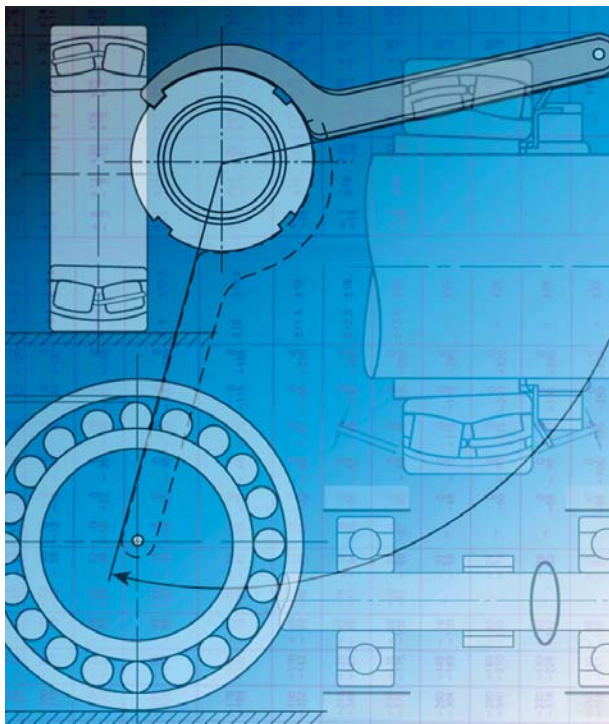


Fits and Clearances

Pocket Guide



Fits and Internal Clearances

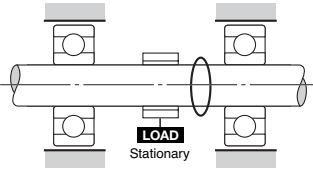
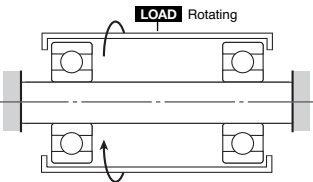
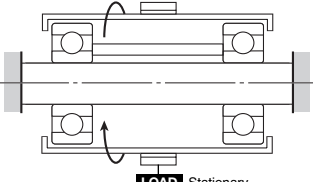
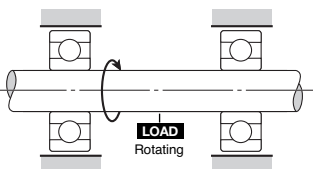
Fits

Importance of Proper Fits

In the case of a rolling bearing with the inner ring fitted to the shaft with only interference, a harmful circumferential slipping may occur between the inner ring and shaft. This slipping of the inner ring, which is called “creep”, results in a circumferential displacement of the ring relative to the shaft if the interference fit is not sufficiently tight. When creep occurs, the fitted surfaces become abraded, causing wear and considerable damage to the shaft. Abnormal heating and vibration may also occur due to abrasive metallic particles entering the interior of the bearing.

It is important to prevent creep by having sufficient interference to firmly secure that ring which rotates to either shaft or housing. Creep cannot always be eliminated using only axial tightening throughout the bearing ring faces. Generally, it is not necessary, however, to provide interference for rings subjected only to stationary loads. Fits are sometimes made without any interference for either the inner or outer ring, to accommodate certain operating conditions, or to facilitate mounting and dismounting. In this case, to prevent damage to the fitting surfaces due to creep, lubrication or other applicable methods should be considered.

Loading Conditions and Fits

Load Application	Bearing Operation		Load Conditions	Fits	
	Inner Ring	Outer Ring		Inner Ring	Outer Ring
	Rotating	Stationary	Rotating Inner Ring Load	Tight Fit	Loose Fit
	Stationary	Rotating	Stationary Outer Ring Load	Tight Fit	Loose Fit
	Stationary	Rotating	Rotating Outer Ring Load	Loose Fit	Tight Fit
	Rotating	Stationary	Stationary Inner Ring Load	Loose Fit	Tight Fit
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

