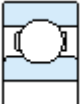
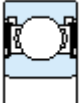


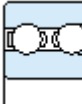


## Nomenclature, Prefix and Suffixes, Tolerances and Clearances

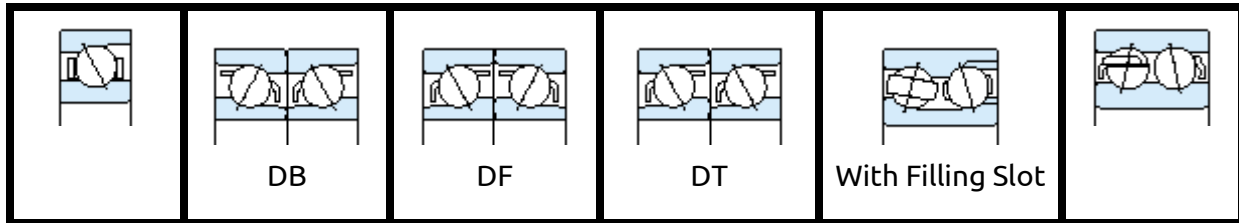
### 1. Deep Groove Ball Bearings

Open Type	Shielded / Sealed Type	With Locating Snap Ring	Maximum Type	Double Row
	 ZZ 2RS	 NR	 With Filling Slot	

- The most popular types among rolling bearings, widely used in a variety of industries.
- Radial load and axial load in both directions can be accommodated.
- Suitable for operation at high speed, with low noise and low vibration.
- Sealed bearings employing steel shields or rubber seals are filled with the appropriate volume of grease when manufactured.

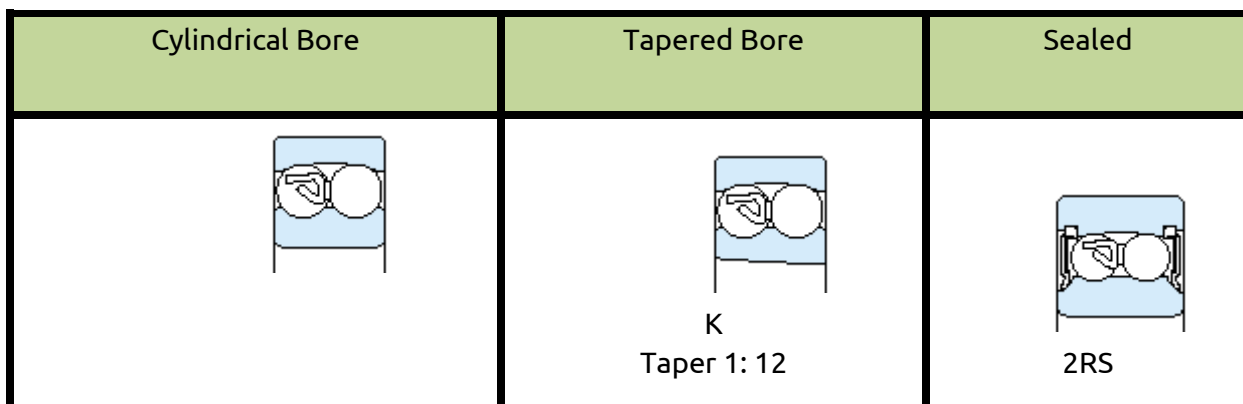
### 2. Angular Contact Ball Bearings

Single Row	Back-to-Back Arrangement	Face-to-Face Arrangement	Tandem Arrangement	Double Row



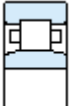
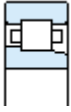
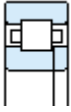
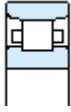
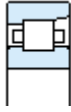
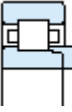
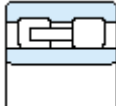
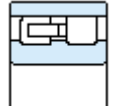
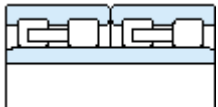
- Bearing rings and balls possess their own contact angle that is normally  $15^\circ$ ,  $30^\circ$  or  $40^\circ$ .  
Larger is the contact angle, higher resistance against axial load.  
Smaller contact angle is more advantageous for high-speed rotation.
  - Single-row bearings can accommodate radial load and axial load in one direction.
  - DB and DF matched pair bearings and double-row bearings can accommodate radial load and axial load in both directions.
- DT matched pair bearings are used for applications where axial load in one direction is too large for one bearing to accept.
- Angular contact ball bearings are used for high accuracy and high-speed operation.

### 3. Self-Aligning Ball Bearings



- Spherical outer ring raceway allows self-alignment, accommodating shaft or housing deflection and misaligned mounting conditions.
- Tapered bore design can be mounted readily using an adapter.

