6. Bearing Tolerances

6.1 Dimensional accuracy and running accuracy

Bearing “tolerances” or dimensional accuracy and running accuracy, are regulated by ISO and JIS B 1514 standards (rolling bearing tolerances). For dimensional accuracy, these standards prescribe the tolerances necessary when installing bearings on shafts or in housings. Running accuracy is defined as the allowable limits for bearing runout during operation.

Dimensional accuracy

Dimensional accuracy constitutes the acceptable values for bore diameter, outer diameter, assembled bearing width, and bore diameter uniformity as seen in chamfer dimensions, allowable inner ring tapered bore deviation and shape error. Also included are, average bore diameter variation, outer diameter variation, average outer diameter unevenness, as well as raceway width and height variation (for thrust bearings).

Running accuracy

Running accuracy constitutes the acceptable values for inner and outer ring radial runout and axial runout, inner ring side runout, and outer ring outer diameter runout.

Allowable rolling bearing tolerances have been established according to precision classes. Bearing precision is stipulated as JIS class 6, class 5, class 4, or class 2, with precision rising from ordinary precision indicated by class 0.

Table 6.1 indicates which standards and precision classes are applicable to the major bearing types. **Table 6.2** shows a relative comparison between JIS B 1514 precision class standards and other standards. For greater detail on allowable limitations and values, refer to **Tables 6.3** - **6.9**. Allowable values for chamfer dimensions are shown in **Table 6.10**, and allowable limitations and values for radial bearing inner ring tapered bores are shown in **Table 6.11**.

Table 6.1 Bearing types and applicable tolerance

Bearing type		Applicable standard	Tolerance class					Tolerance table
Deep groove ball bearings		JIS B 1514 (ISO492)	class 0	class 6	class 5	class 4	class 2	Table 6.3
Angular contact ball bearings			class 0	class 6	class 5	class 4	class 2	
Self-aligning ball bearings			class 0	—	—	—	—	
Cylindrical roller bearigns			class 0	class 6	class 5	class 4	class 2	
Needle roller bearings			class 0	class 6	class 5	class 4	—	
Spherical roller bearings			class 0	—	—	—	—	
Tapered roller bearings	metric	JIS B 1514	class 0,6X	class 6	class 5	class 5	—	**Table 6.4**
	Inch	ANSI/ABMA Std.19	class 4	class 2	class 3	class 0	class 00	**Table 6.5**
	J series	ANSI/ABMA Std.19.1	class K	class N	class C	class B	class A	**Table 6.6**
Thrust ball bearings		JIS B 1514 (ISO199)	class 0	class 6	class 5	class 4	—	**Table 6.7**
Spherical roller thrust bearings			class 0	—	—	—	—	**Table 6.8**
Double direction angular contact thrust ball bearings		**NTN** standard	—	—	class 5	class 4	—	**Table 6.9**

Table 6.2 Comparison of tolerance classifications of national standards

Standard	Applicable standerd	Tolerance Class					Bearing Types
Japanese industrial standard (JIS)	JIS B 1514	Class 0,6X	Class 6	Class 5	Class 4	Class 2	All type
International Organization for Standardization (ISO)	ISO 492	Normal class Class 6X	Class 6	Class 5	Class 4	Class 2	Radial bearings
	ISO 199	Normal Class	Class 6	Class 5	Class 4	—	Thrust ball bearings
	ISO 578	Class 4	—	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)
	ISO 1224	—	—	Class 5A	Class 4A	—	Precision instrument bearings
Deutsches Institut fur Normung(DIN)	DIN 620	P0	P6	P5	P4	P2	All type
American National Standards Institute (ANSI) American Bearing Manufacturer's Association (ABMA)	ANSI/ABMA Std.20 ❶	ABEC-1 RBEC-1	ABEC-3 RBEC-3	ABEC-5 RBEC-5	ABEC-7	ABEC-9	Radial bearings (Except tapered roller bearings)
	ANSI/ABMA Std.19.1	Class K	Class N	Class C	Class B	Class A	Tapered roller bearings (Metric series)
	ANSI/ABMA Std.19	Class 4	Class 2	Class 3	Class 0	Class 00	Tapered roller bearings (Inch series)

❶ "ABEC" is applied for ball bearings and "RBEC" for roller bearings.
Notes 1: JIS B 1514, ISO 492 and 199, and DIN 620 have the same specification level.
2: The tolerance and allowance of JIS B 1514 are a little different from those of ABMA standards.

Table 6.3 Tolerance of radial bearings (Except tapered roller bearings)
Table 6.3 (1) Inner rings

Nominal bore diameter d mm		Dimensional tolerance of mean bore diameter within plane Δ_{dmp}										Bore diameter variation V_{dp}														
		class 0		class 6		class 5		class 4 ❶		class 2 ❶		diameter series 9 (max)					diameter series 0.1 (max)					diameter series 2.3.4 (max)				
over	incl.	high	low	high	low	high	low	high	low	high	low	class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2
0.6 ❹	2.5	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
2.5	10	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
10	18	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
18	30	0	-10	0	-8	0	-6	0	-5	0	-2.5	13	10	6	5	2.5	10	8	5	4	2.5	8	6	5	4	2.5
30	50	0	-12	0	-10	0	-8	0	-6	0	-2.5	15	13	8	6	2.5	12	10	6	5	2.5	9	8	6	5	2.5
50	80	0	-15	0	-12	0	-9	0	-7	0	-4	19	15	9	7	4	19	15	7	5	4	11	9	7	5	4
80	120	0	-20	0	-15	0	-10	0	-8	0	-5	25	19	10	8	5	25	19	8	6	5	15	11	8	6	5
120	150	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
150	180	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	0	-30	0	-22	0	-15	0	-12	0	-8	38	28	15	12	8	38	28	12	9	8	23	17	12	9	8
250	315	0	-35	0	-25	0	-18	—	—	—	—	44	31	18	—	—	44	31	14	—	—	26	19	14	—	—
315	400	0	-40	0	-30	0	-23	—	—	—	—	50	38	23	—	—	50	38	18	—	—	30	23	18	—	—
400	500	0	-45	0	-35	—	—	—	—	—	—	56	44	—	—	—	56	44	—	—	—	34	26	—	—	—
500	630	0	-50	0	-40	—	—	—	—	—	—	63	50	—	—	—	63	50	—	—	—	38	30	—	—	—
630	800	0	-75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
800	1 000	0	-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 000	1 250	0	-125	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 250	1 600	0	-160	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 600	2 000	0	-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

❶ The dimensional difference Δ_{ds} of bore diameter to applied for class 4 and 2 is the same as the tolerance of dimentional difference Δ_{dmp} of average bore diameter. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 against Class 4, and to all the diameter series against Class 2.

