



NSK

NSK

ABC of Bearings



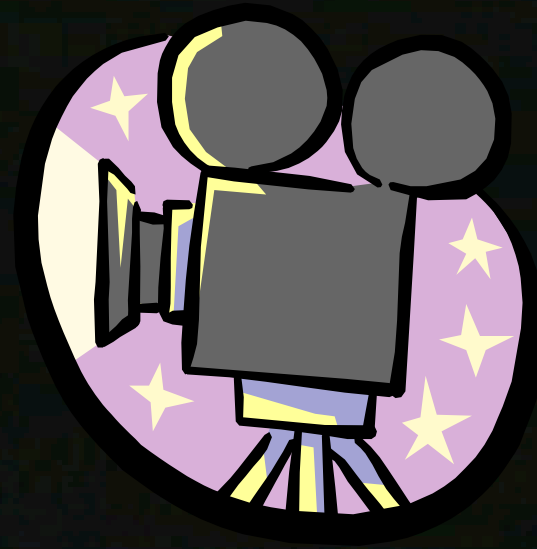
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2	Introduction to Rolling Bearings
3	Types and Features of Rolling Bearings
4	Boundary Dimensions for Rolling Bearings
5	Tolerances, Clearances and Fits
6	Bearing Numbers for Rolling Bearings
7	Bearing Handling



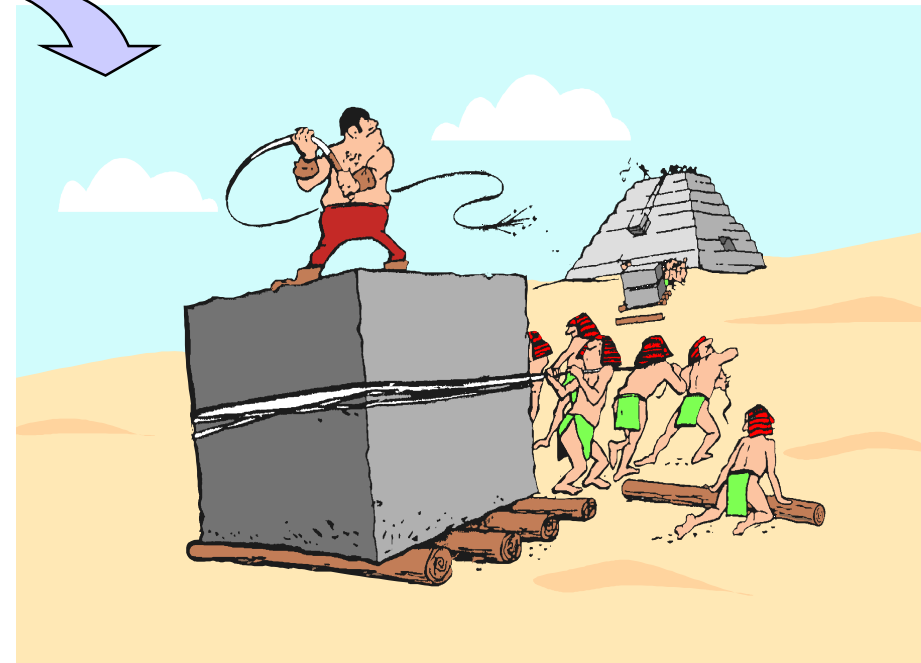
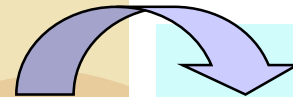
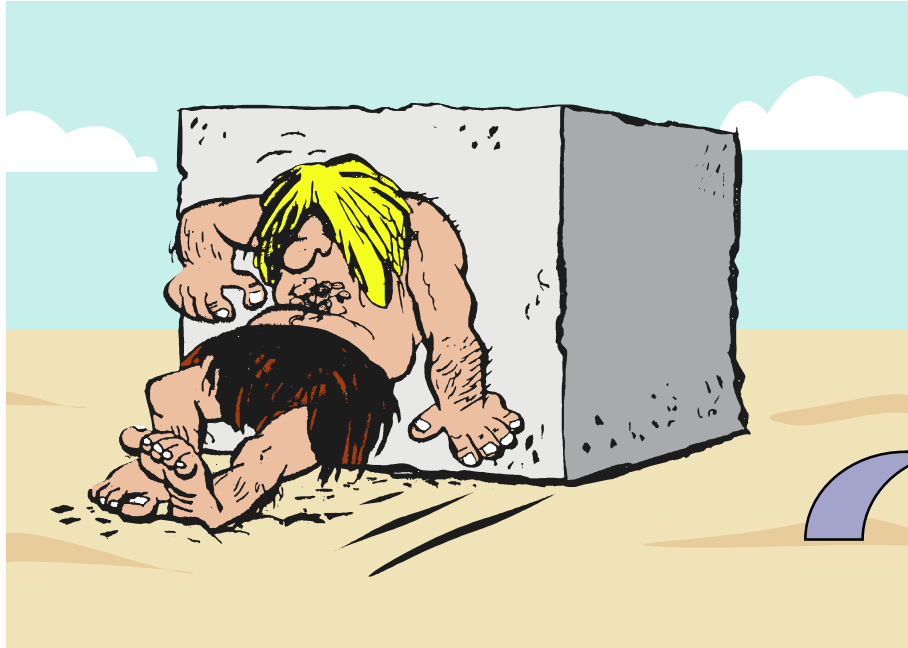
Objectives

- ❑ **Understand the difference between plain and rolling bearings.**
- ❑ **Introduction to the different types of rolling bearings.**
- ❑ **Learn the importance and relationship between tolerances, fits and clearances.**
- ❑ **Identify bearings based on its part numbers.**
- ❑ **Knowledge of how to handle bearings.**

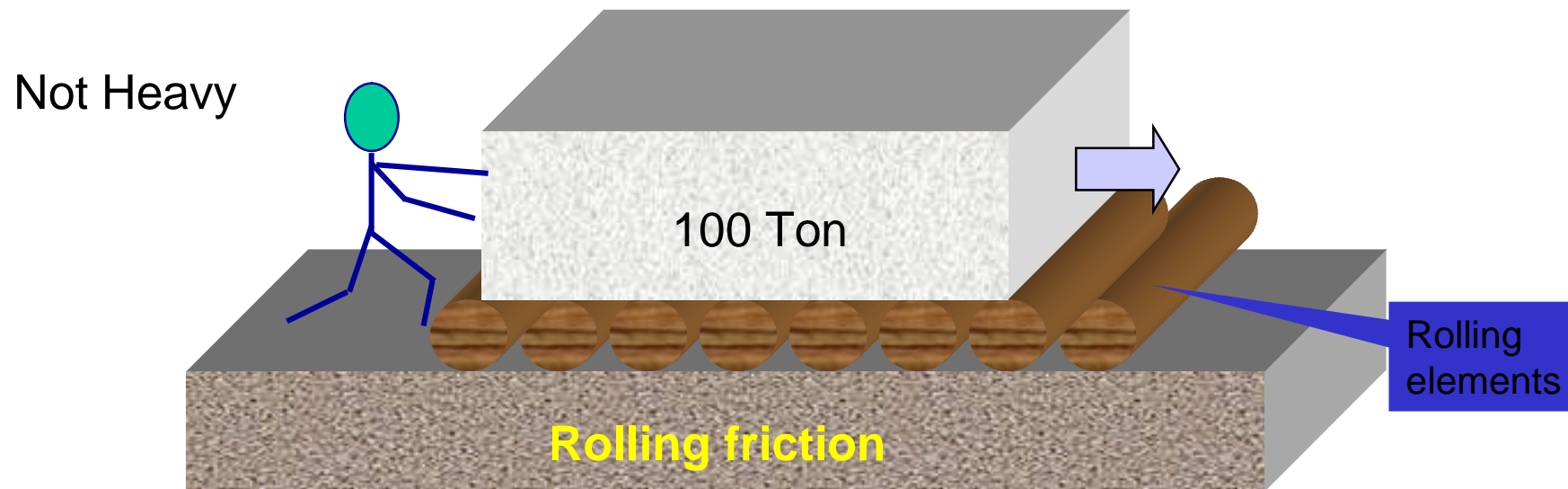
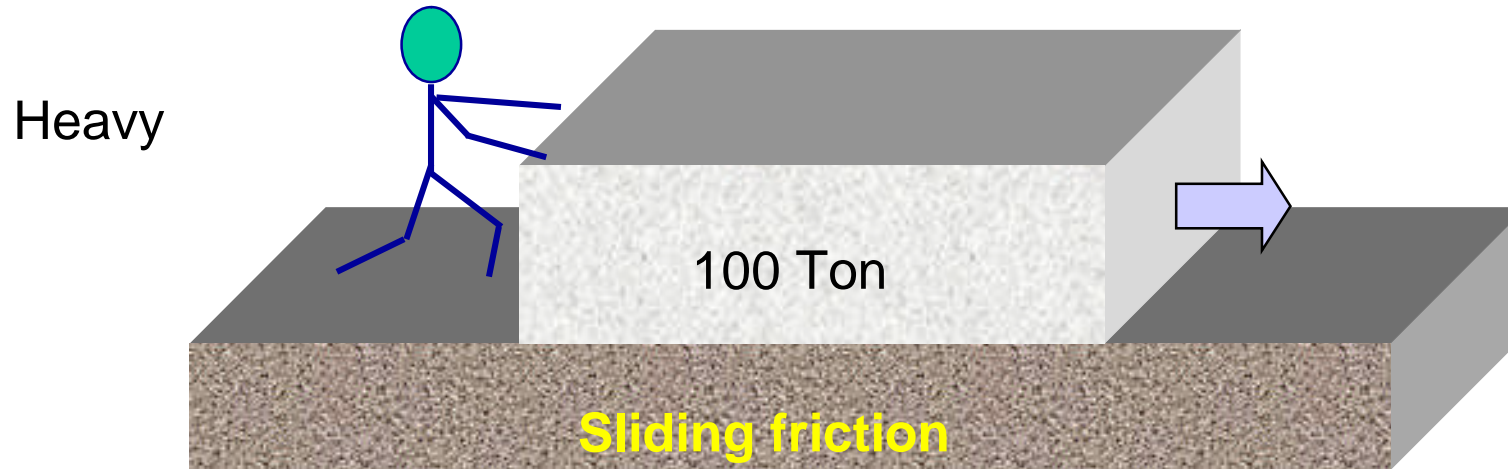


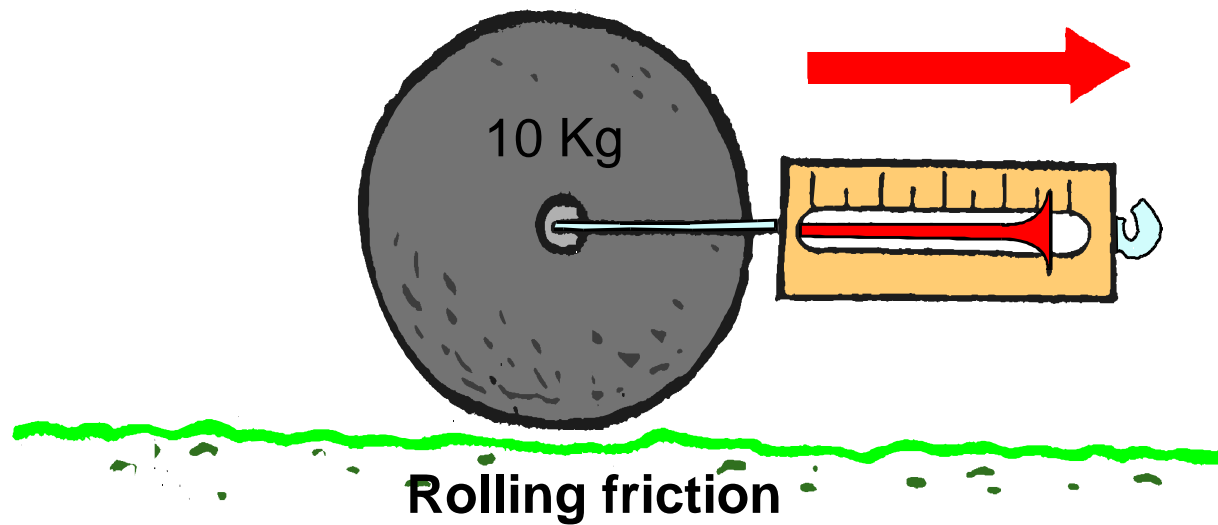
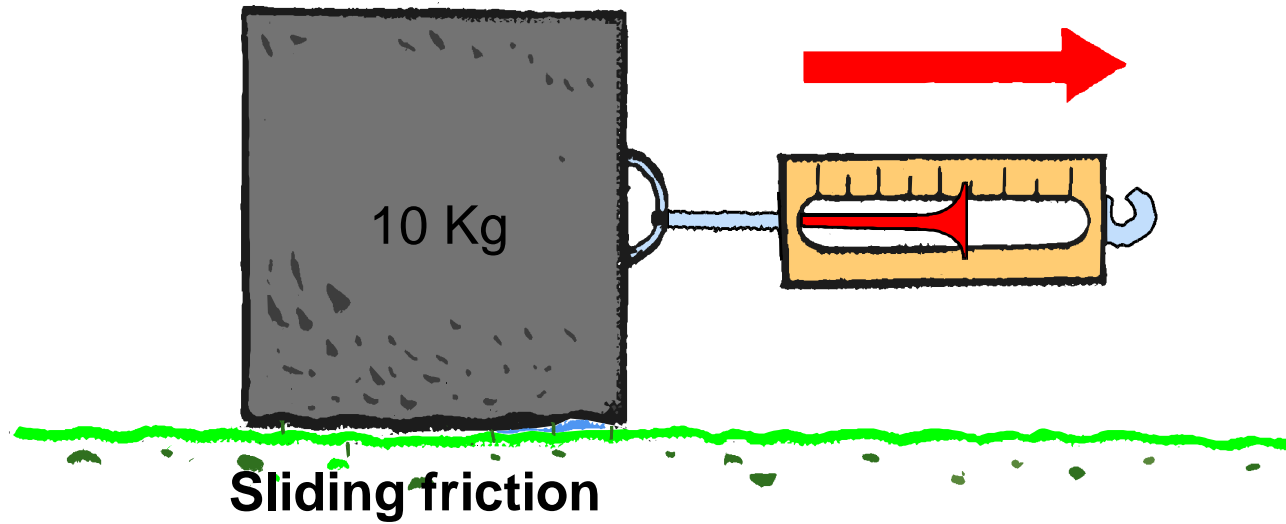


1. Development of Bearings



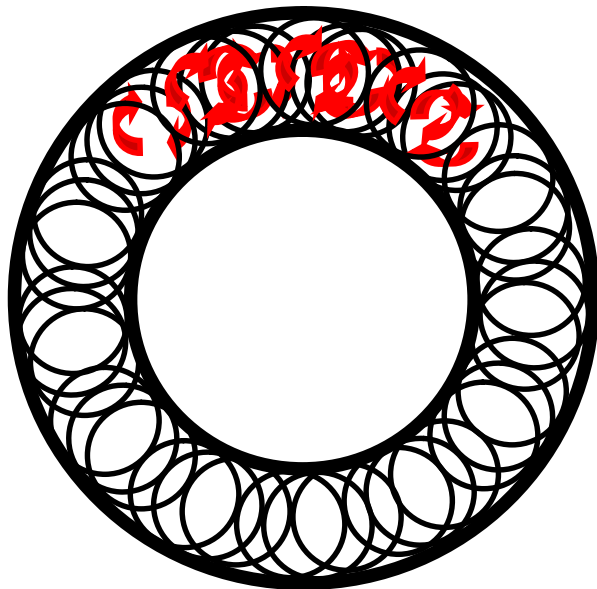
Reduce Friction/Support Load



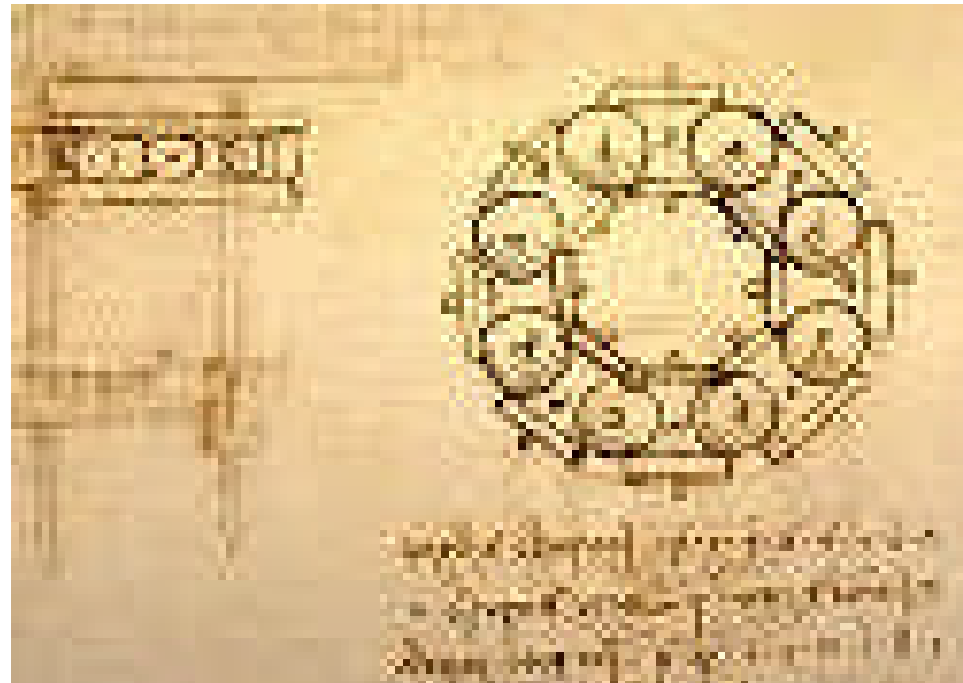




- Leonardo da Vinci discovered the principle of bearing in the 15th century.
- He realised that friction could be reduced if the balls did not touch each other. He designed separators allowing the balls to move freely.

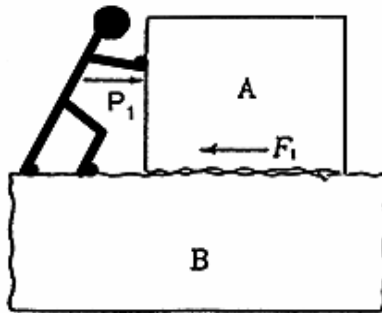


- Without cage, balls rotating contra to each other.

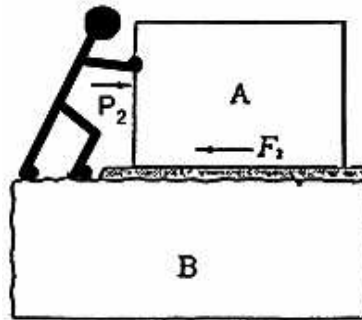


Rolling Bearing Designed by Leonardo da Vinci

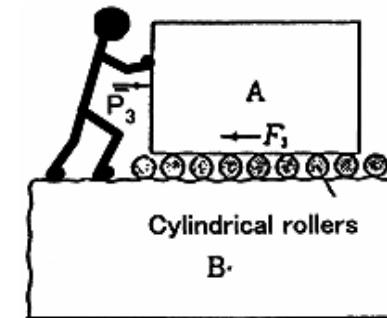
Sliding and Rolling



(1) Sliding (contact among solids)



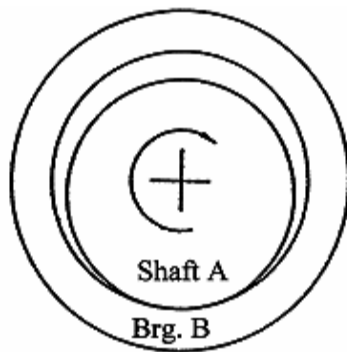
(2) Sliding (use of lubricant)



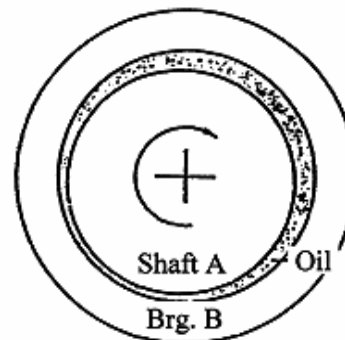
(3) Rolling

Sliding Motion and Rolling Motion

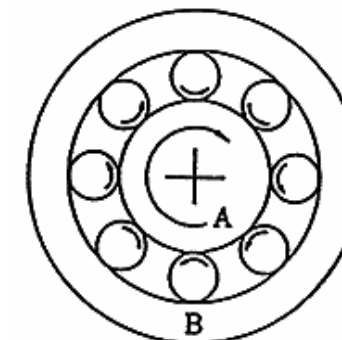
$$P_1 > P_2 > P_3$$



(1) Sliding brg.



(2) Sliding brg. (oil lubrication)



(3) Rolling brg.

Sliding Bearing and Rolling Bearing



Kinds of Bearing

Bearings do not mean rolling bearings alone.

There are Two Kinds of Bearing :-

- **Plain Bearing** - sliding contact between shaft and bearing
- **Rolling Bearing** - rolling contact via balls or rollers between shaft and bearing

Plain Bearings

- **Oil-lubricated bearing:** White metal, copper, lead alloy, etc. .
- **Air bearing:** Used in application of high running accuracy and low friction.
- **Magnetic bearing:** Shaft is supported by using magnetic force.
- **Self-lubricated bearing:** Plastic bearing, solid lubricant bearing, etc.

Reason why rolling bearings are widely used.

Rolling Bearings

- (1) Low starting torque or friction.
- (2) Worldwide standardization of dimension, accuracy and indication. Rolling bearings are internationally available and interchangeable.
- (3) Maintenance/replacement/inspection easy due to simple structure of surrounding bearings.
- (4) Capable of taking both radial and axial loads simultaneously or independently.
- (5) Used under a wide range of temperatures.
- (6) Can be preloaded to achieve greater rigidity.

**Examples of
Rolling Bearing**

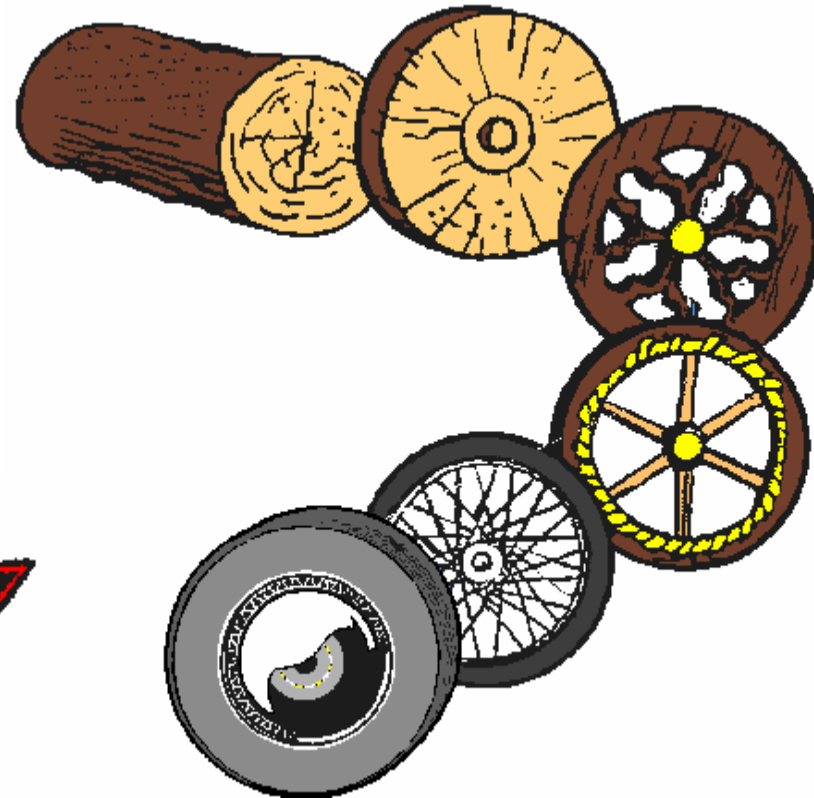




Plain Bearing



Rolling Bearing

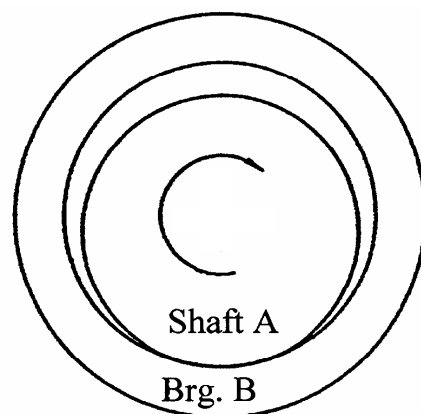


1 – Development of Bearings

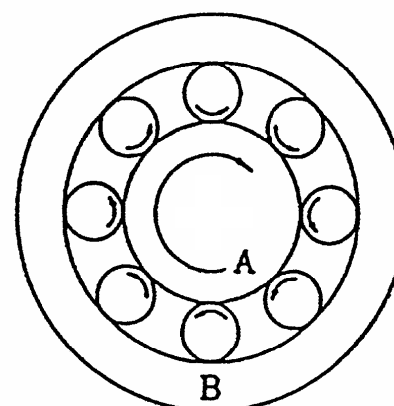
Summary

Two Kinds of Bearing

- ✓ **Plain Bearing** - sliding contact between shaft and bearing
- ✓ **Rolling Bearing** - rolling contact via balls or rollers between shaft and bearing



Plain Bearing



Rolling Bearing



2. Introduction to Rolling Bearings



Bearings Industry Standards

Organizations that control the sizes and tolerance of standard bearings to make sure that all manufacturer's products are interchangeable.

