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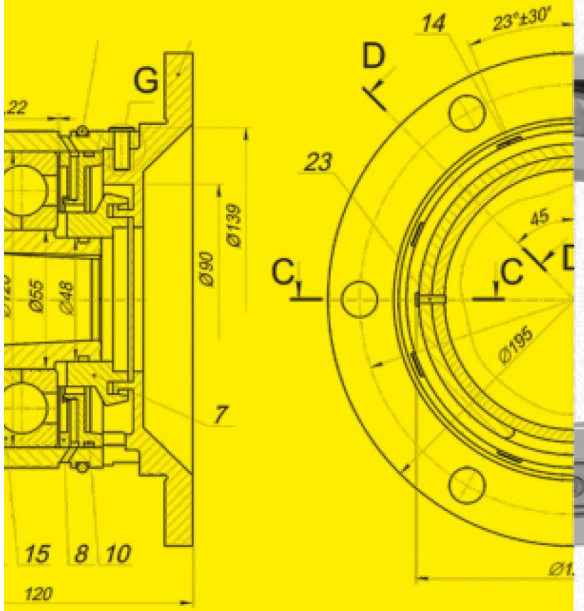

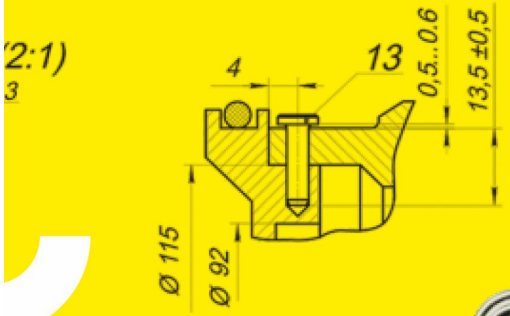

ROLLING BEARINGS

Accuracy and Tolerances

2 WHEELERS | 3 WHEELERS | 4 WHEELERS | TRACTORS | LCV, HCV | INDUSTRIES | RAILWAYS | AEROSPACE

WINNER DEMING GRAND PRIZE

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CATALOGUE/TC-106, 01/2024

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

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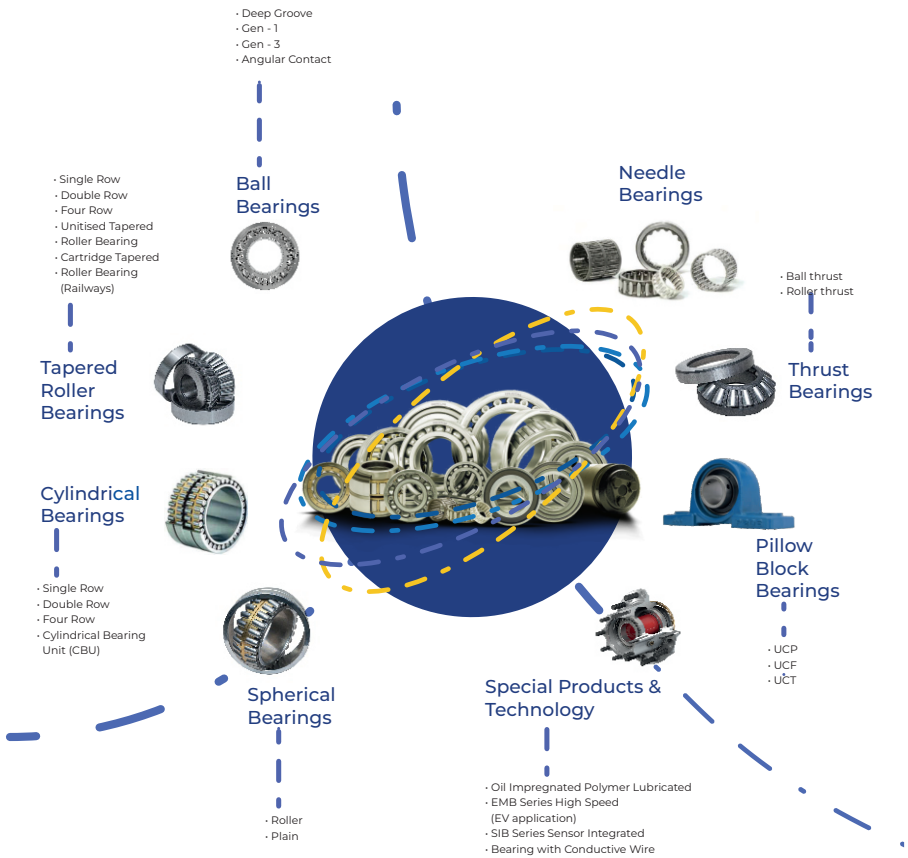
Founded in 1946, NBC is India's first bearings manufacturer and the last word in quality and durability. In 2020, the company acquired leading European manufacturer, Kinex Bearings to further boost its expertise.

