761	257185	587429	518	0.35	1.93	2.87	1.89	2077144	TQO	104.000
206.375	282.575	190.5	190.5	190.5	3.3	3.3	1066	3151	108741	321318	294	0.51	1.32	1.97	1.29	67985DW/20/21D	TQO	36.500
215.9	288.925	177.8	177.8	177.8	0.8	3.3	1400	3600	142758	367092	334	0.43	1.57	2.34	1.53	LM742749DW/14/14D	TQO	32.000
220.663	314.325	239.713	239.713	239.713	1.5	3.3	2100	5100	214137	520047	463	0.33	2.05	3.05	2.00	M244249D/10/10D	TQO	60.400
241.478	349.18	228.6	228.6	228.6	1.5	3.3	2080	4920	212098	501692	434	0.36	1.88	2.79	1.83	EE127097D/135/136D	TQO	71.000
244.475	327.025	193.675	193.675	193.675	1.5	3.3	1569	4309	159991	439389	384	0.32	2.11	3.14	2.06	LM247748DGW/10/10D	TQO	43.590
246.327	381	301.625	301.625	301.625	6.4	1.5	2470	6850	251866	698495	593	0.33	2.05	3.05	2.00	M252330T/45TD/49T/10DM	TQIT	111.000

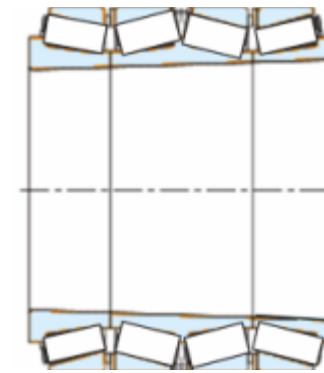
Four Row Taper Roller Bearing



TQO(X- Arrangement)



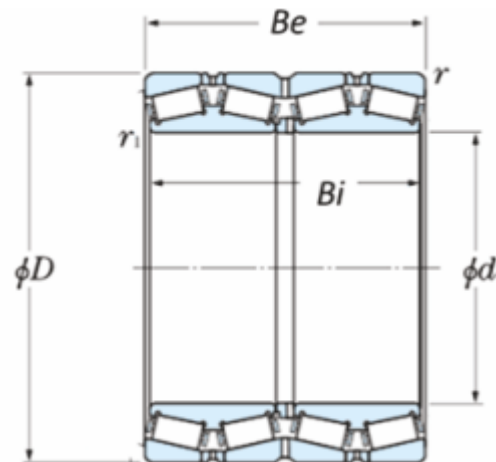
TQIT (O- Arrangement with Straight bore)



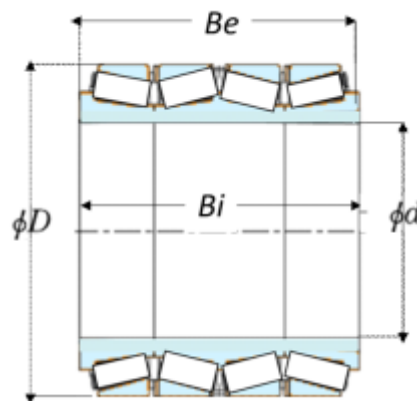
TQIT (O- Arrangement with tapered bore)

Boundary Dimension							Basic Load Rating				Fatigue Load Limit	Constant	Axial Load Factor			Bearing Number	Type*	Mass Kg. (Apporox.)
mm							Dynamic	Static	Dynamic	Static								
d	D	C	Be	Bi	r ₁	r	KN		Kgf				KN					
							Cr	Cor	Cr	Cor	Cu							
254	358.775	269.875	269.875	269.875	3.3	3.3	3200	7100	326304	723987	619	0.33	2.05	3.05	2.00	M249748D/10/10D	TQO	86.000
260	440	128	330	330	5.0	1.5	3300	7772	336501	792511	647	0.30	2.25	3.35	2.20	477752	TQIT	196.000
266.7	355.6	228.6	230.19	230.19	1.6	3.2	1858	5405	189501	551148	469	0.36	1.88	2.79	1.83	LM451349DW/10/10D	TQO	65.500
269.875	381	282.575	282.575	282.575	4.0	4.0	2572	7077	262236	721662	606	0.33	2.05	3.05	2.00	M252349D/10/10D	TQO	96.590
279.4	393.7	269.875	269.875	269.875	1.5	6.4	2340	6560	238610	668923	556	0.38	1.78	2.64	1.74	EE135111DW/55/56D	TQO	103.000
279.578	380.9	244.48	244.48	244.48	1.5	3.2	1973	6020	201197	613890	513	0.43	1.57	2.34	1.53	LM654644DW/10/10D	TQO	81.670
280	460	324	324	324	3.0	6.0	3350	8350	341600	851450	685	0.46	1.47	2.18	1.43	1077756	TQO	220.000
280.27	379.89	244.48	244.48	244.48	1.5	3.2	2631	5900	268283	601623	503	0.43	1.57	2.34	1.53	N1028	TQO	79.200
285.75	380.9	244.48	244.48	244.48	1.5	3.2	1973	6020	201197	613890	513	0.43	1.57	2.34	1.53	LM654648DW/10/10D	TQO	76.420
288.925	406.4	298.45	298.45	298.45	3.3	3.3	3133	8954	319441	913019	752	0.33	2.05	3.05	2.00	M255449D/10/10D	TQO	125.000
300	460	390	390	390	5.0	5.0	4300	10550	438471	1075784	865	0.31	2.18	3.24	2.13	2077160	TQO	238.000
317.5	422.275	269.875	269.875	269.875	1.5	3.3	3360	8150	342619	831056	671	0.32	2.11	3.14	2.06	LM258648DGW/10/10D	TQO	105.000
317.5	447.675	327.025	327.025	327.025	3.3	3.3	4298	10676	438267	1088632	871	0.33	2.05	3.05	2.00	HM259049DGW/10/10D	TQO	166.000
343.05	457.1	254	254	254	1.6	3.2	2416	6752	246319	688471	544	0.47	1.44	2.14	1.40	LM761649DW/10/10D	TQO	110.000

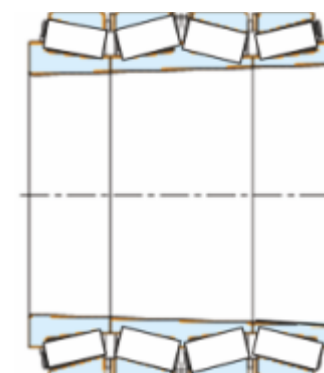
Four Row Taper Roller Bearing



TQO(X- Arrangement)



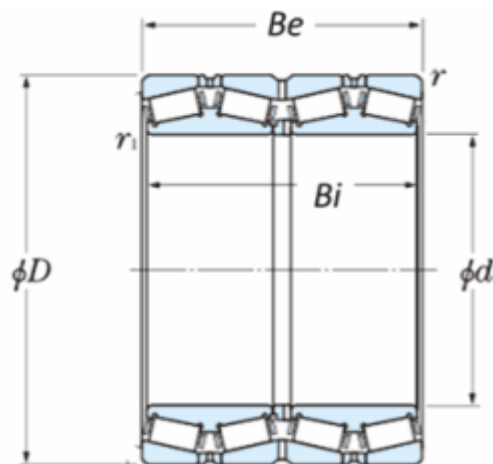
TQIT (O- Arrangement with Straight bore)



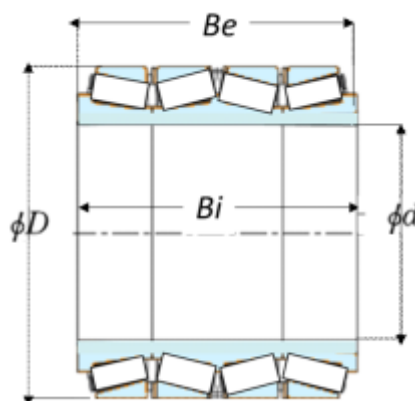
TQIT (O- Arrangement with tapered bore)

Boundary Dimension							Basic Load Rating				Fatigue Load Limit KN	Constant e	Axial Load Factor			Bearing Number	Type*	Mass Kg. (Apporox.)
mm							Dynamic	Static	Dynamic	Static								
d	D	C	Be	Bi	r ₁	r	KN		Kgf		KN		Y ₁	Y ₂	Y ₀			
							Cr	Cor	Cr	Cor	Cu							
355.6	482.6	269.875	265.112	265.112	1.5	3.3	2790	7650	284496	780071	607	0.47	1.44	2.14	1.40	LM763449DW/10/10D	TQO	134.000
355.6	488.95	317.5	317.5	317.5	1.5	3.3	3500	10500	356895	1070685	831	0.33	2.05	3.05	2.00	M263349DW/10/10D	TQO	177.000
368.3	523.875	382.588	382.588	382.588	3.3	6.4	4800	14000	489456	1427580	1090	0.33	2.05	3.05	2.00	HM265049DW/10/10D	TQO	267.000
380	620	418.5	420	420	6.0	6.0	6320	15000	644450	1529550	1130	0.46	1.47	2.18	1.43	1077776	TQO	480.000
384.175	546.1	400.05	400.05	400.05	3.3	6.4	7100	15800	723987	1611126	1216	0.33	2.05	3.05	2.00	HM266449DW/10/10D	TQO	305.000
385.762	514.35	317.5	317.5	317.5	3.3	3.3	4248	12029	433169	1226597	934	0.42	1.61	2.39	1.57	LM665949DW/10/10D	TQO	188.000
400	530	370	370	370	3.0	5.0	4350	13650	443570	1391891	1050	0.40	1.69	2.51	1.65	N1325	SET/TDI	213.000
406.4	546.1	288.93	288.93	288.93	1.5	6.4	3200	10200	326304	1040094	779	0.48	1.41	2.09	1.38	LM767749DW/10/10D	TQO	185.000
431.8	571.5	336.55	336.55	336.55	1.5	6.4	4050	12900	412979	1315413	970	0.47	1.44	2.14	1.40	LM769349DW/10/10D	TQO	230.000
450	595	368	368	368	3.0	6.0	5078	16506	517834	1683117	1226	0.33	2.05	3.05	2.00	M270449DGW/10/10D	TQO	284.000
460	730	438.5	438.5	438.5	5.0	10.0	8438	18000	860423	1835460	1282	0.73	0.92	1.38	0.90	777792	TQO	728.000
460	625	421	421	421	9.5	8.0	8200	19850	836154	2024105	1454	0.33	2.05	3.05	2.00	M271149D/10/10D	TQO	377.150
475	620	380	380	380	3.0	5.0	5858	18014	597371	1836837	1319	0.31	2.18	3.24	2.13	JM171649DGW/10/10D	TQO	293.800
480	700	77	420	420	6.0	2.5	8543	18500	871130	1886445	1315	0.37	1.82	2.72	1.78	577796	TQO	537.000

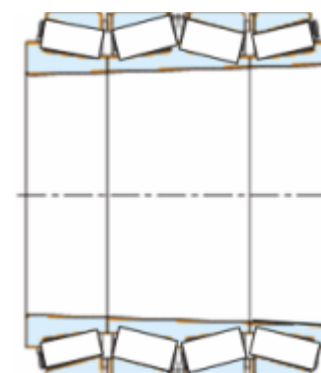
Four Row Taper Roller Bearing



TQO(X- Arrangement)



TQIT (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								
d	D	C	Be	Bi	r ₁	r	KN		Kgf		KN	e	Y ₁	Y ₂	Y ₀			
							Cr	Cor	Cr	Cor	Cu							
482.6	647.7	417.512	417.512	417.512	3.3	6.4	6050	19000	616919	1937430	1378	0.33	2.05	3.05	2.00	M272647DW/10/10D	TQO	398.000
488.95	660.4	361.95	365.125	365.125	8.0	6.4	5350	16100	545540	1641717	1179	0.31	2.18	3.24	2.13	EE640193DW/60/61D	TQO	358.800
489.026	634.873	320.675	320.68	320.68	3.3	3.3	4349	14155	443457	1443365	1029	0.34	1.99	2.96	1.94	EE243193DW/250/251D	TQO	270.000
500	720	420	420	420	8.0	8.0	6761	18275	689419	1863502	1298	0.33	2.05	3.05	2.00	771/500	TQO	560.000
500	830	570	570	570	10.0	10.0	1099	26625	112099	2714921	1839	0.38	1.78	2.64	1.74	10777/500	TQO	1250.000
558.8	736.6	322.26	322.26	322.26	3.3	6.4	6225	16088	634763	1640504	1120	0.34	1.99	2.96	1.94	EE843221D/90/91D	TQO	375.000
571.5	812.8	593.725	593.725	593.725	3.3	6.4	11800	33800	1203246	3446586	2305	0.33	2.05	3.05	2.00	M278749DGW/10/10D	TQO	1012.000
600	800	365	365	365	5.0	5.0	5945	19692	606181	2008034	1341	0.37	1.82	2.72	1.78	779/600	TQO	531.000
630	920	515	515	515	10.0	10.0	9900	27582	1009534	2812567	1822	0.42	1.61	2.39	1.57	771/630	TQO	1160.000
649.924	914.898	674	672	672	3.6	6.0	13900	44600	1417383	4547862	2934	0.33	2.05	3.05	2.00	M281349D/10/10D	TQO	144.000
660.4	812.8	365.13	365.13	365.13	3.2	6.4	7716	20973	786801	2138617	1406	0.48	1.41	2.09	1.38	L281149D/10/10D	TQO	420.000
710	900	610	610	610	1.6	6.6	6882	24867	701758	2535688	1622	0.46	1.47	2.18	1.43	N1217	SET/TDI	771.000

*Type

TQO = One double cup, two single cups, with two cup spacers, two double cones with one cone spacer

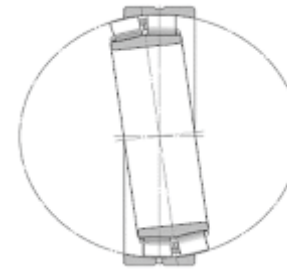
TQIT = Two double cups with one cup spacer, one tapered bore double cone & two tapered bore single cone without cone spacer

TQI = Two double cups with one cup spacer, one double cone & two single cone

20 Spherical Roller Bearing

Spherical Roller Bearing Configuration

Spherical roller bearing inner consists of two rows with symmetrical rollers and outer. The inner raceways are separated by a rib. 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 bearings with cylindrical bore those with tapered bore are also available. Bearings with tapered bore are specified by attaching the 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 ratio for a bearing 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 groove on 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

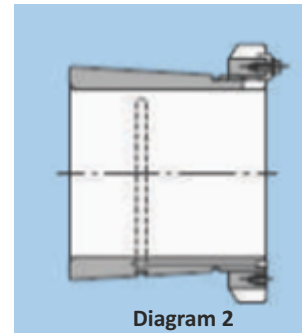
Adapters and withdrawal sleeves

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

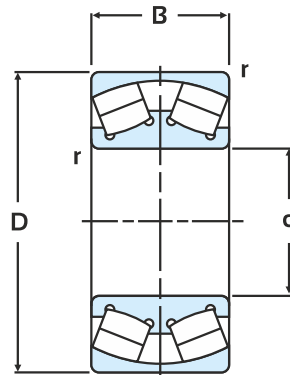
From the shaft, the nut is pressed down against the edge of the inner ring utilizing the bolt provided on the withdrawal sleeve, and then the sleeve is drawn away

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.