List of Standards Organization

ISO (International Organization for Standardization)

ABMA (American Bearing Manufacturers Association)

DIN (Deutsch Industrie Norm)

JIS (Japanese Industrial Standard)

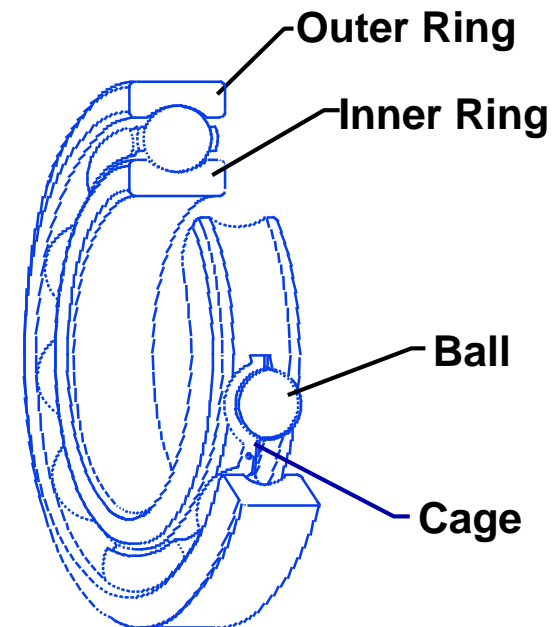


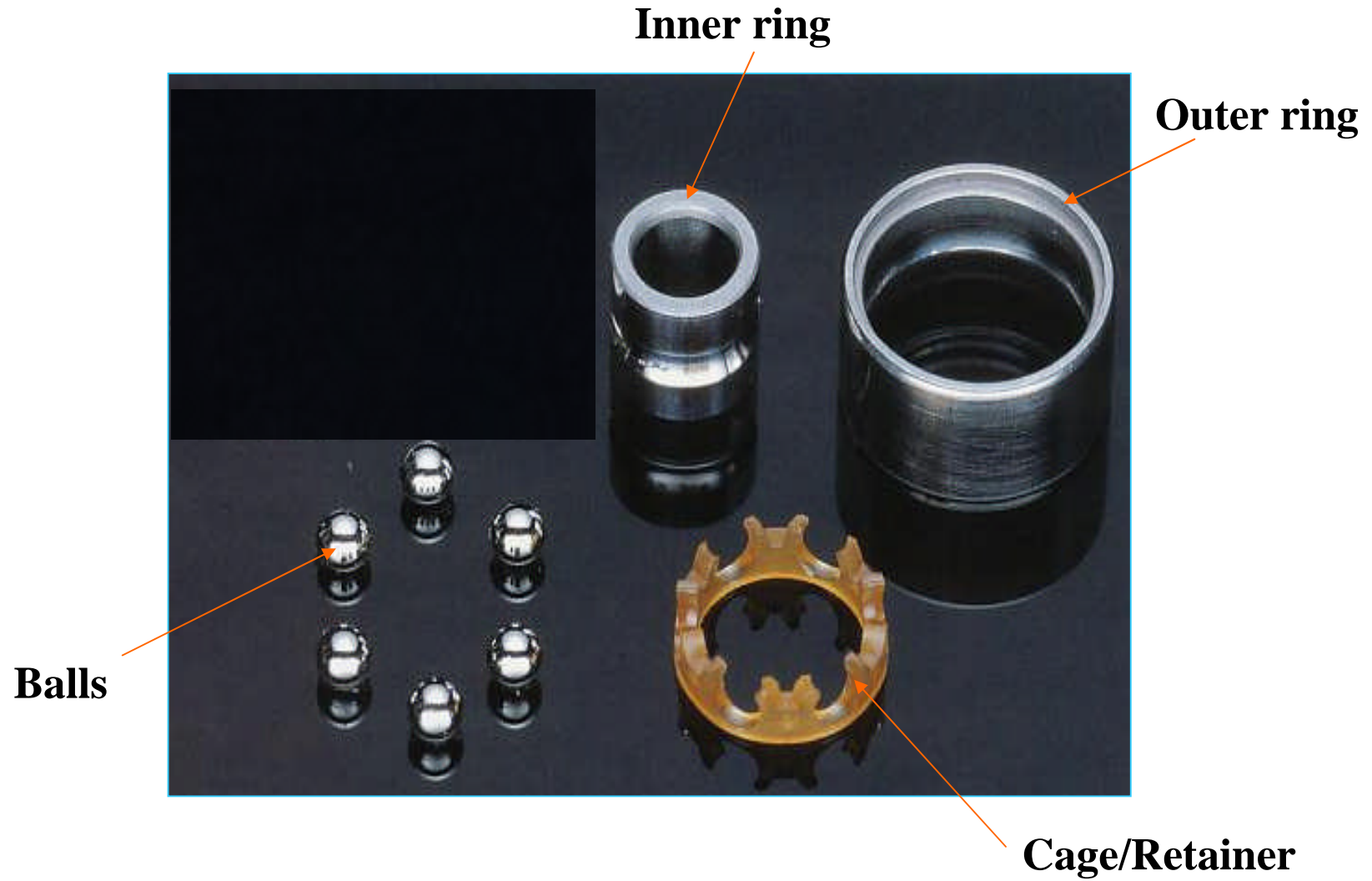
Purpose of Bearings

- (1) Carry load**
- (2) Reduce friction**
- (3) Guide rotation motion**
- (4) Locate a system**

Bearing Components

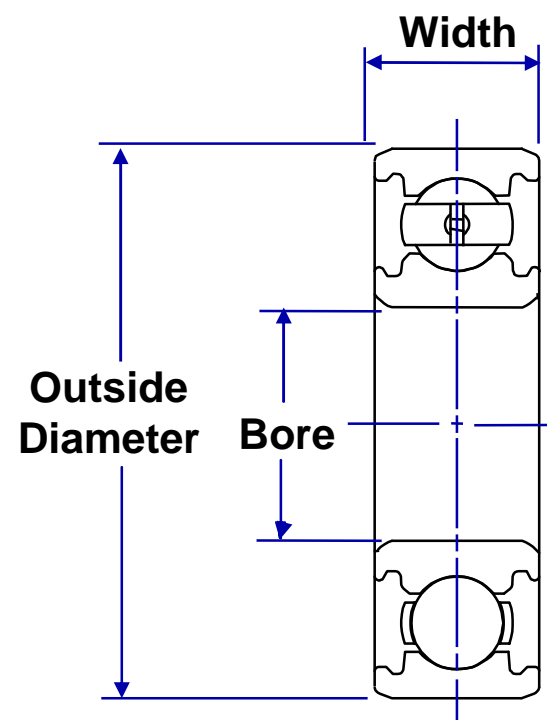
- **Outer Ring**
- **Inner Ring**
- **Rolling Elements** ie. Balls or Rollers
- **Cage/Retainer**
 - Keep rolling elements separated from each other. Normally made of steel, but sometimes brass or plastic.





Bearing Critical Dimensions

- **Bore / Inside Diameter (ID)**
- **Outside Diameter (OD)**
- **Width**



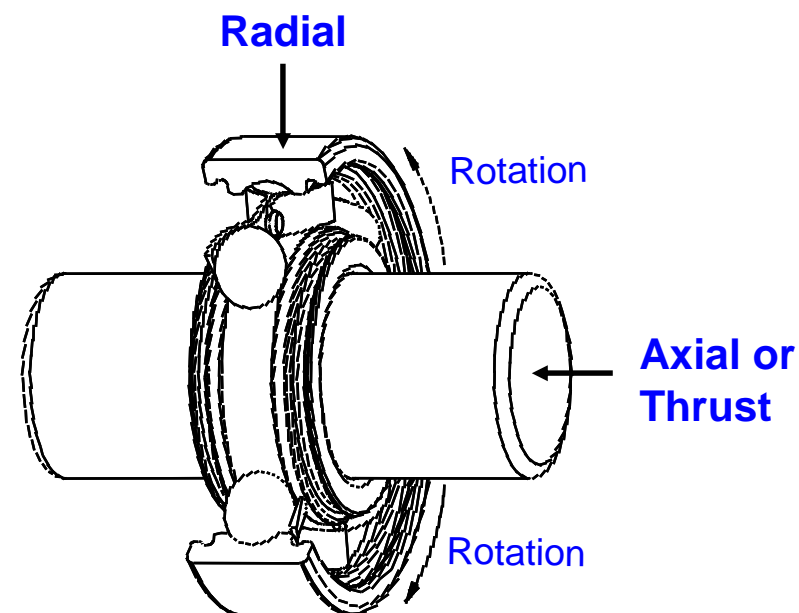
Bearing Loads

Radial

Load acting perpendicular to the shaft/axis ie. around the radius.

Axial or Thrust load

Load acting parallel and along the shaft/axis

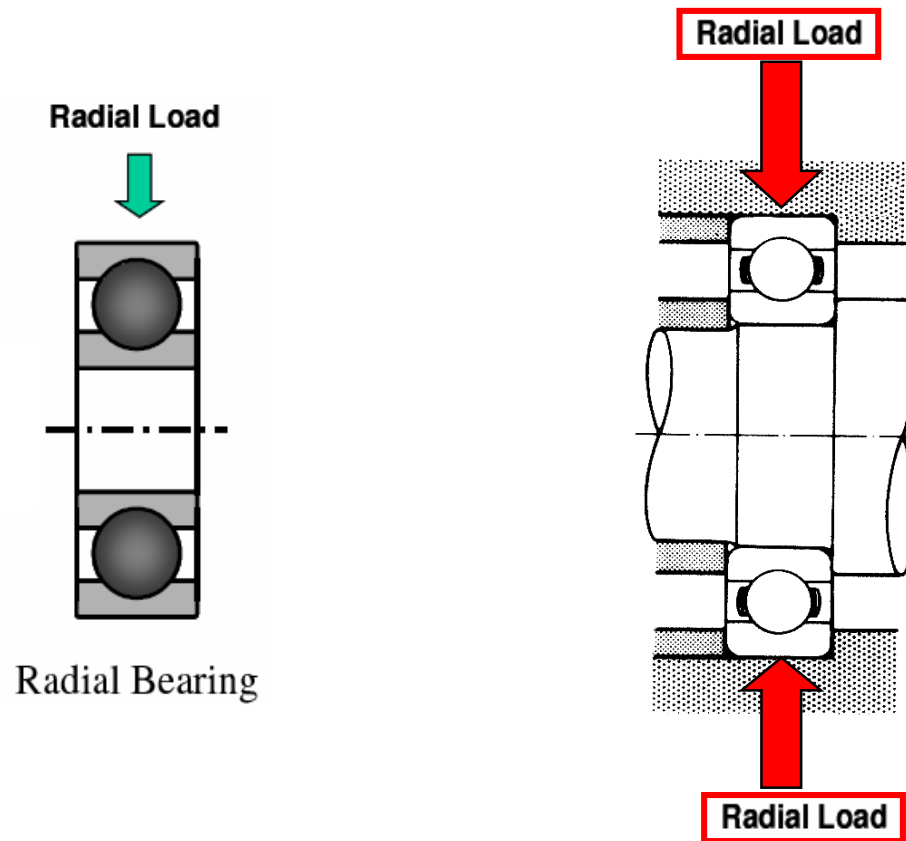




- **Radial Bearings**

Bearings that primarily carry loads perpendicular to the shaft.

Example: Deep Groove Ball Bearing

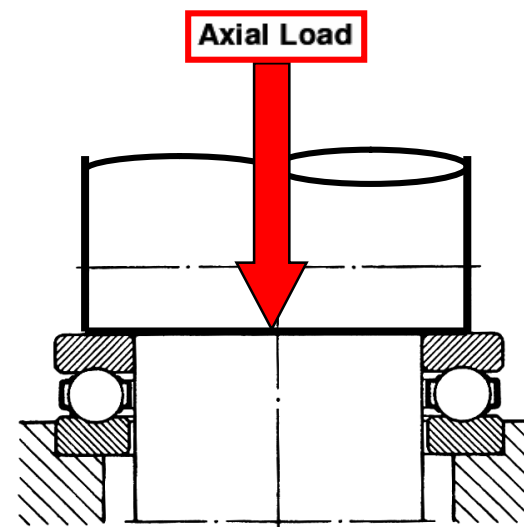
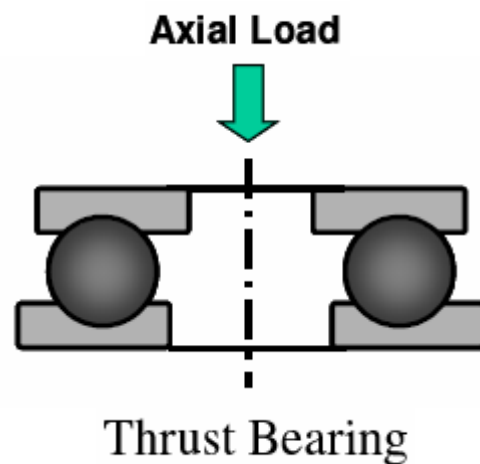


Bearing Classifications

- **Thrust Bearings**

Bearings that primarily carry loads along the shaft.

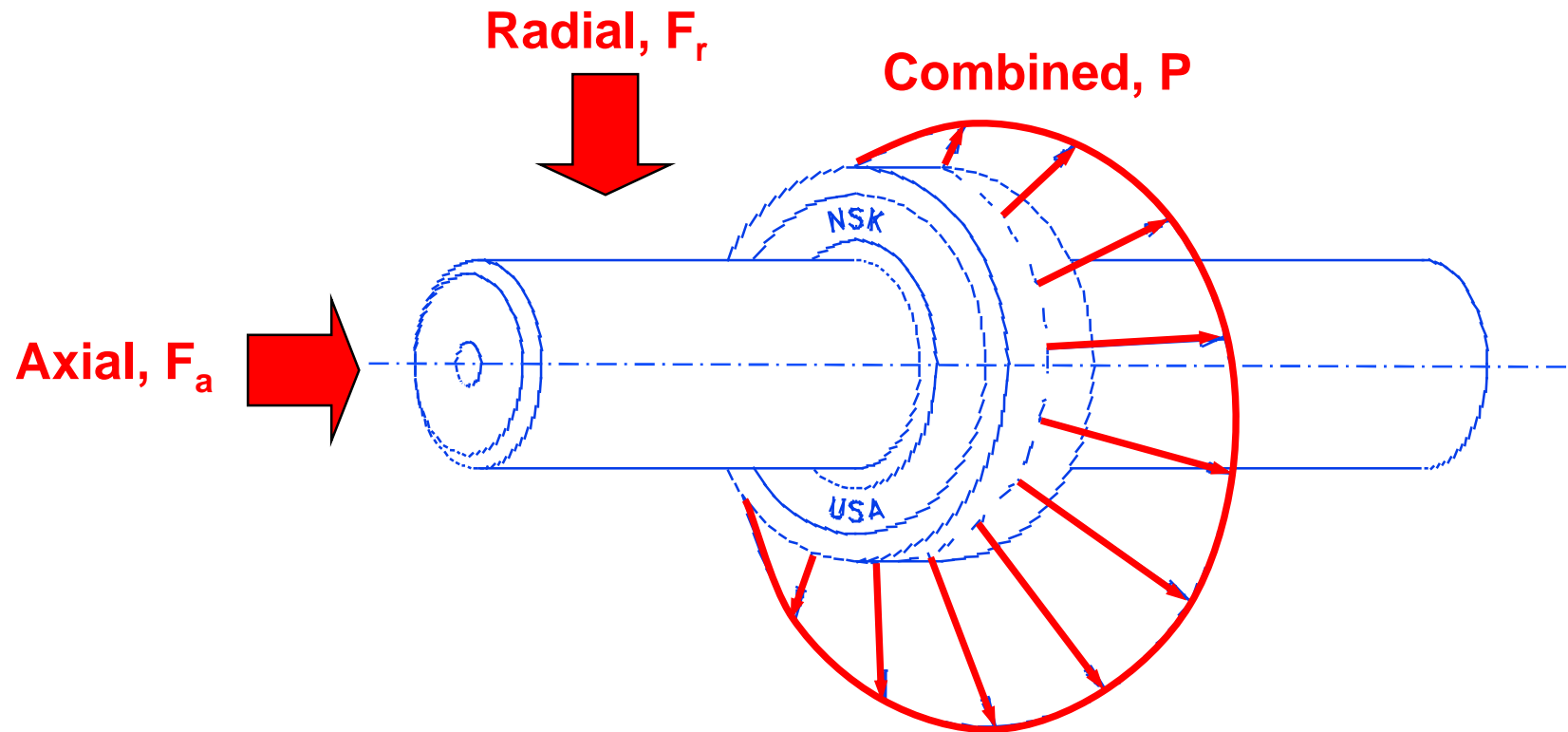
Example: Thrust Ball Bearing





P : Combined load, Equivalent load, or Resultant load

The calculated load derived from the radial and axial load, $P = X F_r + Y F_a$



Basic Rating Life, L_{10}

Refer to Page A25

Definition:

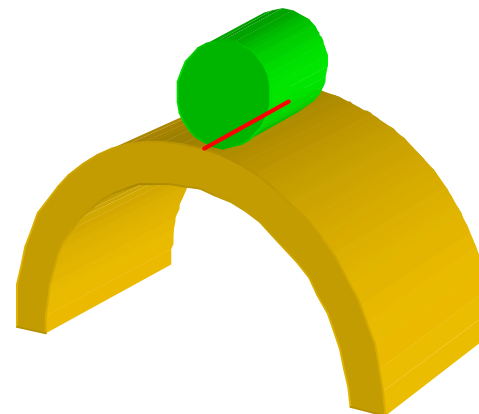
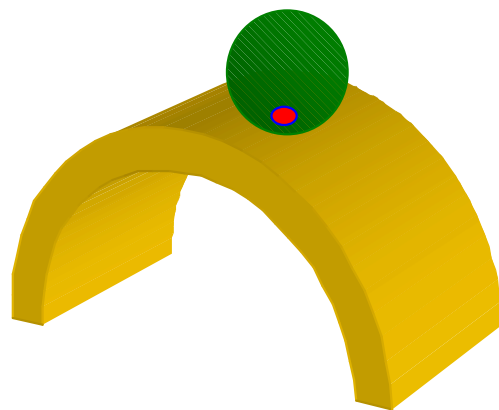
Maximum 10% failure rate for a group of identical bearings able to complete 1 million revolutions, under similar conditions.

For a single bearing, L_{10} refers to the life associated with 10% failure rate (or 90% reliability).

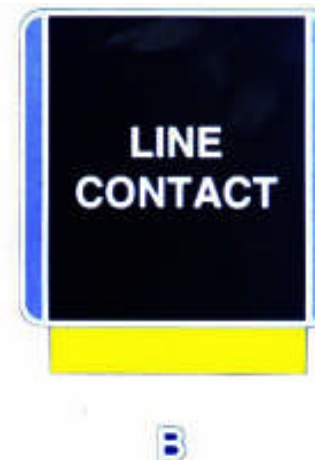
$$\begin{aligned} L_{10} &= (C/P)^3 && \text{for ball bearings, } \textit{or} \\ &= (C/P)^{10/3} && \text{for roller bearings} \end{aligned}$$

where C : Basic Load Rating (N or kgf)
P : Bearing load (equivalent load) (N or kgf)

Bearing Load Contact

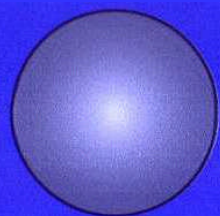


- Point contact, lower load
- Less friction, higher speed

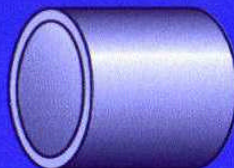


- Line contact, higher load
- More friction, lower speed

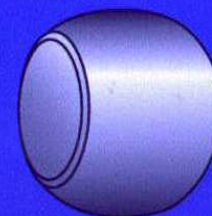
Type of Rolling Elements



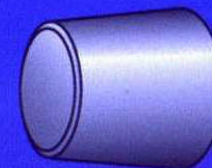
BALL



ROLLER



SPHERICAL



TAPERED

Single Row Deep Groove:

6

Single Row Cylindrical :

NU, NJ, NUP, N, NF

Spherical Roller:

2

Tapered Roller:

3

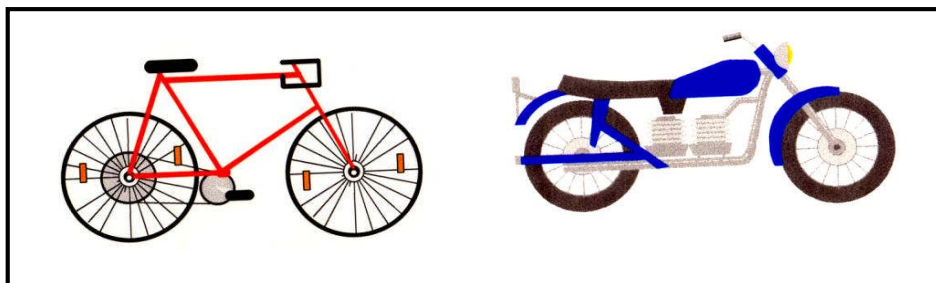
Angular Contact:

7

Double Row Cylindrical:

NNU, NN

Load Carrying Capacity



- Light Load
 - Ball Bearings



- Medium Load
 - Ball or Roller Bearings



- Heavy Load
 - Roller Bearings



2 – Introduction to Rolling Bearings

Summary

- ✓ Purpose of Bearings
 - Carry load
 - Reduce friction
 - Guide rotation motion
 - Locate a system

- ✓ Bearing Loads
 - Radial
 - Axial
 - Combined

- ✓ Basic Rating Life, L_{10}

- ✓ Bearing Load Contact
 - Point Contact
 - Line Contact



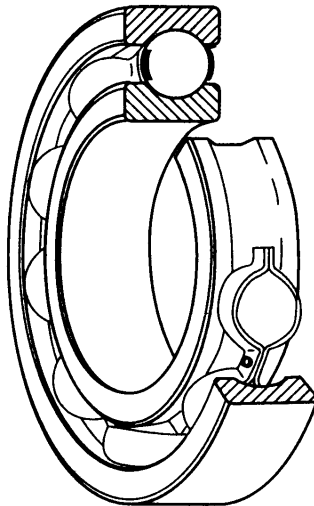
3. Types and Features of Rolling Bearings

Types of Ball Bearings

Refer to Page B5

Deep Groove Ball Bearings

- Most common type of rolling bearings. Their use are widespread.
- Accommodates radial and axial loads.
- Because of their low friction, they are highly suitable for high speed.
- Pressed steel cages are common.