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

- 1946 India's first bearing manufacturer
- 250+ million bearings manufactured/ annum
- 3100+ variants of bearings offered
- 5 manufacturing locations
- Leading exporter
- Happy customers in 30+ countries
- R&D and Innovation Centre
- 2800+People
- Automotive
- Industrial
- Railway
- Aerospace

Products from NBC

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



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

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

Bearing boundary dimensions are standardized by ISO (International Standard Organization)

This has been done to:

- Facilitate interchangeability of bearing
- Standardize shaft and housing dimensions

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

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

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

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

Accuracy

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

5.1 Dimensional Accuracy

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

Dimensional accuracy includes

Tolerances for:

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

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

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

Inner ring form are indicated as:

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

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Outer ring Form are indicated as:

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

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

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

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

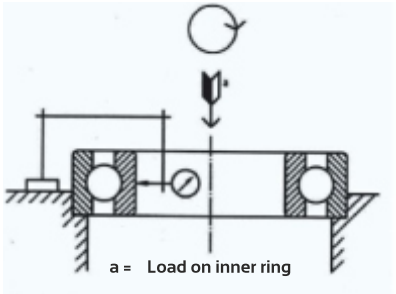
Running accuracies in bearing are:

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

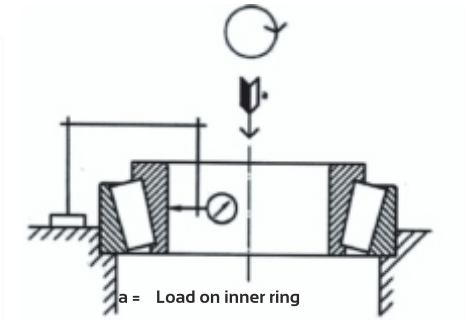
5. 2.1 Radial Run-out

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

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



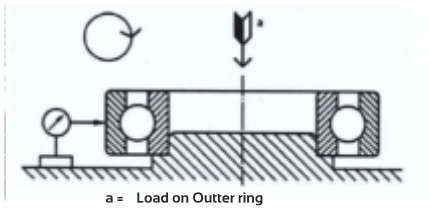
Kia MEASUREMENT OF BALL BEARING



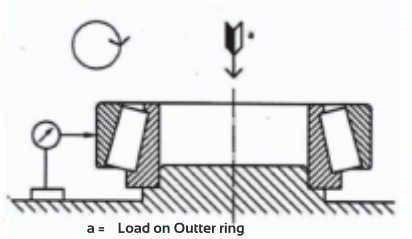
Kia MEASUREMENT OF TAPER ROLLER BEARING

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

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