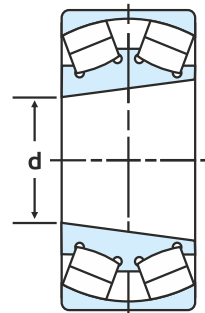
* Adapter as well as withdrawal sleeves are also available



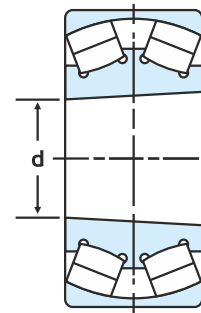
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

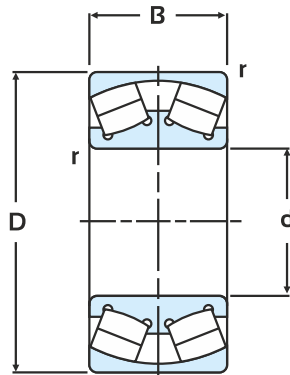
static

$$P_{or} = F_r + Y_0 F_a$$

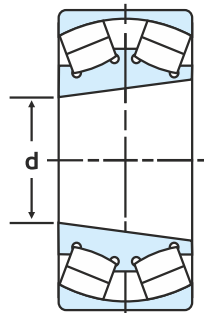
For values of e , Y_2 and Y_0
see the table below.

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						
25	52	18	1	42.1	43.5	4293	4436	5.3	0.35	1.9	2.9	1.9	22205CCW33	0.18
25	52	18	1	42.1	43.5	4293	4436	5.3	0.35	1.9	2.9	1.9	22205MBW33	0.19
30	62	20	1	51.7	55	5272	5608	6.7	0.32	2.1	3.1	2.1	22206CCW33	0.28
30	62	20	1	52	55	5302	5608	6.7	0.33	2.0	3.0	2.0	22206MBW33	0.29
35	72	23	1.1	70.4	78.7	7179	8025	9.6	0.32	2.1	3.2	2.1	22207CCW33	0.44
35	72	23	1.1	69.8	73.9	7118	7536	9.0	0.32	2.1	3.2	2.1	22207MBW33	0.45
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.28	2.4	3.5	2.3	22208CAW33	0.47
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.28	2.4	3.5	2.3	22208CAKW33	0.45
40	80	23	1.1	79.1	87.9	8066	8963	10.7	0.28	2.4	3.5	2.3	22208CCW33	0.53
40	80	23	1.1	79.1	87.9	8066	8963	10.7	0.28	2.4	3.5	2.3	22208CCKW33	0.52
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.31	2.2	3.2	2.1	22208MBW33	0.47
40	80	23	1.1	80.5	90.4	8209	9218	11.0	0.31	2.2	3.2	2.1	22208MBKW33	0.47
40	90	33	1.5	123.6	142.1	12603	14490	17.3	0.39	1.7	2.5	1.7	22308MBW33	1.03
40	90	33	1.5	123.6	142.1	12603	14490	17.3	0.39	1.7	2.5	1.7	22308MBKW33	1.03
40	90	33	1.5	125	135	12746	13766	16.5	0.39	1.7	2.5	1.7	22308MBW33	1.04

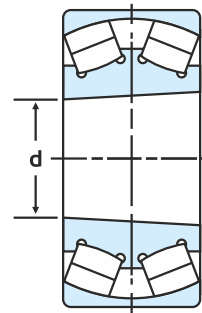
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

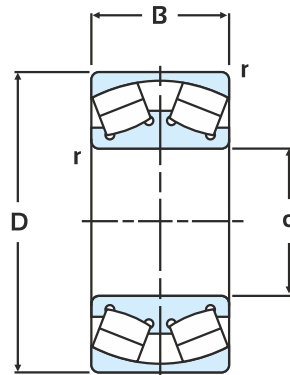
static

$$P_{or} = F_r + Y_0 F_a$$

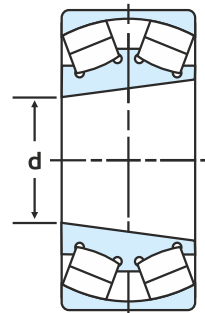
For values of e , Y_2 and Y_0
see the table below.

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						
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.37	1.8	2.7	1.8	22209CAW33	0.61
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.37	1.8	2.7	1.8	22209CAKW33	0.60
45	85	23	1.1	82.6	95	8423	9687	11.6	0.26	2.6	3.8	2.5	22209CCW33	0.59
45	85	23	1.1	82.6	95	8423	9687	11.6	0.26	2.6	3.8	2.5	22209CCKW33	0.58
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.28	2.4	3.5	2.3	22209MBW33	0.61
45	85	23	1.1	82.6	91.3	8423	9310	11.1	0.28	2.4	3.5	2.3	22209MBKCNW33	0.61
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309CAW33	1.40
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309MBW33	1.40
45	100	36	1.5	146	175	14888	17845	21.3	0.37	1.8	2.7	1.8	22309MBKW33	1.38
50	90	23	1.1	82.5	95.8	8413	9769	11.7	0.24	2.8	4.1	2.7	22210CAW33	0.64
50	90	23	1.1	82.5	95.8	8413	9769	11.7	0.24	2.8	4.1	2.7	22210CAKW33	0.62
50	90	23	1.1	85.9	102	8759	10401	12.4	0.24	2.8	4.1	2.7	22210CCW33	0.62
50	90	23	1.1	85.9	102	8759	10401	12.4	0.24	2.8	4.1	2.7	22210CCKW33	0.60
50	90	23	1.1	86.6	103.3	8831	10534	12.6	0.26	2.6	3.8	2.5	22210MBW33	0.64
50	90	23	1.1	86.6	103.3	8831	10534	12.6	0.26	2.6	3.8	2.5	22210MBKW33	0.63

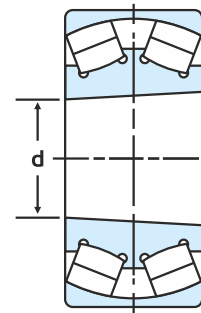
Spherical Roller Bearing



Cylindrical bore



Tapered bore (1K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

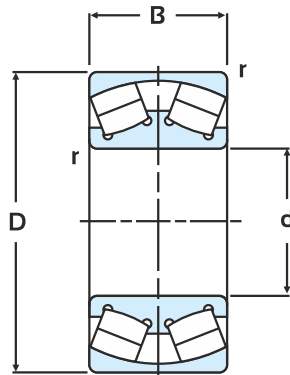
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$$P_{or} = F_r + Y_0 F_a$$

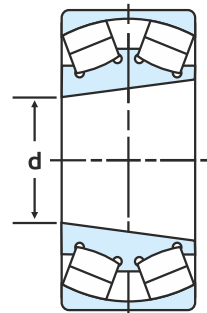
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor							
50	110	40	2	193	227	19680	23147	27.7	0.37	1.8	2.7	1.8	22310CAW33	1.83
50	110	40	2	193	227	19680	23147	27.7	0.37	1.8	2.7	1.8	22310MBW33	1.88
50	110	40	2	193	227	19680	23147	27.7	0.37	1.8	2.7	1.8	22310MBKW33	1.83
55	100	25	1.5	106	126	10809	12848	15.4	0.24	2.8	4.2	2.8	22211CAW33	0.83
55	100	25	1.5	106	126	10809	12848	15.4	0.24	2.8	4.2	2.8	22211CAKW33	0.81
55	100	25	1.5	108	128	11013	13052	15.6	0.24	2.8	4.2	2.8	22211CCW33	0.83
55	100	25	1.5	108	128	11013	13052	15.6	0.24	2.8	4.2	2.8	22211CCKW33	0.83
55	100	25	1.5	98.9	118.9	10085	12124	14.5	0.27	2.5	3.7	2.5	22211MBW33	0.87
55	100	25	1.5	98.9	118.9	10085	12124	14.5	0.27	2.5	3.7	2.5	22211MBKW33	0.85
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311CAW33	2.33
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311CAKW33	2.30
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311MBW33	2.33
55	120	43	2	214	258	21822	26308	31.5	0.36	1.9	2.8	1.8	22311MBKW33	2.30

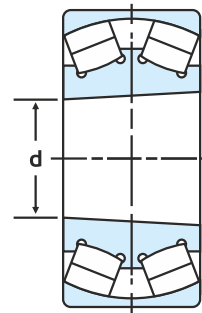
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

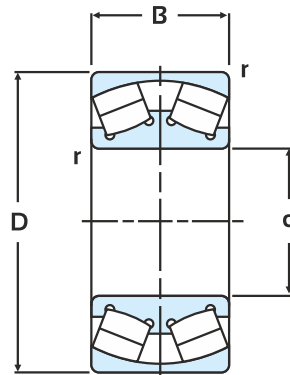
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$$P_{or} = F_r + Y_0 F_a$$

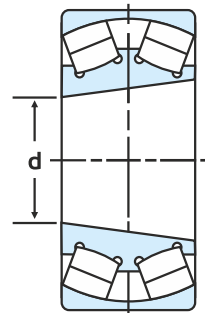
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor							
60	110	28	1.5	135	157	13766	16009	19.1	0.24	2.8	4.1	2.7	22212CAW33	1.18
60	110	28	1.5	135	157	13766	16009	19.1	0.24	2.8	4.1	2.7	22212CAKW33	1.15
60	110	28	1.5	150	182	15296	18559	22.2	0.24	2.8	4.1	2.7	22212CCW33	1.18
60	110	28	1.5	150	182	15296	18559	22.2	0.24	2.8	4.1	2.7	22212CCKW33	1.15
60	110	28	1.5	132	156	13460	15907	19.0	0.25	2.7	4.0	2.7	22212MBW33	1.23
60	110	28	1.5	132	156	13460	15907	19.0	0.25	2.7	4.0	2.7	22212MBKW33	1.20
60	130	31	2.1	167	191	17029	19476	23.3	0.24	2.8	4.2	2.8	21312CAW33	2.10
60	130	31	2.1	174	202	17743	20598	24.6	0.24	2.8	4.2	2.8	21312CCW33	1.98
60	130	46	2.1	240	310	24473	31611	37.8	0.36	1.9	2.8	1.8	22312CAW33	2.91
60	130	46	2.1	240	310	24473	31611	37.8	0.38	1.8	2.7	1.8	22312MBW33	2.90
60	130	46	2.1	240	310	24473	31611	37.8	0.38	1.8	2.7	1.8	22312MBKW33	2.90
65	120	31	1.5	164	197	16723	20088	24.0	0.25	2.7	4.0	2.6	22213CAKW33	1.52
65	120	31	1.5	157.2	196.8	16030	20068	24.0	0.25	2.7	4.0	2.6	22213CCKW33	1.52
65	120	31	1.5	112	158	11421	16111	19.3	0.28	2.4	3.6	2.3	22213MBKW33	1.48
65	120	31	1.5	147	181	14990	18457	22.1	0.28	2.4	3.6	2.3	22213MBW33	1.54
65	140	48	2.1	295	353	30081	35995	42.7	0.35	1.9	2.9	1.9	22313CAW33	2.61

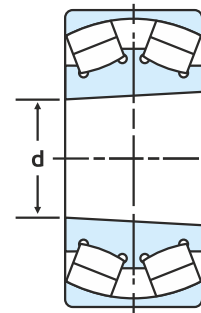
Spherical Roller Bearing



Cylindrical bore



Tapered bore (1K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

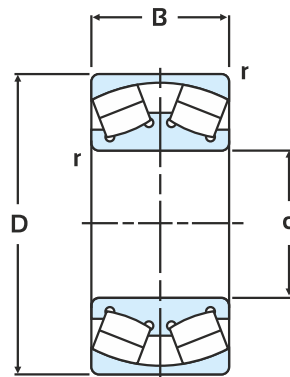
static

$$P_{or} = F_r + Y_0 F_a$$

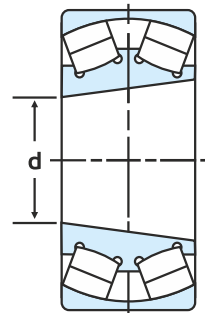
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor							
65	140	48	2.1	295	353	30081	35995	42.7	0.35	1.9	2.9	1.9	22313MBW33	3.61
65	140	48	2.1	295	353	30081	35995	42.7	0.35	1.9	2.9	1.9	22313MBKW33	3.54
70	125	31	1.5	170	218	17335	22229	26.6	0.24	2.8	4.2	2.8	22214MBW33	1.64
70	125	31	1.5	170	218	17335	22229	26.6	0.24	2.8	4.2	2.8	22214MBKW33	1.64
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	2.9	1.9	22314CAW33	4.41
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	3.0	1.9	22314MBW33	4.41
70	150	51	2.1	342	426	34874	43439	50.5	0.34	2.0	3.0	1.9	22314MBKW33	4.32
75	130	31	1.5	170.2	220.3	17355	22464	26.7	0.22	3.0	4.5	2.9	22215CAKW33	1.71
75	130	31	1.5	170	220	17335	22433	26.6	0.22	3.0	4.5	2.9	22215CCW33	1.80
75	130	31	1.5	170.2	220.3	17355	22464	26.7	0.22	3.0	4.5	2.9	22215CCKW33	1.71
75	130	31	1.5	190	240	19374	24473	29.1	0.24	2.9	4.3	2.8	22215MBW33	1.69
75	130	31	1.5	163	215	16621	21924	26.0	0.24	2.9	4.3	2.8	22215MBKW33	1.80
75	160	37	2.1	239	287	24371	29265	33.3	0.23	2.9	4.4	2.9	21315CAW33	3.70
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315CAW33	5.89
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315CAKW33	5.89
75	160	55	2.1	357	449	36403	45785	52.2	0.35	2.0	2.9	1.9	22315CAW33	5.36