Table 6.3 (2) Outer rings

Nominal outside diameter D mm		Dimensional tolerance of mean outside diameter within plane Δ_{Dmp}										Outside diameter variation ❻ V_{Dp} open type														
		class 0		class 6		class 5		class 4 ❺		class 2 ❺		diameter series 9 (max)					diameter series 0.1 (max)					diameter series 2.3.4 (max)				
over	incl.	high	low	high	low	high	low	high	low	high	low	class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2
2.5 ❽	6	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
6	18	0	-8	0	-7	0	-5	0	-4	0	-2.5	10	9	5	4	2.5	8	7	4	3	2.5	6	5	4	3	2.5
18	30	0	-9	0	-8	0	-6	0	-5	0	-4	12	10	6	5	4	9	8	5	4	4	7	6	5	4	4
30	50	0	-11	0	-9	0	-7	0	-6	0	-4	14	11	7	6	4	11	9	5	5	4	8	7	5	5	4
50	80	0	-13	0	-11	0	-9	0	-7	0	-4	16	14	9	7	4	13	11	7	5	4	10	8	7	5	4
80	120	0	-15	0	-13	0	-10	0	-8	0	-5	19	16	10	8	5	19	16	8	6	5	11	10	8	6	5
120	150	0	-18	0	-15	0	-11	0	-9	0	-5	23	19	11	9	5	23	19	8	7	5	14	11	8	7	5
150	180	0	-25	0	-18	0	-13	0	-10	0	-7	31	23	13	10	7	31	23	10	8	7	19	14	10	8	7
180	250	0	-30	0	-20	0	-15	0	-11	0	-8	38	25	15	11	8	38	25	11	8	8	23	15	11	8	8
250	315	0	-35	0	-25	0	-18	0	-13	0	-8	44	31	18	13	8	44	31	14	10	8	26	19	14	10	8
315	400	0	-40	0	-28	0	-20	0	-15	0	-10	50	35	20	15	10	50	35	15	11	10	30	21	15	11	10
400	500	0	-45	0	-33	0	-23	—	—	—	—	56	41	23	—	—	56	41	17	—	—	34	25	17	—	—
500	630	0	-50	0	-38	0	-28	—	—	—	—	63	48	28	—	—	63	48	21	—	—	38	29	21	—	—
630	800	0	-75	0	-45	0	-35	—	—	—	—	94	56	35	—	—	94	56	26	—	—	55	34	26	—	—
800	1 000	0	-100	0	-60	—	—	—	—	—	—	125	75	—	—	—	125	75	—	—	—	75	45	—	—	—
1 000	1 250	0	-125	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 250	1 600	0	-160	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 600	2 000	0	-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 000	2 500	0	-250	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

❺ The dimensional difference Δ_{Ds} of outer diameter to be applied for classes 4 and 2 is the same as the tolerance of dimensional difference Δ_{Dmp} of average outer diameter. However, the dimensional difference is applied to diameter series 0, 1, 2, 3 and 4 against Class 4, and also to all the diameter series against Class 2.

Unit μm

Mean bore diameter variation V_{dmp}					Inner ring radial runout K_{ia}					Side runout with bore S_d			Inner ring axial runout S_{ia} ❷			Inner ring width deviation Δ_{Bs} normal						Inner ring width deviation Δ_{Bs} modified ❸				Inner ring width variation V_{Bs}				
class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 5	class 4	class 2	class 5	class 4	class 2	class 0,6		class 5,4		class 2		class 0,6		class 5,4		class 0	class 6	class 5	class 4	class 2
max					max					max			max			high	low	high	low	high	low	high	low	high	low	max				
6	5	3	2	1.5	10	5	4	2.5	1.5	7	3	1.5	7	3	1.5	0	-40	0	-40	0	-40	—	—	0	-250	12	12	5	2.5	1.5
6	5	3	2	1.5	10	6	4	2.5	1.5	7	3	1.5	7	3	1.5	0	-120	0	-40	0	-40	0	-250	0	-250	15	15	5	2.5	1.5
6	5	3	2	1.5	10	7	4	2.5	1.5	7	3	1.5	7	3	1.5	0	-120	0	-80	0	-80	0	-250	0	-250	20	20	5	2.5	1.5
8	6	3	2.5	1.5	13	8	4	3	2.5	8	4	1.5	8	4	2.5	0	-120	0	-120	0	-120	0	-250	0	-250	20	20	5	2.5	1.5
9	8	4	3	1.5	15	10	5	4	2.5	8	4	1.5	8	4	2.5	0	-120	0	-120	0	-120	0	-250	0	-250	20	20	5	3	1.5
11	9	5	3.5	2	20	10	5	4	2.5	8	5	1.5	8	5	2.5	0	-150	0	-150	0	-150	0	-380	0	-250	25	25	6	4	1.5
15	11	5	4	2.5	25	13	6	5	2.5	9	5	2.5	9	5	2.5	0	-200	0	-200	0	-200	0	-380	0	-380	25	25	7	4	2.5
19	14	7	5	3.5	30	18	8	6	2.5	10	6	2.5	10	7	2.5	0	-250	0	-250	0	-250	0	-500	0	-380	30	30	8	5	2.5
19	14	7	5	3.5	30	18	8	6	5	10	6	4	10	7	5	0	-250	0	-250	0	-250	0	-500	0	-380	30	30	8	5	4
23	17	8	6	4	40	20	10	8	5	11	7	5	13	8	5	0	-300	0	-300	0	-300	0	-500	0	-500	30	30	10	6	5
26	19	9	—	—	50	25	13	—	—	13	—	—	15	—	—	0	-350	0	—	—	—	0	-500	0	—	35	35	13	—	—
30	23	12	—	—	60	30	15	—	—	15	—	—	20	—	—	0	-400	0	—	—	—	0	-630	0	—	40	40	15	—	—
34	26	—	—	—	65	35	—	—	—	—	—	—	—	—	—	0	-450	—	—	—	—	—	—	—	—	50	45	—	—	—
38	30	—	—	—	70	40	—	—	—	—	—	—	—	—	—	0	-500	—	—	—	—	—	—	—	—	60	50	—	—	—
55	—	—	—	—	80	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—	—	70	—	—	—	—
75	—	—	—	—	90	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—	—	80	—	—	—	—
94	—	—	—	—	100	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—	—	100	—	—	—	—
120	—	—	—	—	120	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—	—	120	—	—	—	—
150	—	—	—	—	140	—	—	—	—	—	—	—	—	—	—	0	—	—	—	—	—	—	—	—	—	140	—	—	—	—