Kea MEASUREMENT OF BALL BEARING

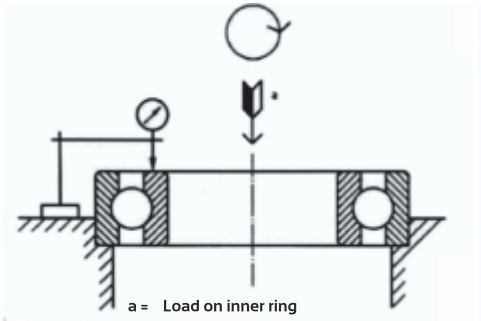


Kea MEASUREMENT OF TAPER ROLLER BEARING

5.2.2 Face run-out with raceway

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

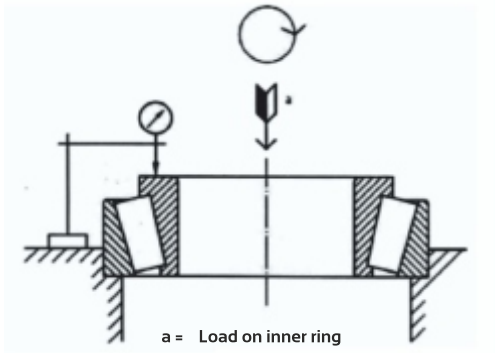
Differences between the largest and the smallest of the axial distances between the reference face of the inner ring, in different relative angular positions of this ring, at a radial distance from the inner ring axis equal to half the inner ring raceway contact diameter, and a point in a fixed position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



Sia MEASUREMENT OF BALL BEARING

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

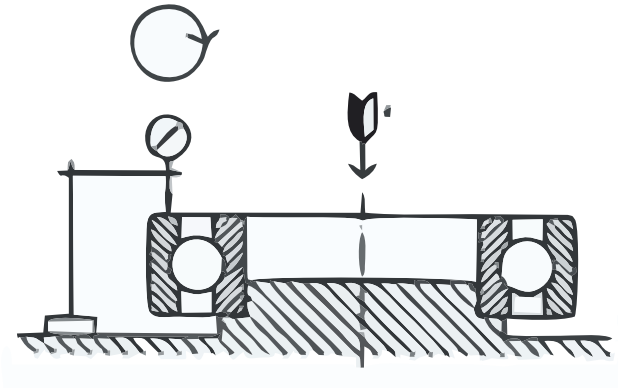
Difference between the largest and the smallest of the axial distances between the cone back face, in different angular positions of the cone, at a radial distance from the cone axis equal to half the cone raceway contact diameter and a point in a fixed position relative to the cup. The cone and cup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



Sia MEASUREMENT OF TAPER ROLLER BEARING

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

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



Load on Outter ring

Sea MEASUREMENT OF BALL BEARING

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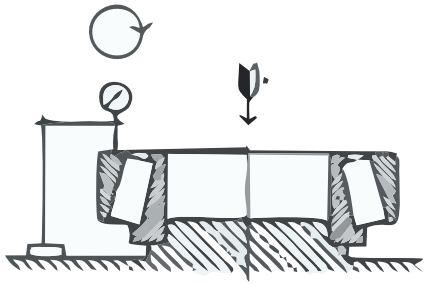
(D) Assembled bearing cup back face run-out with raceway 'Sea' (Taper roller bearing):

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

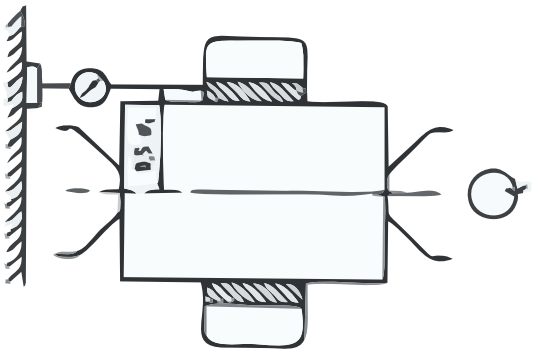


Sea MEASUREMENT OF TAPER ROLLER BEARING

5.2.3 Face run-out with bore

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

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



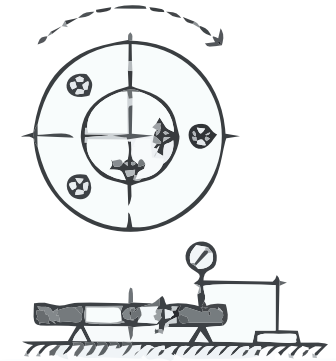
Sd MEASUREMENT

5.2.4 Raceway parallelism with face

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

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

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

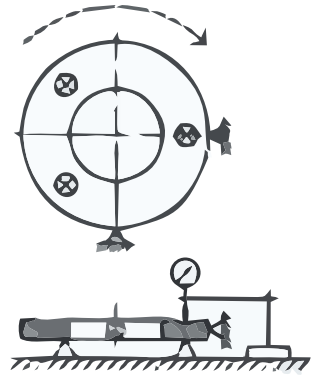


Si MEASUREMENT

5 .2.5 Out side surface inclination

Variation of outside surface generatrix inclination with face, 'SD' (outer ring basically cylindrical surface reference face):