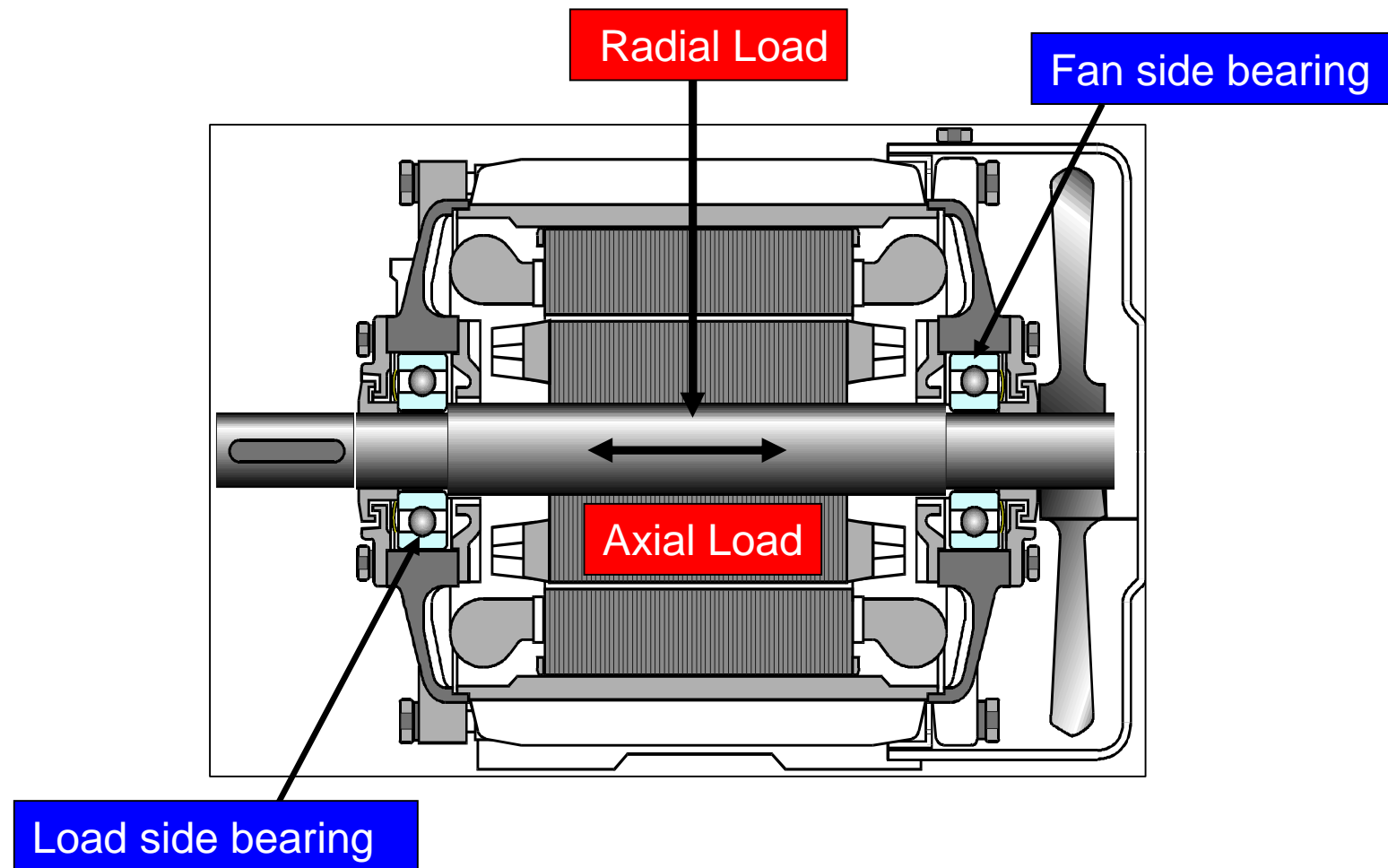
Applications

- ✓ Electric Motors/Power Tools
- ✓ Gearboxes
- ✓ Pumps/Compressors
- ✓ Office Automation

➤ Bearing Series Symbols

- 68xx, 69xx, 60xx, 62xx, 63xx

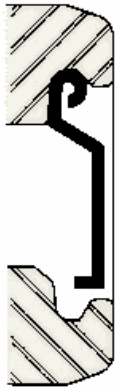
Application – Deep Groove Ball Bearing





Ball Bearing Seals

- Prevents dirt and moisture from entering the bearing, and the lubricant from leaking out.
- Steel or rubber component mounted between the outer and the inner ring in bearing.



ZZ shield



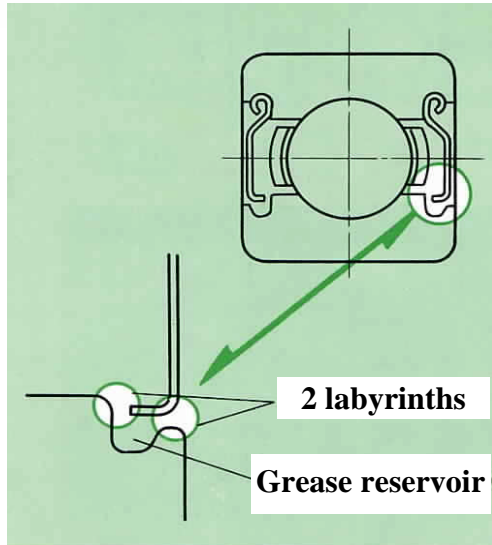
VV seal



DDU seal



DDW seal

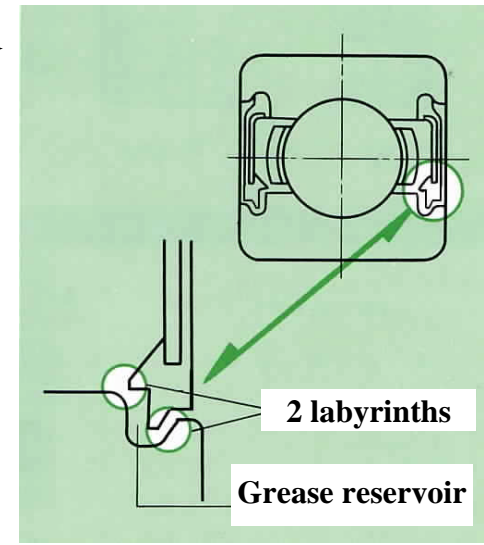


Shield type

Non-Contact Type

- Good grease sealing and dust-proof properties.
- Low starting torque.

Steel shield

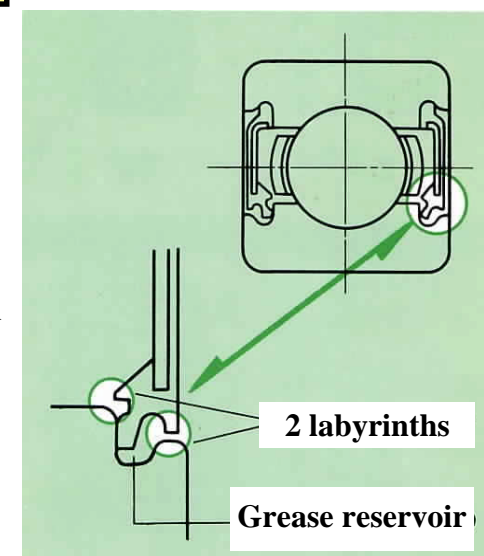


Seal type

Rubber seal

Contact Type (DDU)

- Excellent grease sealing, dust-proofing and water-proofing properties.



Characteristics of Sealed-type Ball Bearings

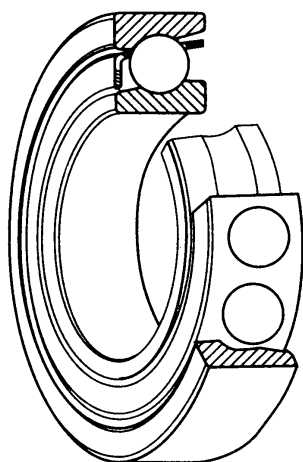
Type	Non-Contact Shield(ZZ)	Non-Contact Rubber Seal (VV)	Contact Rubber Seal (DDU)	Contact Rubber Seal (DDW)
Frictional Torque	Low	Low	Higher than ZZ and VV types	Higher than ZZ and VV types
High-Speed Capability	Good	Good	Limited due to contact type seal	Limited (better than DDU)
Grease Sealing Properties	Good	Better than ZZ type.	Better than DDW type	Slightly better than VV type
Dust Proofing Properties	Good	Better than ZZ type (Usable in little dusty condition)	Best (Usable in dusty environment)	Best (Usable in dusty environment)
Water Proofing Properties	No good	No good	Good (Usable in a splash condition)	Good (Not as good a DDU)
Operating Temp. Range ⁽¹⁾	-10 ~ +110 °C	-10 ~ +110 °C	-10 ~ +100 °C	-10 ~ +100 °C

Note (1): The values shown are for standard products. The temperature range can be extended depending on use of low or high-temperature greases and rubber material for seal.

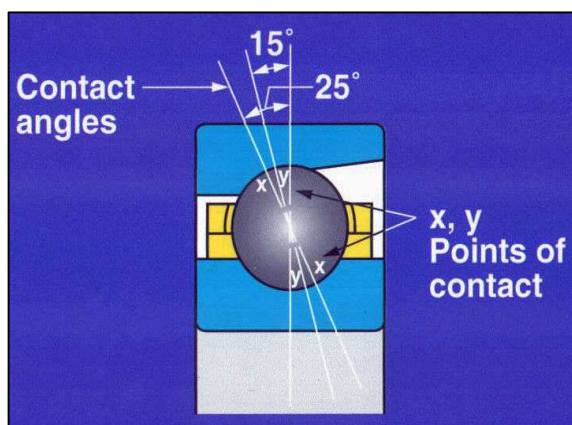
Types of Ball Bearings

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Single-Row Angular Contact Ball Bearings



- Accommodates radial loads, and axial loads in one direction.
- 30°, 40°, 15° and 25° contact angles available.
larger contact angle \Rightarrow higher axial load capacity, lower speed.
- Frequently sold as matched sets.
- High rigidity with preload.
- Pressed steel cages are commonly used.
 - * For high precision bearings with contact angles less than 30°, polyamide resin cages are often used.



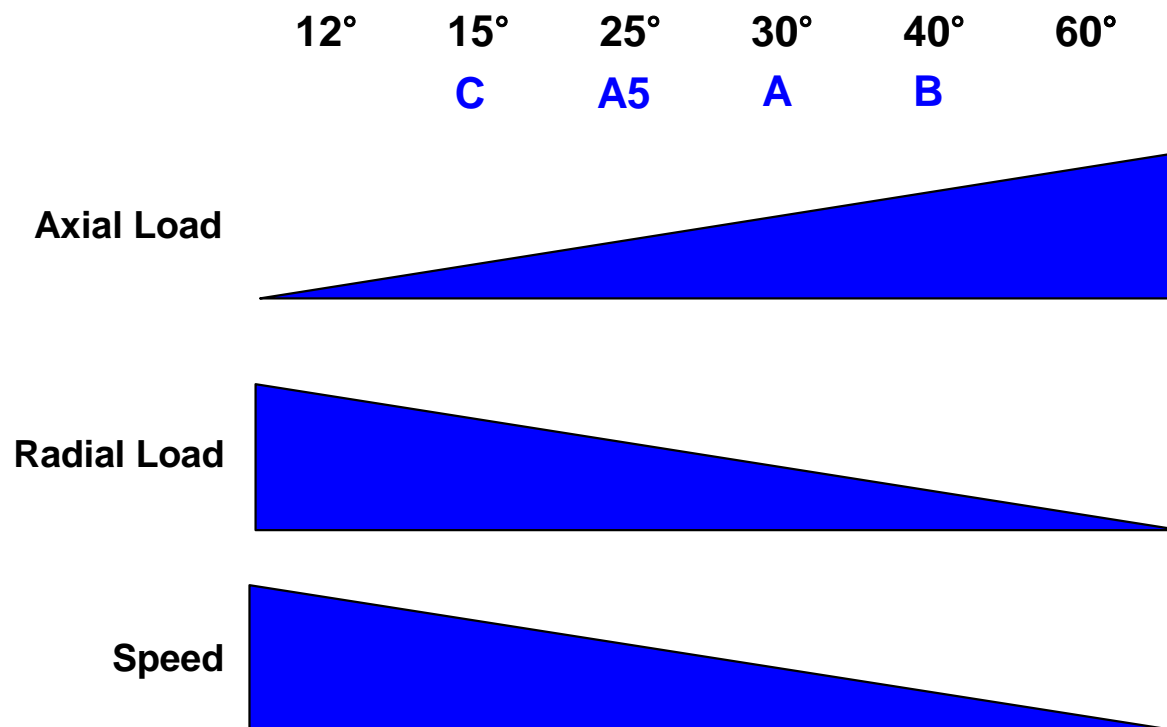
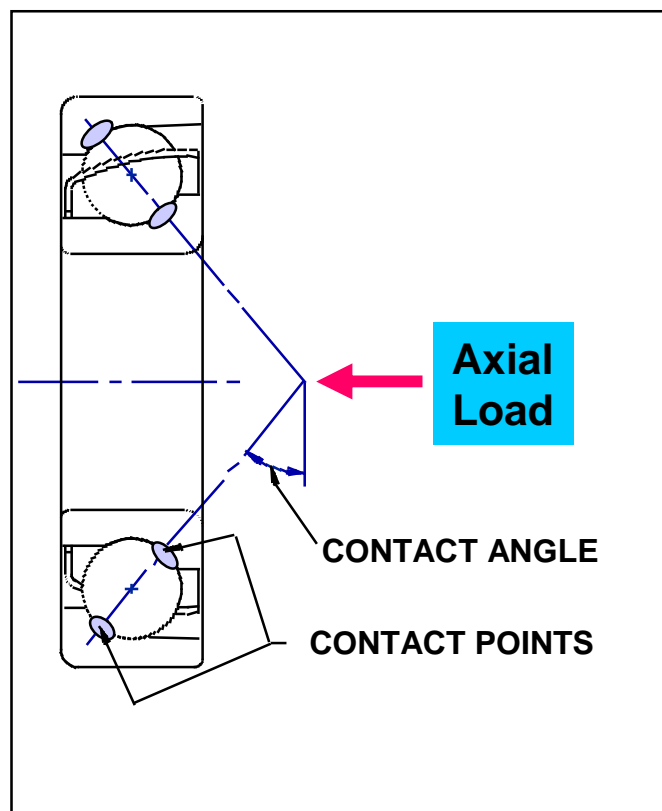
Applications

- ✓ Pumps & Compressors
- ✓ Metal Rolling Mills
- ✓ Electric Motors & Generators

➤ Bearing Series Symbols

- 79xx, 70xx, 72xx, 73xx

ACBB – Contact Angles and Relationship



Matching method of angular contact ball bearings

Table 2 Types and Features of Matched Angular Contact Ball Bearings

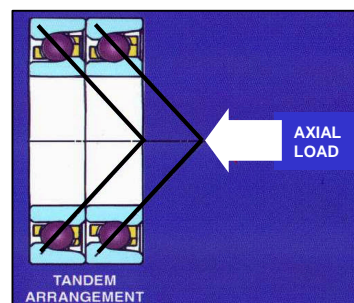
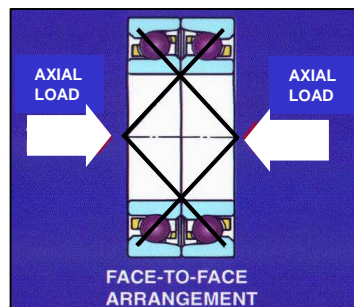
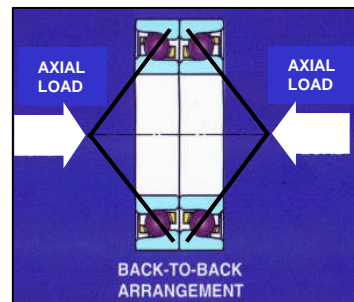
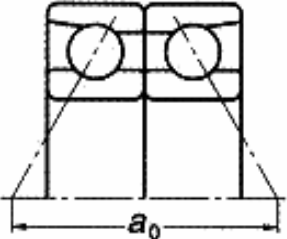
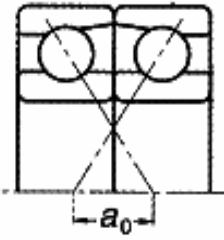
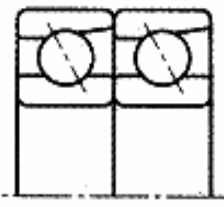
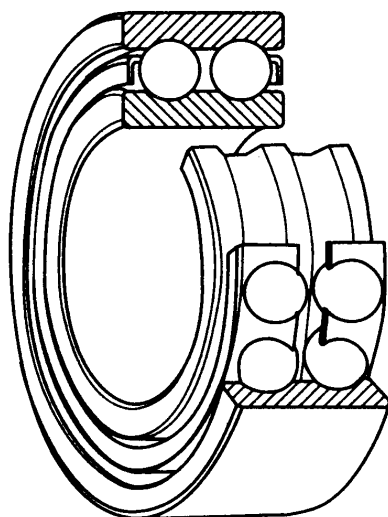


Figure	Arrangement	Features
	Back-to-back (DB) (Example) 7208 A DB	Radial loads and axial loads in both directions can be sustained. Since the distance between the effective load centers a_0 is big, this type is suitable if moments are applied.
	Face-to-face (DF) (Example) 7208 B DF	Radial loads and axial loads in both directions can be sustained. Compared with the DB Type, the distance between the effective load centers is small, so the capacity to sustain moments is inferior to the DB Type.
	Tandem (DT) (Example) 7208 A DT	Radial loads and axial loads in one direction can be sustained. Since two bearings share the axial load, this arrangement is used when the load in one direction is heavy.

Types of Ball Bearings

Refer to Page B66

Double-Row Angular Contact Ball Bearings



- Equivalent to two single-row angular contact ball bearings mounted back-to-back except they have **only one inner ring and one outer ring, each having two raceways.**
- Can take axial loads in either direction.
- Capable of taking moment loads.

Applications

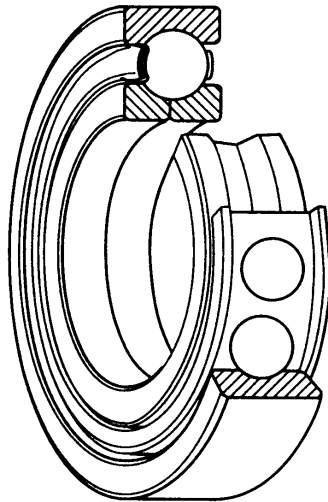
- ✓ Centrifugal Pumps
- ✓ Electric Motor
- ✓ Blowers & Fans

➤ Bearing Series Symbols

- 52xx, 53xx

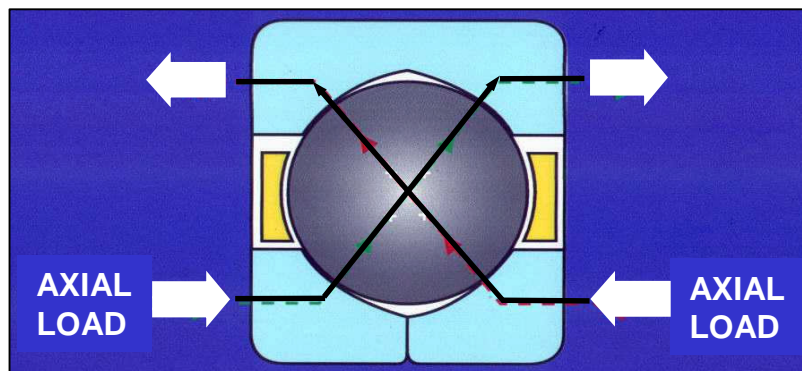
Types of Ball Bearings

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Four-point Contact Ball Bearings

- Outer and inner rings are separable because inner ring is split in radial plane.
- Can take axial loads from either direction.
- Balls have contact angle of 35° with each ring.
- Can replace a combination of face-to-face or back-to-back angular contact bearing.
- Machined brass cages are generally used.

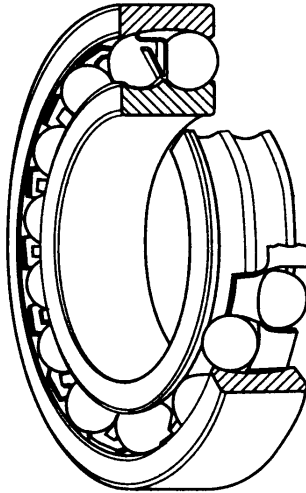


- **Bearing Series Symbols**
- QJ10xx, QJ2xx, QJ3xx

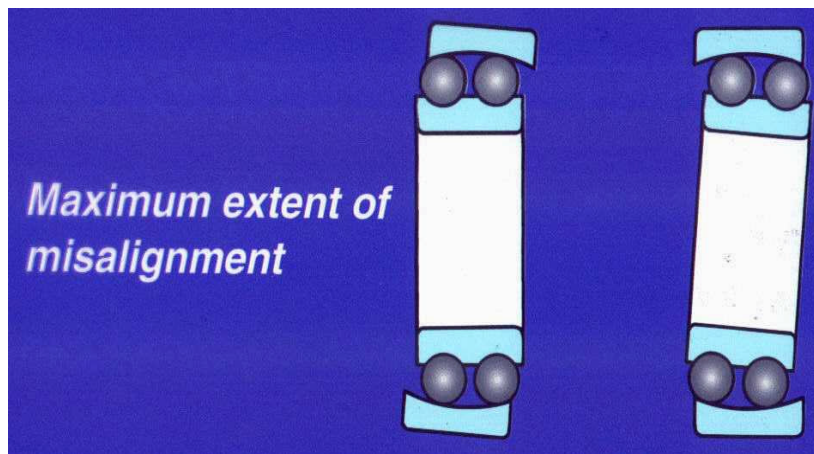
Types of Ball Bearings

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Self-Aligning Ball Bearings



- Inner ring has two raceways.
- Outer ring has single spherical raceway with its center of curvature coincident with bearing axis. **As such, the axis of the inner ring, balls, and cage can deflect to some extent around the bearing center.**
- Able to withstand minor angular misalignment (4° to 7°).

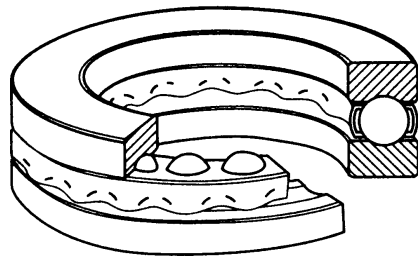


➤ Bearing Series Symbols

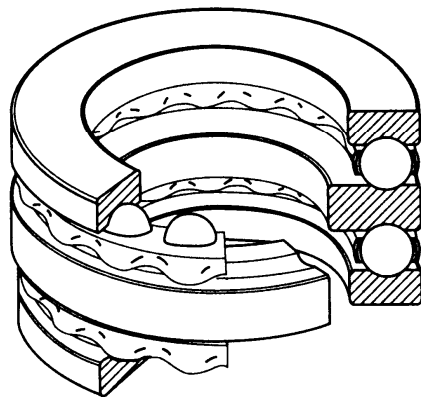
- 12xx, 13xx, 22xx, 23xx

Types of Ball Bearings

Refer to Page B203



Single-direction



Double-direction

Thrust Ball Bearings

- Designed for heavy axial (thrust) loads only.
- Single-direction thrust ball bearings capable of taking axial loads in one direction only.
- Double-direction thrust ball bearings, have three rings with the middle one (central washer) being fixed to the shaft.
- The ring attached to the shaft is called the shaft washer while that attached to the housing is called the housing washer.
- Pressed steel cages are usually used in smaller bearings and machined cages in larger bearings.