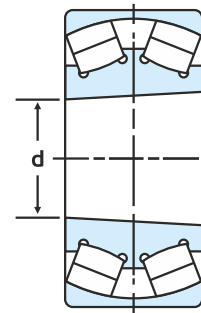
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

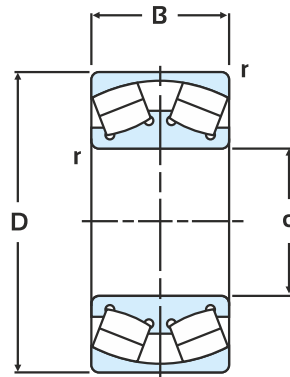
static

$$P_{or} = F_r + Y_0 F_a$$

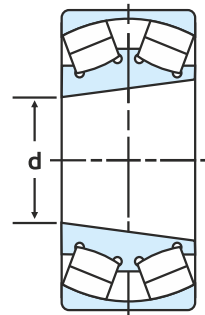
For values of e , Y_2 and Y_0
see the table below.

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						
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315MBW33	5.89
75	160	55	2.1	373	451	38035	45988	52.4	0.35	2.0	2.9	1.9	22315MBKW33	5.89
80	140	33	2	179	240	18253	24473	28.4	0.22	3.0	4.5	3.0	22216CAW33	2.26
80	140	33	2	179	240	18253	24473	28.4	0.22	3.0	4.5	3.0	22216CAKW33	2.24
80	140	33	2	174	234	17743	23861	27.7	0.22	3.0	4.5	3.0	22216MBW33	2.26
80	140	33	2	175	234	17845	23861	27.7	0.22	3.0	4.5	3.0	22216MBKW33	2.26
80	170	39	2.1	256	325	26104	33140	37.1	0.24	2.8	4.2	2.8	21316CCW33	4.50
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316CAW33	6.19
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316CAKW33	6.15
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316MBW33	6.34
80	170	58	2.1	436	533	44459	54350	60.8	0.34	2.0	2.9	1.9	22316MBKW33/H2316	7.50
85	150	36	2	213	282	21720	28756	32.8	0.23	3.0	4.4	2.9	22217CAKW33	2.87
85	150	36	2	225	293	22943	29877	34.0	0.23	3.0	4.4	2.9	22217CCKW33	2.68
85	150	36	2	224	290	22841	29571	33.7	0.24	2.8	4.2	2.8	22217MBW33	2.92
85	180	60	3	438	560	44663	57103	62.8	0.34	2.0	3.0	2.0	22317CAW33	7.31
85	180	60	3	446	563	45479	57409	63.1	0.34	2.0	3.0	2.0	22317CCW33	7.25

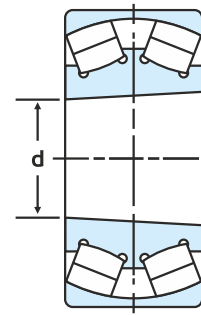
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

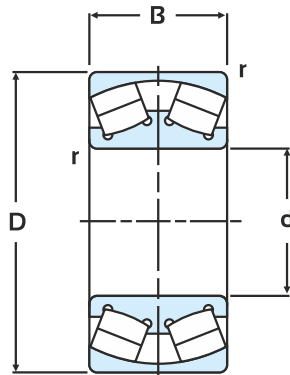
static

$$P_{or} = F_r + Y_0 F_a$$

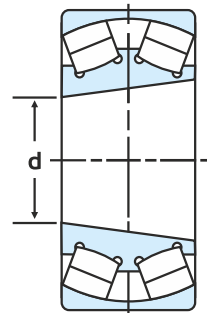
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
85	180	60	3	433	560	44153	57103	62.8	0.34	2.0	3.0	2.0	22317MBW33	7.31
85	180	60	3	433	560	44153	57103	62.8	0.34	2.0	3.0	2.0	22317MBW33	7.31
85	150	63	2	250	310	25493	31611	36.0	0.24	2.8	4.2	2.8	22217MBKW33/H317	3.80
85	180	60	3	462	591	47110	60264	66.2	0.34	2.0	3.0	2.0	22317CAKW33/H2317	8.60
85	180	60	3	462	591	47110	60264	66.2	0.34	2.0	3.0	2.0	22317MBKW33/H2317	8.67
90	160	40	2	248	345	25289	35180	39.3	0.24	2.9	4.3	2.8	22218CCW33	3.50
90	160	40	2	254	336	25900	34262	38.3	0.25	2.7	4.1	2.7	22218MBW33	3.36
90	160	40	2	202	286	20598	29163	32.6	0.25	2.7	4.1	2.7	22218MBKW33	3.67
90	160	52.4	2	335	492	34160	50169	56.1	0.33	2.1	3.1	2.0	23218MBW33	4.58
90	160	52.4	2	339	492	34568	50169	56.1	0.33	2.1	3.1	2.0	23218MBKW33	4.54
90	190	64	3	489	641	49863	65363	70.7	0.34	2.0	3.0	2.0	22318MBW33	8.35
90	190	64	3	489	641	49863	65363	70.7	0.34	2.0	3.0	2.0	22318MBKW33	8.34
95	170	43	2.1	314.4	410.2	32059	41828	46.0	0.25	2.7	4.0	2.6	22219MBW33	4.57
95	200	67	3	536	709	54656	72297	76.9	0.34	2.0	3.0	2.0	22319CAKW33	10.09
95	200	67	3	551	714	56185	72807	77.5	0.34	2.0	3.0	2.0	22319CCW33	10.28
95	200	67	3	536	709	54656	72297	76.9	0.34	2.0	3.0	2.0	22319MBW33	10.11

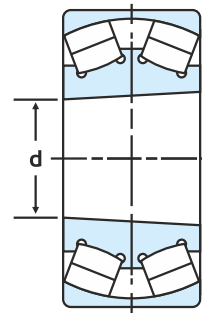
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

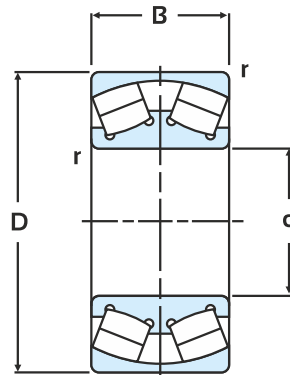
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$$P_{or} = F_r + Y_o F_a$$

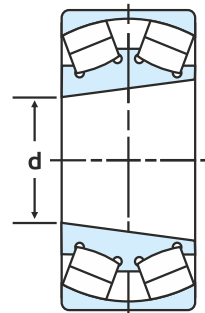
For values of e , Y_2 and Y_o
see the table below.

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						
95	200	67	3	500	615	50985	62712	66.7	0.34	2.0	3.0	2.0	22319MBKW33	10.11
95	170	43	2.1	3144	4102	320594	418281	459.7	0.25	2.7	4.0	2.6	22219MBKW33/H319	5.75
100	165	52	2	340	525	34670	53534	58.8	0.30	2.2	3.3	2.2	23120MBW33	4.34
100	180	46	2.1	324	449	33038	45785	49.5	0.24	2.8	4.2	2.8	22220CCW33	4.95
100	180	46	2.1	360	474	36709	48334	52.3	0.26	2.6	3.9	2.6	22220MBW33	5.03
100	180	60.3	2.1	420	580	42827	59143	63.9	0.32	2.1	3.2	2.1	23220MBW33	6.80
100	215	73	3	626	840	63833	85655	89.4	0.34	2.0	2.9	1.9	22320MBW33	12.95
100	180	71	2.1	360	474	36709	48334	52.3	0.26	2.6	3.9	2.6	22220MBKW33/H320	6.50
100	215	97	2.1	626	840	63833	85655	89.4	0.34	2.0	2.9	1.9	22320MBKW33/H2320	14.50
110	170	45	2	282	455	28756	46396	50.2	0.24	2.8	4.2	2.8	23022MBKW33	3.63
110	180	56	2	325	580	33140	59143	63.3	0.31	2.2	3.3	2.2	23122MBW33	5.90
110	200	53	2.1	572	651	58327	66382	69.6	0.25	2.7	4.0	2.6	22222CCW33	7.40
110	200	53	2.1	424	591	43235	60264	63.2	0.27	2.5	3.7	2.5	22222MBW33	7.54
110	200	69.8	2.1	510	750	52005	76478	80.2	0.35	1.9	2.8	1.9	23222MBKW33	9.50
110	200	69.8	2.1	536.5	802.3	54707	81811	85.8	0.35	1.9	2.8	1.9	23222MBW33	9.90
110	240	80	3	744	935	75866	95342	96.4	0.35	1.9	2.9	1.9	22322CCW33	17.90

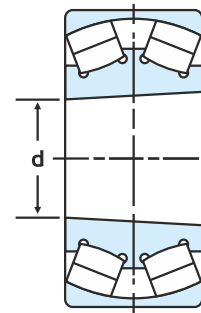
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

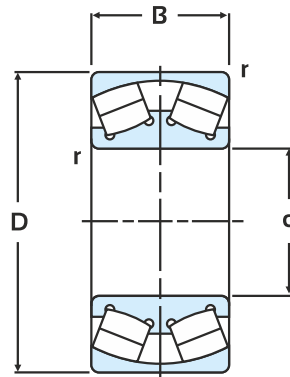
static

$$P_{or} = F_r + Y_0 F_a$$

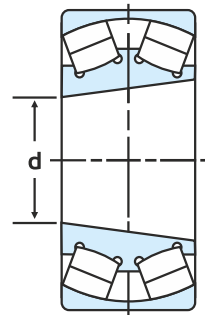
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
110	240	80	3	750	963	76478	98197	99.3	0.36	1.9	2.8	1.8	22322MBW33	18.12
110	240	80	3	723	949	73724	96770	97.8	0.36	1.9	2.8	1.8	22322MBW33	18.20
110	200	53	2.1	410	588	41808	59958	62.9	0.27	2.5	3.7	2.5	22222MBKW33/H322	9.60
120	180	46	2	296	495	30183	50475	53.5	0.23	2.9	4.4	2.9	23024MBW33	4.20
120	180	46	2	324.5	513.5	33089	52362	55.4	0.23	2.9	4.4	2.9	23024MBKW33	4.06
120	180	60	2	353	638	35995	65057	68.9	0.30	2.3	3.4	2.2	24024CAW33	5.30
120	180	60	2	390	700	39768	71379	75.6	0.30	2.3	3.4	2.2	24024MBW33	5.27
120	200	62	2	460	705	46906	71889	74.7	0.30	2.3	3.4	2.2	23124MBW33	8.00
120	200	62	2	460	705	46906	71889	74.7	0.30	2.3	3.4	2.2	23124MBKW33	7.70
120	215	58	2.1	652	765	66484	78007	79.9	0.26	2.6	3.8	2.5	22224CCW33	9.00
120	215	58	2.1	507	697	51699	71073	72.8	0.28	2.4	3.6	2.4	22224MBW33	9.14
120	215	58	2.1	396	582	40380	59347	60.8	0.28	2.4	3.6	2.4	22224MBKW33	9.14
120	215	76	2.1	595	950	60672	96872	99.2	0.35	1.9	2.9	1.9	23224MBW33	12.30
120	260	86	3	880	1130	89734	115226	113.7	0.34	2.0	3.0	2.0	22324CCW33	23.50
120	260	86	3	884	1154	90141	117673	116.1	0.35	1.9	2.9	1.9	22324MBW33	22.67
120	260	86	3	884	1154	90141	117673	116.1	0.35	1.9	2.9	1.9	22324MBKW33	22.40

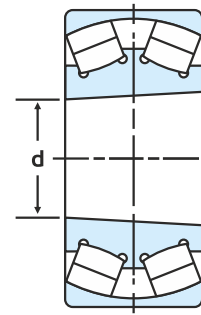
Spherical Roller Bearing



Cylindrical bore



Tapered bore (1:12)
(1:12)



Tapered bore (1:30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

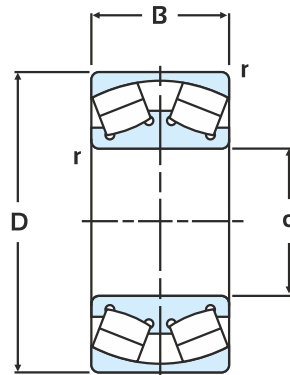
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$$P_{or} = F_r + Y_0 F_a$$