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



Se MEASUREMENT

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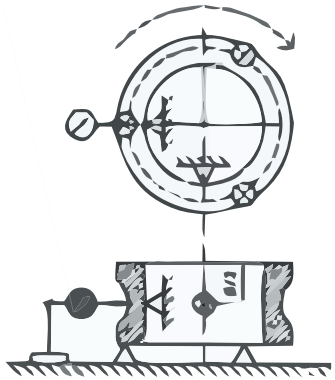
5.2.6 Thickness-variation

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

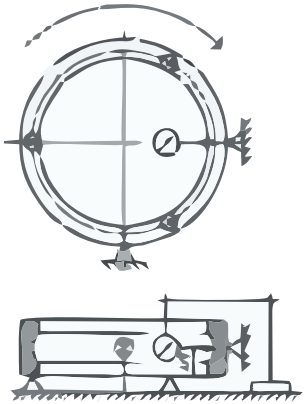
Difference between the largest and the smallest of the radial distances between the bore surface and the middle of a raceway on the outside of the ring.



K_i MEASUREMENT

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

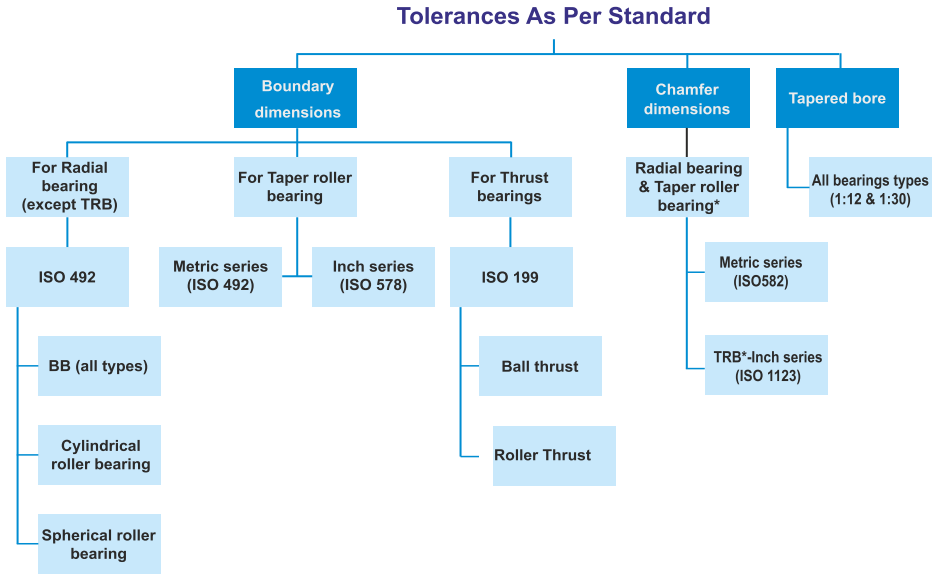
Difference between the largest and the smallest of the radial distances between the outside surface and the middle of a raceway on the inside of the ring.



K_e MEASUREMENT

Tolerances

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



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

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

Note: Reference Standards and organizations

JIS : Japanese Industrial Standard

BAS : The Japan Bearing Industrial Association Standard

ISO : International Organization for Standardization

ANSI : American National Standards Institute, Inc.