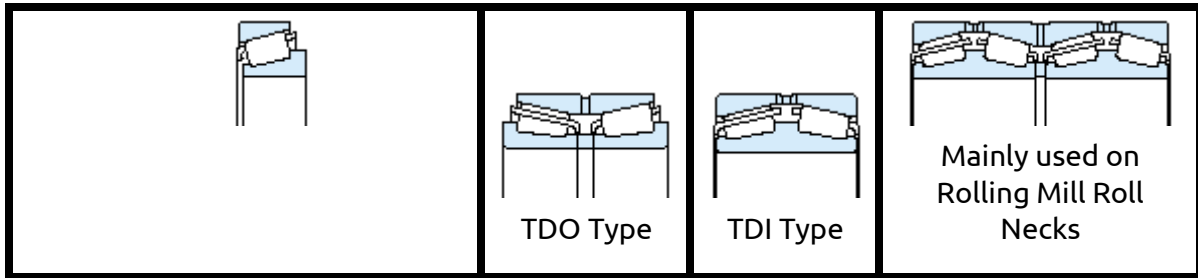
#### 4. Cylindrical Roller Bearings

Single Row						Double Row		Four Row
								 Mainly use on Rolling Mill Roll Neck
NU	NJ	NUP	N	NF	NH	NNU	NN	

- Since the design allowing linear contact of cylindrical rollers with the raceway provides strong resistance to radial load, this type is suitable for use under heavy radial load and impact load, as well as at high speed.
  - N and NU types are ideal for use on the free side: they are movable in the shaft direction in response to changes in bearing position relative to the shaft or housing, which are caused by heat expansion of the shaft or improper mounting.
  - NJ and NF types can accommodate axial load in one direction: and NH and NUP types can accommodate partial axial load in both directions.
  - With separable inner and outer ring, this type ensures easy mounting.
- Due to their high rigidity, NNU and NN types are widely used in machine tool spindles.

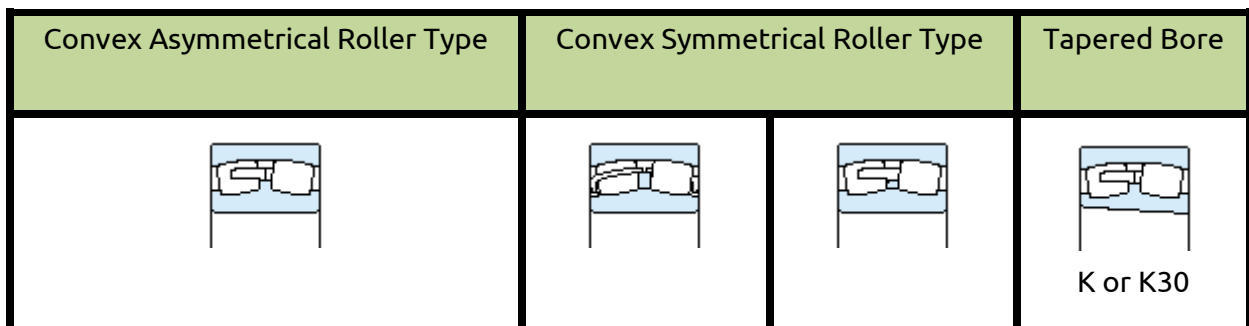
#### 5. Tapered Roller Bearings

Single Row	Double Row	Four Row



- Single-row bearings can accommodate radial load and axial load in one direction, and double-row bearings can accommodate radial load and axial load in both directions.
- This type of bearing is suitable for use under heavy load or impact load.
- Bearings are classified into standard, intermediate and steep types, in accordance with their contact angle.
- The larger the contact angle is, the greater the bearing resistance to axial load.
- Items sized in inches are still widely used.

## 6. Spherical Roller Bearings

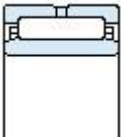
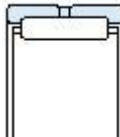
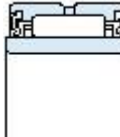
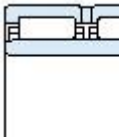
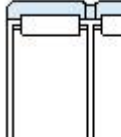


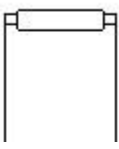
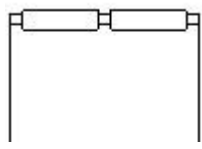
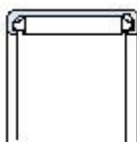
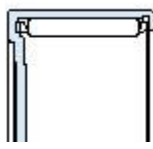
- Spherical roller bearings comprising barrel-shaped convex rollers, double-row inner ring and outer ring are classified into four types: CC, CA, and MB & E type according to their internal structure.
- With the bearing designed such that the circular arc center of the outer ring raceway matches with the bearing center, the bearing is self-aligning, insensitive to errors of alignment of the shaft relative to the housing, and to shaft bending.