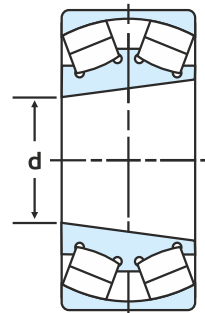
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
130	200	52	2	375	620	38239	63221	65.1	0.25	2.7	4.0	2.6	23026MBW33	6.00
130	200	52	2	377	609	38443	62100	63.9	0.25	2.7	4.0	2.6	23026MBW33	6.00
130	210	64	2	459	721	46804	73520	75.0	0.28	2.4	3.6	2.4	23126MBW33	8.60
130	230	64	3	563	832	57409	84839	85.1	0.26	2.6	3.8	2.5	22226CCW33	11.10
130	230	64	3	570	729	58123	74336	74.5	0.28	2.4	3.6	2.4	22226MBW33	11.30
130	230	80	3	759.2	1172.3	77416	119539	119.9	0.34	2.0	3.0	1.9	23226MBW33	14.30
130	230	80	3	662	1008	67504	102786	103.1	0.34	2.0	3.0	1.9	23226MBW33	14.40
130	280	93	4	1020	1377	104009	140413	135.4	0.33	2.0	3.0	2.0	22326MBW33	27.50
130	280	93	4	1020	1377	104009	140413	135.4	0.33	2.0	3.0	2.0	22326MBKW33	27.10
130	200	52	2	380	630	38749	64241	66.1	0.25	2.7	4.0	2.6	23026MBKW33/H3026	8.70
130	230	64	3	636	898	64853	91569	91.8	0.28	2.4	3.6	2.4	22226MBKW33/H3126	14.60
140	210	53	2	400	675	40788	68830	69.6	0.23	3.0	4.4	2.9	23028CAW33	7.00
140	210	53	2	400	675	40788	68830	69.6	0.23	3.0	4.4	2.9	23028KCAW33	7.00
140	210	53	2	415	695	42318	70869	71.7	0.23	3.0	4.4	2.9	23028MBW33	6.66
140	210	69	2	510	945	52005	96362	97.4	0.29	2.3	3.4	2.2	24028CCW33	8.45
140	210	69	2	510	930	52005	94832	95.9	0.32	2.1	3.2	2.1	24028MBW33	8.50

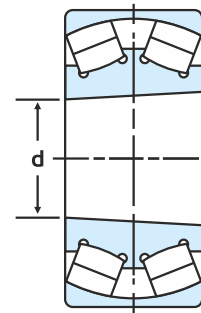
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

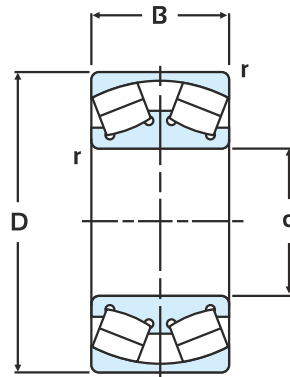
static

$$P_{or} = F_r + Y_0 F_a$$

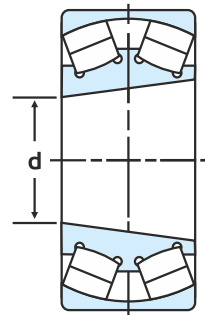
For values of e , Y_2 and Y_0
see the table below.

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						
140	225	68	2.1	540	895	55064	91263	91.1	0.29	2.4	3.5	2.3	23128MBW33	10.70
140	225	68	2.1	540	895	55064	91263	91.1	0.29	2.4	3.5	2.3	23128MBKW33	10.40
140	225	68	2.1	869	940	88612	95852	95.7	0.29	2.4	3.5	2.3	23128MBW33	10.60
140	225	85	2.1	783	1140	79843	116246	116.1	0.35	1.9	2.9	1.9	24128CAW513B2CZ	13.50
140	250	68	3	639	933	65159	95138	93.1	0.27	2.5	3.7	2.4	22228CCKW33	14.00
140	250	68	3	634	924	64649	94220	92.2	0.27	2.5	3.7	2.4	22228MBW33	14.80
140	250	88	3	826	1320	84227	134600	131.7	0.34	2.0	3.0	2.0	23228MBKW33	19.30
140	300	102	4	1154	1620	117673	165191	155.9	0.35	1.9	2.9	1.9	22328MBW33	35.50
140	300	102	4	1154	1620	117673	165191	155.9	0.35	1.9	2.9	1.9	22328MBKW33	35.50
140	300	102	4	1154	1620	117673	165191	155.9	0.35	1.9	2.9	1.9	22328MBW33	35.50
140	210	53	2	410	690	41808	70359	71.1	0.23	3.0	4.4	2.9	23028MBKW33/H3028	9.40
140	250	97	3	685	975	69849	99421	97.3	0.27	2.5	3.7	2.4	22228MBKW33/H3128	18.70
140	280	93	4	830	1250	84635	127463	122.0	0.36	1.9	2.8	1.8	73727	26.00

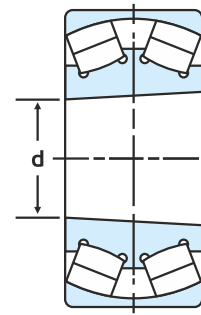
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

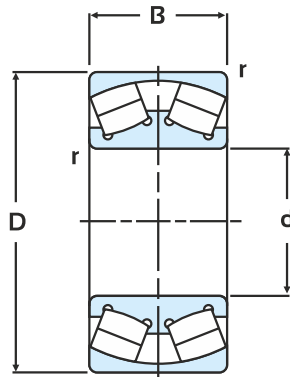
static

$$P_{or} = F_r + Y_0 F_a$$

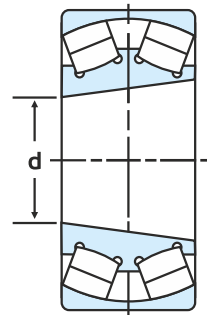
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
150	225	56	2.1	531	820	54146	83615	82.8	0.24	2.8	4.2	2.8	23030CCKW33	7.70
150	225	56	2.1	450	795	45887	81066	80.3	0.23	2.9	4.3	2.8	23030MBW33	8.10
150	225	75	2.1	607	1116	61896	113799	112.7	0.33	2.0	3.0	2.0	24030MBW33	10.52
150	225	75	2.1	590	1080	60162	110128	109.1	0.33	2.0	3.0	2.0	24030MBK30W33	10.37
150	250	80	2.1	745	1244	75968	126851	123.2	0.31	2.2	3.2	2.1	23130MBW33	16.30
150	250	80	2.1	730	1190	74438	121344	117.9	0.31	2.2	3.2	2.1	23130MBKW33	16.00
150	270	73	3	680	965	69340	98401	94.2	0.27	2.5	3.7	2.4	22230MBW33	21.10
150	270	73	3	800	1200	81576	122364	117.1	0.27	2.5	3.7	2.4	22230MBKW33	18.60
150	270	73	3	747	1085	76172	110637	105.9	0.27	2.5	3.7	2.4	22230MBW33	18.50
150	270	96	3	950	1500	96872	152955	146.4	0.36	1.9	2.8	1.8	23230MBW33	24.40
150	270	96	3	950	1500	96872	152955	146.4	0.36	1.9	2.8	1.8	23230MBKW33	23.40
150	320	108	4	1260	1730	128482	176408	163.3	0.36	1.9	2.8	1.8	22330E1CC	
150	320	108	4	1270	1750	129502	178448	165.2	0.36	1.9	2.8	1.8	22330E1MBW33	43.90
150	320	108	4	1270	1750	129502	178448	165.2	0.36	1.9	2.8	1.8	22330MBW33	43.90
150	320	108	4	1270	1750	129502	178448	165.2	0.36	1.9	2.8	1.8	22330MBKW33	41.90
150	225	56	2.1	450	795	45887	81066	80.3	0.23	2.9	4.3	2.8	23030MBKW33/H3030	11.80

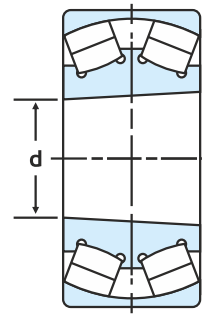
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load

$$P_r = XF_r + YF_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

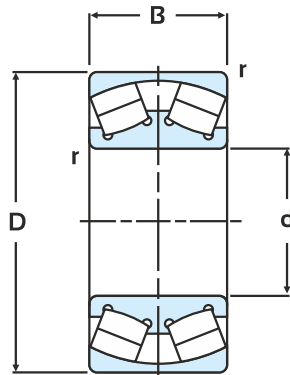
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$$P_{or} = F_r + Y_o F_a$$

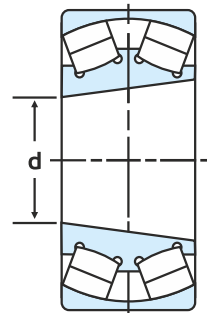
For values of e , Y_2 and Y_o
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
160	240	60	2.1	500	875	50985	89224	86.7	0.22	3.0	4.5	2.9	23032MBW33	9.60
160	240	80	2.1	711	1329	72501	135518	131.6	0.32	2.1	3.1	2.0	24032MBW33	12.82
160	240	80	2.1	711	1329	72501	135518	131.6	0.32	2.1	3.1	2.0	24032MBK30W33	12.82
160	270	86	2.1	839	1350	85553	137660	130.9	0.31	2.2	3.2	2.1	23132MBW33	20.20
160	270	86	2.1	837	1362	85349	138883	132.0	0.31	2.2	3.2	2.1	23132MBKW33	20.50
160	270	86	2.1	839	1350	85553	137660	130.9	0.31	2.2	3.2	2.1	23132MBW33	20.20
160	290	80	3	862	1276	87898	130114	122.0	0.28	2.4	3.6	2.4	22232MBW33	23.50
160	290	104	3	1100	1760	112167	179467	168.3	0.36	1.9	2.8	1.8	23232MBW33	30.90
160	290	104	3	1100	1760	112167	179467	168.3	0.36	1.9	2.8	1.8	23232MBKW33	29.60
160	240	60	2.1	500	880	50985	89734	87.2	0.22	3.0	4.5	2.9	23032MBKW33/H3032	14.40
160	290	80	3	903	1261	92079	128584	120.6	0.28	2.4	3.6	2.4	22232MBKW33/H3132	29.20
170	210	110	4	1470	1960	149896	199861	197.2	0.35	1.9	2.9	1.9	23234MBW33	39.00
170	260	67	2.1	728	1100	74234	112167	106.6	0.23	2.9	4.3	2.9	23034CCW33	12.80
170	260	67	2.1	640	1080	65261	110128	104.7	0.24	2.8	4.2	2.8	23034MBW33	13.20
170	260	67	2.1	630	1090	64241	111147	105.7	0.24	2.8	4.2	2.8	23034MBKW33	12.70
170	260	90	2.1	700	1450	71379	147857	140.5	0.34	2.0	3.0	2.0	24034MBW33	17.90

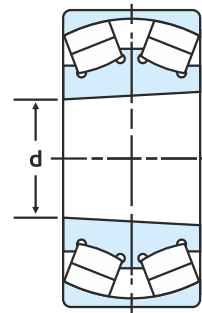
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

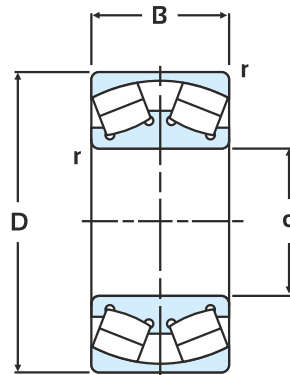
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$$P_{or} = F_r + Y_0 F_a$$

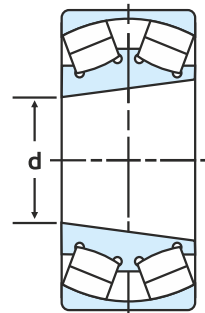
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
170	260	90	2.1	820	1500	83615	152955	145.4	0.34	2.0	3.0	2.0	24034MBK30W33	17.50
170	280	88	2.1	1086	1519	110739	154892	145.2	0.30	2.2	3.3	2.2	23134CCW33	21.40
170	280	88	2.1	840	1530	85655	156014	146.3	0.30	2.2	3.3	2.2	23134MBW33	21.90
170	280	88	2.1	895	1550	91263	158054	148.2	0.30	2.2	3.3	2.2	23134MBKW33	21.80
170	280	109	2.1	1020	1800	104009	183546	172.1	0.36	1.9	2.8	1.8	24134MBW33	26.90
170	310	86	4	999	1518	101868	154790	142.4	0.27	2.5	3.8	2.5	22234MBW33	28.50
170	310	86	4	990	1440	100950	146837	135.0	0.27	2.5	3.8	2.5	22234MBKW33	27.10
170	310	110	4	1472	1980	150100	201901	185.7	0.35	1.9	2.9	1.9	23234CCW33	37.00
170	310	110	4	1206	1946	122976	198434	182.5	0.35	1.9	2.9	1.9	23234MBW33	37.30
170	310	110	4	1180	1960	120325	199861	183.8	0.35	1.9	2.9	1.9	23234MBKW33	35.30
170	360	120	4	1550	2150	158054	219236	195.7	0.35	1.9	2.9	1.9	22334 CAW33	60.00
170	360	120	4	1540	2240	157034	228413	203.9	0.36	1.9	2.8	1.8	22334E1CCW33	58.50
170	360	120	4	1400	1790	142758	182526	163.0	0.36	1.9	2.8	1.8	22334E1MBW33	63.20
170	360	120	4	1550	2200	158054	224334	200.3	0.36	1.9	2.8	1.8	22334MBW33N	61.50

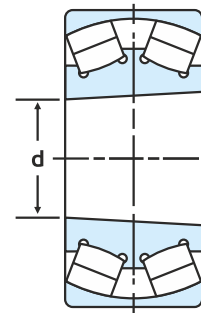
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

