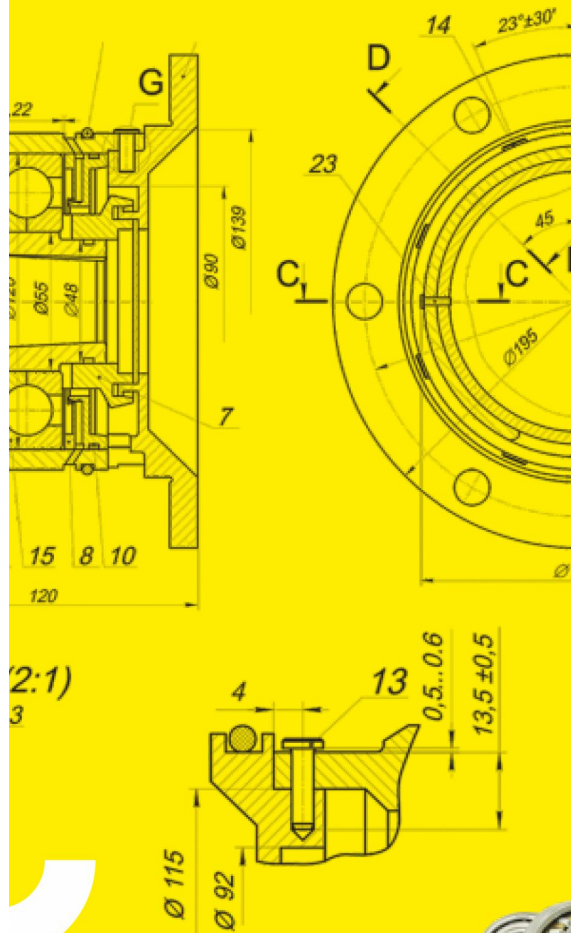


CELEBRATING  
**75**  
YEARS



CK BIRLA GROUP

**nbc**  
flexible solutions



# ROLLING BEARINGS

Basics of Roller Bearings



2 WHEELERS



3 WHEELERS



4 WHEELERS



TRACTORS



LCV, HCV



INDUSTRIES



RAILWAYS



AEROSPACE



**nbc**  
flexible solutions

CATALOGUE/TC-106, 01/2024

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.

The material and Information contained here are for general information purpose only. You should not rely upon the material or information provided herein for any basis for making any business, legal or other decisions.

While we make every endeavour to keep the information accurate and correct, National Engineering Industries Ltd. makes no representations and warranties of any kind either express or implied about the correctness, accuracy, suitability, reliability or productivity with respect to information or concepts contained in this catalogue for any purpose. Any reliance on such material is solely at your risk and consequences.

© NEI Ltd. Jaipur 2024

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

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



## Products from NBC

Since the challenges faced by industry are many, NBC offers a diverse range of exceptional bearings. NBC bearings are available in sizes from 04 mm bore to 2000 mm outer diameter.



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

# 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

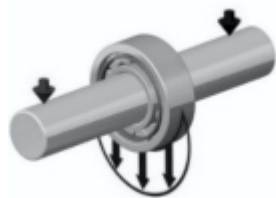
Due to their wide availability and versatility, rolling element bearings are, perhaps, the most widely used bearing type.

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**



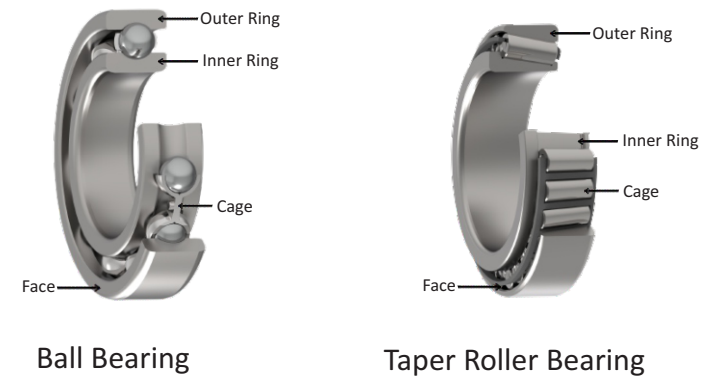
In addition depending upon the type of rolling elements these are further classified into

- 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."



**Ball Bearing**

**Taper Roller Bearing**

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

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



**Ball**

**Cylindrical Roller**

**Tapered Roller**

**Spherical Roller**

**Needle Roller**

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

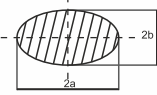
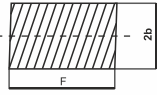


## 1.2 Characteristics of Rolling Bearings

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

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

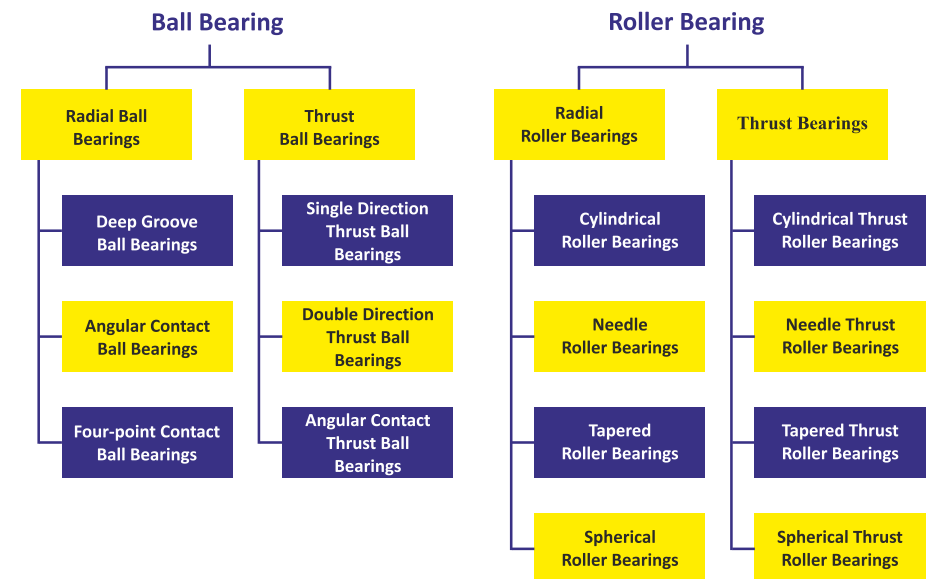
**Table 1.1 Comparison of Ball and Roller bearing**