Applications

- ✓ Jib Cranes
- ✓ Turntables

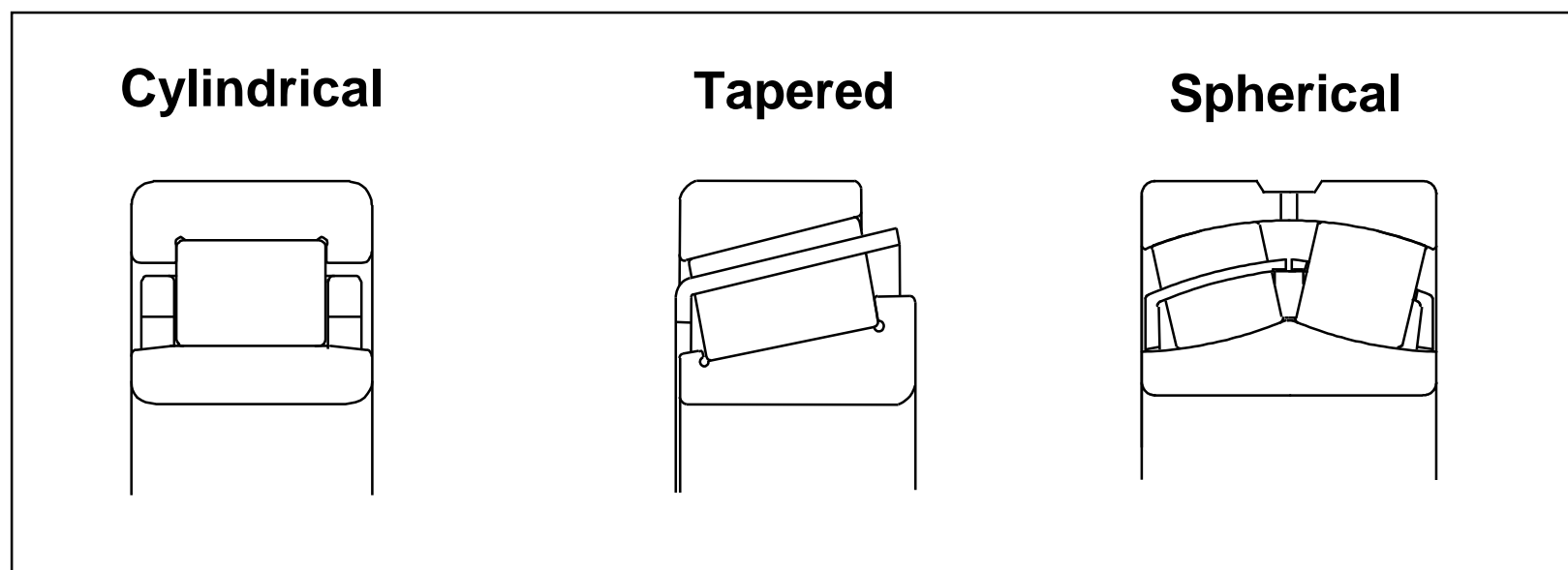
➤ Bearing Series Symbols

- 511xx, 512xx, 513xx, 514xx
522xx, 523xx, 524xx

Types of Roller Bearings

Roller Bearings

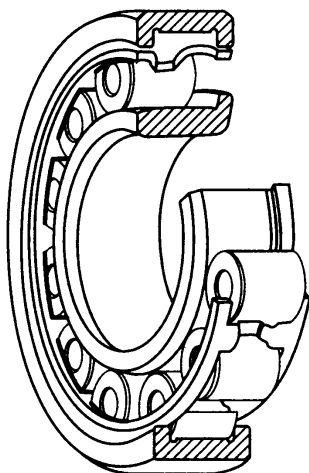
- Generally classified by roller shape.
- Within each type, design varies with number of rolling element rows, cage type, primary load direction, etc.



Types of Roller Bearings

Cylindrical Roller Bearings

- Very high radial loads capacity.
- Suitable for high speed.
- Some have no ribs on either inner or outer ring, so the rings can move axially relative to each other. These can be used as free-end bearings.
- **Outer and inner rings of all types are separable.**
- There are different types designated NU, NJ, NUP, N, NF for single-row bearings, and NNU, NN for double-row bearings.



Applications

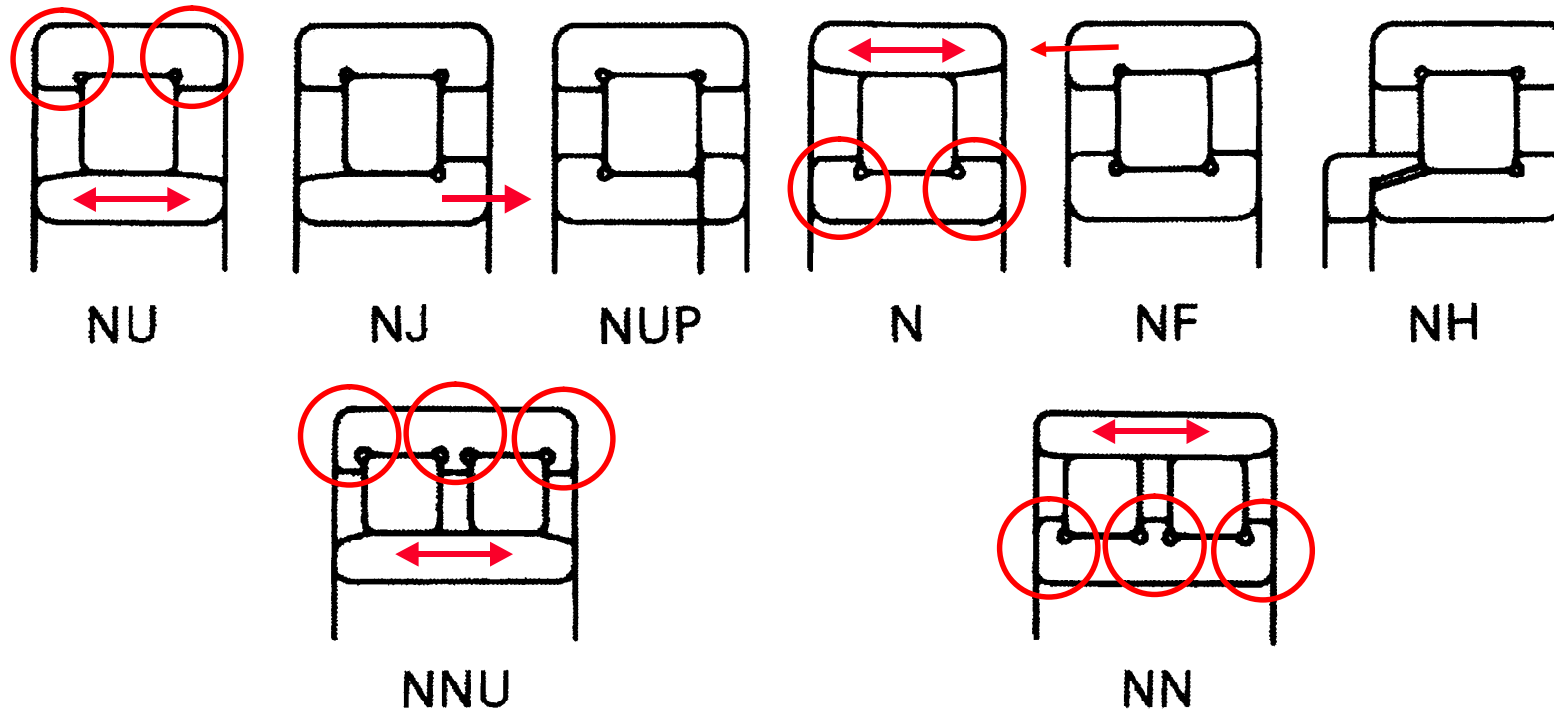
- ✓ Large Electric Motors
- ✓ Gearboxes, Presses
- ✓ Machine Tool Spindles

➤ Bearing Series Symbols

- NUxx, NJxx, NUPxx, Nxx, NFxx



Single-row Cylindrical Roller Bearings



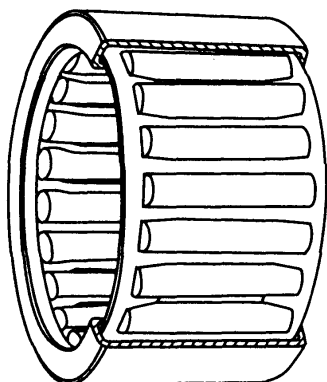
Double-row Cylindrical Roller Bearings

Have high radial rigidity and are used primarily for precision machine tools.

Types of Roller Bearings

Refer to Page B241

Needle Roller Bearings



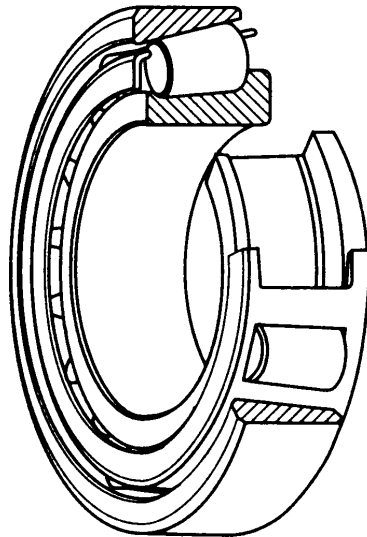
- Rollers of length 3 to 10 times the diameter, and diameter less than 5 mm.
- Numerous types available, and many have no inner rings. **Drawn-cup type** has a pressed steel outer ring and **solid type** has a machined outer ring.
- There are cage and roller assemblies without rings.
- Most have pressed steel cages, but some are without cages.

➤ Bearing Series Symbols

- NA48xx, NA49xx, NA59xx, NA69xx

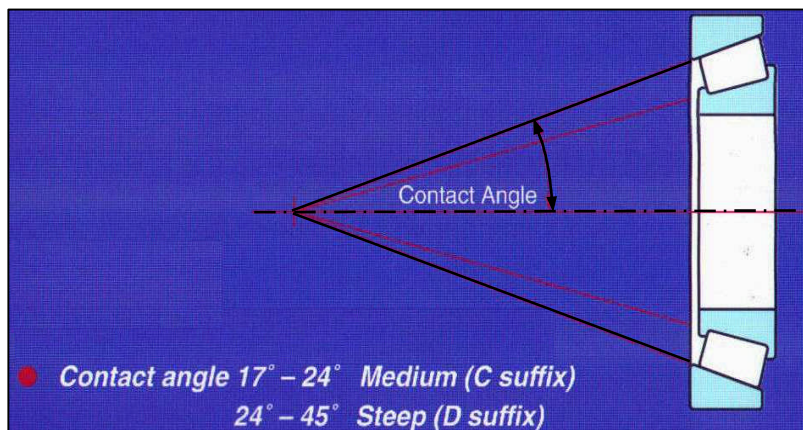
Types of Roller Bearings

Refer to Page B107



Tapered Roller Bearings

- Designed for high radial loads and axial loads in one direction.
- Cone (inner ring) and cup (outer ring) are separable and can be mounted independently.
- Contact angle: Normal, Medium and Steep.
- Generally mounted in pairs.
- Double-row and four-row tapered roller bearings are also available.



Applications

- ✓ Plastic/Metal Forming Equipment

➤ Bearing Series Symbols

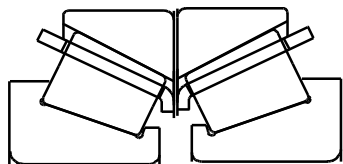
- 329xx, 320xx, 330xx, 331xx, 302xx
322xx, 332xx, 303xx, 323xx



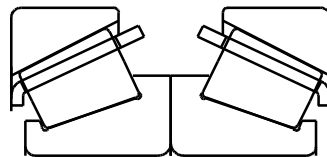
▪ Matching Method of Tapered Roller Bearings

Duplex Designs

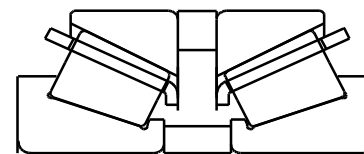
- Back-to-Back (DB) or Face-to-Face (DF)
- DB Type (With or Without Spacers)
- DF Type (With or Without Spacers)



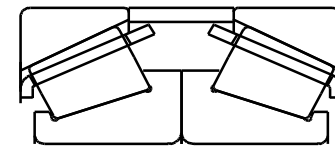
DB Mount



DF Mount



DB + KLR Mount



DF + K Mount

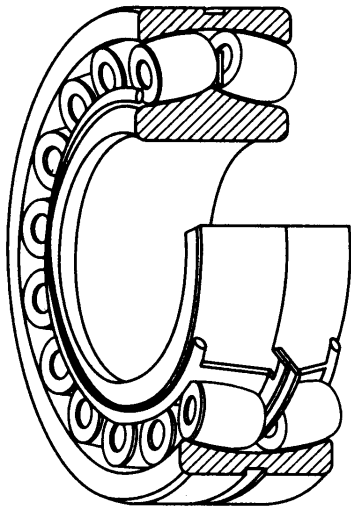
➤ Bearing Series Symbols

- 3xxxx DB or DF or DB+KLR or DF+K

Types of Roller Bearings

Refer to Page B179

Spherical Roller Bearings



- Barrel-shaped rollers between inner ring (with two raceways), and outer ring (with one spherical raceway). **Since center of curvature of outer ring raceway coincides with bearing axis, they are self-aligning.**
- Can take deflection of shaft or misaligned housing (up to 1.5°).
- Heavy radial load capacity, and moderate axial loads in either directions.
- Suitable for heavy or impact loads.

Applications

- ✓ Steel Mills
- ✓ Paper Mills
- ✓ Continuous Casting Machinery

➤ Bearing Series Symbols

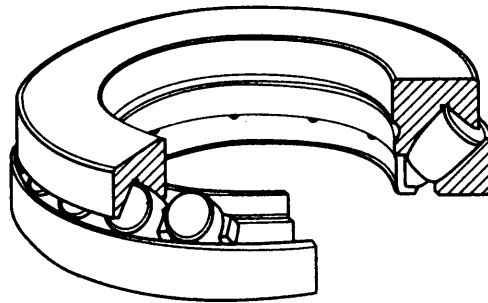
- 230xx, 231xx, 222xx, 232xx, 213xx, 223xx

Types of Roller Bearings

Refer to Page B224

Spherical Thrust Roller Bearings

- Very high axial load capacity and moderate radial loads.
- Spherical raceway in the housing washer and barrel-shaped rollers. The bearings are **self-aligning**.
- Pressed steel cages or machined brass cages are usually used.



Applications

- ✓ Deep Well Pumps
- ✓ Plastic Extruders
- ✓ Large Centrifugal Pumps

➤ Bearing Series Symbols

- 292xx, 293xx, 294xx

Types, Characteristics of Rolling Bearings

Refer to Page A14

Features		Bearing Types						
		Deep Groove Ball Bearings	Magneto Bearings	Angular Contact Ball Bearings	Double-Row Angular Contact Ball Bearings	Duplex Angular Contact Ball Bearings	Four-Point Contact Ball Bearings	Self-Aligning Ball Bearings
Load Capacity	Radial Loads							
	Axial Loads							
	Combined Loads							
High Speeds								
High Accuracy								
Low Noise and Torque								
Rigidity								
Angular Misalignment								
Self-Aligning Capability								☆
Ring Separability			☆				☆	

- There are many types of bearings and each have their own characteristics.
- It is necessary to select correct bearing based on characteristics, availability and cost.



Refer to Page A18

Bearing Characteristics Comparison

	Radial Load Capacity				Axial (Thrust) Load Capacity				Relative Permissible Speed			
	1	2	3	4	1	2	3	4	4	7	10	13
Deep Groove Ball Bearings	[Solid bar from 1 to 1.5]				[Solid bar from 1 to 1.5]				[Solid arrow from 4 to 7] [Solid arrow at 10]			
Angular Contact Ball Bearings	[Solid bar from 1 to 2]				[Solid bar from 1 to 3]				[Solid arrow from 4 to 7] [Solid arrow at 10]			
Cylindrical Roller Bearings	[Solid bar from 1 to 2.5]				[Solid bar from 1 to 3]				[Solid arrow from 4 to 5] [Solid arrow at 7]			
Tapered Roller Bearings	[Solid bar from 1 to 3]				[Solid bar from 1 to 3.5]				[Solid arrow from 4 to 5] [Solid arrow at 7]			
Spherical Roller Bearings	[Solid bar from 1 to 4]				[Solid bar from 1 to 2]				[Solid arrow from 4 to 5] [Solid arrow at 7]			

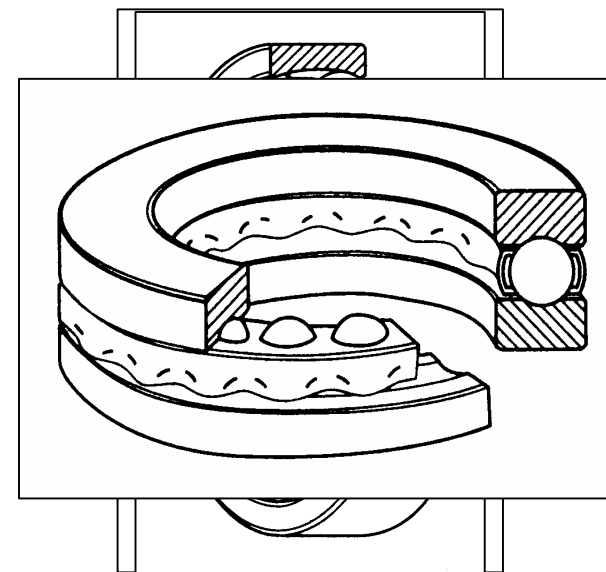
Oil Bath lubrication
 With special measures to increase speed limit

3 - Types and Features of Rolling Bearings

Summary

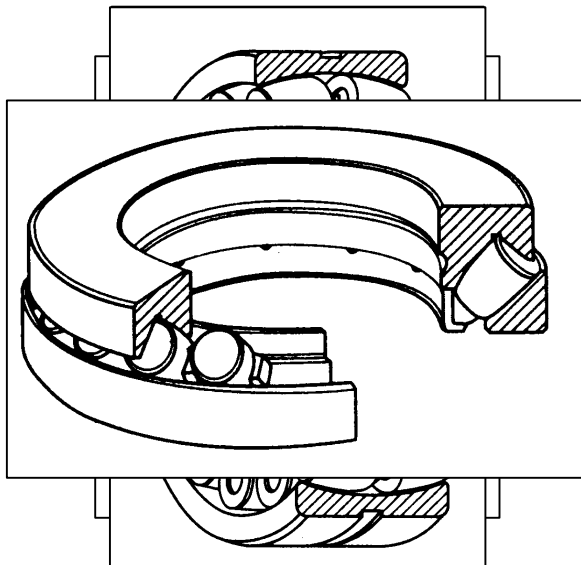
✓ Ball Bearings

- Deep Groove
- Magneto
- Angular Contact
- Self Aligning
- Thrust Ball Bearings



3 - Types and Features of Rolling Bearings

Summary



✓ Roller Bearings

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

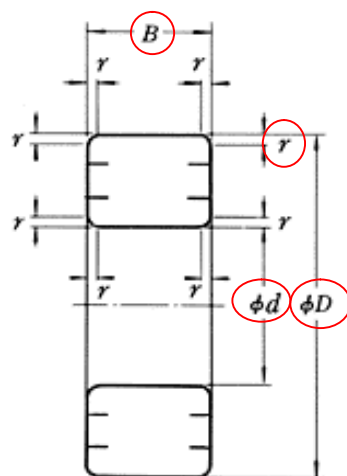


4. Boundary Dimensions for Rolling Bearings

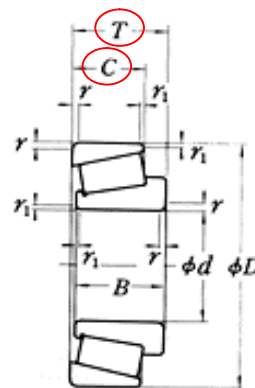
Boundary Dimensions

Refer to Page A38 ~ A39

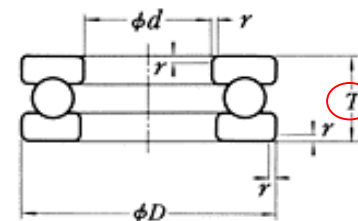
- Dimensions that define their external geometry
 - bore diameter, d
 - outside diameter, D
 - width B , or height T
- Standard bearings are interchangeable.



Radial Ball and Roller Bearings

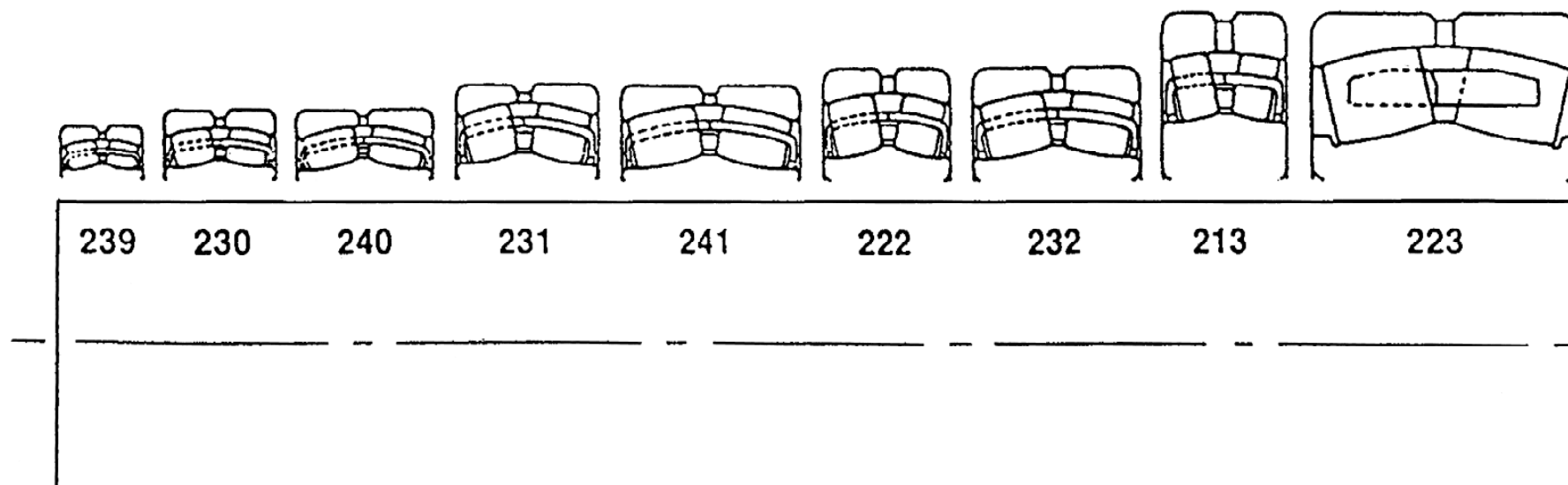


Tapered Roller Bearings



Single-Direction Thrust Ball Bearings

Boundary Dimensions – Dimension Series



There are many sizes even for the spherical roller bearing having the same bore diameter as shown above.



Basic Order of Selection: ID → OD → Width

- Bore Number represents Bore Diameter ie. 231²⁰ 60⁰¹

			*1	*2
Bore Number	1 to 9	00 01 02 03	04 to 96	/500 ~
Bore Dia. (mm)	1 to 9	10 12 15 17	20 to 480	500 ~

*1 For bore number 04 to 96 : Bore dia. = Bore number × 5

*2 For numbers over 500 mm, bore number = /Bore diameter

- Dimension Series indicated by Width & Diameter Series ie. 231²⁰ 60⁰¹

- **Width series:**

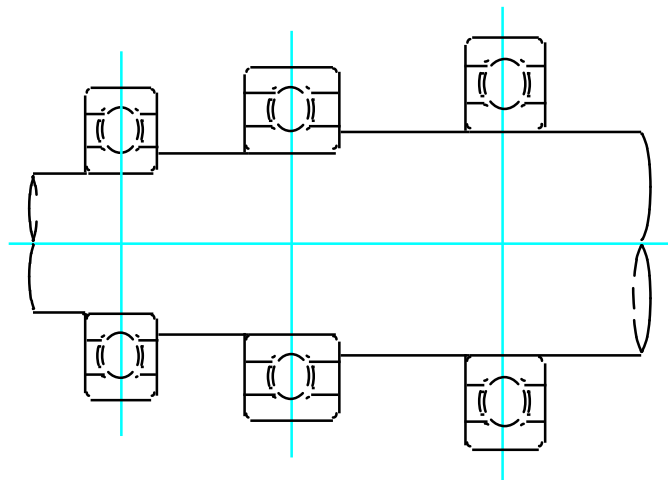
Indicated using one-digit figure specified by the width or the height.

- **Diameter series:**

Indicated using one-digit figure specified by the outside diameter.

- **Dimension series:**

Indicated using two-digit figure with width series as the first digit and diameter series as second digit.