❷ Applies to ball bearings such as deep groove ball bearings and angular ball bearings.
❸ To be applied for individual raceway rings manufactured for combined bearing use.
❹ Nominal bore diameter of bearings of 0.6 mm is included in this dimensional division.

Unit μm

Outside diameter variation V_{Dp} ❻ Sealed/shield bearings diameter series 2,3,4 class 0	Outside diameter variation V_{Dp} ❻ Sealed/shield bearings diameter series 0,1,2,3,4 class 6	Mean bore diameter variation V_{Dmp}					Outer ring radial runout K_{ea}					Outside surface inclination S_D			Outside ring axial runout S_{ea} ❼			Outer ring width deviation Δ_{Cs}	Outer ring width variation V_{Cs}			
		class 0	class 6	class 5	class 4	class 2	class 0	class 6	class 5	class 4	class 2	class 5	class 4	class 2	class 5	class 4	class 2		class 0,6	class 5	class 4	class 2
max		max					max					max			max			all type		max		
10	9	6	5	3	2	1.5	15	8	5	3	1.5	8	4	1.5	8	5	1.5	Depends on tolerance of Δ_{Bs} in relation to d of same bearing	Depends on tolerance of Δ_{Bs} in relation to d of same bearing	5	2.5	1.5
10	9	6	5	3	2	1.5	15	8	5	3	1.5	8	4	1.5	8	5	1.5			5	2.5	1.5
12	10	7	6	3	2.5	2	15	9	6	4	2.5	8	4	1.5	8	5	2.5			5	2.5	1.5
16	13	8	7	4	3	2	20	10	7	5	2.5	8	4	1.5	8	5	2.5			5	2.5	1.5
20	16	10	8	5	3.5	2	25	13	8	5	4	8	4	1.5	10	5	4			6	3	1.5
26	20	11	10	5	4	2.5	35	18	10	6	5	9	5	2.5	11	6	5			8	4	2.5
30	25	14	11	6	5	2.5	40	20	11	7	5	10	5	2.5	13	7	5			8	5	2.5
38	30	19	14	7	5	3.5	45	23	13	8	5	10	5	2.5	14	8	5			8	5	2.5
—	—	23	15	8	6	4	50	25	15	10	7	11	7	4	15	10	7			10	7	4
—	—	26	19	9	7	4	60	30	18	11	7	13	8	5	18	10	7			11	7	5
—	—	30	21	10	8	5	70	35	20	13	8	13	10	7	20	13	8			13	8	7
—	—	34	25	12	—	—	80	40	23	—	—	15	—	—	23	—	—			15	—	—
—	—	38	29	14	—	—	100	50	25	—	—	18	—	—	25	—	—			18	—	—
—	—	55	34	18	—	—	120	60	30	—	—	20	—	—	30	—	—			20	—	—
—	—	75	45	—	—	—	140	75	—	—	—	—	—	—	—	—	—			—	—	—
—	—	—	—	—	—	—	160	—	—	—	—	—	—	—	—	—	—			—	—	—
—	—	—	—	—	—	—	190	—	—	—	—	—	—	—	—	—	—			—	—	—
—	—	—	—	—	—	—	220	—	—	—	—	—	—	—	—	—	—			—	—	—
—	—	—	—	—	—	—	250	—	—	—	—	—	—	—	—	—	—			—	—	—

❻ To be applied in case snap rings are not installed on the bearings.
❼ Applies to ball bearings such as deep groove ball bearings and angular ball bearings.
❽ Nominal outer diameter of bearings of 2.5 mm is included in this dimensional division.

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Table 6.4 Tolerance of tapered roller bearings (Metric series)

Table 6.4 (1) Inner rings

Nominal bore diameter d mm		Dimensional tolerance of mean bore diameter within plane Δ_{dmp}						Bore diameter variation V_{dp}				Mean bore diameter variation V_{dmp}				Inner ring radial runout K_{ia}				Side runout with bore S_d	
		class 0,6X		class 5,6		class 4 ❶		class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 5	class 4
over	incl.	high	low	high	low	high	low	max				max				max				max	
10	18	0	-12	0	-7	0	-5	12	7	5	4	9	5	5	4	15	7	5	3	7	3
18	30	0	-12	0	-8	0	-6	12	8	6	5	9	6	5	4	18	8	5	3	8	4
30	50	0	-12	0	-10	0	-8	12	10	8	6	9	8	5	5	20	10	6	4	8	4
50	80	0	-15	0	-12	0	-9	15	12	9	7	11	9	6	5	25	10	7	4	8	5
80	120	0	-20	0	-15	0	-10	20	15	11	8	15	11	8	5	30	13	8	5	9	5
120	180	0	-25	0	-18	0	-13	25	18	14	10	19	14	9	7	35	18	11	6	10	6
180	250	0	-30	0	-22	0	-15	30	22	17	11	23	16	11	8	50	20	13	8	11	7
250	315	0	-35	—	—	—	—	35	—	—	—	26	—	—	—	60	—	—	—	—	—
315	400	0	-40	—	—	—	—	40	—	—	—	30	—	—	—	70	—	—	—	—	—
400	500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
500	630	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
630	800	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
800	1,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

❶ The dimensional difference Δ_{ds} of bore diameter to be applied for class 4 is the same as the tolerance of dimensional difference Δ_{dmp} of average bore diameter.