ABMA : American Bearing Manufactures Association

DIN : Deutsches Institut für Normung

BS : British Standards Institution

F : Association Francaise de Normalisation

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

(Except Tapered Roller Bearings)

d = bearing bore diameter, nominal

d1 = basic diameter at theoretical large end of a basically tapered bore

Δds = deviation of a single bore diameter

Δdmp = single plane mean bore diameter deviation (for a basically tapered bore **Δ**dmp refers only to the theoretical small end of bore)

Δd1mp = mean bore diameter deviation at theoretical large end of a basically tapered bore

Vdp = bore diameter variation in single radial plane

Vdmp = mean bore diameter variation (this applies only to a basically cylindrical bore)

α = half of the total angle of inner ring bore (for taper bore bearings)

D = bearing outside diameter, nominal

D1 = outer ring flange outside diameter, nominal

Δ Ds = deviation of single outside diameter

Δ Dmp = single plane mean outside diameter deviation

VDp = outside diameter variation in a single radial plane

VDmp = mean outside diameter variation

B = inner ring width, nominal

ΔBs = deviation of single inner ring width

VBs = inner ring width variation

C = outer ring width, nominal

C1 = outer ring flange width, nominal

ΔCs = deviation of single outer ring width

ΔC1s = deviation of a single outer ring flange width

VCs = outer ring width variation

VC1s = outer ring flange width variation

Kia = radial run out or assembled bearing inner ring

Kea = radial run out or assembled bearing outer ring

Sd = inner ring reference race (back face, where applicable) run out with bore

SD = variation of bearing outer surface generatix inclination with outer ring reference face (back face)

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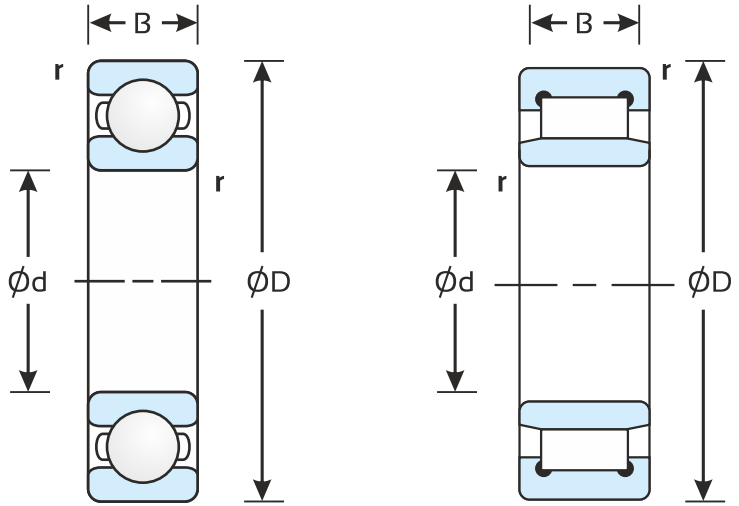
SD1 = variation of bearing outside surface generatix inclination with flange back race

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

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

Sea1 = assembled bearing outer ring flange (back face) runout with raceway



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

Table 5.3.1: Inner Ring

Values in microns

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

Table 5.3.2: Outer Ring

Values in microns

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

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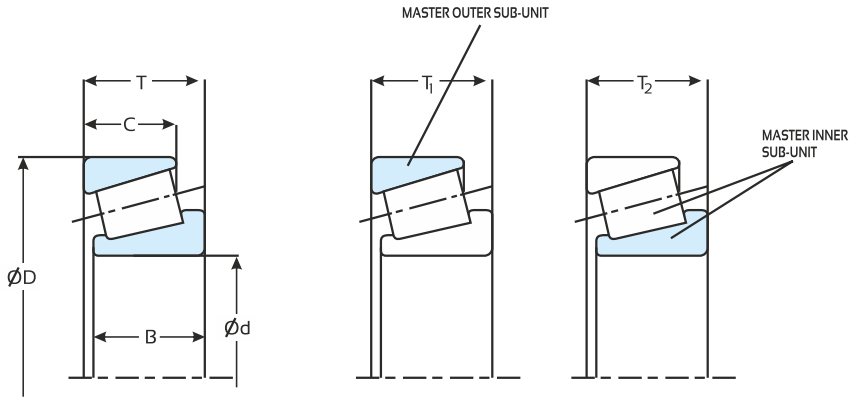
5.4 Tolerance For Tapered Roller Bearing (Metric Series)