6203 6304 6005

- 1st Digit – Type of Bearing
- 2nd Digit - Diameter Series
- 3rd / 4th Digit - Bore Size in mm

<u>Number</u>	<u>Bore Dia (mm)</u>
1	1
2	2
.	.
9	9
00	10
01	12
02	15
03	17
04	20
05	25
06	30
.	.
96	480
.	.
/500	500
/2500	2500

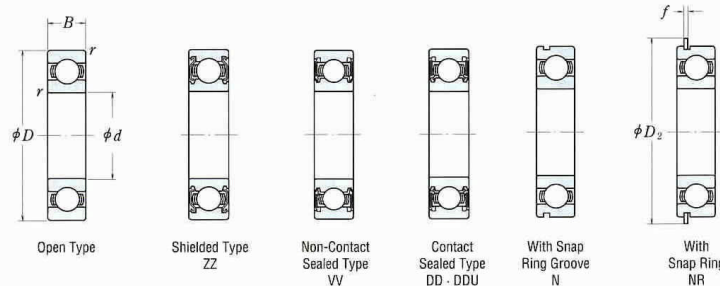
Miniature Bearings
(e.g. 608, 626etc).
Bore Number
= Bore Dia

Multiply bore
number by 5 to
get bore size

Refer to Page B10 ~ B11

SINGLE-ROW DEEP GROOVE BALL BEARINGS

Bore Diameter 25~45 mm



Boundary Dimensions (mm)	Basic Load Ratings (N)				Factor	Limiting Speeds (rpm)		Bearing Numbers				
	C_r	C_{0r}	C_r	C_{0r}		Grease	Oil	Open	Shielded	Sealed		
d	D	R	r		f_0	Open Z	DU DDU	Open Z	Open	Shielded	Sealed	
25	37	7	0.3	4 500	3 150	455	320	16.1	18 000	10 000	22 000	6805 ZZ VV DD
	42	9	0.3	7 050	4 550	715	460	15.4	16 000	10 000	19 000	6905 ZZ VV DDU
	47	8	0.3	8 850	5 600	905	570	15.1	15 000	—	18 000	16005
	47	12	0.6	10 100	5 850	1 030	595	14.5	15 000	9 500	18 000	6005 ZZ VV DDU
	52	12	0.6	14 000	7 850	1 430	800	13.9	13 000	9 000	15 000	6205 ZZ VV DDU
	52	17	1.1	20 600	11 200	2 100	1 150	13.2	11 000	8 000	13 000	6305 ZZ VV DDU
28	52	12	0.6	12 500	7 400	1 270	755	14.5	14 000	8 500	16 000	60/28 ZZ VV DDU
	58	16	1	16 600	9 500	1 700	970	13.9	12 000	8 000	14 000	62/28 ZZ VV DDU
	68	18	1.1	26 700	14 000	2 730	1 430	12.4	10 000	7 500	13 000	63/28 ZZ VV DDU
30	42	7	0.3	4 700	3 650	480	370	16.4	15 000	9 000	18 000	6806 ZZ VV DD
	47	9	0.3	7 250	5 000	740	510	15.8	14 000	8 500	17 000	6906 ZZ VV DDU
	55	9	0.3	11 200	7 350	1 150	750	15.2	13 000	—	15 000	16006
	55	13	1	13 200	8 300	1 350	845	14.7	13 000	8 000	15 000	6006 ZZ VV DDU
	62	16	1	19 500	11 300	1 980	1 150	13.8	11 000	7 500	13 000	6206 ZZ VV DDU
	72	19	1.1	26 700	15 000	2 720	1 530	13.3	9 500	6 700	12 000	6306 ZZ VV DDU
32	58	13	1	15 100	9 150	1 530	935	14.5	12 000	7 500	14 000	60/32 ZZ VV DDU
	65	17	1	20 700	11 600	2 120	1 190	13.6	10 000	7 100	12 000	62/32 ZZ VV DDU
	75	20	1.1	29 900	17 000	3 050	1 730	13.2	9 000	6 300	11 000	63/32 ZZ VV DDU
35	47	7	0.3	4 900	4 100	500	420	16.7	14 000	7 500	16 000	6807 ZZ VV DD
	55	10	0.6	10 600	7 250	1 080	740	15.5	12 000	7 500	15 000	6907 ZZ VV DDU
	62	9	0.3	11 700	8 200	1 190	835	15.6	11 000	—	13 000	16007
	62	14	1	16 000	10 300	1 630	1 050	14.8	11 000	6 700	13 000	6007 ZZ VV DDU
	72	17	1.1	25 700	15 300	2 620	1 580	13.8	9 500	6 300	11 000	6207 ZZ VV DDU
	80	21	1.5	33 500	19 200	3 400	1 980	13.2	8 500	6 000	10 000	6307 ZZ VV DDU
40	52	7	0.3	6 350	5 550	650	565	17.0	12 000	6 700	14 000	6808 ZZ VV DD
	62	12	0.6	13 700	10 000	1 390	1 020	15.7	11 000	6 300	13 000	6908 ZZ VV DDU
	68	9	0.3	12 600	9 650	1 290	985	16.0	10 000	—	12 000	16008
	68	15	1	16 800	11 500	1 710	1 180	15.3	10 000	6 000	12 000	6008 ZZ VV DDU
	80	18	1.1	23 100	17 900	2 970	1 820	14.0	8 500	5 600	10 000	6208 ZZ VV DDU
	90	23	1.5	40 500	24 000	4 150	2 450	13.2	7 500	5 300	9 000	6308 ZZ VV DDU
45	58	7	0.3	6 600	6 150	670	625	17.2	11 000	6 000	13 000	6809 ZZ VV DD
	68	12	0.6	14 100	10 900	1 440	1 110	15.9	9 500	6 000	12 000	6909 ZZ VV DDU
	75	10	0.6	14 900	11 400	1 520	1 160	15.9	9 000	—	11 000	16009
	75	16	1	20 900	15 200	2 140	1 550	15.3	9 000	5 300	11 000	6009 ZZ VV DDU
	85	19	1.1	31 500	20 400	3 200	2 080	14.4	7 500	5 300	9 000	6209 ZZ VV DDU
	100	25	1.5	53 000	32 000	5 400	3 250	13.1	6 700	4 800	8 000	6309 ZZ VV DDU

Notes (1) For tolerances for the snap ring grooves and snap ring dimensions, refer to Pages A50 to A53.
(2) When heavy axial loads are applied, increase d_a and decrease D_a from the above values.

Dynamic Equivalent Load

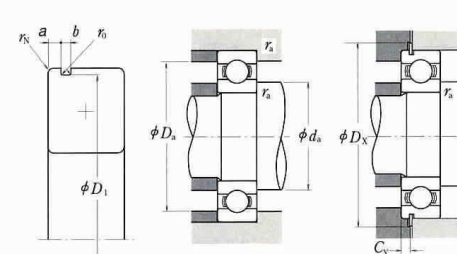
$$P = X F_r + Y F_a$$

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

Static Equivalent Load

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

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



With Snap Ring Groove	With Snap Ring	Snap Ring Groove Dimensions (1) (mm)					Snap Ring (1) Dimensions (mm)		Abutment and Fillet Dimensions (mm)					Mass (kg)	
		a max	b min	D_1 max	r_0 max	r_{0s} min	D_2 max	f max	d_a (2) min	d_a (2) max	D_a (2) max	r_a max	D_x min		C_v max
N	NR	1.3	0.95	35.7	0.25	0.3	39.8	0.85	27	27	35	0.3	40.5	1.8	0.021
N	NR	1.7	0.95	40.7	0.25	0.3	44.8	0.85	27	28.5	40	0.3	45.5	2.3	0.042
									27		45	0.3			0.059
N	NR	2.06	1.35	44.6	0.4	0.5	52.7	1.12	29	30	43	0.6	53.5	2.9	0.079
N	NR	2.46	1.35	49.73	0.4	0.5	57.9	1.12	30	32	47	1	58.5	3.3	0.129
N	NR	3.28	1.9	59.61	0.6	0.5	67.7	1.7	31.5	36	55.5	1	68.5	4.6	0.235
N	NR	2.06	1.35	49.73	0.4	0.5	57.9	1.12	32	34	48	0.6	58.5	2.9	0.096
N	NR	2.46	1.35	55.6	0.4	0.5	63.7	1.12	33	35.5	53	1	64.5	3.3	0.175
N	NR	3.28	1.9	64.82	0.6	0.5	74.6	1.7	34.5	38	61.5	1	76	4.6	0.287
N	NR	1.3	0.95	40.7	0.25	0.3	44.8	0.85	32	32	40	0.3	45.5	1.8	0.024
N	NR	1.7	0.95	45.7	0.25	0.3	49.8	0.85	32	34	45	0.3	50.5	2.3	0.052
									32		53	0.3			0.087
N	NR	2.08	1.35	52.6	0.4	0.5	60.7	1.12	35	36.5	50	1	61.5	2.9	0.116
N	NR	3.28	1.9	59.61	0.6	0.5	67.7	1.7	35	38.5	57	1	68.5	4.6	0.199
N	NR	3.28	1.9	68.81	0.6	0.5	78.6	1.7	36.5	42.5	65.5	1	80	4.6	0.345
N	NR	2.08	1.35	55.6	0.4	0.5	63.7	1.12	37	38.5	53	1	64.5	2.9	0.122
N	NR	3.28	1.9	62.6	0.6	0.5	70.7	1.7	37	40	60	1	71.5	4.6	0.225
N	NR	3.28	1.9	71.83	0.6	0.5	81.6	1.7	38.5	44.5	68.5	1	83	4.6	0.389
N	NR	1.3	0.95	45.7	0.25	0.3	49.8	0.85	37	37	45	0.3	50.5	1.8	0.027
N	NR	1.7	0.95	53.7	0.25	0.5	57.8	0.85	39	39	51	0.6	58.5	2.3	0.075
									37		60	0.3			0.107
N	NR	2.08	1.9	59.61	0.6	0.5	67.7	1.7	40	41.5	57	1	68.5	3.4	0.151
N	NR	3.28	1.9	68.81	0.6	0.5	78.6	1.7	41.5	44.5	65.5	1	80	4.6	0.284
N	NR	3.28	1.9	76.81	0.6	0.5	86.6	1.7	42	47	72	1.5	88	4.6	0.464
N	NR	1.3	0.95	50.7	0.25	0.3	54.8	0.85	42	42	50	0.3	55.5	1.8	0.031
N	NR	1.7	0.95	60.7	0.25	0.5	64.8	0.85	44	46	58	0.6	65.5	2.3	0.112
									42		86	0.3			0.13
N	NR	2.49	1.9	64.82	0.6	0.5	74.6	1.7	45	47.5	63	1	76	3.8	0.19
N	NR	3.28	1.9	76.81	0.6	0.5	86.6	1.7	46.5	50.5	73.5	1	88	4.6	0.366
N	NR	3.28	2.7	86.79	0.6	0.5	96.5	2.46	48	53	82	1.5	98	5.4	0.636
N	NR	1.3	0.95	56.7	0.25	0.3	60.8	0.85	47	47.5	56	0.3	61.5	1.8	0.038
N	NR	1.7	0.95	66.7	0.25	0.5	70.8	0.85	49	50	64	0.6	72	2.3	0.126
									49		71	0.6			0.167
N	NR	2.49	1.9	71.83	0.6	0.5	81.6	1.7	50	53.5	70	1	83	3.8	0.241
N	NR	3.28	1.9	81.81	0.6	0.5	91.6	1.7	51.5	55.5	78.5	1	93	4.6	0.42
N	NR	3.28	2.7	96.8	0.6	0.5	106.5	2.46	53	61.5	92	1.5	108	5.4	0.829

Remarks 1. Diameter Series 7 (extra thin section bearings) are also available, please contact NSK.
2. When using bearings with rotating outer rings, contact NSK if

4 - Boundary Dimensions for Rolling Bearings

Summary

Basic Order of Selection: ID → OD → Width

✓ **Dimension series**

- Indicated using two-digit figure
- 1st digit represents : Width series
- 2nd digit represents : Diameter series

✓ **Bore Number represents Bore Diameter**

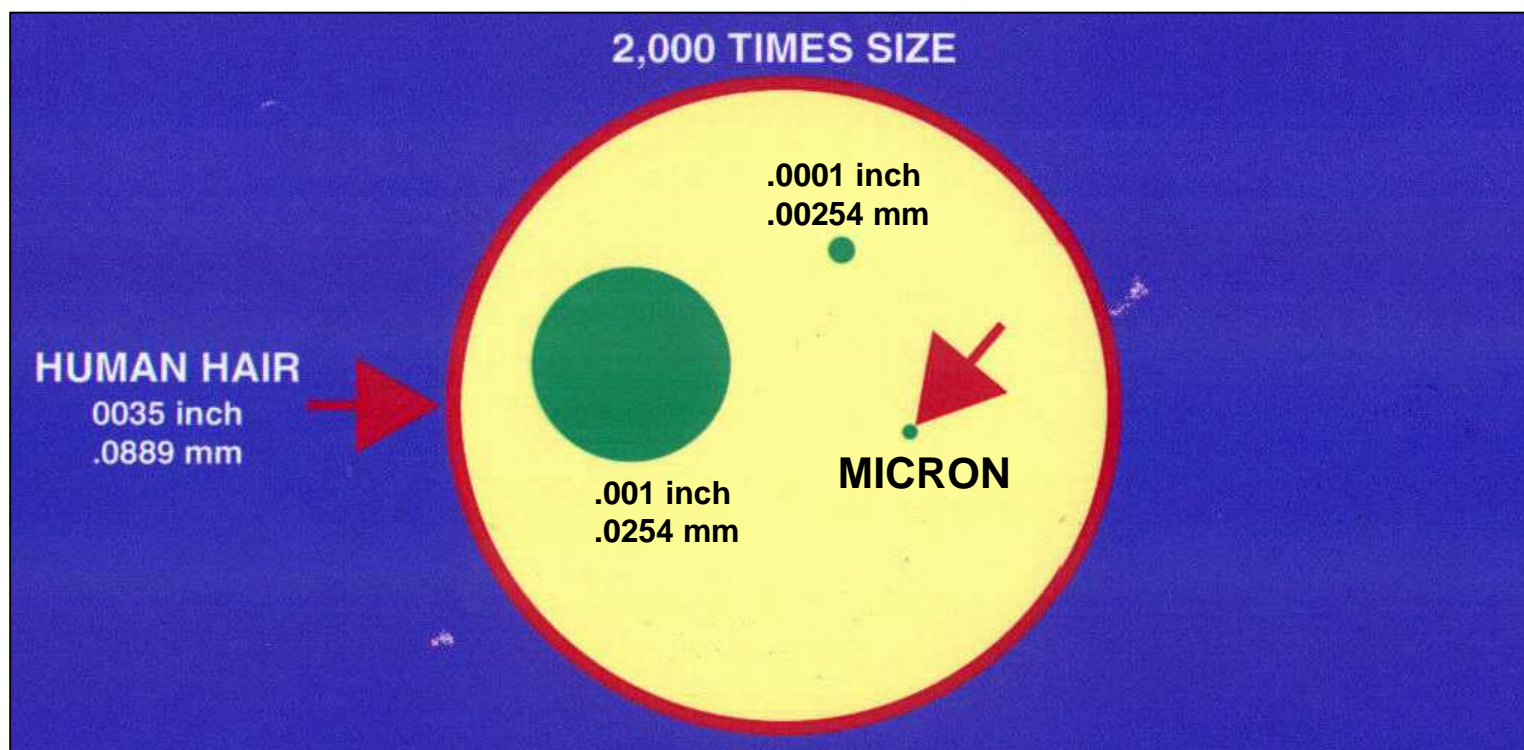
- For bore number 04 to 96, Bore diameter = Bore number x 5



5. Tolerances, Clearances and Fits

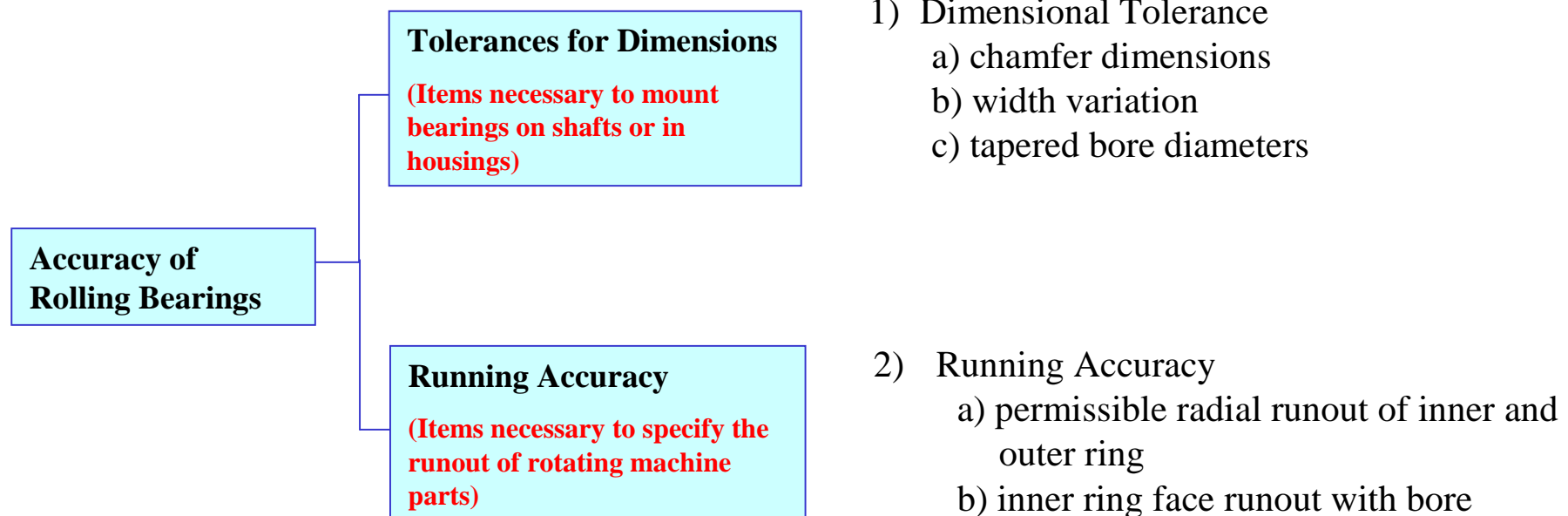
Tolerances

- 1 micron (μm) = 0.001 mm



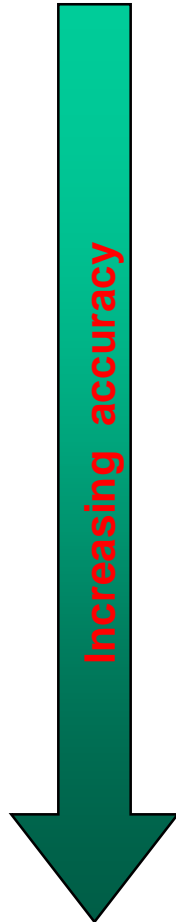
Tolerances – Bearing Precision Class

- Bearing Precision Class also known as “Tolerance” or “Accuracy” class.
- Accuracy of Rolling Bearing Consists of Two Parts:





Low Accuracy



Increasing accuracy

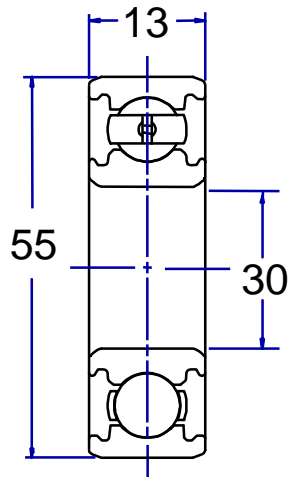
High Accuracy

ABMA	ISO	NSK (ISO)
ABEC 1	NORMAL	P0
ABEC 3	CLASS 6	P6
ABEC 5	CLASS 5	P5
ABEC 7	CLASS 4	P4
ABEC 9	CLASS 2	P2

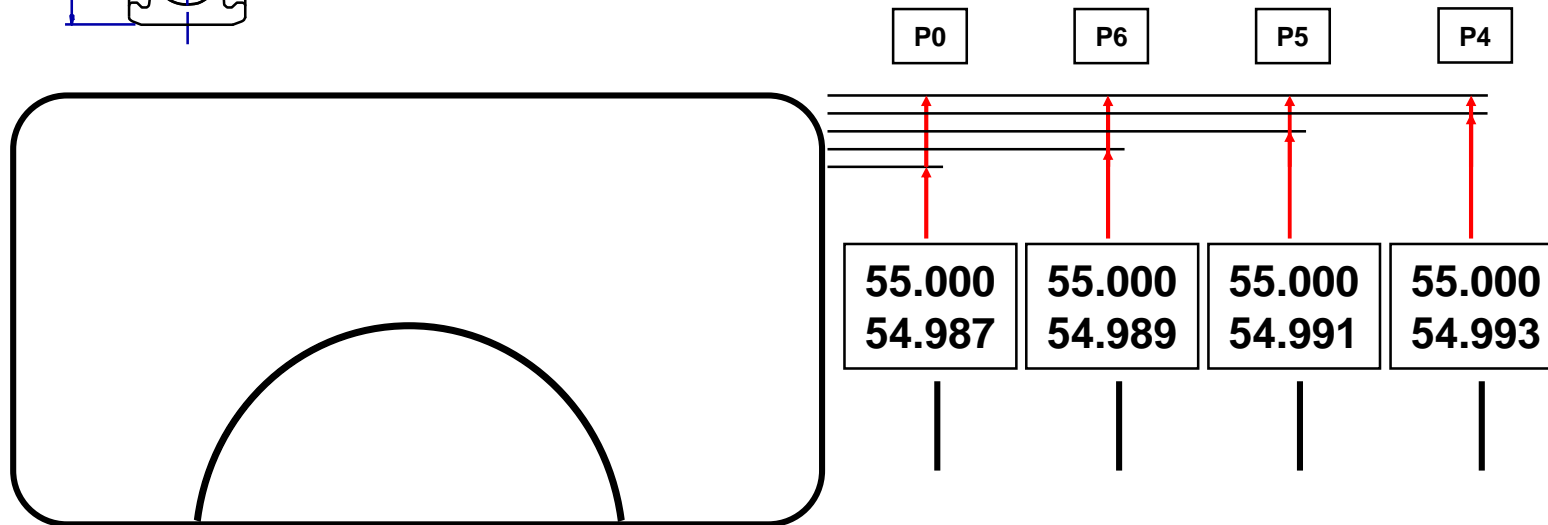


Refer to Page A62 ~ A63

- Example: OD Tolerance of a 6006 Single Row Deep Groove Ball Bearing



Normal (P0)	P6	P5	P4
High , Low	High , Low	High , Low	High , Low
0 , -13 μm	0 , -11 μm	0 , -9 μm	0 , -7 μm

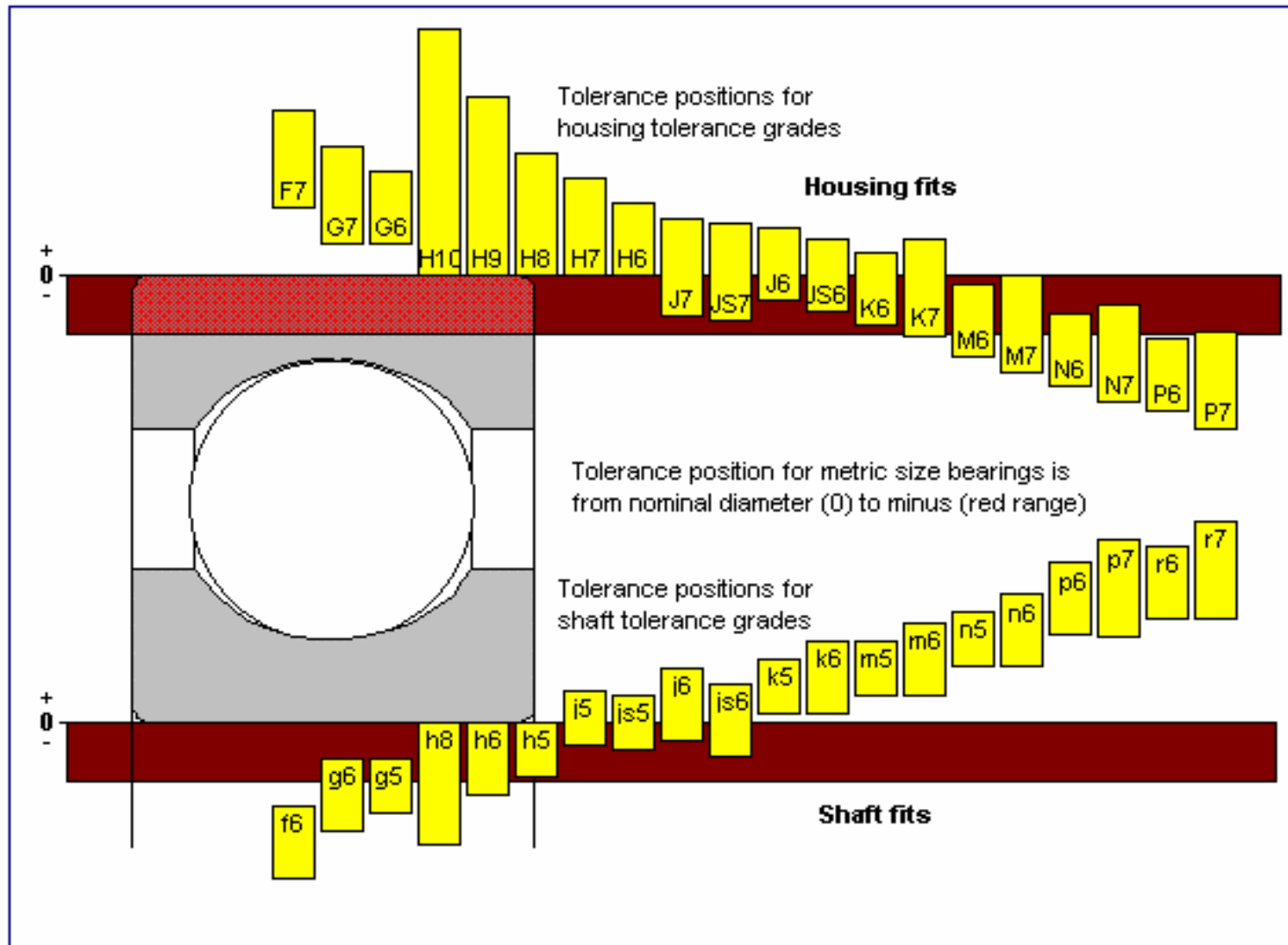


Tolerances – Bore and Shaft

- Bore and shaft tolerances are represented by:
 - a) Upper case – *housing ID* : *F, G, H, J, JS, K, M, N, P*
 - b) Lower case – *shaft OD* : *f, g, h, j, js, k, m, n, p, r*
 - c) Interference increases when alphabet increases: “*m*” has greater press fit than “*j*”