Table 6.4 (2) Outer rings

Nominal outside diameter D mm		Dimensional tolerance of mean outside diameter within plane D_{Dmp}						Outside diameter variation V_{Dp}				Mean bore diameter variation V_{Dmp}				Outer ring radial runout K_{ea}				Outside surface inclination S_D ❷	
		class 0,6X		class 5,6		class 4 ❸		class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 0,6X	class 6	class 5	class 4	class 5	class 4
over	incl.	high	low	high	low	high	low	max				max				max				max	
18	30	0	-12	0	-8	0	-6	12	8	6	5	9	6	5	4	18	9	6	4	8	4
30	50	0	-14	0	-9	0	-7	14	9	7	5	11	7	5	5	20	10	7	5	8	4
50	80	0	-16	0	-11	0	-9	16	11	8	7	12	8	6	5	25	13	8	5	8	4
80	120	0	-18	0	-13	0	-10	18	13	10	8	14	10	7	5	35	18	10	6	9	5
120	150	0	-20	0	-15	0	-11	20	15	11	8	15	11	8	6	40	20	11	7	10	5
150	180	0	-25	0	-18	0	-13	25	18	14	10	19	14	9	7	45	23	13	8	10	5
180	250	0	-30	0	-20	0	-15	30	20	15	11	23	15	10	8	50	25	15	10	11	7
250	315	0	-35	0	-25	0	-18	35	25	19	14	26	19	13	9	60	30	18	11	13	8
315	400	0	-40	0	-28	0	-20	40	28	22	15	30	21	14	10	70	35	20	13	13	10
400	500	0	-45	—	—	—	—	45	—	—	—	34	—	—	—	80	—	—	—	—	—
500	630	0	-50	—	—	—	—	50	—	—	—	38	—	—	—	100	—	—	—	—	—

❷ Does not apply to bearings with flange.
❸ The dimensional difference D_{Ds} of outside diameter to be applied for class 4 is the same as the tolerance of dimensional difference D_{Dmp} of average outside diameter.

Unit μm

Inner ring axial runout S_{ia}	Inner ring width deviation Δ_{Bs}						Assembly width deviation of single-row tapered roller bearings Δ_{Ts}						Combination width deviation of double row bearings Δ_{B1s}, Δ_{C1s}		Combination width deviation of 4-row bearings Δ_{B2s}, Δ_{C2s}	
class 4	class 0,6		class 6X		class 4,5		class 0,6		class 6X		class 4,5		class 0,6,5		class 0,6,5	
max	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low
3	0	-120	0	-50	0	-200	+200	0	+100	0	+200	-200	—	—	—	—
4	0	-120	0	-50	0	-200	+200	0	+100	0	+200	-200	—	—	—	—
4	0	-120	0	-50	0	-240	+200	0	+100	0	+200	-200	+240	-240	—	—
4	0	-150	0	-50	0	-300	+200	0	+100	0	+200	-200	+300	-300	—	—
5	0	-200	0	-50	0	-400	+200	-200	+100	0	+200	-200	+400	-400	+500	-500
7	0	-250	0	-50	0	-500	+350	-250	+150	0	+350	-250	+500	-500	+600	-600
8	0	-300	0	-50	0	-600	+350	-250	+150	0	+350	-250	+600	-600	+750	-750
—	0	-350	0	-50	—	—	+350	-250	+200	0	—	—	+700	-700	+900	-900
—	0	-400	0	-50	—	—	+400	-400	+200	0	—	—	+800	-800	+1 000	-1 000
—	—	—	—	—	—	—	—	—	—	—	—	—	+900	-900	+1 200	-1 200
—	—	—	—	—	—	—	—	—	—	—	—	—	+1 000	-1 000	+1 200	-1 200
—	—	—	—	—	—	—	—	—	—	—	—	—	+1 500	-1 500	+1 500	-1 500
—	—	—	—	—	—	—	—	—	—	—	—	—	+1 500	-1 500	+1 500	-1 500

Unit μm

Outer ring axial runout S_{ea}	Outer ring width deviation Δ_{Cs}			
class 4	class 0,6,5,4		class 6X ❹	
max	sup.	inf.	sup.	inf.
5	Depends on tolerance of Δ_{Bs} in relation to d of same bearing		0	-100
5			0	-100
5			0	-100
6			0	-100
7			0	-100
8			0	-100
10			0	-100
10			0	-100
13			0	-100
—			0	-100
—			0	-100

❹ Applies to bearing where d is greater than 10 mm but is less than or equal to 400 mm.

Table 6.4 (3) Effective width of outer and inner rings with roller Unit μm

Nominal bore diameter d mm		Effective width deviation of roller and inner ring assembly of tapererd roller bearing Δ_{T1s}				Tapered roller bearing outer ring effective width deviation Δ_{T2s}			
		class 0		class 6X		class 0		class 6X	
over	incl.	high	low	high	low	high	low	high	low
10	18	+100	0	+50	0	+100	0	+50	0
18	30	+100	0	+50	0	+100	0	+50	0
30	50	+100	0	+50	0	+100	0	+50	0
50	80	+100	0	+50	0	+100	0	+50	0
80	120	+100	-100	+50	0	+100	-100	+50	0
120	180	+150	-150	+50	0	+200	-100	+100	0
180	250	+150	-150	+50	0	+200	-100	+100	0
250	315	+150	-150	+100	0	+200	-100	+100	0
315	400	+200	-200	+100	0	+200	-200	+100	0