This type can accommodate radial load and axial load in both directions, which makes it especially suitable for applications in which heavy load or impact load is applied.

- The tapered bore type can be easily mounted/dismounted by using an adapter or withdrawal sleeve.

## 7. Needle Roller Bearings



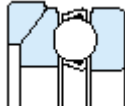
Machined Ring Needle Roller Bearings				
Single Row			Double Row	
				
With Inner Ring	Without Inner Ring	Sealed	With Inner Ring	Without Inner Ring

Needle Roller and Cage Assemblies		Drawn Cup Needle Roller Bearings			
Single Row	Double Row	With Open Ends		With Closed End	
					
R	WR	Full complement type	BM	Full complement type	MM
RS	WV				
V				With Cage	MKM
VS		With Cage	BTM		MHK
			BHT M		M

In spite of their basic structure, which is the same as that of NU type cylindrical roller bearings, bearings with minimum ring sections offer space savings and greater resistance to radial load, by using needle rollers.

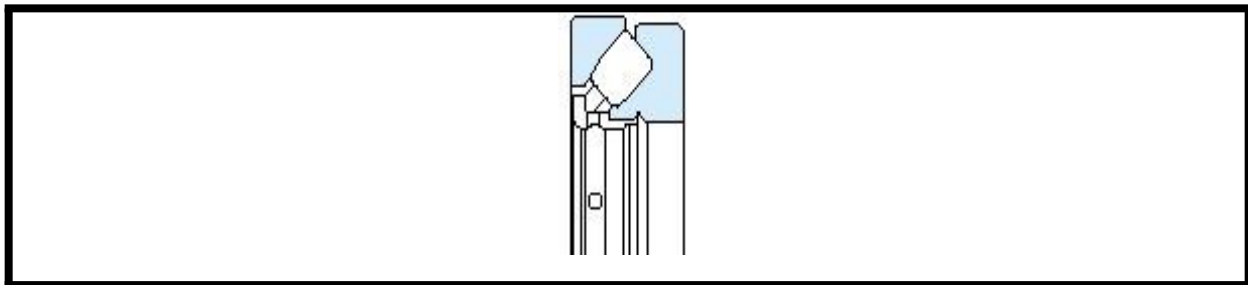
Bearings with no inner rings function using heat-treated and ground shafts as their raceway surface.

## 8. Thrust Ball Bearings

With Flat Back Faces	With Spherical Back Face	With Aligning Seat Washer
		

- This type of bearing comprises washer-shaped rings with raceway groove and ball and cage assembly.
- These bearings cannot accommodate radial loads.