- Number represents amount of tolerance:
 - a) Tolerance range increases when number increases: 5, 6, 7, 8, 9, 10

Diameter Classification (mm)		j6	j7	k5	k6	k7	m5
over	incl						
18	30	+9	+13	+11	+15	+23	+17
		-4	-8	+2	+2	+2	+8
30	50	+11	+15	+13	+18	+27	+20
		-5	-10	+2	+2	+2	+9



Refer to Page C18 ~ C19

Appendix Table 9 Tolerances for Shaft Diameters

Units : μm

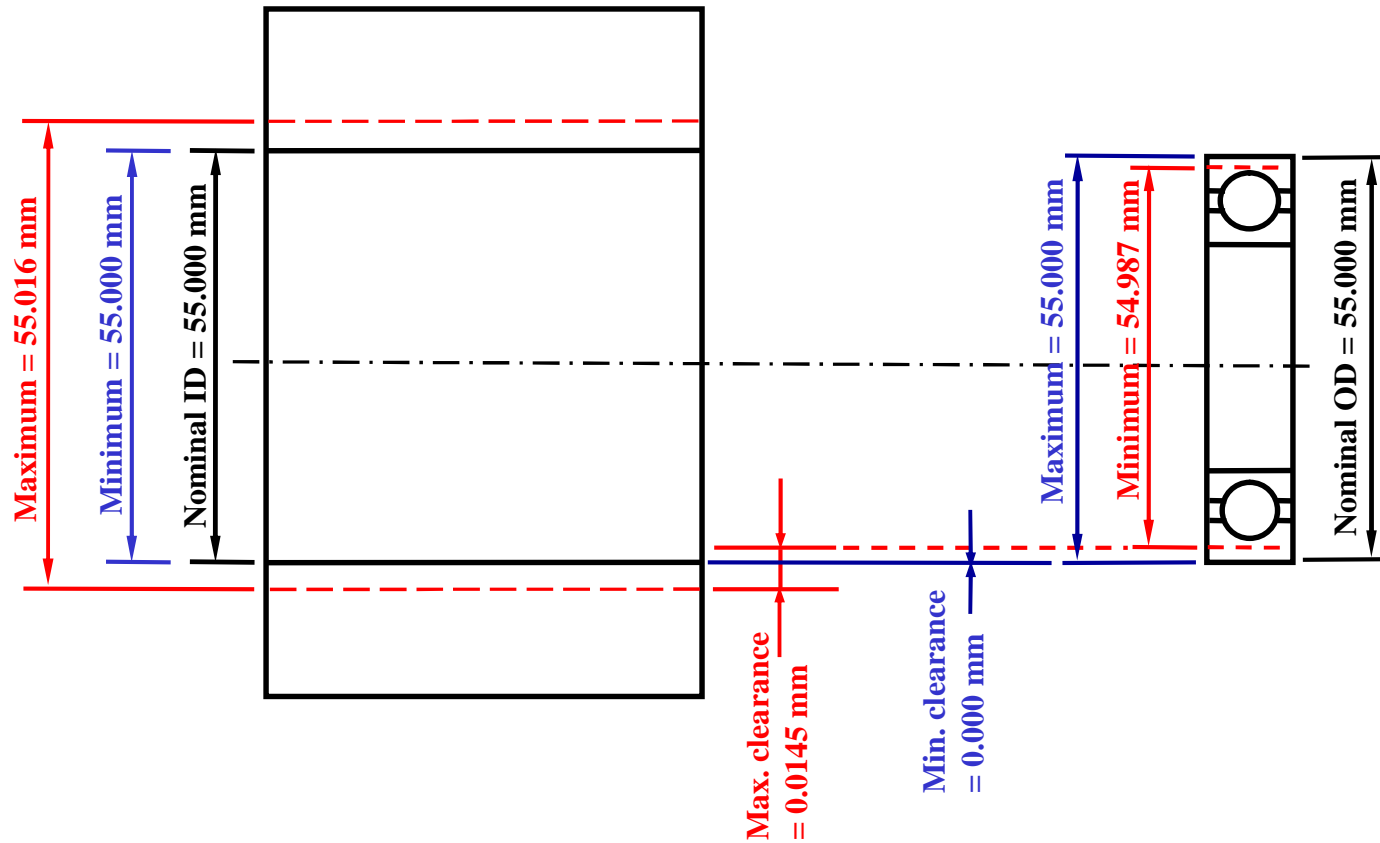
Diameter Classification (mm)		Single Plane Mean & D. Deviation (Normal Δ_{dmp})	d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6	j5	j6	j7	k5	k6	k7	m5	m6	n6	p6	r6	r7	Diameter Classification (mm)	
over	incl																											over	incl
3	6	0 - 8	- 30 - 38	- 20 - 28	- 10 - 18	- 4 - 4 - 9 - 12	0 0 - 5 - 8	0 0 - 12 - 18	0 0 - 30 - 48			$\pm 2.5 \pm 4$		- 3 - 6 - 2 - 4	+ 6 + 9 + 1 + 1	+ 13 + 1 + 4 + 4	+ 12 + 16 + 8 + 8	+ 20 + 23 + 12 + 15	+ 27 + 27 + 15 + 15	3	6								
6	10	0 - 8	- 40 - 49	- 25 - 34	- 13 - 22	- 5 - 5 - 11 - 14	0 0 - 6 - 9	0 0 - 15 - 22	0 0 - 36 - 58			$\pm 3 \pm 4.5$		+ 4 + 7 - 2 - 2	+ 10 + 10 + 1 + 1	+ 16 + 16 + 6 + 6	+ 15 + 19 + 10 + 10	+ 24 + 28 + 15 + 19	+ 34 + 41 + 19 + 19	6	10								
10	18	0 - 8	- 50 - 61	- 32 - 43	- 16 - 27	- 6 - 6 - 14 - 17	0 0 - 8 - 11	0 0 - 18 - 27	0 0 - 43 - 70			$\pm 4 \pm 5.5$		+ 5 + 8 - 3 - 3	+ 12 + 12 + 1 + 1	+ 19 + 19 + 7 + 7	+ 23 + 29 + 12 + 12	+ 34 + 41 + 18 + 18	+ 41 + 49 + 23 + 23	10	18								
18	30	0 - 10	- 65 - 78	- 40 - 53	- 20 - 33	- 7 - 7 - 16 - 20	0 0 - 9 - 13	0 0 - 21 - 33	0 0 - 52 - 84			$\pm 4.5 \pm 6.5$		+ 5 + 9 - 4 - 4	+ 13 + 13 + 6 + 6	+ 23 + 23 + 2 + 2	+ 21 + 28 + 8 + 8	+ 25 + 35 + 15 + 22	+ 59 + 65 + 28 + 28	18	30								
30	50	0 - 12	- 80 - 96	- 50 - 66	- 25 - 41	- 9 - 9 - 20 - 25	0 0 - 11 - 16	0 0 - 25 - 39	0 0 - 62 - 100			$\pm 5.5 \pm 8$		+ 6 + 11 - 5 - 5	+ 15 + 15 + 2 + 2	+ 27 + 27 + 2 + 2	+ 25 + 33 + 9 + 9	+ 42 + 50 + 26 + 34	+ 59 + 65 + 34 + 34	30	50								
50	80	0 - 15	- 100 - 119	- 60 - 79	- 30 - 49	- 10 - 10 - 23 - 29	0 0 - 13 - 19	0 0 - 30 - 46	0 0 - 74 - 120			$\pm 6.5 \pm 9.5$		+ 6 + 12 - 7 - 7	+ 18 + 18 - 12 - 12	+ 32 + 32 + 2 + 2	+ 30 + 39 + 11 + 20	+ 51 + 62 + 32 + 43	+ 71 + 73 + 41 + 43	50	80								
80	120	0 - 20	- 120 - 142	- 72 - 94	- 36 - 58	- 12 - 12 - 27 - 34	0 0 - 15 - 22	0 0 - 35 - 54	0 0 - 87 - 140			$\pm 7.5 \pm 11$		+ 6 + 13 - 9 - 9	+ 20 + 20 - 15 - 15	+ 38 + 38 + 3 + 3	+ 35 + 45 + 13 + 23	+ 59 + 76 + 37 + 54	+ 89 + 99 + 51 + 54	80	120								
120	180	0 - 25	- 145 - 170	- 85 - 110	- 43 - 68	- 14 - 14 - 32 - 39	0 0 - 18 - 25	0 0 - 40 - 63	0 0 - 100 - 160			$\pm 9 \pm 12.5$		+ 7 + 14 - 11 - 11	+ 22 + 22 - 18 - 18	+ 43 + 43 + 3 + 3	+ 40 + 52 + 15 + 27	+ 68 + 88 + 43 + 51	+ 103 + 105 + 63 + 65	120	180								
180	250	0 - 30	- 170 - 199	- 100 - 129	- 50 - 79	- 15 - 15 - 35 - 44	0 0 - 20 - 29	0 0 - 46 - 72	0 0 - 115 - 185			$\pm 10 \pm 14.5$		+ 7 + 16 - 13 - 13	+ 25 + 25 - 21 - 21	+ 50 + 50 + 4 + 4	+ 46 + 60 + 17 + 31	+ 79 + 109 + 50 + 80	+ 123 + 126 + 77 + 80	180	250								
250	315	0 - 35	- 190 - 222	- 110 - 142	- 56 - 88	- 17 - 17 - 40 - 49	0 0 - 23 - 32	0 0 - 52 - 81	0 0 - 130 - 210			$\pm 11.5 \pm 16$		+ 7 + 16 - 16 - 16	$\pm 16 \pm 26$	+ 56 + 56 + 4 + 4	+ 52 + 66 + 20 + 34	+ 88 + 130 + 56 + 98	+ 146 + 150 + 94 + 98	250	315								
315	400	0 - 40	- 210 - 246	- 125 - 161	- 62 - 98	- 18 - 18 - 43 - 54	0 0 - 25 - 36	0 0 - 57 - 89	0 0 - 140 - 230			$\pm 12.5 \pm 18$		+ 7 + 16 - 18 - 18	$\pm 18 \pm 29$	+ 61 + 61 + 4 + 4	+ 57 + 73 + 21 + 37	+ 98 + 144 + 62 + 98	+ 165 + 165 + 108 + 114	315	400								
400	500	0 - 45	- 230 - 270	- 135 - 175	- 68 - 108	- 20 - 20 - 47 - 60	0 0 - 27 - 40	0 0 - 63 - 97	0 0 - 155 - 250			$\pm 13.5 \pm 20$		+ 7 + 16 - 20 - 20	$\pm 20 \pm 31$	+ 68 + 68 + 5 + 5	+ 63 + 80 + 23 + 40	+ 108 + 126 + 68 + 98	+ 189 + 196 + 126 + 132	400	500								
500	630	0 - 50	- 260 - 304	- 145 - 189	- 76 - 120	- 22 - 22 - 66 - 66	0 0 - 44 - 70	0 0 - 110 - 175	0 0 - 280 - 280			± 22		- - -	+ 70 + 70 0 0	+ 88 + 88 + 44 + 44	+ 122 + 150 + 78 + 155	+ 189 + 225 + 155 + 155	500	630									
630	800	0 - 75	- 290 - 340	- 160 - 210	- 80 - 130	- 24 - 24 - 74 - 74	0 0 - 50 - 80	0 0 - 125 - 200	0 0 - 320 - 320			± 25		- - -	+ 80 + 80 0 0	+ 100 + 100 + 50 + 50	+ 138 + 156 + 88 + 100	+ 255 + 266 + 175 + 185	630	800									
800	1 000	0 - 100	- 320 - 376	- 170 - 226	- 86 - 142	- 26 - 26 - 82 - 82	0 0 - 56 - 90	0 0 - 140 - 230	0 0 - 360 - 360			± 28		- - -	+ 90 + 90 0 0	+ 112 + 112 + 56 + 56	+ 156 + 156 + 100 + 100	+ 300 + 310 + 210 + 220	800	1 000									
1 000	1 250	0 - 125	- 350 - 416	- 195 - 261	- 98 - 164	- 28 - 28 - 94 - 94	0 0 - 66 - 105	0 0 - 165 - 260	0 0 - 420 - 420			± 33		- - -	+ 105 + 105 0 0	+ 132 + 132 + 66 + 66	+ 186 + 186 + 120 + 120	+ 355 + 365 + 250 + 260	1 000	1 250									
1 250	1 600	0 - 160	- 390 - 468	- 220 - 298	- 110 - 188	- 30 - 30 - 105 - 105	0 0 - 78 - 125	0 0 - 195 - 310	0 0 - 500 - 500			± 39		- - -	+ 125 + 125 0 0	+ 156 + 156 + 78 + 78	+ 218 + 218 + 140 + 140	+ 425 + 455 + 300 + 330	1 250	1 600									
1 600	2 000	0 - 200	- 430 - 522	- 240 - 332	- 120 - 212	- 32 - 32 - 124 - 124	0 0 - 92 - 150	0 0 - 230 - 370	0 0 - 600 - 600			± 46		- - -	+ 150 + 150 0 0	+ 184 + 184 + 92 + 92	+ 262 + 262 + 170 + 170	+ 520 + 550 + 370 + 400	1 600	2 000									

Refer to Page C20 ~ C21

Appendix Table 10 Tolerances for Housing Bore Diameters

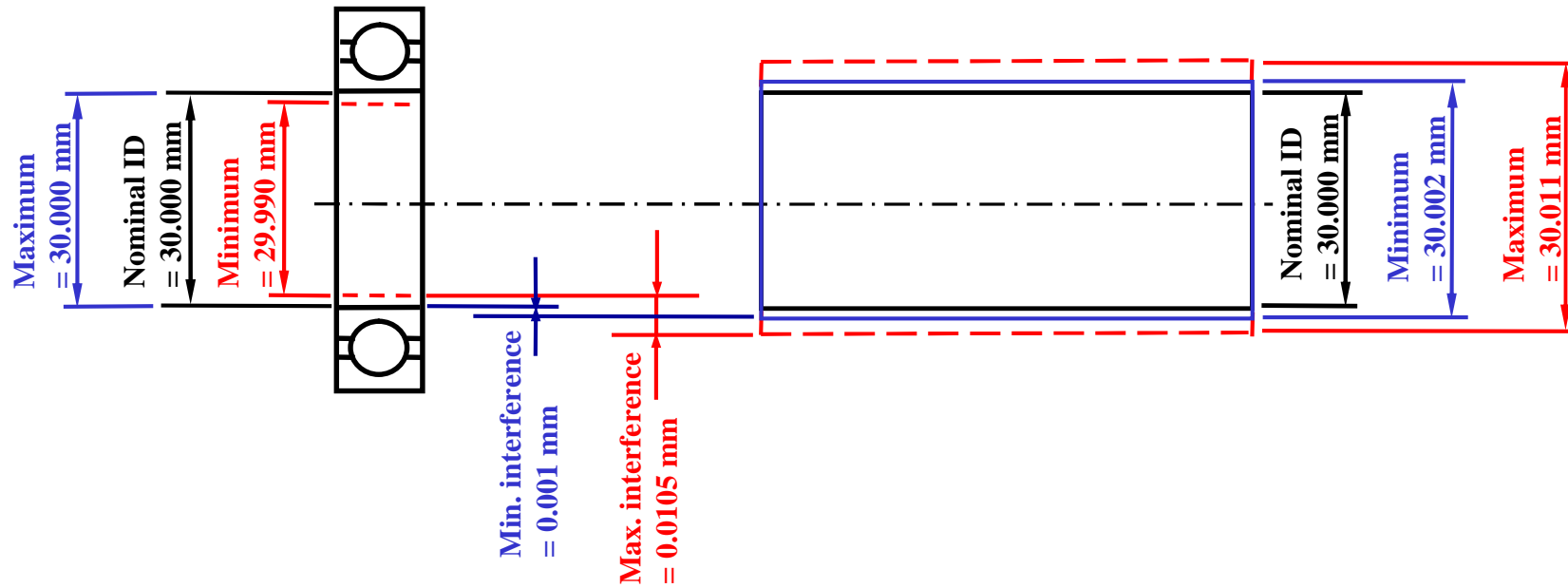
Units : μm

Diameter Classification (mm)		Single Plane Mean S.D. Deviation (Normal Distribution)	E6		F6		F7		G6		G7		H6		H7		H8		J6		J7		JS6		JS7		K5			K6			K7			M5			M6			M7			N5			N6			N7			P6		P7		Diameter Classification (mm)	
over	incl		over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl	over	incl									
10	18	-0 -8	+43 +32	+27 +16	+34 +16	+17 +6	+24 +6	+11 0	+18 0	+27 0	+6 -5	+10 -8	±5.5	±9	+2 -6	+2 -9	+6 -12	-4 -12	-4 -15	0 -18	-9 -17	-9 -20	-5 -23	-15 -26	-11 -29	10	18																																
18	30	-0 -9	+53 +40	+33 +20	+41 +20	+20 +7	+28 +7	+13 0	+21 0	+33 0	+8 -5	+12 -9	±6.5	±10.5	+1 -8	+2 -11	+6 -15	-5 -14	-4 -17	0 -21	-12 -21	-11 -24	-7 -28	-18 -31	-14 -35	18	30																																
30	50	-0 -11	+66 +50	+41 +25	+50 +25	+25 +9	+34 +9	+16 0	+25 0	+39 0	+10 -6	+14 -11	±8	±12.5	+2 -9	+3 -13	+7 -18	-5 -16	-4 -20	0 -25	-13 -24	-12 -28	-8 -33	-21 -37	-17 -42	30	50																																
50	80	-0 -13	+79 +60	+49 +30	+60 +30	+29 +10	+40 +10	+19 0	+30 0	+46 0	+13 -6	+18 -12	±9.5	±15	+3 -10	+4 -15	+9 -21	-6 -19	-5 -24	0 -30	-15 -28	-14 -33	-9 -39	-26 -45	-21 -51	50	80																																
80	120	-0 -15	+94 +72	+58 +36	+71 +36	+34 +12	+47 +12	+22 0	+35 0	+54 0	+16 -6	+22 -13	±11	±17.5	+2 -13	+4 -18	+10 -25	-8 -23	-6 -28	0 -35	-18 -33	-16 -38	-10 -45	-30 -52	-24 -59	80	120																																
120	150	0 -18	+110 +85	+68 +43	+83 +43	+39 +14	+54 +14	+25 0	+40 0	+63 0	+18 -7	+26 -14	±12.5	±20	+3 -15	+4 -21	+12 -28	-9 -27	-8 -33	0 -40	-21 -39	-20 -45	-12 -52	-36 -61	-28 -68	120	180																																
150	180	0 -25	+110 +85	+68 +43	+83 +43	+39 +14	+54 +14	+25 0	+40 0	+63 0	+18 -7	+26 -14	±12.5	±20	+3 -15	+4 -21	+12 -28	-9 -27	-8 -33	0 -40	-21 -39	-20 -45	-12 -52	-36 -61	-28 -68	120	180																																
180	250	-0 -30	+129 +100	+79 +50	+96 +50	+44 +15	+61 +15	+29 0	+46 0	+72 0	+22 -7	+30 -16	±14.5	±23	+2 -18	+5 -24	+13 -33	-11 -31	-8 -37	0 -46	-25 -45	-22 -51	-14 -60	-41 -70	-33 -79	180	250																																
250	315	-0 -35	+142 +110	+88 +56	+108 +56	+49 +17	+69 +17	+32 0	+52 0	+81 0	+25 -7	+36 -16	±16	±26	+3 -20	+5 -27	+16 -36	-13 -36	-9 -41	0 -52	-27 -50	-25 -57	-14 -66	-47 -79	-36 -88	250	315																																
315	400	-0 -40	+161 +125	+98 +62	+119 +62	+54 +18	+75 +18	+36 0	+57 0	+89 0	+29 -7	+39 -18	±18	±28.5	+3 -22	+7 -29	+17 -40	-14 -39	-10 -46	0 -57	-30 -55	-26 -62	-16 -73	-51 -87	-41 -98	315	400																																
400	500	-0 -45	+175 +135	+108 +68	+131 +68	+60 +20	+83 +20	+40 0	+63 0	+97 0	+33 -7	+43 -20	±20	±31.5	+2 -25	+8 -32	+18 -45	-16 -43	-10 -50	0 -63	-33 -60	-27 -67	-17 -80	-55 -95	-45 -108	400	500																																
500	630	-0 -50	+189 +145	+120 +76	+146 +76	+66 +22	+92 +22	+44 0	+70 0	+110 0	—	—	±22	±35	—	0 -44	0 -70	—	-26 -70	-26 -96	—	-44 -88	-44 -114	-78 -122	-78 -148	500	630																																
630	800	-0 -75	+210 +160	+130 +80	+160 +80	+74 +24	+104 +24	+50 0	+80 0	+125 0	—	—	±25	±40	—	0 -50	0 -80	—	-30 -80	-30 -110	—	-50 -100	-50 -130	-88 -138	-88 -168	630	800																																
800	1 000	-0 -100	+226 +170	+142 +86	+176 +86	+82 +26	+116 +26	+56 0	+90 0	+140 0	—	—	±28	±45	—	0 -56	0 -90	—	-34 -90	-34 -124	—	-56 -112	-56 -146	-100 -156	-100 -190	800	1 000																																
1 000	1 250	-0 -125	+261 +195	+164 +98	+203 +98	+94 +28	+133 +28	+66 0	+105 0	+165 0	—	—	±33	±52.5	—	0 -66	0 -105	—	-40 -106	-40 -145	—	-66 -132	-66 -171	-120 -186	-120 -225	1 000	1 250																																
1 250	1 600	-0 -160	+298 +220	+188 +110	+235 +110	+108 +30	+155 +30	+78 0	+125 0	+195 0	—	—	±39	±62.5	—	0 -78	0 -125	—	-48 -126	-48 -173	—	-78 -156	-78 -203	-140 -218	-140 -265	1 250	1 600																																
1 600	2 000	-0 -200	+332 +240	+212 +120	+270 +120	+124 +32	+182 +32	+92 0	+150 0	+230 0	—	—	±46	±75	—	0 -92	0 -150	—	-58 -150	-58 -208	—	-92 -184	-92 -242	-170 -262	-170 -320	1 600	2 000																																
2 000	2 500	-0 -250	+370 +260	+240 +130	+305 +130	+144 +34	+209 +34	+110 0	+175 0	+280 0	—	—	±55	±87.5	—	0 -110	0 -175	—	-68 -178	-68 -243	—	-110 -220	-110 -285	-195 -305	-195 -370	2 000	2 500																																