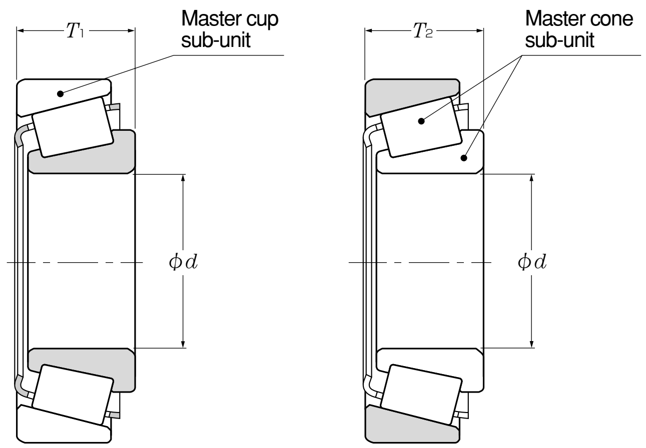

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Table 6.5 Tolerance of tapered roller bearings (Inch series)

Table 6.5 (1) Inner rings

Unit μm

Nominal bore diameter d mm (inch)		Single bore diameter deviation Δ_{ds}									
		Class 4		Class 2		Class 3		Class 0		Class 00	
over	incl.	high	low	high	low	high	low	high	low	high	low
—	76.2 (3)	+13	0	+13	0	+13	0	+13	0	+8	0
76.2 (3)	266.7 (10.5)	+25	0	+25	0	+13	0	+13	0	+8	0
266.7 (10.5)	304.8 (12)	+25	0	+25	0	+13	0	+13	0	—	—
304.8 (12)	609.6 (24)	+51	0	+51	0	+25	0	—	—	—	—
609.6 (24)	914.4 (36)	+76	0	—	—	+38	0	—	—	—	—
914.4 (36)	1 219.2 (48)	+102	0	—	—	+51	0	—	—	—	—
1 219.2 (48)	—	+127	0	—	—	+76	0	—	—	—	—

Table 6.5 (2) Outer rings

Unit μm

Nominal outside diameter D mm (inch)		Single outside diameter deviation Δ_{Ds}									
		Class 4		Class 2		Class 3		Class 0		Class 00	
over	incl.	high	low	high	low	high	low	high	low	high	low
—	266.7 (10.5)	+25	0	+25	0	+13	0	+13	0	+8	0
266.7 (10.5)	304.8 (12)	+25	0	+25	0	+13	0	+13	0	—	—
304.8 (12)	609.6 (24)	+51	0	+51	0	+25	0	—	—	—	—
609.6 (24)	914.4 (36)	+76	0	+76	0	+38	0	—	—	—	—
914.4 (36)	1 219.2 (48)	+102	0	—	—	+51	0	—	—	—	—
1 219.2 (48)	—	+127	0	—	—	+76	0	—	—	—	—

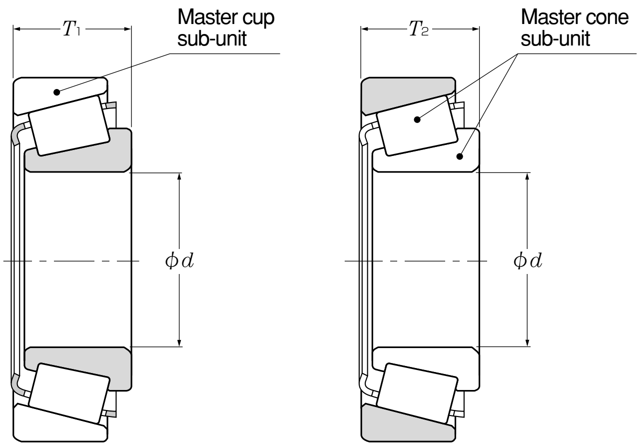
Table 6.5 (3) Single-row tapered roller bearing assembly width, combination width of 4-row bearings, effective width of inner ring with rollers, effective width of outer ring

Nominal bore diameter d mm (inch)		Nominal outside diameter D mm (inch)		Overall width deviation of assembled single row tapered roller bearing Δ_{Ts}								Overall width deviation of assembled 4-row tapered roller bearings Δ_{B2s}, Δ_{C2s}	
				Class 4		Class 2		Class 3		Class 0,00		Class 4,2,3,0	
over	incl.	over	incl.	high	low	high	low	high	low	high	low	high	low
—	101.6 (4)			+203	0	+203	0	+203	-203	+203	-203	+1 524	-1 524
101.6 (4)	304.8 (12)			+356	-254	+203	0	+203	-203	+203	-203	+1 524	-1 524
304.8 (12)	609.6 (24)	—	508.0 (20)	+381	-381	+381	-381	+203	-203	—	—	+1 524	-1 524
304.8 (12)	609.6 (36)	508.0 (20)	—	+381	-381	+381	-381	+381	-381	—	—	+1 524	-1 524
609.6 (24)	—			+381	-381	—	—	+381	-381	—	—	+1 524	-1 524

Table 6.5 (4) Radial deflection of inner and outer rings

Unit μm

Nominal outside diameter D mm (inch)		Inner ring radial runout K_{ia} Outer ring radial runout K_{ea}				
		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	—	—



Unit μm

Effective width deviation of roller and inner ring assembly of tapered roller bearing Δ_{T1s}						Tapered roller bearing outer ring effective width deviation Δ_{T2s}					
Class 4		Class 2		Class 3		Class 4		Class 2		Class 3	
high	low	high	low	high	low	high	low	high	low	high	low
+102	0	+102	0	+102	-102	+102	0	+102	0	+102	-102
+152	-152	+102	0	+102	-102	+203	-102	+102	0	+102	-102
—	—	+178	-178 ❶	+102	-102 ❶	—	—	+203	-203 ❶	+102	-102 ❶
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—

❶ To be applied for nominal bore diameters d of 406.400 mm (16 inch) or less.

Table 6.6 Tolerance of tapered roller bearings of J series (Metric series)

Table 6.6 (1) Inner rings

Nominal bore diameter d mm		Mean bore diameter deviation Δ_{dmp}								Bore diameter variation V_{dp}				Mean bore diameter variation V_{dmp}			
		Class K		Class N		Class C		Class B		Class K	Class N	Class C	Class B	Class K	Class N	Class C	Class B
over	incl.	high	low	high	low	high	low	high	low	max				max			
10	18	0	-12	0	-12	0	-7	0	-5	12	12	4	3	9	9	5	4
18	30	0	-12	0	-12	0	-8	0	-6	12	12	4	3	9	9	5	4
30	50	0	-12	0	-12	0	-10	0	-8	12	12	4	3	9	9	5	5
50	80	0	-15	0	-15	0	-12	0	-9	15	15	5	3	11	11	5	5
80	120	0	-20	0	-20	0	-15	0	-10	20	20	5	3	15	15	5	5
120	180	0	-25	0	-25	0	-18	0	-13	25	25	5	3	19	19	5	7
180	250	0	-30	0	-30	0	-22	0	-15	30	30	6	4	23	23	5	8

Note: Please consult **NTN** Engineering for Class A bearings.