Fits between Radial Bearings and Housing Bores

Load Conditions			Examples	Tolerances for Housing Bores	Axial Displacement of Outer Ring	Remarks
Solid Housings	Rotating Outer Ring Load	Heavy Loads on Bearing in Thin-Walled Housing or Heavy Shock Loads	Automotive Wheel Hubs (Roller Bearings) Crane Travelling Wheels	P7	Impossible	—
		Normal or Heavy Loads	Automotive Wheel Hubs (Ball Bearings), Vibrating Screens	N7		
		Light or Variable Loads	Conveyor Rollers, Rope Sheaves, Tension Pulleys	M7		
	Direction of Load Indeterminate	Heavy Shock Loads	Traction Motors	K7	Generally Impossible	If axial displacement of the outer ring is not required.
		Normal or Heavy Loads	Pumps, Crankshaft Main Bearings, Medium and Large Motors			
Solid or Split Housings	Rotating Inner Ring Load	Normal or Light Loads		JS7 (J7)	Possible	Axial displacement of outer ring is necessary.
		Loads of all Kinds	General Bearing Applications, Railway Axleboxes	H7	Easily Possible	—
		Normal or High Loads	Plummer Blocks	H8		
	High Temperature Rise of Inner Ring Through Shaft	Paper Dryers	G7			
	Solid Housings	Direction of Load Indeterminate	Accurate Running Desirable under Normal or Light Loads	Grinding Spindle Rear Ball Bearings, High-Speed Centrifugal Compressor Free Bearings	JS6 (J6)	Possible
Grinding Spindle Front Ball Bearings, High-Speed Centrifugal Compressor Fixed Bearings				K6	Generally Impossible	
Rotating Inner Ring Load		Accurate Running and High Rigidity Desirable under Variable Loads	Cylindrical Roller Bearings for Machine Tool Main Spindle	M6 or N6	Impossible	
		Minimum noise is required	Electrical Home Appliances	H6	Easily Possible	—

- Remarks**
1. This table is applicable to cast iron and steel housings. For housings made of light alloys, the interference should be tighter than in this table.
 2. Not applicable to special fits.

Fits between Radial Bearings and Shafts

Load Conditions		Examples	Shaft Diameter (mm)			Tolerance of Shaft	Remarks
			Ball Bearings	Cylindrical Roller Bearings, Tapered Roller Bearings	Spherical Roller Bearings		
RADIAL BEARINGS WITH CYLINDRICAL BORES							
Rotating Outer Ring Load	Easy axial displacement of inner ring on shaft desirable	Wheels on Stationary Axles	All Shaft Diameters			g6	Use g5 and h5 where accuracy is required. In case of large bearings, f6 can be used to allow easy axial movement.
	Easy axial displacement of inner ring on shaft unnecessary	Tension Pulleys Rope Sheaves				h6	
Rotating Inner Ring Load or Direction of Load Indeterminate	Light Loads or Variable Loads (< 0.06C r)	Electrical Home Appliances, Pumps, Blowers, Transport Vehicles, Precision Machinery, Machine Tools	<18	–	–	js5	–
			18~100	<40	–	js6 (j6)	
			100~200	40~140	–	k6	
			–	140~200	–	m6	
	Normal Loads (0.06 to 0.13 Cr)	General Bearing Applications, Medium and Large Motors, Turbines, Pumps, Engine Main Bearings, Gears, Woodworking Machines	<18	–	–	js5 (j5-6)	k6 and m6 can be used for single-row tapered roller bearings and single-row angular contact ball bearings instead of k5 and m5.
			18~100	<40	<40	k5-6	
			100~140	40~100	40~65	m5-6	
			140~200	100~140	65~100	m6	
			200~280	140~200	100~140	n6	
			–	200~400	140~280	p6	
	Heavy Loads or Shock Loads (< 0.13C r)	Railway Axleboxes, Industrial Vehicles, Traction Motors, Construction, Equipment, Crushers	–	–	280~500	r6	More than CN bearing internal clearance is necessary.
			–	50~140	50~100	n6	
			–	140~200	100~140	p6	
			–	Over 200	140~200	r6	
			–	–	200~500	r7	
			–	–	over 500	r7	
Axial Loads Only			All Shaft Diameters			js6 (j6)	–
RADIAL BEARINGS WITH TAPERED BORES AND SLEEVES							
All Types of Loading		General Bearing Applications, Railway Axleboxes	All Shaft Diameters			H9/IT5	IT5 and IT7 mean that the deviation of the shaft from its true geometric form, e.g. roundness and cylindricity should be within the tolerances of IT5 and IT7 respectively.
		Transmission Shafts, Woodworking Spindles				H10/IT7	