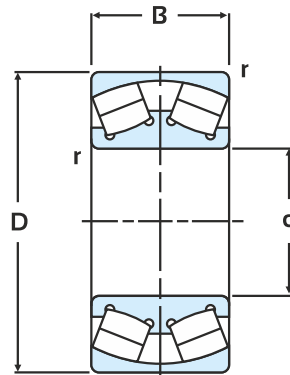
static

$$P_{or} = F_r + Y_0 F_a$$

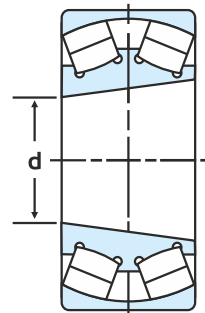
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
180	280	74	2.1	752.5	1299.9	76732	132551	123.5	0.24	2.8	4.2	2.7	23036CCW33	17.20
180	280	74	2.1	756	1308	77089	133377	124.2	0.25	2.7	4.0	2.6	23036MBW33	17.50
180	280	74	2.1	740	129	75458	13154	12.3	0.25	2.7	4.0	2.6	23036MBKW33	17.50
180	280	74	2.1	740	1290	75458	131541	122.5	0.25	2.7	4.0	2.6	23036MBW33	17.50
180	280	100	2.1	930	1700	94832	173349	161.5	0.35	1.9	2.9	1.9	24036CAW33	23.50
180	280	100	2.1	970	1770	98911	180487	168.1	0.33	2	3	2	24036MBK30W33	22.50
180	300	96	3	1050	1750	107069	178448	164.1	0.30	2.3	3.4	2.2	23136CAKW33	26.64
180	300	96	3	1030	1730	105029	176408	162.2	0.33	2.0	3.0	2.0	23136MBW33	26.00
180	300	118	3	1438	2201	146633	224436	206.4	0.38	1.8	2.7	1.7	24136CCW33	33.50
180	320	86	4	940	1390	95852	141738	128.8	0.28	2.4	3.6	2.3	22236MBW33	30.00
180	320	86	4	1080	1630	110128	166211	151.0	0.28	2.4	3.6	2.3	22236MBW33	29.50
180	320	86	4	1040	1610	106049	164172	149.2	0.28	2.4	3.6	2.3	22236MBKW33	28.10
180	320	112	4	1230	2030	125423	206999	188.1	0.35	1.9	2.9	1.9	23236MBW33	39.40
180	320	112	4	1230	2130	125423	217196	197.3	0.35	1.9	2.9	1.9	23236MBKW33	36.20
180	300	96	3	1263	1760	128788	179467	165.1	0.33	2.0	3.0	2.0	23136MBKW33/H3136	37.50
180	380	160	4	1740	2560	177428	261043	229.2	0.28	2.4	3.6	2.3	22336MBKW33/AH2336	75.00

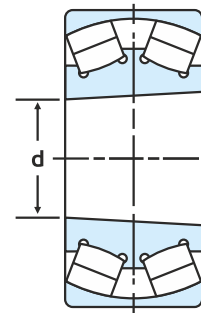
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

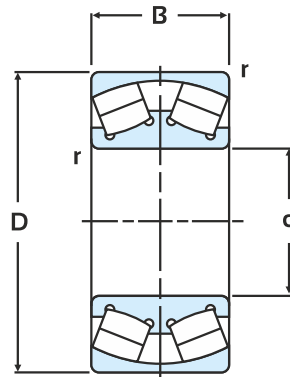
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$$P_{or} = F_r + Y_0 F_a$$

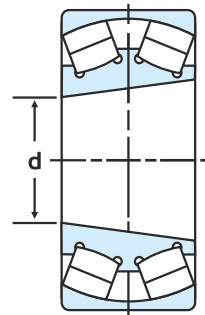
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor							
190	290	75	2.1	916	1355	93405	138169	127.1	0.23	2.9	4.3	2.8	23038CCKW33	17.40
190	290	75	2.1	760	1350	77497	137660	126.6	0.23	2.9	4.4	2.9	23038MBW33	18.00
190	290	75	2.1	760	1350	77497	137660	126.6	0.23	2.9	4.4	2.9	23038MBKW33	17.50
190	320	104	3	1190	2020	121344	205979	186.0	0.33	2.1	3.1	2.0	23138MBW33	35.10
190	320	128	3	1420	2480	144797	252886	228.4	0.39	1.7	2.6	1.7	24138MBW33	41.60
190	340	92	4	1150	1820	117266	185585	165.7	0.27	2.5	3.7	2.4	22238MBKW33	35.60
190	340	120	4	1450	2370	147857	241669	215.8	0.35	1.9	2.9	1.9	23238MBW33	48.10
190	340	120	4	1450	2350	147857	239630	213.9	0.35	1.9	2.9	1.9	23238MBKW33	47.60
200	310	82	2.1	1038	1606	105845	163764	147.9	0.24	2.8	4.2	2.7	23040CCW33	23.10
200	310	82	2.1	910	1614	92793	164580	148.6	0.25	2.7	4.0	2.6	23040MBW33	23.70
200	310	109	2.1	1310	2090	133581	213117	192.5	0.34	2.0	2.9	1.9	24040MBW33	30.40
200	310	109	2.1	1150	2150	117266	219236	198.0	0.33	2.0	3.0	2.0	24040MBK30W33	30.00
200	340	112	3	1340	2220	136640	226373	201.0	0.32	2.1	3.2	2.1	23140MBKW33	42.00
200	340	112	3	1355	2280	138169	232492	206.4	0.32	2.1	3.2	2.1	23140MBW33	42.50
200	360	98	4	1500	1950	152955	198842	174.6	0.26	2.6	3.9	2.5	22240CCKW33	42.20
200	360	98	4	1190	1810	121344	184566	162.1	0.28	2.4	3.6	2.4	22240MBW33	44.50

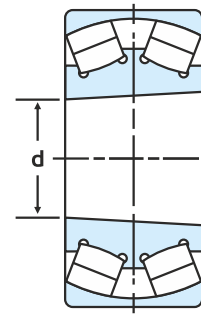
Spherical Roller Bearing



Cylindrical bore



Tapered bore (1:12)
(K)



Tapered bore (1:30)
(K30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

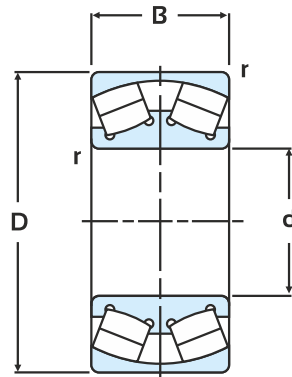
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$$P_{or} = F_r + Y_0 F_a$$

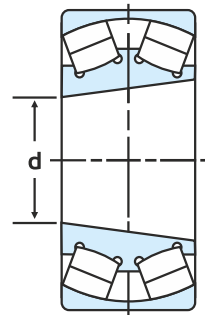
For values of e , Y_2 and Y_0
see the table below.

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						
200	360	98	4	1190	1810	121344	184566	162.1	0.28	2.4	3.6	2.4	22240MBW33	44.50
200	360	128	4	1620	2630	165191	268181	235.5	0.35	1.9	2.8	1.9	23240MBW33	57.90
200	360	128	4	1620	2640	165191	269201	236.4	0.35	1.9	2.8	1.9	23240MBKW33	57.40
200	420	138	5	2040	3050	208019	311009	264.9	0.35	1.9	2.9	1.9	22340MBW33	94.50
200	340	112	3	1400	2500	142758	254925	226.3	0.32	2.1	3.2	2.1	23140CCKC4W33/H3140	52.00
200	360	150	4	1310	2010	133581	204960	180.0	0.28	2.4	3.6	2.4	22240MBKW33/H3140	56.50
220	340	90	3	1100	1920	112167	195782	171.9	0.25	2.7	4.1	2.7	23044MBW33	30.10
220	340	118	3	1355	2580	138169	263083	231.0	0.33	2.1	3.1	2.0	24044MBK30W33	38.60
220	340	118	3	1355	2580	138169	263083	231.0	0.33	2.1	3.1	2.0	24044MBW33	39.30
220	370	161	4	1520	2710	154994	276339	238.9	0.31	2.2	3.2	2.1	23144MBKW33/H3144	67.00
220	400	108	4	1835	2460	187115	250846	213.7	0.27	2.5	3.7	2.4	22244MBKW33/H3144	72.50
220	340	90	3	1050	1900	107069	193743	170.1	0.25	2.7	4.1	2.7	23044MBKW33/H3044	39.30

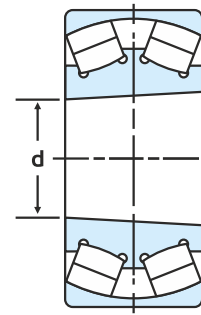
Spherical Roller Bearing



Cylindrical bore



Tapered bore (1:12)



Tapered bore (1:30)

Equivalent radial load

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

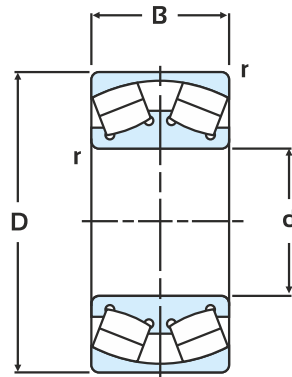
static

$$P_{or} = F_r + Y_o F_a$$

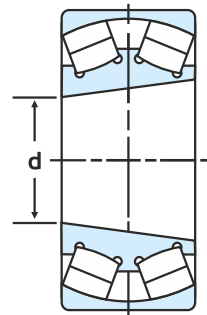
For values of e , Y_2 and Y_o see the table below.

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	Cu					
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	23048MBKW33	33.50
240	360	92	3	1130	2170	115226	221275	190.3	0.25	2.7	4.0	2.7	23048MBW33	33.70
240	400	128	4	2130	3240	217196	330383	278.7	0.30	2.3	3.4	2.2	23148CCKW33	61.80
240	400	128	4	1730	3050	176408	311009	262.4	0.30	2.2	3.3	2.2	23148MBKW33	64.60
240	400	128	4	1770	3090	180487	315087	265.8	0.30	2.2	3.3	2.2	23148MBW33	67.00
240	400	160	4	2000	3850	203940	392585	331.2	0.30	2.2	3.3	2.2	24148CAW33	79.00
240	440	120	4	1940	3130	197822	319166	264.4	0.27	2.5	3.7	2.5	22248CCKW33	79.90
240	440	120	4	1900	3050	193743	311009	257.7	0.27	2.5	3.7	2.4	22248MBKW33	82.60
260	360	75	2.1	976	1790	99523	182526	155.5	0.18	3.8	5.6	3.6	23952CAW33	22.90
260	400	104	4	1671	2580	170392	263083	219.9	0.23	2.9	4.3	2.8	23052CCKW33	46.40
260	400	104	4	1450	2700	147857	275319	230.1	0.24	2.8	4.2	2.7	23052MBW33	47.20
260	400	104	4	1400	2610	142758	266142	222.5	0.24	2.8	4.2	2.7	23052MBKW33	45.00
260	440	144	4	2120	3830	216176	390545	320.7	0.32	2.1	3.2	2.1	23152MBKW33	92.00
260	540	165	6	3200	4750	326304	484358	382.2	0.31	2.1	3.2	2.1	22352CCW33	181.00

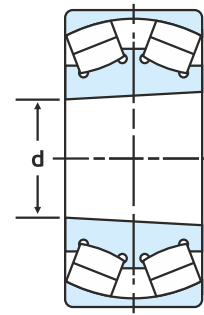
Spherical Roller Bearing



Cylindrical bore



Tapered bore (1:12)
(1:12)



Tapered bore (1:30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

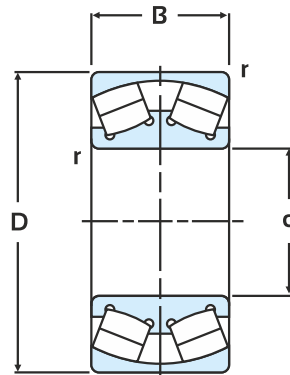
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$$P_{or} = F_r + Y_0 F_a$$

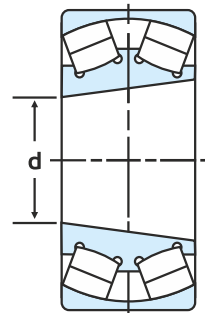
For values of e , Y_2 and Y_0
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
280	420	106	4	1500	2800	152955	285516	234.5	0.24	2.9	4.3	2.8	23056KCAW33	54.00
280	420	106	4	1320	2850	134600	290615	238.7	0.24	2.9	4.3	2.8	23056MB W33	52.50
280	420	106	4	1480	3150	150916	321206	263.8	0.24	2.9	4.3	2.8	23056MBW33	52.90
280	460	146	5	2300	4250	234531	433373	350.0	0.30	2.3	3.4	2.2	23156ECAW33	97.50
280	460	146	5	2295	4150	234021	423176	341.8	0.30	2.3	3.4	2.2	23156MBKW33	96.20
280	460	180	5	2767	5308	282151	541257	437.2	0.36	1.9	2.8	1.8	24156CCW33	114.00
280	460	180	5	2730	5200	278378	530244	428.3	0.36	1.9	2.8	1.8	24156ECCW33X	121.00
280	500	130	5	2310	3800	235551	387486	308.1	0.26	2.6	3.8	2.5	22256MBW33	113.00
300	440	105	4	1450	2760	147857	281437	227.3	0.21	3.2	4.7	3.1	3760	55.00
300	460	118	4	1840	3440	187625	350777	281.1	0.24	2.9	4.3	2.8	23060CK W33	70.00
300	460	118	4	1890	3550	192723	361994	290.1	0.24	2.9	4.3	2.8	23060MBKW33	70.00
300	460	118	4	1890	3550	192723	361994	290.1	0.24	2.9	4.3	2.8	23060MBW33	72.50
300	500	160	5	2720	4690	277358	478239	377.3	0.31	2.2	3.3	2.2	23160MBKW33	127.0
300	500	200	5	3300	6400	336501	652608	514.9	0.4	1.7	2.5	1.6	24160ECCW33X	159.0
320	480	121	4	1940	3790	197822	386466	304.9	0.23	2.9	4.4	2.9	23064CAW33	80.1
320	480	160	4	2892	5212	294897	531468	419.3	0.30	2.3	3.4	2.2	24064CAW33	103.6

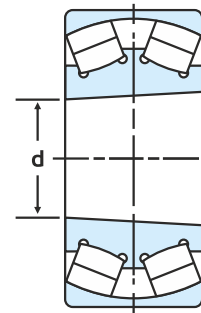
Spherical Roller Bearing



Cylindrical bore



Tapered bore (1:12)
(K)