Normal tolerance class

Symbols (Applicable for metric and inch series)

d = bearing bore diameter, nominal
Δds = deviation of a single bore diameter
Δdmp = single plane mean bore diameter deviation (for a basically tapered bore dmp refers only to the theoretical small end of bore)
Vdp = bore diameter variation in single radial plane
Vdmp = mean bore diameter variation (this applies only to a basically cylindrical bore)
D = bearing outside diameter, nominal
D1 = outer ring flange outside diameter, nominal
Δ Ds = deviation of a single outside diameter
Δ Dmp = single plane mean outside diameter deviation
VDp = outside diameter variation in a single radial plane
VDmp = mean outside diameter variation
B = inner ring width, nominal
T = bearing width, nominal
Δ Ts = deviation of the actual bearing width
T1 = effective width of inner sub-unit, nominal
Δ Bs = deviation of single inner ring width
C = outer ring width, nominal
Δ Cs = deviation of single outer ring width
Kia = radial run out or assembled bearing inner ring
Kea = radial run out or assembled bearing outer ring
Sd = inner ring reference face (back face, where applicable) run out with bore
SD = variation of bearing outside surface generatix inclination with outer ring reference face (back face)
Sia = assemble bearing inner ring face (back face) run out with raceway
Sea = assembled bearing outer ring face (back face) run out with raceway
Δ T1s = deviation of the actual effective width of inner sub unit
T2 = effective width of outer sub-unit, nominal
T2s = deviation of the actual effective width or outer sub-unit



SYMBOLS FOR TAPERED ROLLER BEARINGS

Metric Series (ISO 492 / IS 7460)
Table 5.4.1 Bore-Inner Ring

Tolerance value in microns

d (mm)		Δ dmp		Vdp	Kia	Vdmp
Over	Including	High	Low	Max	Max	Max
10	18	0	-12	12	9	15
18	30	0	-12	12	9	18
30	50	0	-12	12	9	20
50	80	0	-15	15	11	25
80	120	0	-20	20	15	30
120	180	0	-25	25	19	35
180	250	0	-30	30	23	50
250	315	0	-35	35	26	60
315	400	0	-40	40	30	70
400	500	0	-45	45	34	80
500	630	0	-50	50	38	90
630	800	0	-75	75	56	105
800	1000	0	-100	100	75	120
1000	1250	0	-125	125	94	140
1250	1600	0	-160	160	120	160

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Table 5.4.2 - Outer diameter

Tolerance value in microns

D (mm)		Δ Dmp		VDp	VDmp	Kea
Over	Including	High	Low	Max	Max	Max
18	30	0	-12	12	9	18
30	50	0	-14	14	11	20
50	80	0	-16	16	12	25
80	120	0	-18	18	14	35
120	150	0	-20	20	15	40
150	180	0	-25	25	19	45
180	250	0	-30	30	23	50
250	315	0	-35	35	26	60
315	400	0	-40	40	30	70
400	500	0	-45	45	34	80
500	360	0	-50	50	38	100
630	800	0	-75	75	56	120
800	1000	0	-100	100	75	140
1000	1250	0	-125	125	84	165
1250	1600	0	-160	160	120	190
1600	2000	0	-200	200	150	230

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

Tolerance value in microns

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

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

Tolerance value in microns

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

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

5.5.1 Tolerance for inner ring bore diameter

Unit : microns

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

5.5.2 Tolerance for outer ring outside diameter

Unit : microns

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

5.5.3 Tolerance for overall width or combined width

Unit : microns

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

5.5.4 Radial runout of of inner and outer rings

Unit : microns

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

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Basic Symbol for Dimension & Accuracy

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

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

d = bore diameter of shaft washer,single-direction bearing
d2 = bore diameter of shaft washer,double-direction bearing
Δdmp = deviation of mean bore diameter in a single plan ofshaft, single-direction bearing
Δd2mp = deviation of mean bore diameter in a single plan ofshaft, double-direction bearing
D = outside dianneter of housing washer
Δdmp = deviation of mean outside diameter in a single of plan of housing washer
Se = variation in thichness between housing washer raceway and face
(Note: Applies only to ball thrust bearings and cylindrical roller thrust bearings with 90°contact angle)
Si = variation in thichness between shaft washer raceway and bach face
(Note: Applies only to ball thrust bearings and cylindrical roller thrust bearings with 90°contact angle)
T1 = bearing height, single-direction bearing
T2 = bearing height, double direction bearing
ΔTs = deviation of the actual bearing height, single-direction bearing
ΔT1s = deviation of the actual bearing height, double-direction bearing
Vdp = variation of bore diameter in a single plane ofshaft washer, single-direction bearing
Vd2p = variation ofbore diameter in a single plane ofshaft washer, double-direction bearing
Vdp = variation ofoutside diameter in a single radial plane of housing washer