Remarks This table is applicable only to solid steel shafts

Tolerances for Shaft Diameters

Units : μm

Diameter Classification (mm) Over	incl.	Single Plane Mean & D Deviation (Normal) μm	d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6
3	6	0 -8	-30 -38	-20 -28	-10 -18	-4 -9	-4 -12	0 -5	0 -8	0 -12	0 -18	0 -30	0 -48	± 2.5	± 4
6	10	0 -8	-40 -49	-25 -34	-13 -22	-5 -11	-5 -14	0 -6	0 -9	0 -15	0 -22	0 -36	0 -58	± 3	± 4.5
10	18	0 -8	-50 -61	-32 -43	-16 -27	-6 -14	-6 -17	0 -8	0 -11	0 -18	0 -27	0 -43	0 -70	± 4	± 5.5
18	30	0 -10	-65 -78	-40 -53	-20 -33	-7 -16	-7 -20	0 -9	0 -13	0 -21	0 -33	0 -52	0 -84	± 4.5	± 6.5
30	50	0 -12	-80 -96	-50 -66	-25 -41	-9 -20	-9 -25	0 -11	0 -16	0 -25	0 -39	0 -62	0 -100	± 5.5	± 8
50	80	0 -15	-100 -119	-60 -79	-30 -49	-10 -23	-10 -29	0 -13	0 -19	0 -30	0 -46	0 -74	0 -120	± 6.5	± 9.5
80	120	0 -20	-120 -142	-72 -94	-36 -58	-12 -27	-12 -34	0 -15	0 -22	0 -35	0 -54	0 -87	0 -140	± 7.5	± 11
120	180	0 -25	-145 -170	-85 -110	-43 -68	-14 -32	-14 -39	0 -18	0 -25	0 -40	0 -63	0 -100	0 -160	± 9	± 12.5
180	250	0 -30	-170 -199	-100 -129	-50 -79	-15 -35	-15 -44	0 -20	0 -29	0 -46	0 -72	0 -115	0 -185	± 10	± 14.5
250	315	0 -35	-190 -222	-110 -142	-56 -88	-17 -40	-17 -49	0 -23	0 -32	0 -52	0 -81	0 -130	0 -210	± 11.5	± 16
315	400	0 -40	-210 -246	-125 -161	-62 -98	-18 -43	-18 -54	0 -25	0 -36	0 -57	0 -89	0 -140	0 -230	± 12.5	± 18
400	500	0 -45	-230 -270	-135 -175	-68 -108	-20 -47	-20 -60	0 -27	0 -40	0 -63	0 -97	0 -155	0 -250	± 13.5	± 20
500	630	0 -50	-260 -304	-145 -189	-76 -120	-	-22 -66	-	0 -44	0 -70	0 -110	0 -175	0 -280	-	± 22
630	800	0 -75	-290 -340	-160 -210	-80 -130	-	-24 -74	-	0 -50	0 -80	0 -125	0 -200	0 -320	-	± 25
800	1000	0 -100	-320 -376	-170 -226	-86 -142	-	-26 -82	-	0 -56	0 -90	0 -140	0 -230	0 -360	-	± 28
1000	1250	0 -125	-350 -416	-195 -261	-98 -164	-	-28 -94	-	0 -66	0 -105	0 -165	0 -260	0 -420	-	± 33
1250	1600	0 -160	-390 -468	-220 -298	-110 -188	-	-30 -108	-	0 -78	0 -125	0 -195	0 -310	0 -500	-	± 39
1600	2000	0 -200	-430 -522	-240 -332	-120 -164	-	-32 -124	-	0 -92	0 -150	0 -230	0 -370	0 -600	-	± 46