Table 6.6 (2) Outer rings

Nominal outside diameter D mm		Mean outside diameter deviation Δ_{Dmp}								Outside diameter variation V_{Dp}				Mean outside diameter variation V_{Dmp}				outer ring axial runout S_{ea}
		Class K		Class N		Class C		Class B		Class K	Class N	Class C	Class B	Class K	Class N	Class C	Class B	Class B
over	incl.	high	low	high	low	high	low	high	low	max				max				max
18	30	0	-12	0	-12	0	-8	0	-6	12	12	4	3	9	9	5	4	3
30	50	0	-14	0	-14	0	-9	0	-7	14	14	4	3	11	11	5	5	3
50	80	0	-16	0	-16	0	-11	0	-9	16	16	4	3	12	12	6	5	4
80	120	0	-18	0	-18	0	-13	0	-10	18	18	5	3	14	14	7	5	4
120	150	0	-20	0	-20	0	-15	0	-11	20	20	5	3	15	15	8	6	4
150	180	0	-25	0	-25	0	-18	0	-13	25	25	5	3	19	19	9	7	5
180	250	0	-30	0	-30	0	-20	0	-15	30	30	6	4	23	23	10	8	6
250	315	0	-35	0	-35	0	-25	0	-18	35	35	8	5	26	26	13	9	6
315	400	0	-40	0	-40	0	-28	0	-20	40	40	10	5	30	30	14	10	6

Note: Please consult **NTN** Engineering for Class A bearings.

Table 6.6 (3) Effective width of inner and outer rings

Unit μm

Nominal bore diameter d mm		Effective width deviation of roller and inner ring assembly of tapered roller bearing Δ_{T1s}								Tapered roller bearing outer ring effective width deviation Δ_{T2s}							
		Class K		Class N		Class C		Class B		Class K		Class N		Class C		Class B	
over	incl.	high	low	high	low	high	low	high	low	high	low	high	low	high	low	high	low
10	80	+100	0	+50	0	+100	-100	*	*	+100	0	+50	0	+100	-100	*	*
80	120	+100	-100	+50	0	+100	-100	*	*	+100	-100	+50	0	+100	-100	*	*
120	180	+150	-150	+50	0	+100	-100	*	*	+200	-100	+100	0	+100	-150	*	*
180	250	+150	-150	+50	0	+100	-150	*	*	+200	-100	+100	0	+100	-150	*	*

Note 1: "*" mark are to be manufactured only for combined bearings.
2: Please consult **NTN** Engineering for Class A bearings.

Unit μm

Inner ring axial runout S_{ia} Class B	Overall width deviation of assembled tapered roller bearing Δ_{Ts} Class K		Class N		Class C		Class B	
max	sup	inf	sup	inf	sup	inf	sup	inf
3	+200	0	+100	0	+200	-200	+200	-200
4	+200	0	+100	0	+200	-200	+200	-200
4	+200	0	+100	0	+200	-200	+200	-200
4	+200	0	+100	0	+200	-200	+200	-200
5	+200	-200	+100	0	+200	-200	+200	-200
7	+350	-250	+150	0	+350	-250	+200	-250
8	+350	-250	+150	0	+350	-300	+200	-300

Table 6.6 (4) Radial runout of inner and outer rings

Unit μm

Nominal outside diameter D mm		Inner ring radial runout K_{ia} and Outer ring radial runout K_{ea} Class K	Class N	Class C	Class B
over	incl.	max			
18	30	18	18	5	3
30	50	20	20	6	3
50	80	25	25	6	4
80	120	35	35	6	4
120	150	40	40	7	4
150	180	45	45	8	4
180	250	50	50	10	5
250	315	60	60	11	5
315	400	70	70	13	5

Note: Please consult **NTN** Engineering for Class A bearings.

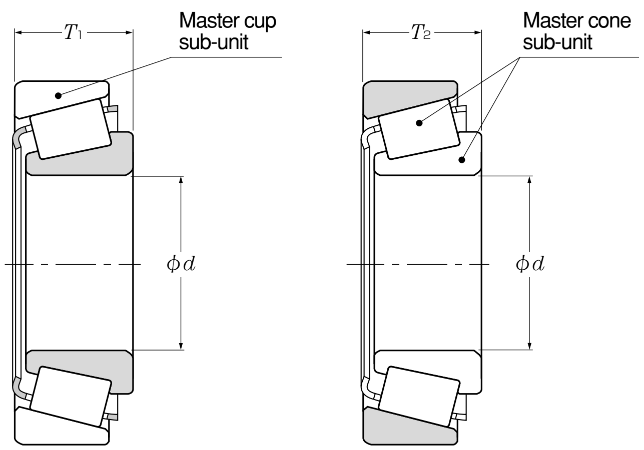


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Table 6.7 Tolerance of thrust ball bearings

Table 6.7 (1) Shaft raceway disc

Unit μm

Nominal bore diameter d mm		Mean bore diameter deviation Δ_{dmp}				Bore diameter variation V_{dp}		Raceway thickness variation S_i			
		Class 0,6,5		Class 4		Class 0,6,5	Class 4	Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	max		max			
—	18	0	-8	0	-7	6	5	10	5	3	2
18	30	0	-10	0	-8	8	6	10	5	3	2
30	50	0	-12	0	-10	9	8	10	6	3	2
50	80	0	-15	0	-12	11	9	10	7	4	3
80	120	0	-20	0	-15	15	11	15	8	4	3
120	180	0	-25	0	-18	19	14	15	9	5	4
180	250	0	-30	0	-22	23	17	20	10	5	4
250	315	0	-35	0	-25	26	19	25	13	7	5
315	400	0	-40	0	-30	30	23	30	15	7	5
400	500	0	-45	0	-35	34	26	30	18	9	6
500	630	0	-50	0	-40	38	30	35	21	11	7