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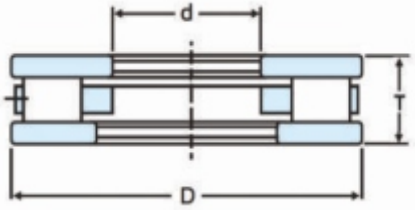
Single direction thrust bearing



Double direction thrust bearing

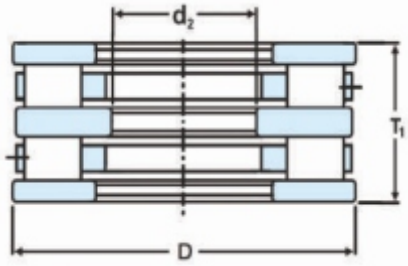


Table 5.6.1 Shaft washer and bearing height (As per ISO:199/Normal tolerance class)

Tolerance value in microns

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

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

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

Tolerance value in microns

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

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

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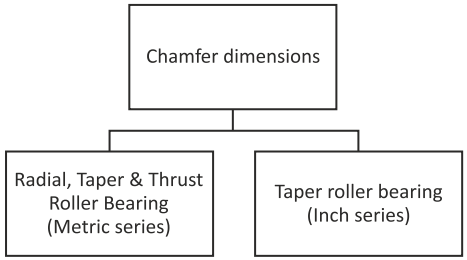
5.7 Chamfer Dimensions Limits For Rolling Bearings



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

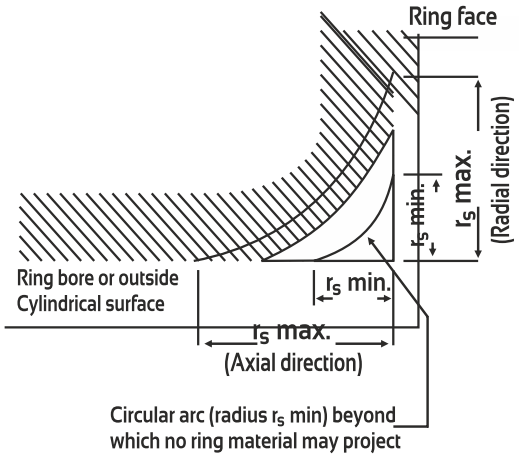
d = bearing bore diameter, nominal

D = bearing outside diameter, nominal

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

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

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



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

Table 5.7.1 Tapered Roller Bearings (Metric Series)

Dimensions in mm

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

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Table 5.7.2 Radial Bearings Except Tapered Roller Bearings

Dimensions in mm

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

Table 5.7.3 Thrust bearings

Dimensions in mm

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

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Comparison between nominal chamfer dimension & minimum chamfer limits