Tapered bore (1:30)
(K30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

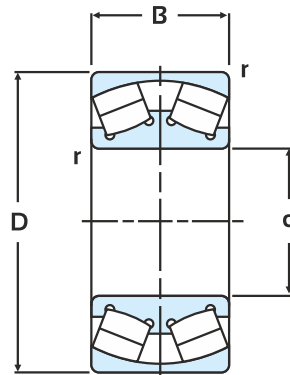
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$$P_{or} = F_r + Y_o F_a$$

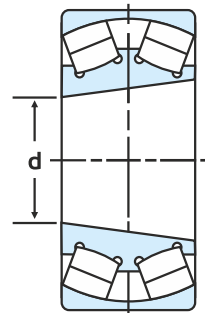
For values of e , Y_2 and Y_o
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor	Cu						
320	480	160	4	2511	5201	256047	530346	418.5	0.35	1.9	2.9	1.9	24064CCW33	97.8
320	540	176	5	3650	5800	372191	591426	456.6	0.32	2.1	3.1	2.1	23164MBW33	167.0
320	580	208	5	4000	7050	407880	718889	547.5	0.36	1.9	2.8	1.8	23264CAW33X	240.0
320	580	208	5	4050	7130	412979	727046	553.7	0.36	1.9	2.8	1.8	23264MBKW33	243.0
320	580	208	5	4000	7050	407880	718889	547.5	0.36	1.9	2.8	1.8	23264CAW33	246.0
320	580	208	5	4050	7130	412979	727046	553.7	0.36	1.9	2.8	1.8	23264MBW33	247.0
340	460	90	3	1290	2720	131541	277358	218.8	0.17	4.0	6.0	3.9	23968CAW33	44.0
340	520	133	5	2310	4450	235551	453767	350.4	0.24	2.8	4.2	2.8	23068MBKW33	103.0
340	580	190	5	3600	6600	367092	673002	509.2	0.34	2.0	2.9	1.9	23168MBW33	211.0
340	580	243	5	5168	8950	526981	912632	690.5	0.39	1.7	2.6	1.7	24168ECAW33	266.5
340	620	224	6	5127.5	7980.4	522851	813761	607.9	0.36	1.9	2.8	1.8	23268CAW33	303.4
340	460	90	3	1290	2720	131541	277358	218.8	0.17	4.0	6.0	3.9	23968CAKW33/H3968	66.5
360	540	134	5	2370	4750	241669	484358	368.9	0.22	3.1	4.5	3.0	23072CCW33	110
360	540	180	5	3100	6500	316107	662805	504.8	0.36	1.9	2.8	1.8	24072CAW33	145
360	540	180	5	3200	6650	326304	678101	516.5	0.31	2.2	3.3	2.2	24072MBW33	147

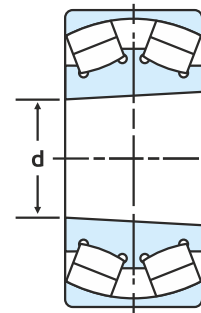
Spherical Roller Bearing



Cylindrical bore



Tapered bore (K)
(1:12)



Tapered bore (K30)
(1:30)

Equivalent radial load dynamic

$$P_r = X F_r + Y F_a$$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.67	Y_2

static

$$P_{or} = F_r + Y_o F_a$$

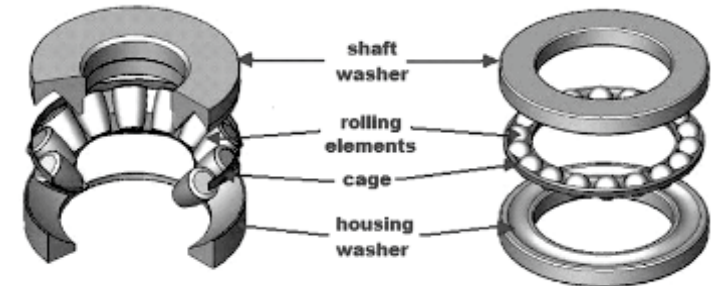
For values of e , Y_2 and Y_o
see the table below.

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	Cu					
d	D	B	r	Cr	Cor	Cr	Cor							
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	23080CAW33	154
400	650	250	6	5100	10500	520047	1070685	778.6	0.36	1.9	2.8	1.8	24180ECAW33	322
420	760	272	7.5	6550	12100	667904	1233837	866.4	0.36	1.9	2.8	1.9	23284MBKW33	526
440	720	226	6	5200	10100	530244	1029897	726.9	0.30	2.2	3.3	2.2	23188CAW33	377
440	720	280	6	6450	13100	657707	1335807	942.8	0.37	1.8	2.7	1.8	24188MBW33	473
460	680	163	4	3450	7100	351797	723987	510	0.22	3	4.6	2.8	23092CAW33	203
480	790	308	7.5	7450	15300	759677	1560141	1072	0.38	1.8	2.7	1.7	24196ECAW33	584
480	870	310	7.5	8300	15500	846351	1580535	1066	0.36	1.9	2.8	1.8	23296CAW33	820
480	870	310	7.5	8350	15500	851450	1580535	1066	0.36	1.9	2.8	1.8	23296MBW33	808
750	920	170	5	3600	11050	367092	1126769	712.9	0.16	4.2	6.2	4.1	40038/750 (248/750MBW33)	245
850	1220	365	7.5	12700	31500	1295019	3212055	1906	0.27	2.5	3.7	2.5	40031/850 (240/850CAW33)	1410
850	1420	620	12	23300	49260	2375901	5023042	2899	0.34	2.0	3.0	1.9	241/900MBK30W33/AH241_900G_H	3480
1180	1420	180	6	5620	17200	573071	1753884	972	0.10	6.4	9.6	6.3	238/1180CAW33	565

21 Thrust Bearing

Types of Thrust Roller Bearing

A thrust bearing is designed to support predominantly axial load. They are available in steel and brass cage.



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 less axial load.



- Cylindrical thrust roller bearings consist of straight rollers arranged. They have high load carrying capacity and , but tend to wear due to the differences in radial speed and friction which is higher than with ball bearings.



- 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.

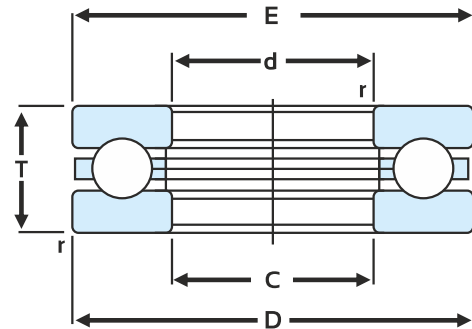
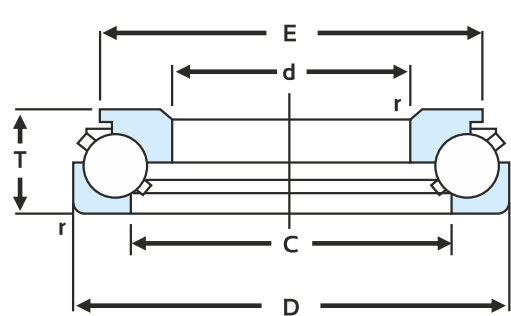


- Spherical roller thrust bearings use rollers of spherical shape, rolling inside a housing washer with a raceway with spherical inner shape. They can accommodate combined radial and axial loads and also accommodate misalignment of the shafts.



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 Ball Bearing



Equivalent bearing load
dynamic

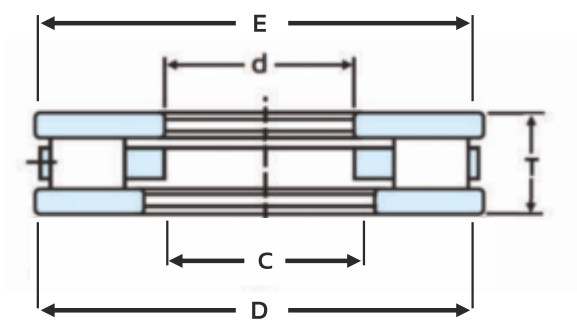
$P_a = F_a$

Static

$P_{0a} = F_a$

Boundary Dimension						Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Type	Mass Kg. (Approx.)
						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
110	113	187	190	63	2.0	280	705	28511	71919	26	51322	BALL	7.2
280	284	380	375	80	2.1	493	1980	50271	201901	50	51256M	BALL	25.3
710	711	950	950	185	8.0	1215	8018	123853	817616	127	N1013	BALL	407

Cylindrical Roller Thrust Bearing



Equivalent bearing load

dynamic

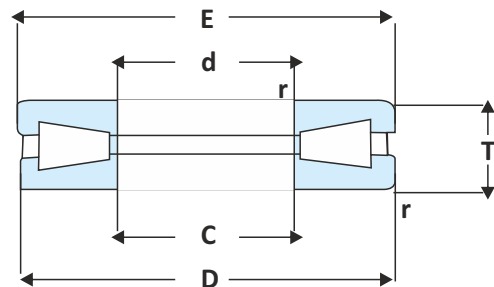
$P_a = F_a$

Static

$P_{oa} = F_a$

Boundary Dimension						Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Type	Mass Kg. (Approx.)
						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
88.9	90.475	138.887	129.362	33.325	-	167	528	16978	53840	62	AT626	CRB	1.87
152.4	154	254	252.4	50.8	4.0	716	3214	72991	327744	317	9923	CRB	10.98
260	260.5	420	419.5	95	5.0	1475	5850	150406	596525	494	9809352	CRB	58
304.8	307.181	609.6	607.219	114.3	9.5	3907	23042	398367	2349543	1781	N1011	CRB	157

Taper Roller Thrust Bearing

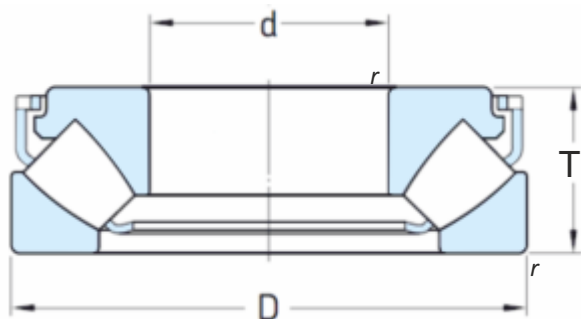


Equivalent bearing load
dynamic
 $P_a = F_a$

Static
 $P_{0a} = F_a$

Boundary Dimension						Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Type	Mass Kg. (Approx.)
						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
203.2	203.2	419.1	419.1	92.075	9.7	2.49	10.6	254	1081	0.92	T811-TTHD	TRB	69
228.6	228.6	482.6	482.6	104.775	11.2	3.50	14.7	357	1499	1.23	T911-TTHD	TRB	103
260	265	480	475	132	6.0	3.30	12.8	337	1305	1.05	9019452	TRB	115
279.4	282.575	603.25	601.726	136.525	11.2	7.70	7.9	785	807	0.62	T1100-TTHD	TRB	198
279.4	282.575	603.25	601.726	136.525	11.2	7.91	32.7	807	3335	2.55	N1146	TRB	198

Spherical Roller Thrust Bearing



Equivalent bearing load

dynamic

$$P_a = F_a + 1.2F$$

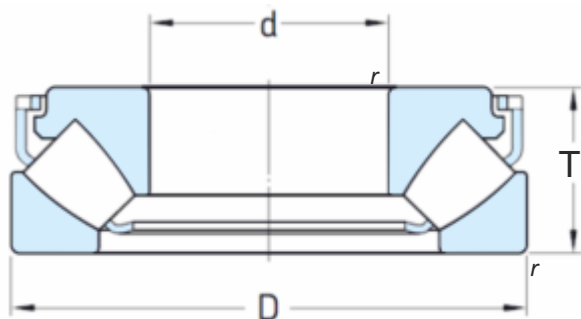
Static

$$P_{0a} = F_a + 1.2F$$

$$\text{When } \frac{Fr}{F_a} \leq 0.55$$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		C _u		
d	D	T	r	Ca	Coa	Ca	Coa			
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

$$P_a = F_a + 1.2F$$

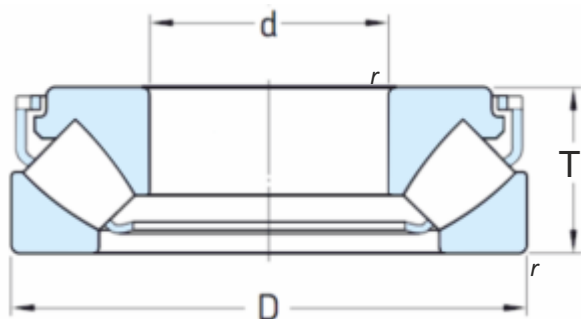
Static

$$P_{0a} = F_a + 1.2F$$

$$\text{When } \frac{F_r}{F_a} \leq 0.55$$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		C _u		
d	D	T	r	Ca	Coa	Ca	Coa			
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

Spherical Roller Thrust Bearing



Equivalent bearing load

dynamic

$$P_a = F_a + 1.2F$$

Static

$$P_{oa} = F_a + 1.2F$$

$$\text{When } \frac{Fr}{F_a} \leq 0.55$$

Boundry Dimensions				Basic Load Rating				Fatigue Load Limit (KN)	Bearing Number	Mass Kg. (Approx.)
				Dynamic	Static	Dynamic	Static			
mm				KN		Kgf		C _u		
d	D	T	r	Ca	Coa	Ca	Coa			
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

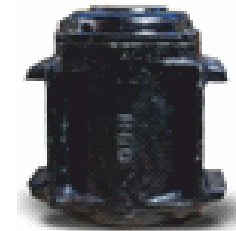
22 Railway Bearing Technical Data

22.1 Bearing and Axle Box details for Railway Applications

NBC provides cost effective solution and bearings to meet railway applications 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



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.