Table 6.7 (2) Housing raceway disc

Unit μm

Nominal outside diameter D mm		Mean outside diameter deviation Δ_{Dmp}				Outside diameter variation V_{Dp}		Raceway thickness variation S_e			
		Class 0,6,5		Class 4		Class 0,6,5	Class 4	Class 0	Class 6	Class 5	Class 4
over	incl.	high	low	high	low	max		max			
10	18	0	-11	0	-7	8	5	According to the tolerance of S_1 against "d" of the same bearings			
18	30	0	-13	0	-8	10	6				
30	50	0	-16	0	-9	12	7				
50	80	0	-19	0	-11	14	8				
80	120	0	-22	0	-13	17	10				
120	180	0	-25	0	-15	19	11				
180	250	0	-30	0	-20	23	15				
250	315	0	-35	0	-25	26	19				
315	400	0	-40	0	-28	30	21				
400	500	0	-45	0	-33	34	25				
500	630	0	-50	0	-38	38	29				
630	800	0	-75	0	-45	55	34				

Table 6.7 (3) Bearing height

Unit μm

Nominal bore diameter d mm		Single direction Bearing height ❶ deviation Δ_{Ts}	
over	incl.	high	low
—	30	0	-75
30	50	0	-100
50	80	0	-125
80	120	0	-150
120	180	0	-175
180	250	0	-200
250	315	0	-225
315	400	0	-300
400	500	0	-350
500	630	0	-400

❶ This standard is applied for flat back face bearing of class 0.

Table 6.8 Tolerance of spherical thrust roller bearing

Table 6.8 (1) Shaft raceway disc

Unit μm

Nominal bore diameter d mm		Mean bore diameter deviation Δ_{dmp}		Bore diameter variation V_{dp}	Side runout with bore S_d	Bearing height deviation Δ_{Ts}	
over	incl.	high	low	max	max	high	low
50	80	0	-15	11	25	+150	-150
80	120	0	-20	15	25	+200	-200
120	180	0	-25	19	30	+250	-250
180	250	0	-30	23	30	+300	-300
250	315	0	-35	26	35	+350	-350
315	400	0	-40	30	40	+400	-400
400	500	0	-45	34	45	+450	-450

Table 6.8 (2) Housing raceway disc

Unit μm

Nominal outside diameter D mm		Single plane mean outside diameter deviation Δ_{Dmp}	
over	incl.	high	low
120	180	0	-25
180	250	0	-30
250	315	0	-35
315	400	0	-40
400	500	0	-45
500	630	0	-50
630	800	0	-75
800	1,000	0	-100

Table 6.9 Tolerance of double direction type angular contact thrust ball bearings

Table 6.9 (1) Inner rings and bearing height

Unit μm

Nominal bore diameter d mm		Mean bore diameter deviation Δ_{dmp} Bore diameter deviation Δ_{ds}				Side runout with bore S_d		Inner ring axial runout S_{ia}		Inner ring width variation V_{Bs}		Bearing height deviation Δ_{Ts}	
		Class 5		Class 4		Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 5, Class 4	
over	incl.	high	low	high	low	max		max		max		high	low
18	30	0	-6	0	-5	8	4	5	3	5	2.5	0	-300
30	50	0	-8	0	-6	8	4	5	3	5	3	0	-400
50	80	0	-9	0	-7	8	5	6	5	6	4	0	-500
80	120	0	-10	0	-8	9	5	6	5	7	4	0	-600
120	180	0	-13	0	-10	10	6	8	6	8	5	0	-700
180	250	0	-15	0	-12	11	7	8	6	10	6	0	-800
250	315	0	-18	0	-15	13	8	10	8	13	7	0	-900
315	400	0	-23	0	-18	15	9	13	10	15	9	0	-1,000

Table 6.9 (2) Outer rings

Unit μm

Nominal outside diameter D mm		Mean outside diameter deviation Δ_{Dmp} Outside diameter deviation Δ_{Ds}		Outside surface inclination S_D		Outer ring axial runout S_{ea}		Outer ring width variation V_{Cs}	
		Class 5	Class 4	Class 5	Class 4	Class 5	Class 4	Class 5	Class 4
over	incl.	high	low	max		max		max	
30	50	-30	-40	8	4	According to tolerance of S_{ia} against "d" of the same bearings		5	2.5
50	80	-40	-50	8	4			6	3
80	120	-50	-60	9	5			8	4
120	150	-60	-75	10	5			8	5
150	180	-60	-75	10	5			8	5
180	250	-75	-90	11	7			10	7
250	315	-90	-105	13	8			11	7
315	400	-110	-125	13	10			13	8
400	500	-120	-140	15	13			15	10

6.2 Chamfer measurements and tolerance or allowable values of tapered bore

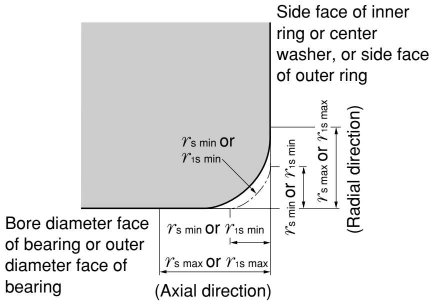

Table 6.10 Allowable critical-value of bearing chamfer

Table 6.10 (1) Radial bearing (Except tapered roller bearing)

Unit mm

$r_{s\,min}$ ❶ or $r_{1s\,min}$	Nominal bore diameter d over	incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	Axial direction
0.05	—	—	0.1	0.2
0.08	—	—	0.16	0.3
0.1	—	—	0.2	0.4
0.15	—	—	0.3	0.6
0.2	—	—	0.5	0.8
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
5	—	—	8	10
6	—	—	10	13
7.5	—	—	12.5	17
9.5	—	—	15	19
12	—	—	18	24
15	—	—	21	30
19	—	—	25	38

❶ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

Table 6.10 (2) Tapered roller bearings of metric series

Unit mm

$r_{s\,min}$ ❷ or $r_{1s\,min}$	Nominal bore❸ diameter of bearing "d" or nominal outside diameter "D" over	incl.	$r_{s\,max}$ or $r_{1s\,max}$ Radial direction	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	—	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

❷ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.
❸ Inner rings shall be in accordance with the division of "d" and outer rings with that of "D".