Housing with tolerance,
H6 $+16 \mu\text{m}$
0

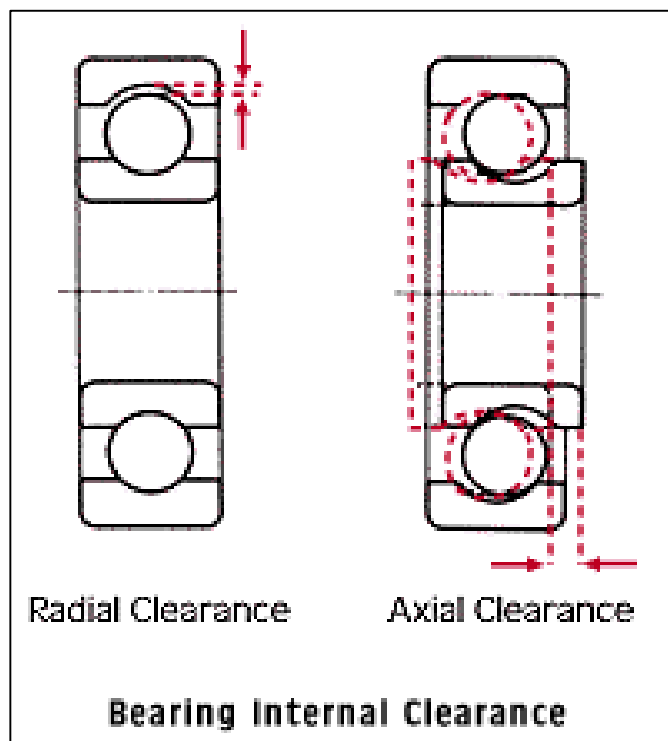
6006 Bearing with Precision Class,
“Normal” 0
-13 μm



6006 Bearing with Precision Class,
“Normal” $\begin{matrix} 0 \\ -10 \mu\text{m} \end{matrix}$

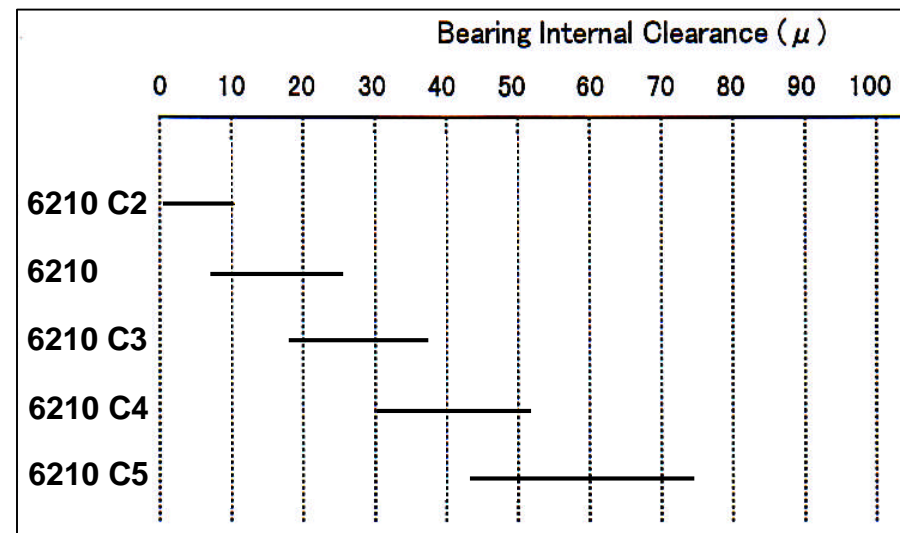
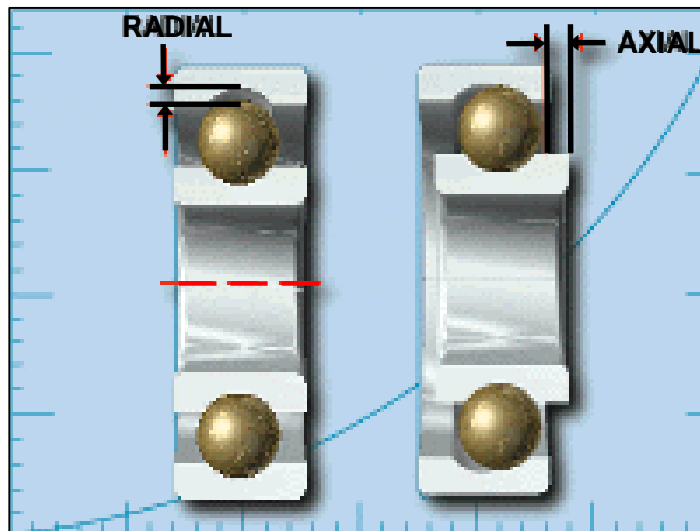
Shaft with tolerance,
k5 $\begin{matrix} +11 \mu\text{m} \\ +2 \mu\text{m} \end{matrix}$

Clearances



- Bearings are designed with a specific internal clearance between the raceways and the rolling elements.
- Internal clearance provides:
 - a) Free rotation of rolling elements
 - b) Compensation for thermal expansion
 - c) Optimum load distribution
- Correct clearance is important to hold the rotating parts of a machine in proper position across the whole range of conditions.

- **CN Clearance** is adequate for standard operating conditions.
- Clearance becomes **progressively larger from C1 to C5**.
 - a) In ball bearings, as radial clearance increases, axial clearance increases too.
 - b) The higher the clearance, the more the elements can shift in relation to each other.
 - c) Higher clearance = more tolerance of thermal effects.
 - d) Lower clearance = restriction of noise and vibration required.



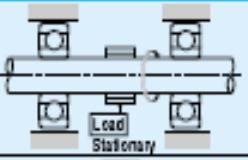
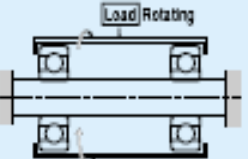
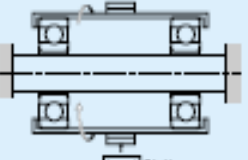
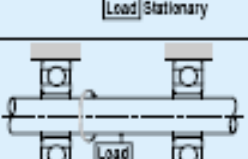


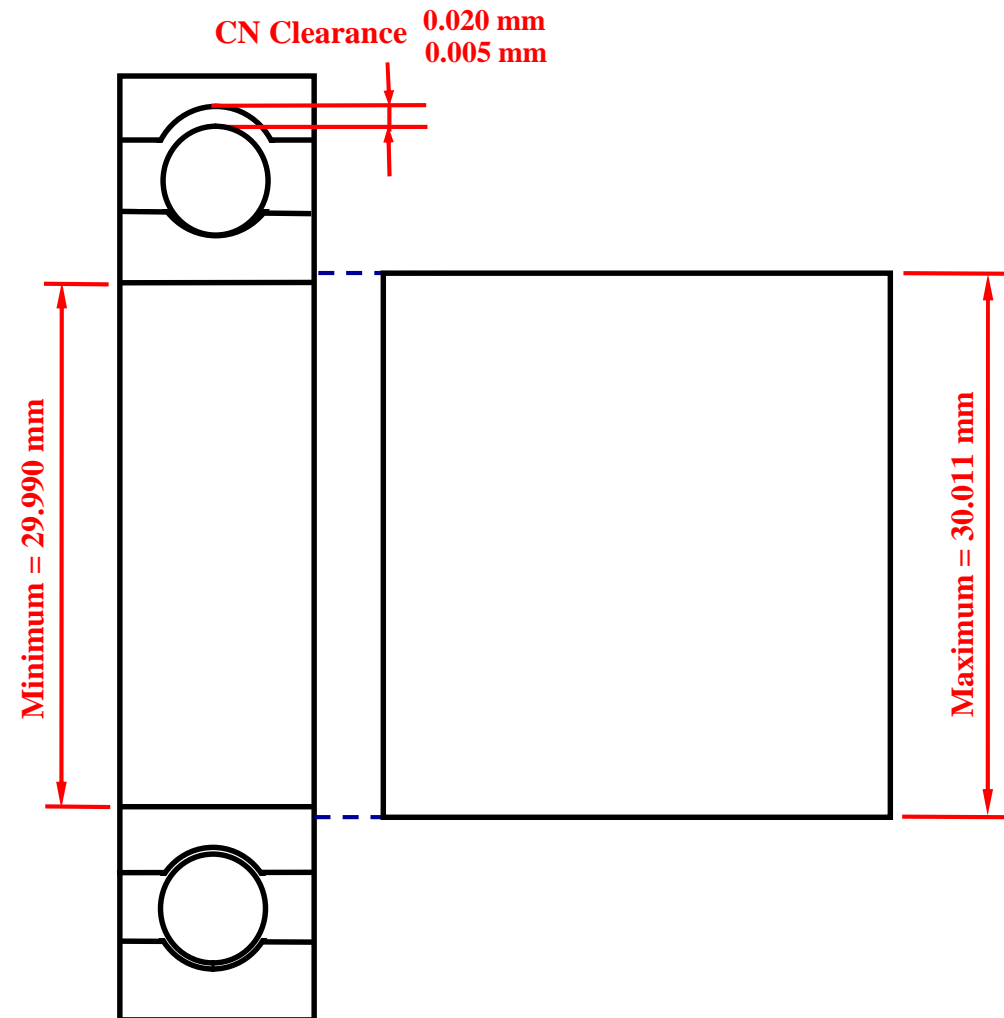
Fits

Refer to Page A14 ~ A15

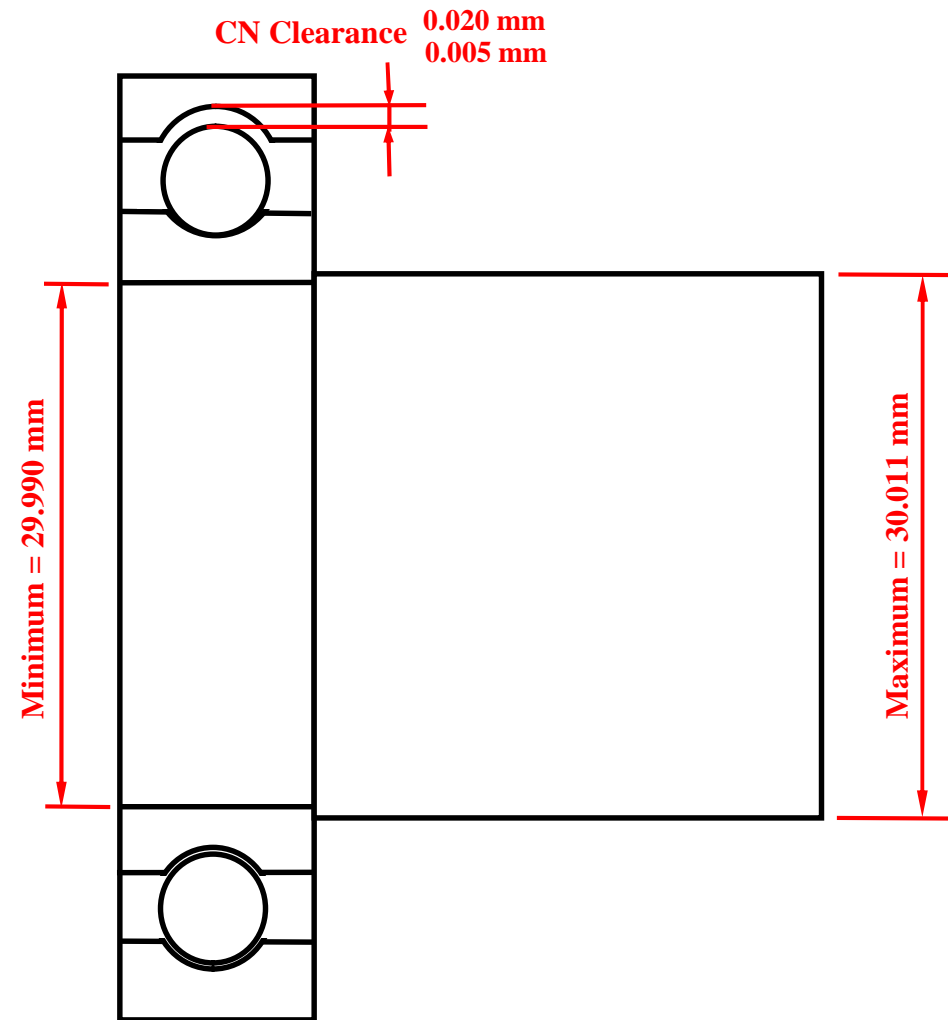
- Many equipment breakdowns because of improper sizing between bores and shafts.
- Generally, a tight fit is required on the ring sustaining the rotating load.

Table 9.1 Loading Conditions and Fits

Load Application	Bearing Operation		Load Conditions	Fitting	
	Inner Ring	Outer Ring		Inner Ring	Outer Ring
	Rotating	Stationary	Rotating Inner Ring Load	Tight Fit	Loose Fit
	Stationary	Rotating	Stationary Outer Ring Load		
	Stationary	Rotating	Rotating Outer Ring Load	Loose Fit	Tight Fit
	Rotating	Stationary	Stationary Inner Ring Load		
Direction of load indeterminate due to variation of direction or unbalanced load	Rotating or Stationary	Rotating or Stationary	Direction of Load Indeterminate	Tight Fit	Tight Fit



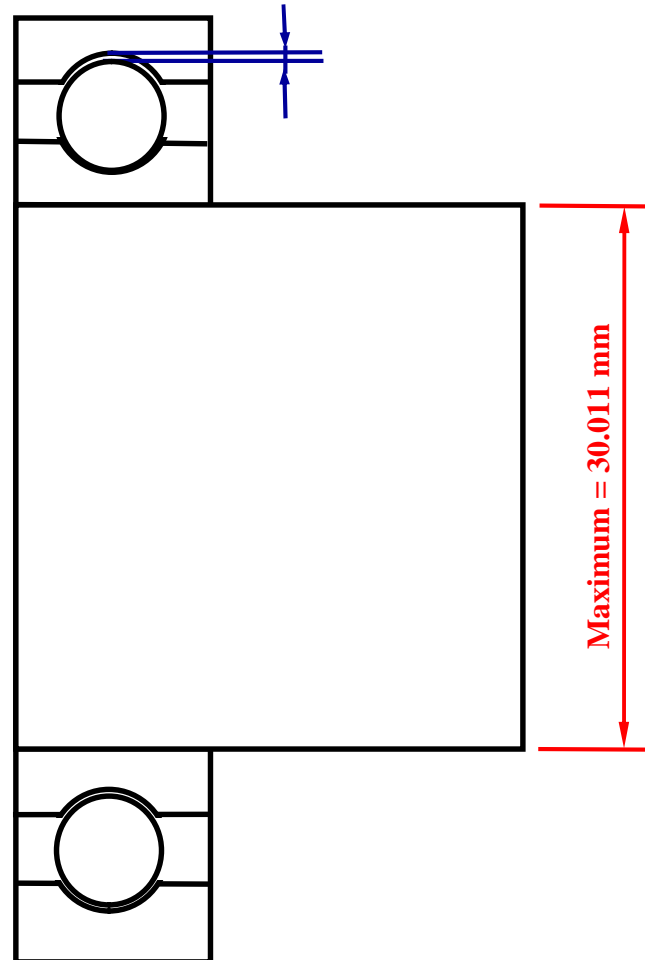
6006 Bearing with CN Clearance



6006 Bearing with CN Clearance



CN Clearance Reduced



6006 Bearing with CN Clearance

Importance of Proper Fits

- Slight Interference/Loose Fit – Creep occurs (relative movement)

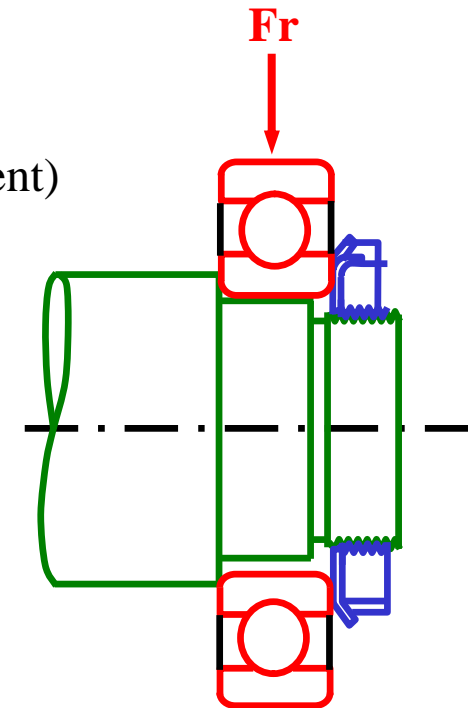
Damages – fitted surfaces becomes abraded

- a) cause wear (increasing clearance),
- b) considerable damage to shaft,
- c) abnormal heating,
- d) vibration (particles enters interior),
- e) contamination from accumulated wear particles.

- Excessive Interference – High stress buildup

Damages –

- a) fracture inner rings,
- b) decrease service life,
- c) excess heat buildup,
- d) premature bearing failure,
- e) decrease internal clearance (growth of inner ring or shrinkage in outer ring).



6 – Tolerances, Fits and Clearances

Summary

- ✓ Bore and shaft tolerances represented:
 - a) Upper case – *housing diameter (ID)*: $F, G, H, J, JS, K, M, N, P$
 - b) Lower case – *shaft diameter (OD)*: $f, g, h, j, js, k, m, n, p, r$

- ✓ Precision class (accuracy) of rolling bearing consists of:
 - a) Dimensional Tolerance
 - b) Running Accuracy

- ✓ Internal clearance provides
 - a) Free rotation of rolling elements
 - b) Compensation for thermal expansion
 - c) Optimum load distribution

- ✓ Type of fits achieved by specifying the tolerance range for the parts.



6. Bearing Numbers for Rolling Bearings

Bearing Numbers

Refer to Page A54 ~ A57

Consists of alphanumeric combinations that indicate:

- bearing type, boundary dimensions, internal clearance, dimensional and running accuracies, and other related specifications.

- Bearing series symbols

- 1st figure or symbol - bearing type
- 2nd & 3rd figure - dimension series

Basic Number	Bearing series symbol
	Bore number
	Contact angle symbol
Supplementary Symbol	Internal design symbol
	Material symbol
	Cage symbol
	Seals, shields symbol
	Symbol for design of rings
	Arrangement symbol
	Internal clearance symbol
	Tolerance class symbol
	Special specification symbol
	Spacer or sleeve symbol
	Grease symbol
	Bearing series symbol

Bearing Series Symbols

Refer to Page A54 ~A55

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

Note (1) Bearing Series Symbol 213 should logically be 203, but customarily it is numbered 213.
Remarks Numbers in () in the column of width symbols are usually omitted from the bearing number.



Refer to Page A56 ~ A57

BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS

Table 7. 6 Formulation of

Basic Numbers							
Bearing Series Symbols (*)	Bore Number	Contact Angle Symbol	Internal Design Symbol	Material Symbol	Cage Symbol	External Features	
Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
68	Single-Row Deep Groove Ball Bearings	1	Bearing Bore 1mm	A	Internal Design Differs from Standard One	g	Case-Hardened Steel Used in Rings, Rolling Elements
69	Deep Groove Ball Bearings	2	2	J	Smaller Diameter of Outer Ring Raceway, Contact Angle, and Outer Ring Width of Tapered Roller Bearings Conform to ISO	M	Machined Brass Cage
70	Single-Row Angular Contact Ball Bearings	3	3	A5	Standard Contact Angle of 25°	h	Stainless Steel Used in Rings, Rolling Elements
72	Angular Contact Ball Bearings	9	9	B	Standard Contact Angle of 40°	W	Pressed Steel Cage
73	Ball Bearings	00	10			DU	Contact Rubber Seal on One Side Only
12	Self-Aligning Ball Bearings	01	12			T	Synthetic Resin Cage
13	Ball Bearings	02	15			DDU	Contact Rubber Seals on Both Sides
22	Ball Bearings	03	17			V	Non-Contact Rubber Seal on One Side Only
NU10	Cylindrical Roller Bearings	/22	22	C	Standard Contact Angle of 15°	AA	Non-Contact Rubber Seals on Both Sides
NJ 2	Ball Bearings	/28	28		(For High Capacity Bearings)	CA	Spherical Roller Bearings
N 3	Ball Bearings	/28	28			CD	Spherical Roller Bearings
NN 30	Ball Bearings	/32	32			EA	Spherical Thrust Roller Bearings
NA48	Needle Roller Bearings	04(*)	20			E	Cylindrical Roller Bearings
NA49	Needle Roller Bearings	05	25			E	Spherical Thrust Roller Bearings
NA69	Needle Roller Bearings	06	30			HR(*)	Tapered Roller Bearings
320	Tapered Roller Bearings	88	440				
322	Tapered Roller Bearings	92	460				
323	Tapered Roller Bearings	96	480				
230	Spherical Roller Bearings	/500	500				
222	Spherical Roller Bearings	/500	500				
223	Spherical Roller Bearings	/500	500				
511	Thrust Ball Bearing with Flat Seats	/2 360	2 360				
512	Thrust Ball Bearing with Flat Seats	/2 500	2 500				
513	Thrust Ball Bearing with Flat Seats						
292	Spherical Thrust Roller Bearings						
293	Spherical Thrust Roller Bearings						
294	Spherical Thrust Roller Bearings						

Symbols and Numbers Conform to JIS(*) NSK Symbol NSK Symbol

Marked on Bearings Not Marked on Bearings

- Notes**
- (*) Bearing Series Symbols conform to Table 7.5.
 - (*) For basic numbers of tapered roller bearings in ISO's new series, refer to Page B111.
 - (*) For Bearing Bore Numbers 04 through 96, five times the bore number gives the bore size (mm) (except double-direction thrust ball bearings).
 - (*) HR is prefix to bearing series symbols.

Bearing Numbers

Auxiliary Symbols							
Symbol	Arrangement Symbol	Internal Clearance Symbol	Tolerance Class Symbol	Special Specification Symbol	Spacer or Sleeve Symbol	Grease Symbol	
Symbol	Meaning	Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
K	Tapered Bore of Inner Ring (Taper 1:12)	DB	Back-to-Back Arrangement	C1	Clearance Less than C2	Omitted	ISO Normal
		DF	Face-to-Face Arrangement	C2	Clearance Less than CN	P6	ISO Class 6
		DT	Tandem Arrangement	Omitted	For All Radial Bogs. For All Radial Bogs. For All Radial Bogs.	P6X	ISO Class 6X
K30	Tapered Bore of Inner Ring (Taper 1:30)			C3	Clearance Greater than CN	X26	Working Temperature Lower than 150°C
				C4	Clearance Greater than C3	X28	Working Temperature Lower than 200°C
				C5	Clearance Greater than C4	X29	Working Temperature Lower than 250°C
E	Notch or Lubricating Groove in Ring			CC1	Clearance Less than CC2		
				CC2	Clearance Less than CC		
				CC	Normal Clearance		
				CC4	Clearance Greater than CC		
				CC5	Clearance Greater than CC3		
E4	Lubricating Groove in Outside Surface and Holes in Outer Ring			MC1	Clearance Less than MC2		
				MC2	Clearance Less than MC3		
N	Snap Ring Groove in Outer Ring			MC3	Normal Clearance		
				MC4	Clearance Greater than MC3		
NR	Snap Ring Groove with Snap Ring in Outer Ring			MC5	Clearance Greater than MC4		
				MC6	Clearance Greater than MC5		
				CM	Clearance in Deep Groove Ball Bearings for Electric Motors		
				CT	Clearance in Cylindrical Roller Bearings for Electric Motors		

Partially the same as JIS(*) Same as JIS(*) NSK Symbol Partially the same as JIS(*)/BAS(*)

Same as JIS(*) In Principle, Marked on Bearings Not Marked on Bearings

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



Refer to Page A56 ~ A57

■ Marking on Bearings

BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS **NSK**

Table 7.6 Formulation of Bearing Numbers

Basic Numbers							Auxiliary Symbols						
Bearing Series Symbols (*)	Bore Number	Contact Angle Symbol	Internal Design Symbol	Material Symbol	Cage Symbol	External Features Seals, Shields Symbol	Symbol System for Design of Rings	Arrangement Symbol	Internal Clearance Symbol	Tolerance Class Symbol	Special Specification Symbol	Spacer or Sleeve Symbol	Grease Symbol
Symbols and Numbers Conform to JIS(*)			NSK Symbol				Partially the same as JIS(*)			Same as JIS(*)		NSK Symbol, Partially the same as JIS(*)	
Marked on Bearings			Not Marked on Bearings				In Principle, Marked on Bearings			Not Marked on Bearings		Not Marked on Bearings	

Notes

- (*) Bearing Series Symbols conform to Table 7.5.
- (*) For basic numbers of tapered roller bearings in ISO's new series, refer to Page 111.
- (*) For Bearing bore Numbers D4 through 96, five times the bore number gives the bore size (mm) (except double-direction thrust ball bearings).
- (*) HR is prefix to bearing series symbols.