j5	j6	j7	k5	k6	k7	m5	m6	n6	p6	r6	r7	Diameter Classification (mm) Over	incl.
+3 -2	+6 -2	+8 -4	+6 +1	+9 +1	+13 +1	+9 +4	+12 +4	+16 +8	+20 +12	+23 +15	+27 +15	3	6
+4 -2	+7 -2	+10 -5	+7 +1	+10 +1	+16 +1	+12 +6	+15 +6	+19 +10	+24 +15	+28 +19	+34 +19	6	10
+5 -3	+8 -3	+12 -6	+9 +1	+12 +1	+19 +1	+15 +7	+18 +7	+23 +12	+29 +23	+34 +23	+41 +23	10	18
+6 -4	+9 -4	+13 -8	+11 +2	+15 +2	+23 +2	+17 +8	+21 +8	+28 +15	+35 +22	+41 +28	+49 +28	18	30
+7 -5	+11 -5	+15 -10	+13 +2	+18 +2	+27 +2	+20 +9	+25 +9	+33 +17	+42 +26	+50 +34	+59 +34	30	50
+8 -7	+12 -7	+18 -12	+15 +2	+21 +2	+32 +2	+24 +11	+30 +11	+39 +20	+51 +32	+60 +41	+71 +43	50	65
+9 -9	+13 -9	+20 -15	+18 +3	+25 +3	+38 +3	+28 +13	+35 +13	+45 +23	+59 +37	+70 +54	+89 +54	80	100
+10 -11	+14 -11	+22 -18	+21 +3	+28 +3	+43 +3	+33 +15	+40 +15	+52 +27	+68 +43	+80 +65	+105 +105	120	140
+11 -13	+16 -13	+25 -21	+24 +4	+33 +4	+50 +4	+37 +17	+46 +17	+60 +31	+79 +50	+109 +80	+126 +126	140	160
+12 -16	+18 -16	+26 -26	+27 +4	+36 +4	+56 +4	+43 +20	+52 +20	+66 +34	+88 +56	+114 +130	+146 +146	160	180
+13 -18	+20 -18	+29 -28	+29 +4	+40 +4	+61 +4	+46 +21	+57 +21	+73 +37	+98 +62	+128 +150	+168 +171	180	200
+14 -20	+22 -20	+31 -32	+32 +5	+45 +5	+68 +5	+50 +23	+63 +23	+80 +40	+108 +68	+139 +172	+182 +195	200	225
+15 -25	+24 -25	+33 -32	+34 +5	+48 +5	+74 +5	+55 +23	+66 +23	+86 +40	+116 +68	+150 +172	+194 +195	225	250
+16 -30	+26 -30	+35 -34	+36 +5	+51 +5	+80 +5	+60 +26	+70 +26	+88 +44	+122 +78	+166 +199	+209 +225	250	280
+17 -35	+28 -35	+37 -34	+38 +5	+54 +5	+86 +5	+65 +26	+76 +26	+94 +44	+130 +98	+184 +216	+240 +255	280	315
+18 -40	+30 -40	+39 -38	+40 +5	+57 +5	+92 +5	+70 +26	+80 +26	+100 +44	+138 +88	+194 +225	+255 +265	315	355
+19 -45	+32 -45	+41 -42	+42 +5	+60 +5	+98 +5	+75 +26	+86 +26	+112 +56	+146 +100	+209 +276	+266 +310	355	400
+20 -50	+34 -50	+43 -44	+44 +5	+63 +5	+104 +5	+80 +26	+90 +26	+116 +56	+156 +100	+220 +276	+286 +310	400	450
+21 -55	+36 -55	+45 -46	+46 +5	+66 +5	+110 +5	+85 +26	+96 +26	+120 +56	+166 +100	+230 +276	+296 +310	450	500
+22 -60	+38 -60	+47 -48	+48 +5	+69 +5	+116 +5	+90 +26	+100 +26	+124 +56	+176 +100	+240 +276	+306 +310	500	560
+23 -65	+40 -65	+49 -50	+50 +5	+72 +5	+122 +5	+95 +26	+106 +26	+128 +56	+186 +100	+250 +276	+316 +310	560	630
+24 -70	+42 -70	+51 -52	+52 +5	+75 +5	+128 +5	+100 +26	+110 +26	+132 +56	+196 +100	+260 +276	+326 +310	630	710
+25 -75	+44 -75	+53 -54	+54 +5	+78 +5	+134 +5	+105 +26	+116 +26	+136 +56	+206 +100	+270 +276	+336 +310	710	800
+26 -80	+46 -80	+55 -56	+56 +5	+81 +5	+140 +5	+110 +26	+120 +26	+140 +56	+216 +100	+280 +276	+346 +310	800	900
+27 -85	+48 -85	+57 -58	+58 +5	+84 +5	+146 +5	+115 +26	+126 +26	+144 +56	+226 +100	+290 +276	+356 +310	900	1000
+28 -90	+50 -90	+59 -60	+60 +5	+87 +5	+152 +5	+120 +26	+130 +26	+148 +56	+236 +100	+300 +276	+366 +310	1000	1200
+29 -95	+52 -95	+61 -62	+62 +5	+90 +5	+158 +5	+125 +26	+136 +26	+152 +56	+246 +100	+310 +276	+376 +310	1200	1400
+30 -100	+54 -100	+63 -64	+64 +5	+93 +5	+164 +5	+130 +26	+140 +26	+156 +56	+256 +100	+320 +276	+386 +310	1400	1600
+31 -105	+56 -105	+65 -66	+66 +5	+96 +5	+170 +5	+135 +26	+146 +26	+160 +56	+266 +100	+330 +276	+396 +310	1600	1800
+32 -110	+58 -110	+67 -68	+68 +5	+99 +5	+176 +5	+140 +26	+150 +26	+164 +56	+276 +100	+340 +276	+406 +310	1800	2000