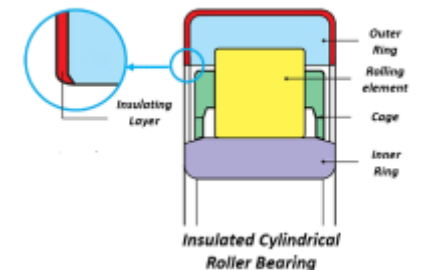
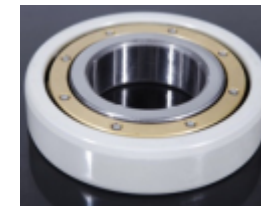
“Insuohm” Insulated Cylindrical Roller Bearing

Electrical insulation coating to prevent electrical pitting in the bearings and hence improved bearing life in Traction motor bearings. Features:

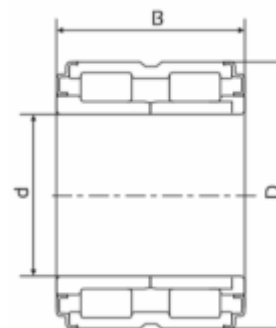
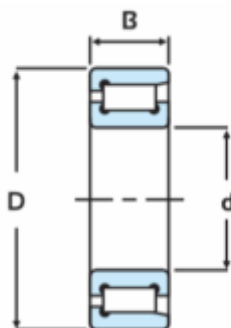
- Improves bearing life in electrical current passage
- Optimized coating with plasma spray process
- High insulation resistance
- High dimensional stability after coating
- Easy to mount

Benefits:

- 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



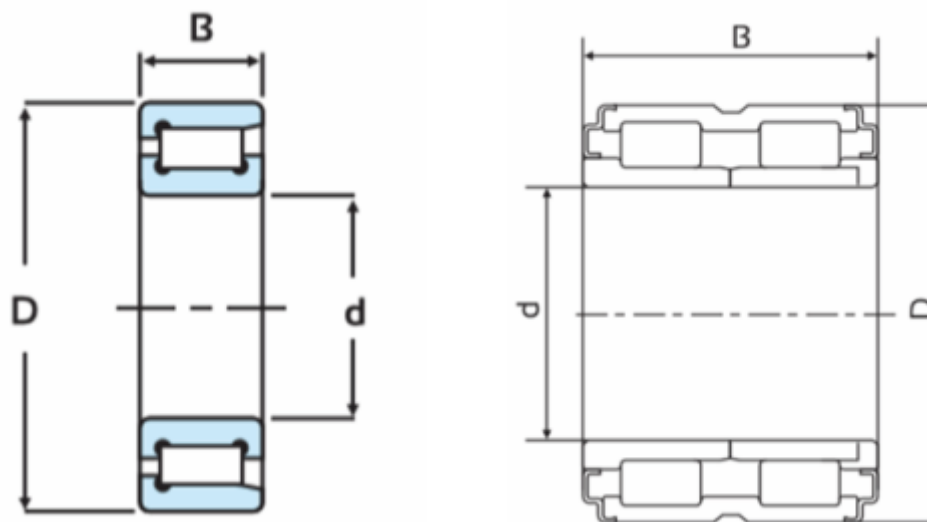
Locomotives	NEI Assembly Drg.	Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number
		mm				KN		Kgf		KN	
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
WDP4	X-190	Refer CTRB Page of Catalogue									Adapter Assembly with CTRB 6-1/2x12 Class 'F' Bearing
WDG3A, WDM3D	X-191	150	270	174	1.2	1280	198	130522	20190	19	RB5081D-E (End Axle) RB5081D-M (Middle Axle)
WDM3D, WDM3E, WDM3F	X-192	150	270	80	2.0	641	932	65363	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	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
WDM3A	X-197	150	270	174	1.2	1280	198	130522	20190	19	RB5081D-E (End Axle) RB5081D-M (Middle Axle)
WDG3A, WDM3D	X-198	150	270	174	1.2	1280	198	130522	20190	19	RB5081D-E (End Axle) RB5081D-M (Middle Axle)
WAG9, WAP7	X-181	150	250	160	2.1	1184	1800	120681	183546	178	RB5080D
	X-202 (Step Size)	148	250	160	2.1	1184	1800	120681	183546	178	RB5088D
Sri Lankan Railways M8A Loco	X-205	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
WDP1M	X-211	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021
WDP3AM	X-212	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5022 L6204 & L6205

Bearings and Axle Boxes For Diesel Electric Locomotives



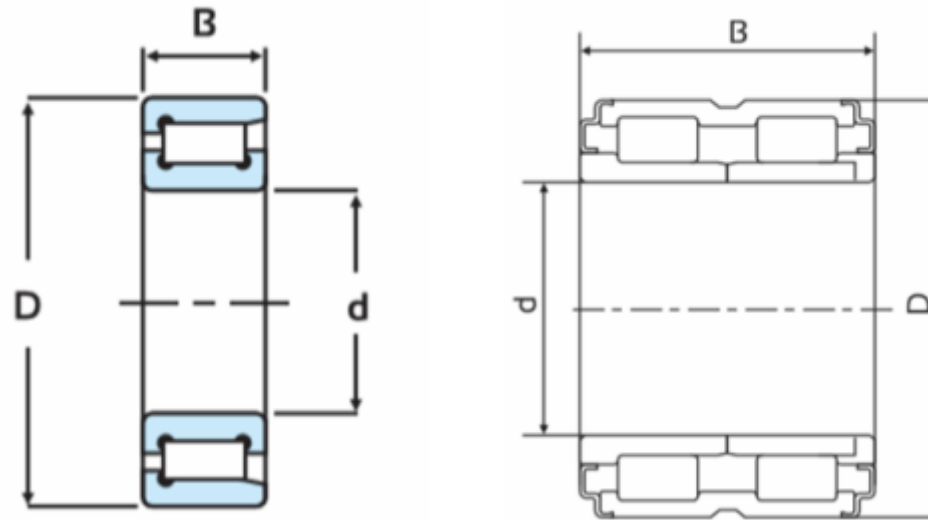
Locomotives	NEI Assembly Drg.	Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number
		mm				KN		Kgf		KN	
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
ZDM4	X-158	100	200	67	4.0	394	496	40146	50536	54	WJ100X200 & WU100X200W
YDM4, YDM4A	92-4253	120	215	60	4.0	374	540	38137	55054	56	L6179 & L6180
	X-151	118	215	60	4.0	374	540	38137	55054	56	RB5069 & RB5070
	(Step Size)										
WDS5, WDS6,	92-4271C	150	270	80	2.0	641	932	65363	95036	91	L6204 & L6205
WDM2, WCG2,	X-119	148	270	80	2.0	641	932	65363	95036	91	RB5043 & RB5044
WAM4, WAM4A,	(Step Size)										
WDM3A, WAM4	X-105	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-141	148	270	80	1.5	641	932	65363	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
	(Step Size)										
WDS3	92-4204	200	360	98	4.0	913	1370	93076	139691	123	L6019 (2 Nos.)
WDS4	92-4277A	200	360	236	1.6	1568	2742	159838	279551	245	L6207 (1-Set)
WDP3A, WAP3,	X-180 (End Axle)	150	270	80	2.0	641	932	65363	95036	91	L6204 & L6205
WAP6	X-180 (Middle Axle)	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5022
WDP1	X-174	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
WDG3A, WDM3B, WDM3D	X-171	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-182	148	270	80	1.5	641	932	65363	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
	(Step Size)										
WAP1, WAP4	X-122	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-186	148	270	80	1.5	641	932	65363	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
	(Step Size)										
Sri Lankan Railways (SL3200WB)	X-187	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
Malaysian Railways 2300HP	X-188	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022

Bearings and Axle Boxes For Electric Locomotives



Locomotives	NEI Assembly Drg.	Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number
		mm				KN		Kgf		KN	
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
WAM4, WAM4A, WAG5, WAG5A, WAG5C, WAG5D, WCAM1, WCG2	92-4271C	150	270	80	2.0	641	932	65363	95036	91	L6204 & L6205
	X-119	148	270	80	2.0	641	932	65363	95036	91	RB5043 & RB5044
	(Step Size)										
WAM4, WAG5B, WCAM1	X-105	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-141 (Step Size)	148	270	80	1.5	641	932	65363	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
WAP3, WAP6	X-180 (End Axle)	150	270	80	2.0	641	932	65363	95036	91	L6204 & L6205
	X-180 (Middle Axle)	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5022
WAG7, WCM6	X-171	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-182 (Step Size)	148	270	80	1.5	641	932	65363	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064

Bearings and Axle Boxes For Electric Locomotives

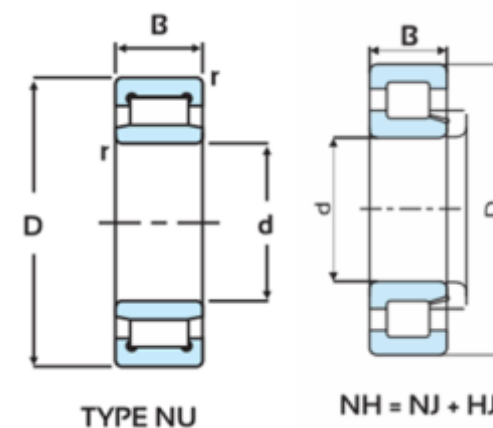


Locomotives	NEI Assembly Drg.	Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number
		mm				KN		Kgf		KN	
		d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu	
WAP1, WAP4	X-122	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-186 (Step Size)	148	270	80	1.5	641	932	65363	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
WAP3, WAP6	X-149	150	270	80	2.0	641	932	65363	95036	91	L6204 & L6205
WAG9, WAP7	X-181	150	250	160	2.1	1184	1800	120681	183546	178	RB5080D
	X-202 (Step Size)	148	250	160	2.1	1184	1800	120681	183546	178	RB5088D
WAG7	X-207	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022
	X-182 (Step Size)	148	270	80	1.5	641	932	65363	95036	91	RB5062 (2 Nos.) with Special Loose Lip RB5063 & RB5064
WAG5HB, 1400 HP LOCO	X-179	150	270	80	2.0	641	932	65363	95036	91	RB5020 (2 Nos.) with Special Loose Lip RB5021 & RB5022

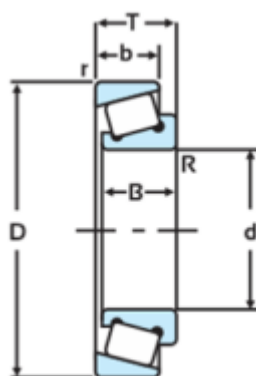
Bearing for Traction Motor Suspension Unit Application

Cylindrical roller bearing

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		
220	340	56	3	500	750	50985	76478	67	NH1044	20.6
320	440	56	3	625	1100	63731	112167	90	NU1964	24.7

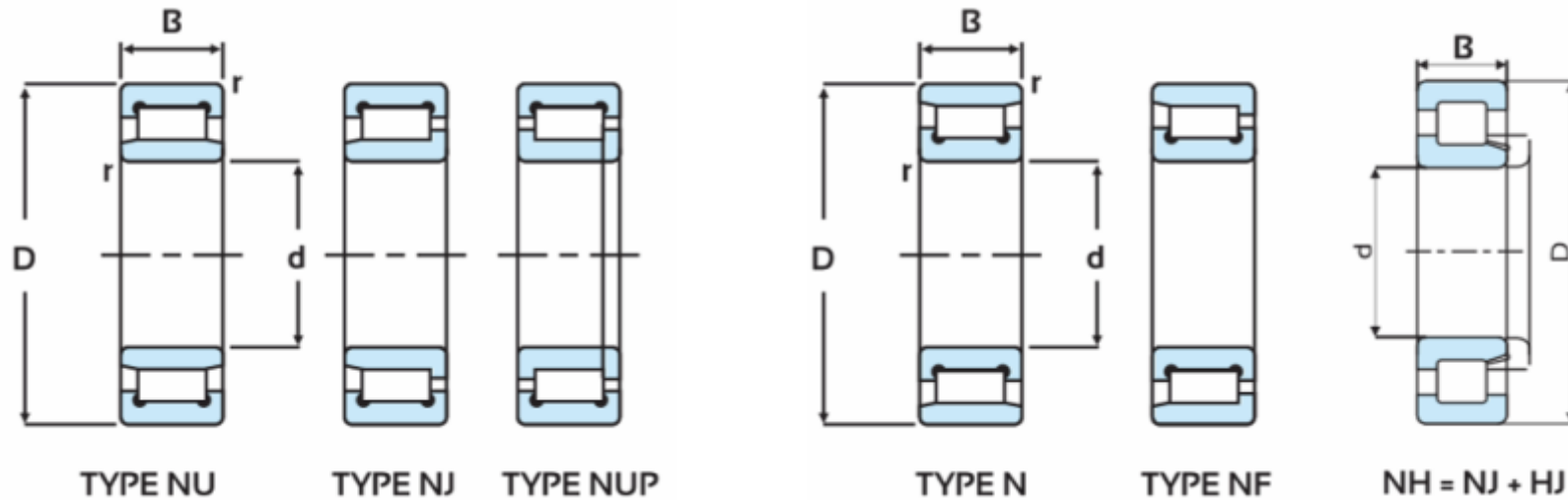


Single Row Taper Roller Bearing (Inch series)



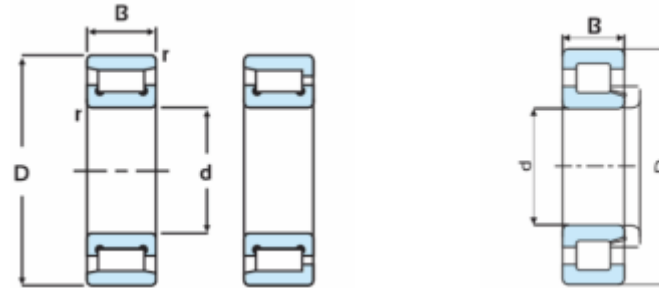
Boundary Dimensions							Basic Load Rating				Fatigue load limit	e	Bearing Number	Mass Kg. (Apporox.)
mm							KN		Kgf		KN			
d	D	T	B	b	R	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu			
198.298	279.4	46.038	49.212	36.513	3.5	3.3	363.9	786.8	37107	80230	73	0.51	67981/67919	9.3
199.949	279.4	46.038	49.212	36.513	3.5	3.3	363.9	786.8	37107	80230	73	0.51	67982/67919	9.0
220.662	314.325	61.912	66.675	49.212	1.6	5.0	625	1239	63731	126341	113	0.33	M244249A/N1060	15.0
221.17	314.325	61.91	66.675	49.212	1.6	5.0	625	1239	63731	126341	113	0.33	M244210/N1059	14.0
255.6	342.9	57.15	63.5	44.45	1.5	3.3	614.1	1282.4	62620	130766	113	0.35	M349547/M349510	13.80
257.175	358.775	71.438	76.2	53.975	1.5	3.3	818.5	1663.6	83462	169637	145	0.33	M249747/M249710	20.65

Cylindrical Roller Bearing for Traction Motor



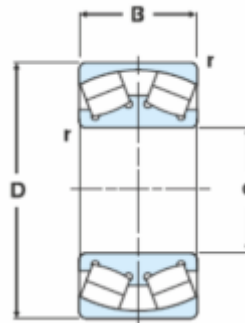
Boundary Dimensions				Basic Load Rating				Fatigue load limit	Bearing Number	Mass Kg. (Apporox.)
mm				KN		Kgf		KN		
d	D	B	r	Dynamic Cr	Static Cor	Dynamic Cr	Static Cor	Cu		
90	190	43	3	315	355	32121	36199	39	TS2-NH318C L1BX C4 P6	6.7
90	190	43	3	315	355	32121	36199	39	TS2-NH318C L1BX2 C4 P6	6.6
100	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	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		
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

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.