A 57

Marked on Bearings

Not Marked on Bearings

In Principle, Marked on Bearings

Not Marked on Bearings



NSK Single row, deep groove, ball bearings

6 2 05 -H- T1X ZZ NR C3 E P5 X28

Bearing Type
R - Single row, deep groove - inch
6 - Single row, deep groove - metric
BL - Single row, deep groove, Max-type - metric

Bearing Series
0 - 600 extra small series - metric
0 - 6000 extra light, metric
2 - 6200 light, metric
3 - 6300 medium, metric
8 - 6800 extra thin, metric
9 - 6900 very thin, metric
32 - 63200 light, cartridge type, metric
33 - 63300 medium, cartridge type, metric

Bore Size

Metric
00 - 10mm
01 - 12mm
02 - 15mm
03 - 17mm
04 and above - multiply last two numbers by 5 to get bore size in mm.
 **Odd size metric bores will be called out as the bore size followed by the letter "M" to indicate metric (ex - 6205-13M has a 13mm bore). **

Inch
 Inch series bore sizes are called out in 16ths of an inch (ex - 6205-16 has a 1" bore because 16/16 = 1")

Cage
Blank - Steel
J - Steel (truncated number only)
M - Brass
T12/T1X - Non-metallic

Special feature
h - Bearing is made of stainless steel
 Shown on ASPACS as "-H-"
a - Special corner radius.
 Shown on ASPACS as "-A-"

Closures
Z - Single shield
ZZ - Double shield
V - Single non-contact seal
VV - Double non-contact seal
DU - Single contact seal
DDU - Double contact seal

Heat Stabilization
X26 - 150°C
X28 - 200°C
X29 - 250°C

Precision Class
Blank - ABEC 1
P6 - ABEC 3
P5 - ABEC 5
P4 - ABEC 7
P2 - ABEC 9

Noise level
E - Electric motor quality

Clearance
C2 - Tight
Blank - Normal
C3 - Loose
C4 - Extra loose
CG** - Special clearance in μm

Features
NR - Snap-ring and groove
N - Groove only

Ball Bearing Nomenclature

(10 mm bore or greater)

62

02

T1X

VV

C3E

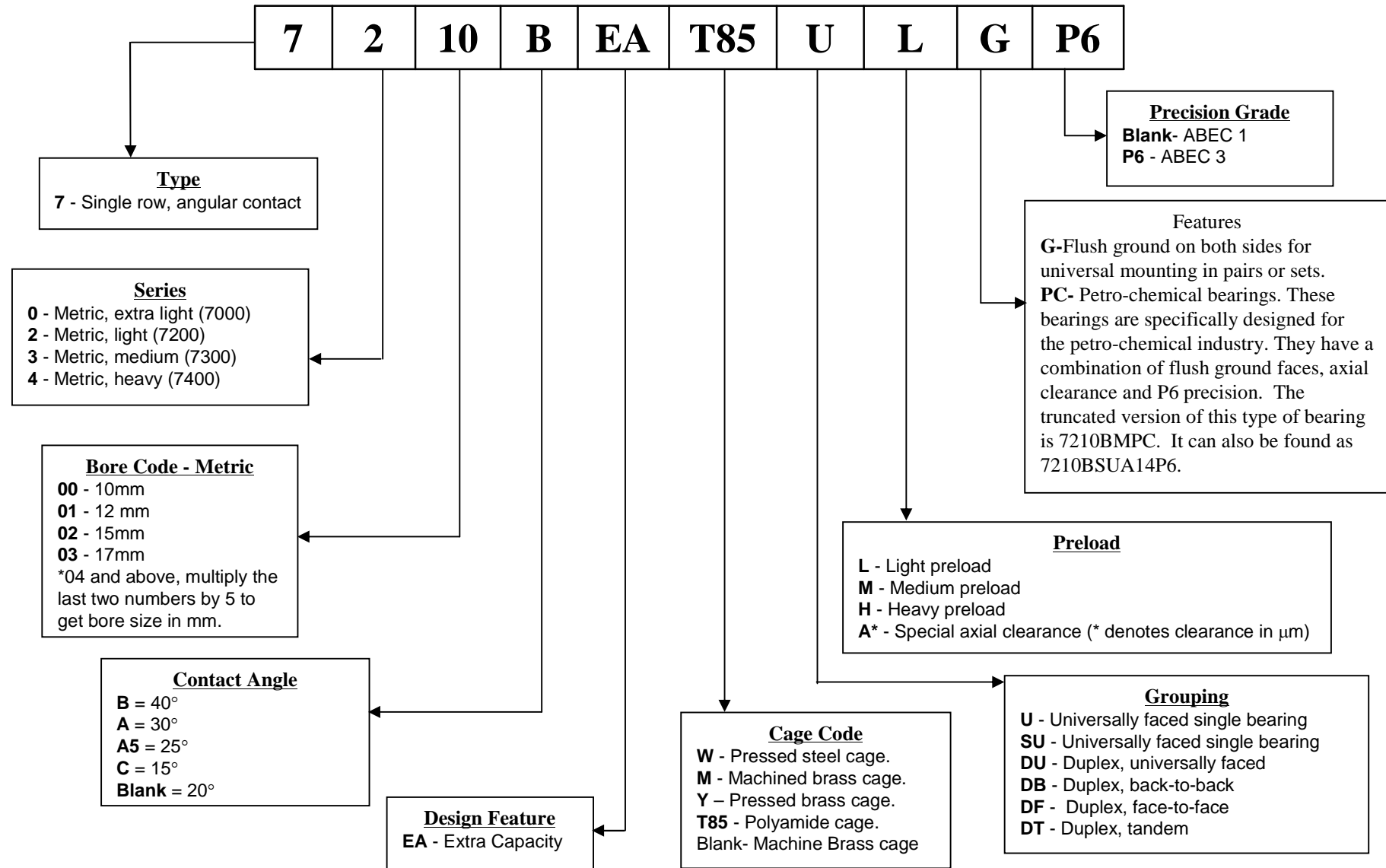
SRI

S



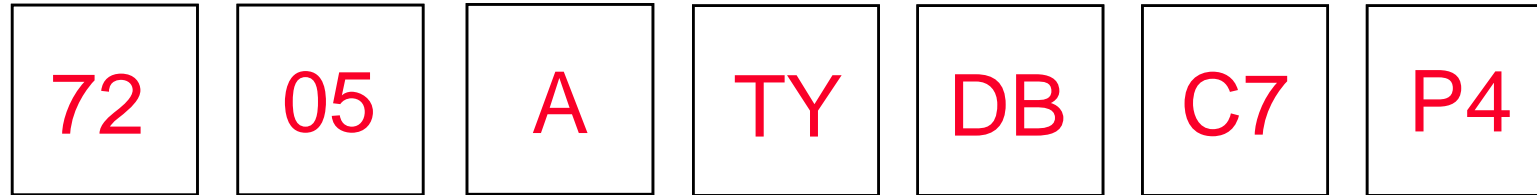
- 62** Basic Type and Series – Deep Groove Ball Bearing
- 02** Bore Size (15 mm)
- T1X** Polyamide (Nylon) Cage
- VV** Double Non-Contact Seal
- C3E** Loose Clearance – Low Noise Level
- SRI** Grease – Chevron SRI-2
- S** Grease Fill – Standard 35%

NSK Angular contact ball bearings





Angular Contact Nomenclature



- 72** Basic Type and Series
- 05** Bore Size in mm (Multiply by 5)
- A** Contact Angle – 30 degrees
- TY** Nylon Cage
- DB** Duplex Set – Back to Back
- C7** Light Preload
- P4** ISO Precision 4 = ABEC 7

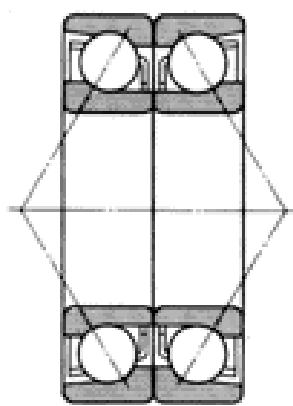
Refer to Page A54



6 3 0 8 ZZ C3

- Radial Clearance **C3** (Internal Clearance Symbol)
- Shields on Both Sides (Shield Symbol)
- Bearing Bore **40mm** (Bore Number)
- | | | |
|----------------------|---|---|
| Dia. Series 3 | } | The width series 0 is omitted, this indicated the diameter series 3 . |
| Single-Row | | |
| Deep Groove | | |
| Ball Bearing | | |
- } Bearing Series Symbol

Example : Deep Groove Ball Bearing



7 2 2 0 A DB C3

- Axial Clearance **C3**
- Back-to-Back Arrangement
- Contact Angle **30°**
- Bearing Bore **100mm**
- Diameter Series **2**
- Single-Row Angular Contact Ball Bearing

Example : Angular Contact Ball Bearing



NSK Cylindrical roller bearings

NU 2 20 E T C3 E

Bearing type
 RNU- Single row, no inner ring, flanges outer ring.
N - Single row, no flanges on outer ring
NU - Single row, no flanges on inner
NJ - Single row, one flange on inner ring
NUP - Single row, NJ style w/locating ring
NF - Single row, one flange on outer ring
NH - Single row, NJ w/stabilizing ring
NN - Double row, no flanges on outer ring
NNU - Double row, no flanges on inner ring

Series
2 - light series
3 - medium series
4 - heavy series
10 - extra light series
22 - light, wide series
23 - medium, wide series

Bore code
00 - 10mm
01 - 12mm
02 - 15mm
03 - 17mm
04 and above - multiply last two numbers by 5 to get bore size in mm.

Noise level
E - Electric motor quality

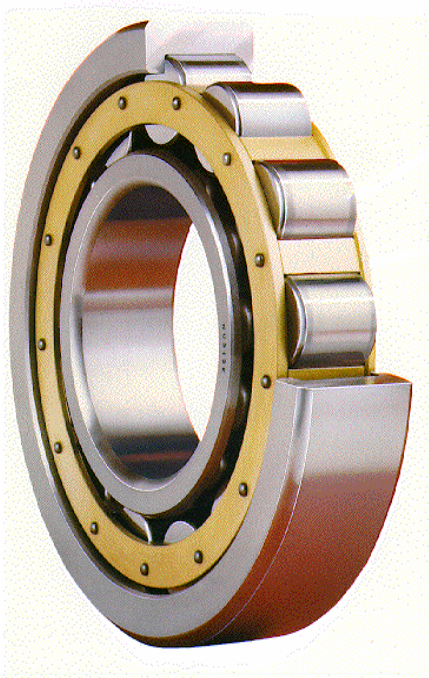
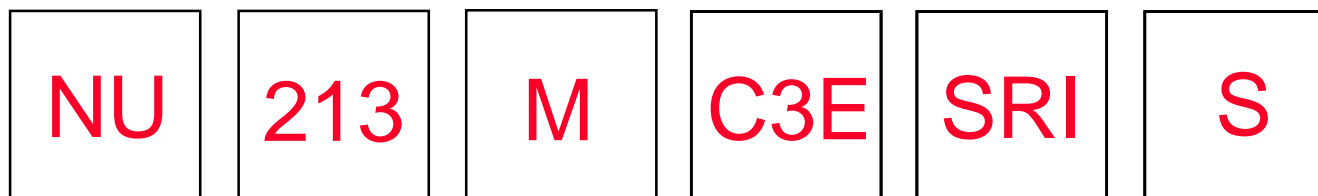
Clearance
C2 - tight
Blank - normal
C3 - loose
C4 - extra loose
CG** - Special clearance in μm
CM - electric motor quality, matched rings.
CT - electric motor quality, interchangeable rings.

Cage
T - Polyamide (only available in extra capacity bearings)
T7 - High temp composite cage (200°F)
M - Machined brass
Blank - Machined brass
W - Pressed steel
WS - Pressed steel for extra capacity bearings
V - Full compliment, no cage

Features
E - extra capacity (bigger rollers)
Blank - standard capacity

Cylindrical Bearing Nomenclature

(10 mm bore or greater)



NU	Basic Type - Cylindrical Roller NU
213	Dimension Series (2) and ID (65 mm)
M	Brass Cage
C3E	Loose Clearance – Low Noise Level
SRI	Grease – Chevron SRI
S	Grease Fill – Standard 35%

NSK Spherical roller bearings

2 31 72 CD g3 K E4 C3 P53 S11

Bearing type
2 - Spherical roller bearing
TF2/HTF2/STF2 - Spherical roller bearing made of Tough Steel
TL2 - Spherical roller bearing made of TL steel

Series
22 - 22200 series, medium
23 - 22300 series, heavy
30 - 23000 series, very light
31 - 23100 series, light
32 - 23200 series, medium, wide
39 - 23900 series, extra light
40 - 24000 series, very light, wide
41 - 24100 series, light, wide

Bore code
 Multiply the last two numbers by 5 to get bore size in mm.
 Bore sizes 500mm and larger are written as:
/500 - 500mm (ex - 232/500)

Cage
CAM - One piece brass cage
M - Two piece brass cage
C, CD - Two piece steel cage
EA - High capacity steel cage
H - Two piece polyamide cage

Material modification
g - Carburized bearing - complete
g2 - Carburized outer ring
g3 - Carburized inner ring
g4 - Carburized rollers
g5 - Carburized inner and outer ring
g6 - Carburized rollers and outer ring
g7 - Carburized rollers and inner ring

Features
U22 - Special inspection measures
S11 - Bearing heat treated to 200°C
U15-VS - Shaker screen designation

Tolerance
P52 - Outer ring accuracy
P53 - Inner ring accuracy
P55 - Inner and outer ring accuracy

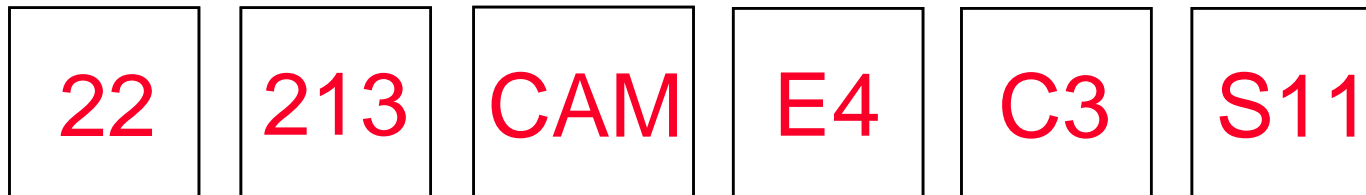
Clearance
C2 - Tight
Blank - Normal
C3 - Loose
C4 - Extra loose

Lubrication features
Blank - No lubrication feature
E2 - Oil holes, groove and knock pin hole in outer ring
E3 - Oil holes in outer ring
E4 - Oil holes and groove in outer ring
E5 - Oil holes and groove in inner ring
E6 - Either oil holes, groove or notch in inner ring (drawing required)
E7 - Oil holes and groove in both inner and outer rings
E9 - Special lubrication features (drawing required)
E42 - E4 feature with plugs provided for oil holes

Bore type
Blank - cylindrical bore
K - tapered bore 1:12
K30 - tapered bore 1:30, found only on 240 and 241 series



Spherical Bearing Nomenclature



- 22** Basic Type/Width Series – Spherical Roller
- 213** Dimension Series (2) and ID (65 mm)
- CAM** Inner Ring Design/Brass Cage
- E4** Lube Groove and Holes
- C3** Radial Internal Clearance - Loose
- S11** Temperature Stabilized to 200 deg C



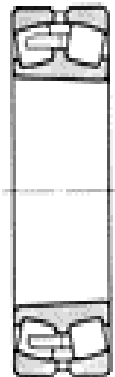
Refer to Page A54



NU 3 1 8 M CM

- Radial Clearance for Electric-Motor Bearing **CM**
- Machined Brass Cage
- Bearing Bore **90 mm**
- Diameter Series **3**
- NU Type Cylindrical Roller Bearing

Example : Cylindrical Roller Bearing



2 4 0 /1000 M K30 E4 C3

- Radial Clearance **C3**
- Outer ring with Oil Groove and Oil Holes
- Tapered Bore (Taper **1 : 30**)
- Machined Brass Cage
- Bearing Bore **1000 mm**
- Diameter Series **0**
- Width Series **4**
- Spherical Roller Bearing

Example : Spherical Roller Bearing



Bearing Nomenclature Exercises

What is the bearing type and bore for following bearings?

<u>Bearing Number</u>	<u>Bearing Type</u>	<u>Bore</u>
6000	Single Row Deep Groove Ball Bearing	10 mm
7202	Angular Contact Ball Bearing	15 mm
22228	Spherical Roller Bearing	140 mm
696	SRDG Miniature Ball Bearing	6 mm
NUP22/28	Cylindrical Roller Bearing	28 mm



Questions

Refer to Page A14 ~ A15

Identify the type of bearing which would best perform under the following conditions:

- Q # 1: High speed application requiring low torque, with ability to take both radial and axial loads.
Deep Groove Ball Bearings
- Q # 2: Heavy or impact radial loads, medium axial loads, and moderate angular misalignment.
Spherical Roller Bearings
- Q # 3: Machine tool spindles requiring high speed, high load and high accuracy.
Angular Contact Ball Bearings
- Q # 4: Small radial load and high angular misalignment.
Self-Aligning Ball Bearings

Refer to Rolling Bearing catalog for answers



7. Bearing Handling



Bearing Handling

- Rolling bearings are high precision machine parts.
- They must be handled accordingly.
- Even if high quality bearings are used, their expected performance cannot be achieved if they are not handled properly.

Precautions for Proper Handling of Bearings

The following main precautions to be observed:

~~Dust, Flaws, Rust~~

- (1) Store in Clean, Dry Area**
(Prevent the entry of dust and dirt)
- (2) Careful Handling**
(Avoid excessive strong impacts)
- (3) Use Proper Tools**
(Avoid general purpose tools)
- (4) Prevent Corrosion**
(Wear gloves to prevent adherence of perspiration on hand to bearings.
Pay attention to corrosive gases.)

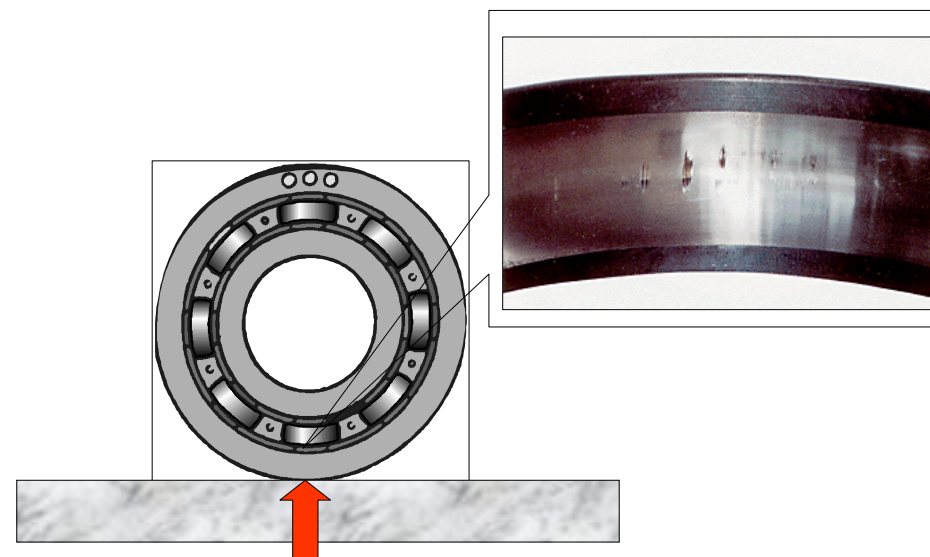
Proper Storage Condition

- Clean
- Non-Humid
- Place which is not exposed to direct sunshine
- Air flow between the box and floor



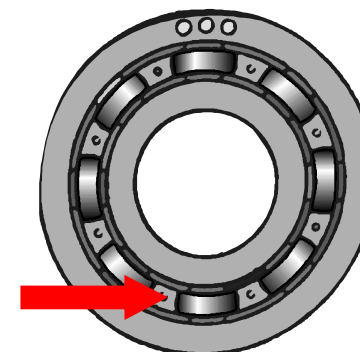
Proper Handling of Bearings

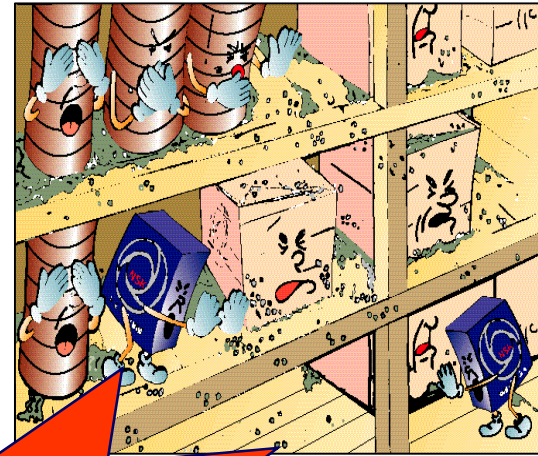
- Do Not Drop Bearing



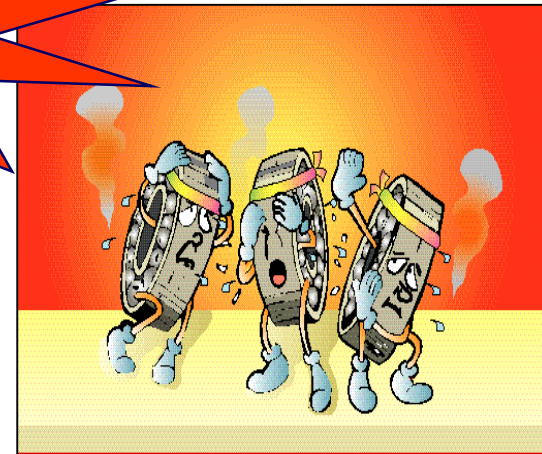
- Work In Clean Condition To Reduce Contamination

Debris, metal powder, foreign particle, etc

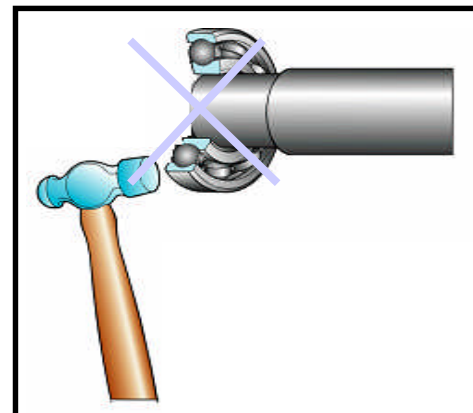
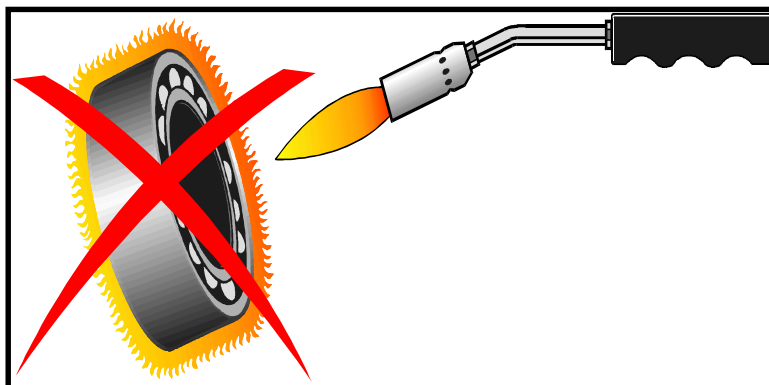




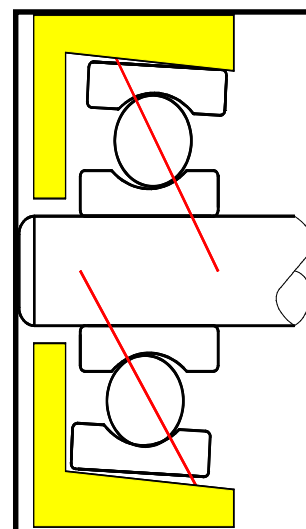
INCORRECT !!



- Use Proper Tools



- Ensure Proper Alignment





Bearing Basic – Lessons Learnt

- ✓ Understood the difference between plain and rolling bearings.
- ✓ Introduced to the different types of rolling bearings.
- ✓ Learnt the importance and relationship between tolerances, clearances and fits.
- ✓ Able to identify bearings based on its part numbers.
- ✓ Knowledge of how to handle bearings.



End of Presentation

THANK YOU!