Tolerances for Housing Bore Diameters

Units : μm

Diameter Classification (mm) Over	incl.	Single Plane Mean B.D. Deviation (Normal) Δ Dmp	E6	F6	F7	G6	G7	H6	H7	H8	J6	J7	JS6	JS7
10	18	0	+43	+27	+34	+17	+24	+11	+18	+27	+6	+10	± 5.5	± 9
		-8	+32	+16	+16	+6	+6	0	0	0	-5	-8		
18	30	0	+53	+33	+41	+20	+28	+13	+21	+33	+8	+12	± 6.5	± 10.5
		-9	+40	+20	+20	+7	+7	0	0	0	-5	-9		
30	50	0	+66	+41	+50	+25	+34	+16	+25	+39	+10	+14	± 8	± 12.5
		-11	+50	+25	+25	+9	+9	0	0	0	-6	-11		
50	80	0	+79	+49	+60	+29	+40	+19	+30	+46	+13	+18	± 9.5	± 15
		-13	+60	+30	+30	+10	+10	0	0	0	-6	-12		
80	120	0	+94	+58	+71	+34	+47	+22	+35	+54	+16	+22	± 11	± 17.5
		-15	+72	+36	+36	+12	+12	0	0	0	-6	-13		
120	150	0												
		18	+110	+68	+83	+39	+54	+25	+40	+63	+18	+26	± 12.5	± 20
150	180	-0	+85	+43	+43	+14	+14	0	0	0	-7	-14		
		-25												
180	250	0	+129	+79	+96	+44	+61	+29	+46	+72	+22	+30	± 14.5	± 23
		-30	+100	+50	+50	+15	+15	0	0	0	-7	-16		
250	315	0	+142	+88	+108	+49	+69	+32	+52	+81	+25	+36	± 16	± 26
		-35	+110	+56	+56	+17	+17	0	0	0	-7	-16		
315	400	0	+161	+98	+119	+54	+75	+36	+57	+89	+29	+39	± 18	± 28.5
		-40	+125	+62	+62	+18	+18	0	0	0	-7	-18		
400	500	0	+175	+108	+131	+60	+83	+40	+63	+97	+33	+43	± 20	± 31.5
		-45	+135	+68	+68	+20	+20	0	0	0	-7	-20		
500	630	0	+189	+120	+146	+66	+92	+44	+70	+110	-	-	± 22	± 35
		-50	+145	+76	+76	+22	+22	0	0	0				
630	800	0	+210	+130	+160	+74	+104	+50	+80	+125	-	-	± 25	± 40
		-75	+160	+80	+80	+24	+24	0	0	0				
800	1000	0	+226	+142	+176	+82	+116	+56	+90	+140	-	-	± 28	± 45
		-100	+170	+86	+86	+26	+26	0	0	0				
1000	1250	0	+261	+164	+203	+94	+133	+66	+105	+165	-	-	± 33	± 52.5
		-125	+195	+98	+98	+28	+28	0	0	0				
1250	1600	0	+298	+188	+235	+108	+155	+78	+125	+195	-	-	± 39	± 62.5
		-160	+220	+110	+110	+30	+30	0	0	0				
1600	2000	0	+332	+212	+270	+124	+182	+92	+150	+230	-	-	± 46	± 75
		-200	+240	+120	+120	+32	+32	0	0	0				
2000	2500	0	+370	+240	+305	+144	+209	+110	+175	+280	-	-	± 55	± 87.5
		-250	+260	+130	+130	+34	+34	0	0	0				