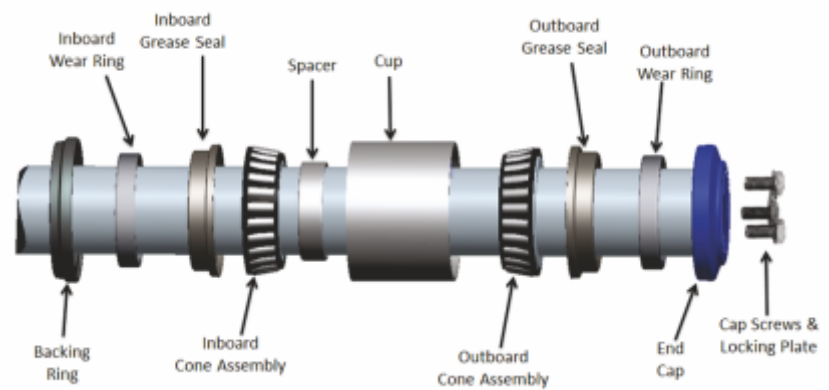


Fig. 1: Exploded View of Cartridge Tapered Roller Bearing



CTRB part 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 PLUS 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 PLATE	1	913	1013	1113	1213	1213
7.3	CAP SCREW	3	1012	1012	1112	1212	1212

Upgraded Class E (6x11) CTRB **OPTIMO^X**

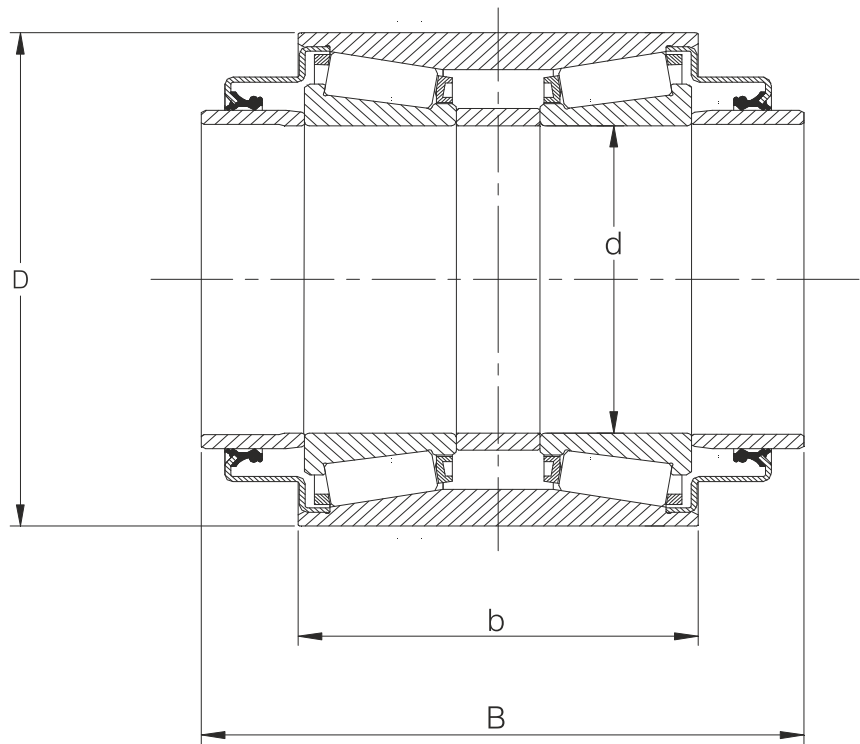
Upgraded (OptimoX) Cartridge Taper Roller Bearing (CTRB 6x11 Class 'E') for 25 tonne axle load

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 L₁₀ Bearing Life
- Stronger Polymer Cage for Rail Impact Conditions
- Optimized Raceways for the Rail Environment

AAR Standard Cartridge Tapered Roller Bearings

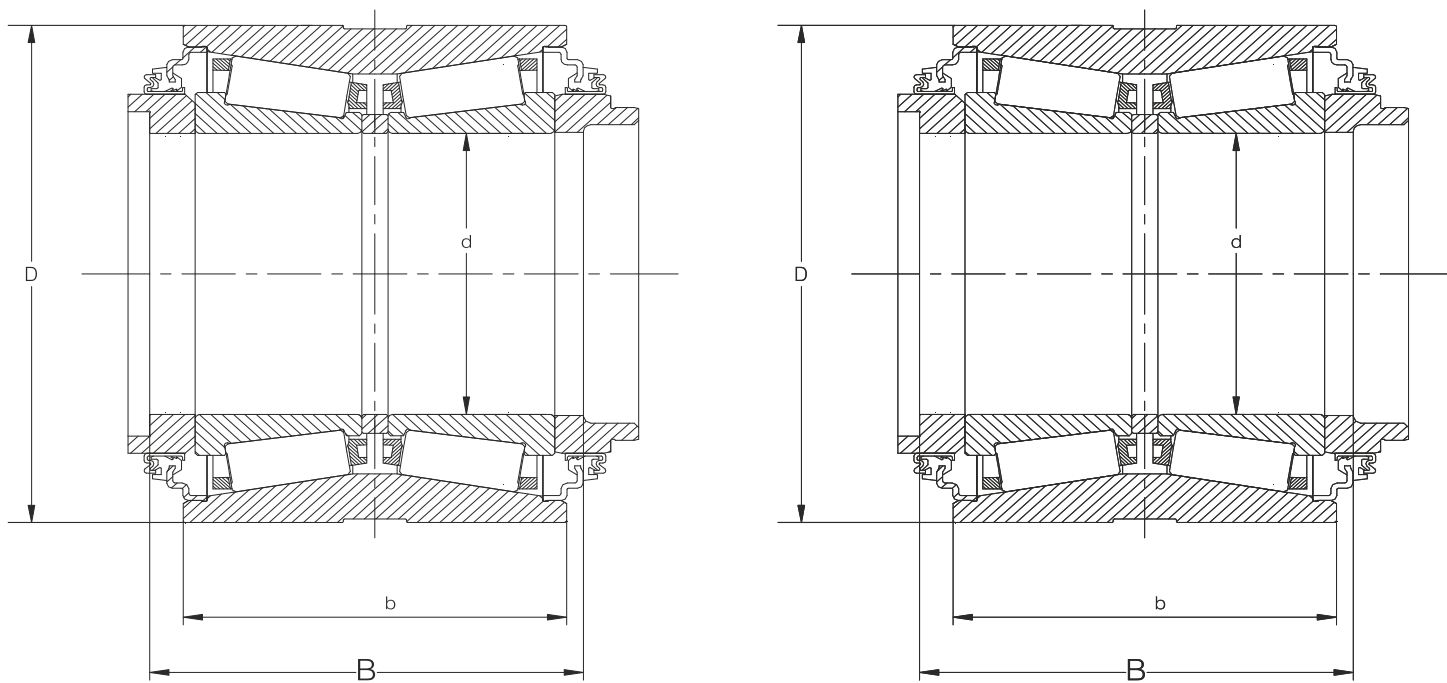


Boundary Dimensions				Basic Load Rating				Fatigue load limit	BEARING SIZE
mm				KN		Kgf		KN	
d	D	b	B	DYNAMIC C	STATIC Co	DYNAMIC C	STATIC Co	Cu	
119.063	195.263	142.9	217.1	684	1109	69747	113085	119	CTRB 5x9 CLASS 'C' *
131.75	207.963	152.4	225.4	724	1232	73826	125643	129	CTRB 5 1/2X10 CLASS 'D' *
144.45	220.663	163.5	241.3	774	1348	78925	137436	138	CTRB 6X11 CLASS 'E' **
157.15	252.413	184.15	273.1	1052	1825	107272	186095	180	CTRB 6 1/2X12 CLASS 'F'
157.15	249.873	160	216.6	1052	1825	107272	186095	180	CTRB 6 1/2X9 CLASS 'K'

* Available with steel cage only

** Available with upgraded (NEI optimo series)

Metric Cartridge Tapered Roller Bearings (metric series)



Boundary Dimensions				Basic Load Rating				Fatigue load limit	BEARING SIZE
mm				KN		Kgf		KN	
d	D	b	B	DYNAMIC C	STATIC Co	DYNAMIC C	STATIC Co	Cu	
130	230	160	183	852	1636	86878	166823	167	UIC130X230
130	230	160	198	852	1636	86878	166823	167	UIC130X230
130	240	160	170	983	1727	100238	176104	176	UIC130X240
150	250	160	180	903	1834	92079	187013	181	UIC150X250

Note:- Available with polyamide cage only

23 Units SI

Units Specified in SI System

Force

1 KN (Kilo newton)	=	1000N	=	102Kgf
1 Kgf	=	9.81N		

Pressure

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 (Centi stoke)
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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
27/32	40.05	25	64.41
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	mm		Inches	mm	
1/64	.015625	.03969	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	.78125	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	20.6375
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	.69875	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	.43360	.82677	1.22047	1.61417	2.00788	2.40158	2.79528	3.18898	3.58288
2	.47244	.86614	1.25984	1.65354	2.04495	2.83465	3.22835	3.62205	3.62205
3	.51181	.90551	1.29921	2.08662	2.08662	2.48034	2.87402	3.26772	3.66142
4	.55118	.94488	1.33858	1.73228	2.12599	2.15969	2.91339	3.30709	3.70079
5	.59055	.98425	1.37795	1.77165	2.16536	2.55906	2.95276	3.34646	3.74016
6	.62992	1.02362	1.41732	1.81103	2.20473	2.59843	2.99213	3.38583	3.77953
7	.66929	1.06299	1.45669	1.85040	2.24410	2.63780	3.03150	3.42520	3.81890
8	.70866	1.10236	1.49606	1.88977	2.28347	2.67717	3.07087	3.46457	3.85827
9	.74803	1.14173	1.53543	1.92914	2.32284	2.71654	3.11024	3.50395	3.89764

CONVERSION TABLES.

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	4.33071	8.26772	12.2047	16.1417	20.0788	24.0158	27.9528	31.8898	35.8268
20	4.72441	8.66142	12.5984	16.5354	20.4725	24.4095	28.3465	32.2835	36.2205
30	5.11811	9.05513	16.9921	16.9291	20.8662	24.8032	28.7402	32.6772	36.6142
40	5.51181	9.44883	13.3858	17.3228	21.2599	25.1969	29.1339	33.0709	37.0079
50	5.90552	9.84252	13.7795	17.7165	21.6536	25.5906	29.5276	33.4646	37.4016
60	6.29922	10.2362	14.1732	18.1103	22.0473	25.9843	29.9213	33.8583	37.7953
70	6.69292	10.6299	14.5669	18.5040	22.4410	26.3780	30.3150	34.2520	38.1890
80	7.08662	11.0236	14.9606	18.8977	22.8347	26.7717	30.7087	34.6457	38.5827
90	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

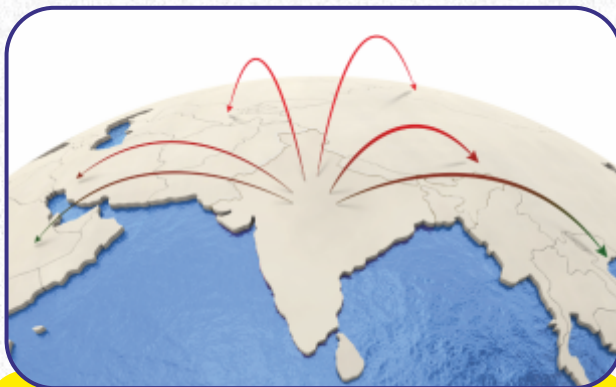
Inch	mm	mm	mm
0	254.0	508.0	762.0
1	25.4	279.4	533.4
2	50.8	304.8	558.8
3	76.2	330.2	584.2
4	101.6	355.6	609.6
5	127.0	381.0	635.0
6	152.4	406.4	660.4
7	177.8	431.8	685.8
8	203.2	457.2	711.2
9	228.6	482.6	736.6

26 Hardness Conversion Table

Hardness conversion table (reference)

Rockwell hardness C scale 1471.ON (150kgf)	Vicker's hardness	BRINELL HARDNESS		ROCKWELL HARDNESS		Shore hardness
		Standard steel ball	Tungsten carbide steel ball	A scale 588.4N (60kgf)	B scale 980.7N (100kgf)	
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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