## 9. Spherical Thrust Roller Bearings



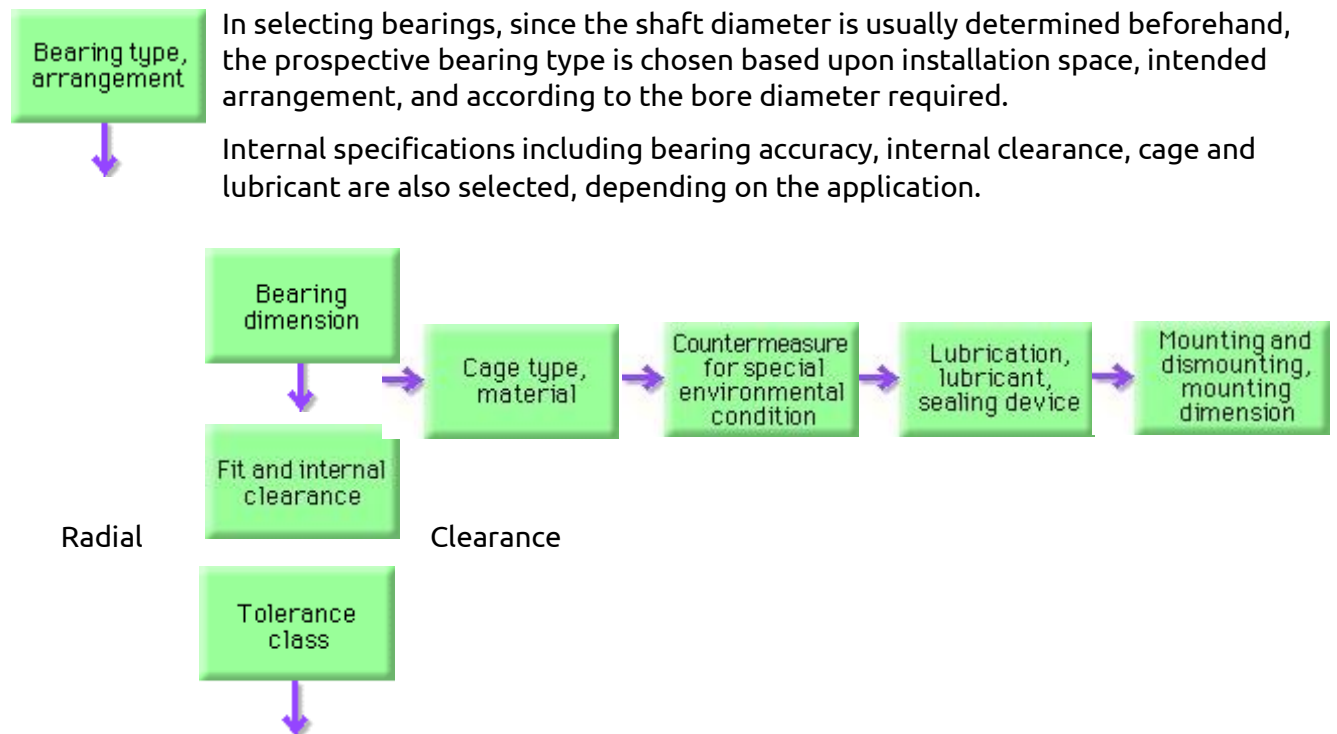
- This type of bearings, comprising barrel-shaped convex rollers arranged at an angle with the axis, is self-aligning due to spherical housing washer raceway; therefore, shaft inclination can be compensated for to a certain degree.
- Great axial load resistance is provided. This type can accommodate a small amount of radial load as well as heavy axial load.

Currently, as bearing design has become diversified, their application range is being increasingly extended. In order to select the most suitable bearings for an application, it is

necessary to conduct a comprehensive study on both bearings and the equipment in which the bearings will be installed, including operating conditions, the performance required of the bearings, specifications of the other components to be installed along with the bearings, marketability, and cost performance, etc.

For reference, general selection procedure and operating conditions are described as follows. There is no need to follow a specific order since the goal is to select the right bearing to achieve optimum performance.

### Selection of Bearing:



Virtually all rolling element bearings are designed with a specific internal clearance. The internal clearance is defined as the total clearance between the rings and the rolling elements. This clearance provides:





- Free rotation of rolling element
- Compensation for thermal expansion
- Optimum load distribution

Selecting the correct internal clearance is important because bearings hold the rotating parts of a mechanism in proper position across the entire performance envelope of the application. The amount of internal clearance can influence:

- Noise
- Vibration
- Heat build-up
- Fatigue life

Vibration, interface fits and temperature will also have some effect on internal clearance. To obtain the optimal internal clearance for a specific application, these parameters must be taken into consideration. In certain applications, the correct choice of clearance for the bearings is critical. Internal clearance can be separated into two categories:

- Radial
- Axial

The total internal clearance is the amount that one ring can be displaced relative to the other ring, either radially or axially. The radial clearance is the total clearance between the raceway and the rolling elements - measured normal to the bearing axis. The clearance changes with the expansion or contraction of the bearing rings. The axial clearance is the total amount that one ring can be displaced relative to the other in an axial direction.

In ball bearings, as the radial clearance increases, the axial clearance increases as well. The more room between the balls and the rings (radial clearance), the more the elements can shift in relation to each other. Generally, internal clearances are designated from C1 (the tightest) through to C5 (the loosest or largest). The 'normal'



clearance is CN, a range sitting between C2 and C3. It is worth noting that if the bearing clearance is not stated in the bearing reference it can be assumed to be normal clearance. With a higher clearance there is more tolerance of thermal expansion effects on the rings and rolling elements. When noise and vibration must be restricted, lower clearances are necessary. Ultimately the specific application and operating conditions determine the appropriate internal clearance. For example, paper-drying machines that operate under hot conditions usually need C3 and C4 clearances. The severe vibration in vibrating screens normally means that C3 and C4 clearances are required. Selection of the correct radial internal clearance group is by calculation and you should refer to your bearing manufacturers handbook. Factors to be assessed include:

- Expansion of the inner ring due to interference fit on shaft.
- Contraction of the outer ring due to interference fit in the housing.
- Differential temperature between the inner and outer rings
- Differential expansions due to non-ferrous mountings