Note: This standard will be applied to the bearings whose dimensional series (refer to the dimensional table) are specified in the standard of ISO 355 or JIS B 1512. For further information concerning bearings outside of these standards or tapered roller bearings using US customary unit, please contact **NTN** Engineering.

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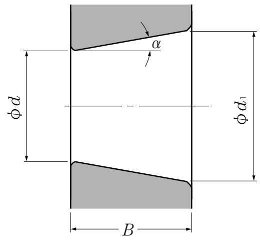
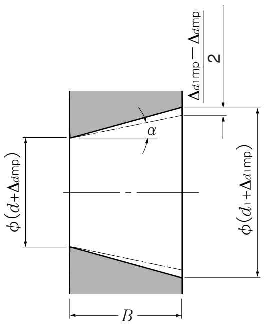


Theoretical tapered bore



Tapered bore having dimensional difference of the average bore diameter within the flat surface

Table 6.10 (3) Thrust bearings

Unit mm

$r_{s\,min}$ or $r_{1\,min}$ ❹	$r_{s\,max}$ or $r_{1s\,max}$ Radial and axial direcition
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
7.5	12.5
9.5	15
12	18
15	21
19	25

❹ These are the allowable minimum dimensions of the chamfer dimension "r" or "r_1" and are described in the dimensional table.

Table 6.11 (1) Tolerance of and tolerance values for tapered bore of radial bearings
Standard taper ratio 1:12 tapared hole (class 0) Unit μm

d mm		Δ_{dmp}		Δ_{d1mp} - Δ_{dmp}		V_{dp} ❶ ❷
over	incl.	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	1,000	+140	0	+ 90	0	—
1,000	1,250	+165	0	+105	0	—
1,250	1,600	+195	0	+125	0	—

Table 6.11 (2) Tolerance of and tolerance values for tapered bore of radial bearings
Standard taper ratio 1:30 tapered bore (class 0) Units μm

d mm		Δ_{dmp}		Δ_{d1mp} − Δ_{dmp}		V_{dp} ❶ ❷
over	incl.	high	low	high	low	max
50	80	+15	0	+30	0	19
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

❶ Applies to all radial flat planes of inner ring tapered bore.
❷ Does not apply to diameter series 7 and 8.

Note: Quantifiers

For a standard taper ratio of 1:12 $d_1 = d + \frac{1}{12}B$

For a standard taper ratio of 1:30 $d_1 = d + \frac{1}{30}B$

Δ_{dmp} : Dimensional difference of the average bore diameter within the flat surface at the theoretical small end of the tapered bore.

Δ_{d1mp} : Dimensional difference of the average bore diameter within the flat surface at the theoretical large end of the tapered bore.

V_{dp} : Unevenness of the bore diameter with the flat surface

B : Nominal width of inner ring

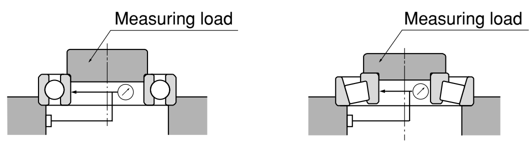
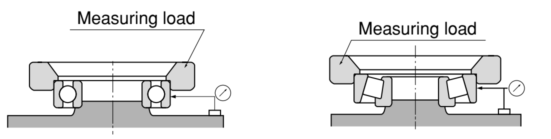
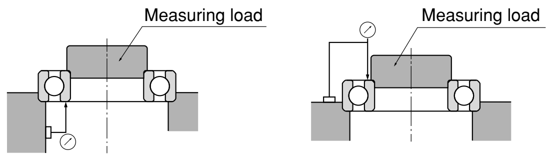
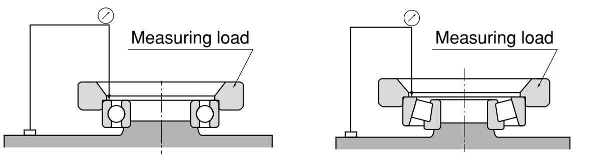
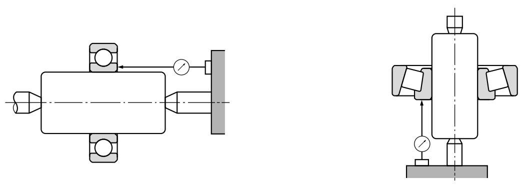
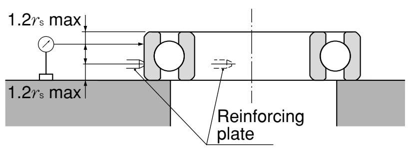
α : Half of the tapered bore's nominal taper angle
For a standard taper ratio of 1:12 $\alpha = 2°23'9.4''$
For a standard taper ratio of 1:30 $\alpha = 0°57'7.4''$

6.3 Bearing tolerance measurement methods

For reference, measurement methods for rolling bearing tolerances are in JIS B 1515.

Table 6.12 shows some of the major methods of measuring rotation tolerances.

Table 6.12 Rotation tolerance measurement methods

Characteristic tolerance	Measurement method	
Inner ring radial runout (K_{ia})		Radial runout of the inner ring is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Outer ring radial runout (K_{ea})		Radial runout of the outer ring is the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Inner ring axial runout (S_{ia})		Axial runout of the inner ring is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution.
Outer ring axial runout (S_{ea})		Axial runout of the outer ring is the difference between the maximum and minimum reading of the measuring device when the outer ring is turned one revolution.
Inner ring side runout with bore (S_d)		Inner ring side runout with bore is the difference between the maximum and minimum reading of the measuring device when the inner ring is turned one revolution together with the tapered mandrel.
Outer ring outside surface inclination (S_D)		Outer ring outside surface inclination is the difference between the maximum and minimum reading of the measuring device when the outside ring is turned one revolution along the reinforcing plate.

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