K5	K6	K7	M5	M6	M7	N5	N6	N7	P6	P7	Diameter Classification (mm)	
											Over	incl.
+2	+2	+6	-4	-4	0	-9	-9	-5	-15	-11	10	18
-6	-9	-12	-12	-15	-18	-17	-20	-23	-26	-29		
+1	+2	+6	-5	-4	0	-12	-11	-7	-18	-14	18	30
-8	-11	-15	-14	-17	-21	-21	-24	-28	-31	-35		
+2	+3	+7	-5	-4	0	-13	-12	-8	-21	-17	30	50
-9	-13	-18	-16	-20	-25	-24	-28	-33	-37	-42		
+3	+4	+9	-6	-5	0	-15	-14	-9	-26	-21	50	80
-10	-15	-21	-19	-24	-30	-28	-33	-39	-45	-51		
+2	+4	+10	-8	-6	0	-18	-16	-10	-30	-24	80	120
-13	-18	-25	-23	-28	-35	-33	-38	-45	-52	-59		
+3	+4	+12	-9	-8	0	-21	-20	-12	-36	-28	120	180
-15	-21	-28	-27	-33	-40	-39	-45	-52	-61	-68		
+2	+5	+13	-11	-8	0	-25	-22	-14	-41	-33	180	250
-18	-24	-33	-31	-37	-46	-45	-51	-60	-70	-79		
+3	+5	+16	-13	-9	0	-27	-25	-14	-47	-36	250	315
-20	-27	-36	-36	-41	-52	-50	-57	-66	-79	-88		
+3	+7	+17	-14	-10	0	-30	-26	-16	-51	-41	315	400
-22	-29	-40	-39	-46	-57	-55	-62	-73	-87	-98		
+2	+8	+18	-16	-10	0	-33	-27	-17	-55	-45	400	500
-25	-32	-45	-43	-50	-63	-60	-67	-80	-95	-108		
-	0	0	-	-26	-26	-	-44	-44	-78	-78	500	630
	-44	-70		-70	-96		-88	-114	-122	-148		
-	0	0	-	-30	-30	-	-50	-50	-88	-88	630	800
	-50	-80		-80	-110		-100	-130	-138	-168		
-	0	0	-	-34	-34	-	-56	-56	-100	-100	800	1000
	-56	-90		-90	-124		-112	-146	-156	-190		
-	0	0	-	-40	-40	-	-66	-66	-120	-120	1000	1250
	-66	-105		-106	-145		-132	-171	-186	-225		
-	0	0	-	-48	-48	-	-78	-78	-140	-140	1250	1600
	-78	-125		-126	-173		-156	-203	-218	-265		
-	0	0	-	-58	-58	-	-82	-82	-170	-170	1600	2000
	-92	-150		-150	-208		-184	-242	-262	-320		
-	0	0	-	-68	-68	-	-110	-110	-195	-195	2000	2500
	-110	-175		-178	-243		-220	-285	-305	-370		

Radial Internal Clearances in Deep Groove Ball Bearings

Units : μm

Nominal Bore Diameter <i>d</i> (mm)		Clearance											
		C2		CM*		Normal		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max	min	max
10	only	0	7	4	11	2	13	8	23	14	29	20	37
10	18	0	9	4	11	3	18	11	25	18	33	25	45
18	24	0	10	5	12	5	20	13	28	20	36	28	48
24	30	1	11	5	12	5	20	13	28	23	41	30	53
30	40	1	11	9	17	6	20	15	33	28	46	40	64
40	50	1	11	9	17	6	23	18	36	30	51	45	73
50	65	1	15	12	22	8	28	23	43	38	61	55	90
65	80	1	15	12	22	10	30	25	51	46	71	65	105
80	100	1	18	18	30	12	36	30	58	53	84	75	120
100	120	2	20	18	30	15	41	36	66	61	97	90	140
120	140	2	23	24	38	18	48	41	81	71	114	105	160
140	160	2	23	24	38	18	53	46	91	81	130	120	180
160	180	2	25	-	-	20	61	53	102	91	147	135	200
180	200	2	30	-	-	25	71	63	117	107	163	150	230
200	225	2	35	-	-	25	85	75	140	125	195	175	265
225	250	2	40	-	-	30	95	85	160	145	225	205	300
250	280	2	45	-	-	35	105	90	170	155	245	225	340
280	315	2	55	-	-	40	115	100	190	175	270	245	370
315	355	3	60	-	-	45	125	110	210	195	300	275	410
355	400	3	70	-	-	55	145	130	240	225	340	315	460
400	450	3	80	-	-	60	170	150	270	250	380	350	510
450	500	3	90	-	-	70	190	170	300	280	420	390	570
500	560	10	100	-	-	80	210	190	330	310	470	440	630
560	630	10	110	-	-	90	230	210	360	340	520	490	690
630	710	20	130	-	-	110	260	240	400	380	570	540	760
710	800	20	140	-	-	120	290	270	450	430	630	600	840