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

## 1.3 Rolling Bearing Classification

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

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



### 1.3.1 Deep Groove Ball Bearing

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

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



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

### 1.3.2 Angular Contact Bearing

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

Single Row  
Angular Contact



Double Row  
Angular Contact

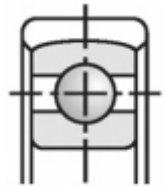


Four Point  
bearings



### Single Row Externally Aligned Ball Bearing

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



### 1.3.3 Self-Aligning Ball Bearing

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

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



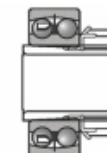
Self-Aligning  
Ball Bearing



Cylindrical  
Bore



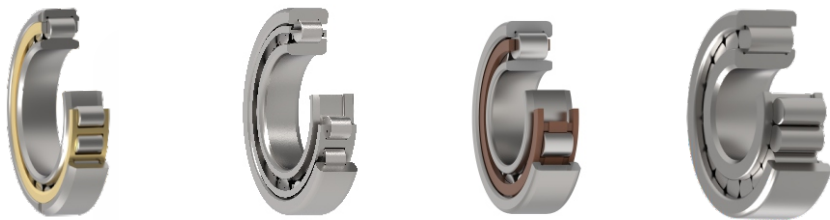
Tapered  
Bore



Tapered Clamping  
Sleeve and Nut

### 1.3.4 Cylindrical Roller Bearing

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



Brass Cage

Steel Cage

Polyamide Cage

Full Compliment



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.

#### Back to Back Arrangement



Double Row

#### Face to Face Arrangement



Double Row



Four Row

### 1.3.6. Spherical Roller Bearing

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



**Spherical Roller Bearing**



**Cylindrical bore**



**Tapered bore**

### 1.3.7 Thrust Bearing

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

Thrust bearings come in several varieties.

- Thrust ball bearings, consists of balls supported in a ring, can be used in low thrust applications where there is little axial load.
- Cylindrical thrust roller bearings consist of cylindrical rollers arranged flat with their axes pointing to the axis of 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**



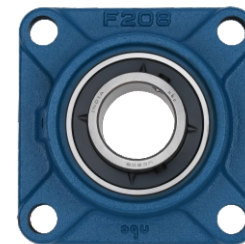
**Cylindrical Roller Thrust Bearing**



**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.



**UCF**



**UCP**



### 1.3.9 Needle Roller Bearing

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

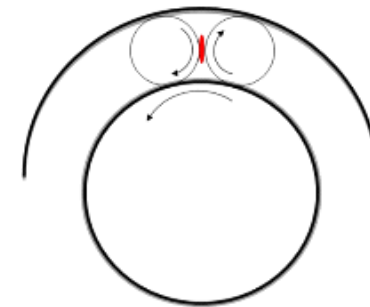
Shell type needle roller bearing comprises of an outer shell ring made from special thin steel, needle rollers and cage. A hardened and ground inner ring/shaft is used as the raceway.



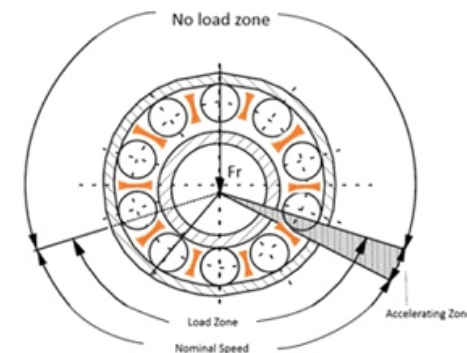
### 1.4 Cage

#### Function of cage

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



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



### 1.4.1 Types of Cages

#### Sheet Metal Cages

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



Riveted type cage  
For deep groove  
ball bearing



Steel stamped cage  
for taper roller  
bearing



Steel stamped cage  
for cylindrical roller  
bearing

#### Machined Brass Cages

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



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



Split type  
machined brass  
cage for spherical  
roller bearings



Window type  
machined brass  
cage for angular  
contact ball bearing



Brass cage  
for deep groove  
ball bearing

#### Polyamide Cage

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

Please note that:

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



Molded polyamide  
snap cage for deep  
groove ball bearing



Molded polyamide  
window type cage  
for taper roller



Polyamide cage for  
double row angular  
contact bearing

#### Pin-type Steel Cages

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



Pin-type cage in TRB

## 1.5 Seals and Shield

Seals/shields have significant effect on the life of rolling bearing.

The shields are non- contact type and made of sheet steel. Provides protection from dirt and dust. Mostly used in application with inner rotating.

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

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

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

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

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



**Sealed Bearing**  
(Contact Rubber Type)



**Shield Bearing**  
(Non-Contact Type)

## 1.6 Bearing Material

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

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

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

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

### Through-Hardening

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

### Induction-Hardening

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

### Case-Hardening

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

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

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

## 02 Bearing Designation & Nomenclature