Table 5.7.4 Radial bearings except tapered roller bearings and thrust bearings

Dimensions in millimetres

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

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

Comparison between nominal chamfer dimension & minimum chamfer limits

Table 5.7.5 Tapered roller bearings

Dimensions in Millimetres

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

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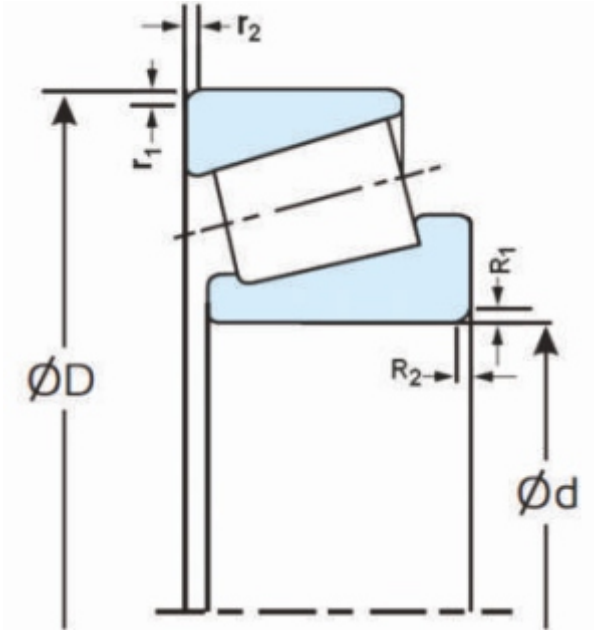
Chamfer dimensions limits for Tapered roller bearing

(Inch series as per ISO : 1123)

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



Chamfer dimensions limits for tapered roller bearing (inch series)

Table 5.7.6 Inner ring chamfer dimension limits

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

Table 5.7.7 Outer ring chamfer dimension limits

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

The value of r is identical with that r_{min} in ISO/R 355, Part 1.

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5. 8 Basic Tolerance for Tapered Bore

d- Nominal bore diameter

d1- Basic diameter at the theoretical large end of a tapered bore

B- Nominal bearing inner ring width

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

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

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

b). Taper tolerance diameter, given by limits for the difference between the actual mean diameter deviations at the two ends of the bore, Δd1mp- Δdmp

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

For taper 1/12, normal taper angle (half the cone angle):

a = 2°23'9.4"

= 2.385 94

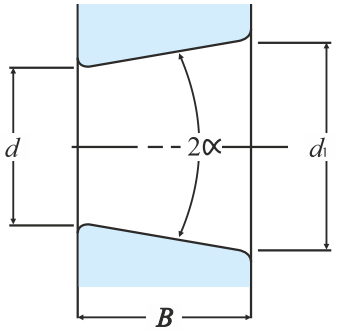
=0.041643 rad

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

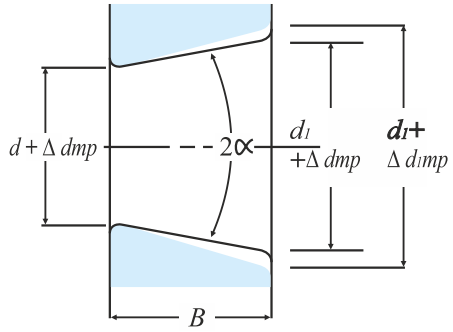
a = 0° 57' 17.4"

= 0.95484

=0.016665 rad



Theoretical tapered hole



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

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

Unit : µm

d (mm)		Δ dmp		Δ d1mp - Δ dmp		Vdp
Over	Including	High	Low	High	Low	Max.
-	10	+22	0	+15	0	9
10	18	+27	0	+18	0	11
18	30	+33	0	+21	0	13
30	50	+39	0	+25	0	16
50	80	+46	0	+30	0	19
80	120	+54	0	+35	0	22
120	180	+63	0	+40	0	40
180	250	+72	0	+46	0	46
250	315	+81	0	+52	0	52
315	400	+89	0	+57	0	57
400	500	+97	0	+63	0	63
500	630	+110	0	+70	0	70
630	800	+125	0	+80	0	-
800	1000	+140	0	+90	0	-
1 000	1250	+165	0	+105	0	-
1250	1600	+195	0	+125	0	-

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Table 5.8: Tolerance and allowable value (Class 0) for tapered bore (1: 30) of Radial bearing

Unit : µm

d (mm)		Δ dmp		Δ d1mp - Δ dmp		Vdp
Over	Including	High	Low	High	Low	Max.
80	120	+ 20	0	+ 35	0	22
120	180	+ 25	0	+ 40	0	40
180	250	+ 30	0	+ 46	0	46
250	315	+ 35	0	+ 52	0	52
315	400	+ 40	0	+ 57	0	57
400	500	+ 45	0	+ 63	0	63
500	630	+ 50	0	+ 70	0	70

5.9 Selection of accuracy class for specific application

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

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

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