Radial Internal Clearances in Miniature Deep Groove Ball Bearings

Nominal Bore Diameter <i>d</i> (mm)		Clearance									
		MC1		MC2		MC3**		MC4		MC5	
over	incl	min	max	min	max	min	max	min	max	min	max
1	10	0	5	3	8	5	10	8	13	13	20

Notes *: **CM** is the normal clearance class for electrical motors.
 : **MC3 is the normal clearance class for miniature bearings.

Radial Internal Clearances in Self-Aligning Ball Bearings with Cylindrical Bores

Units : μm

Nominal Bore Diameter <i>d</i> (mm)		Clearance									
		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
2.5	6	1	8	5	15	10	20	15	25	21	33
6	10	2	9	6	17	12	25	19	33	27	42
10	14	2	10	6	19	13	26	21	35	30	48
14	18	3	12	8	21	15	28	23	37	32	50
18	24	4	14	10	23	17	30	25	39	34	52
24	30	5	16	11	24	19	35	29	46	40	58
30	40	6	18	13	29	23	40	34	53	46	66
40	50	6	19	14	31	25	44	37	57	50	71
50	65	7	21	16	36	30	50	45	69	62	88
65	80	8	24	18	40	35	60	54	83	76	108
80	100	9	27	22	48	42	70	64	96	89	124
100	120	10	31	25	56	50	83	75	114	105	145
120	140	10	38	30	68	60	100	90	135	125	175
140	160	15	44	35	80	70	120	110	161	150	210

Radial Internal Clearances in Self-Aligning Ball Bearings with Tapered Bores

Units : μm

Nominal Bore Diameter <i>d</i> (mm)		Clearance									
		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
2.5	6	-	-	-	-	-	-	-	-	-	-
6	10	-	-	-	-	-	-	-	-	-	-
10	14	-	-	-	-	-	-	-	-	-	-
14	18	-	-	-	-	-	-	-	-	-	-
18	24	7	17	13	26	20	33	28	42	37	55
24	30	9	20	15	28	23	39	33	50	44	62
30	40	12	24	19	35	29	46	40	59	52	72
40	50	14	27	22	39	33	52	45	65	58	79
50	65	18	32	27	47	41	61	56	80	73	99
65	80	23	39	35	57	50	75	69	98	91	123
80	100	29	47	42	68	62	90	84	116	109	144
100	120	35	56	50	81	75	108	100	139	130	170
120	140	40	68	60	98	90	130	120	165	155	205
140	160	45	74	65	110	100	150	140	191	180	240

Radial Internal Clearances in Cylindrical Roller Bearings with Cylindrical Bores

Units : μm

Nominal Bore Diameter d (mm)		Clearance									
		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
–	10	0	25	20	45	35	60	50	75	–	–
10	24	0	25	20	45	35	60	50	75	65	90
24	30	0	25	20	45	35	60	50	75	70	95
30	40	5	30	25	50	45	70	60	85	80	105
40	50	5	35	30	60	50	80	70	100	95	125
50	65	10	40	40	70	60	90	80	110	110	140
65	80	10	45	40	75	65	100	90	125	130	165
80	100	15	50	50	85	75	110	105	140	155	190
100	120	15	55	50	90	85	125	125	165	180	220
120	140	15	60	60	105	100	145	145	190	200	245
140	160	20	70	70	120	115	165	165	215	225	275
160	180	25	75	75	125	120	170	170	220	250	300
180	200	35	90	90	145	140	195	195	250	275	330
200	225	45	105	105	165	160	220	220	280	305	365
225	250	45	110	110	175	170	235	235	300	330	395
250	280	55	125	125	195	190	260	260	330	370	440
280	315	55	130	130	205	200	275	275	350	410	485
315	355	65	145	145	225	225	305	305	385	455	535
355	400	100	190	190	280	280	370	370	460	510	600
400	450	110	210	210	310	310	410	410	510	565	665
450	500	110	220	220	330	330	440	440	550	625	735

Radial Internal Clearances in Double-Row and Combined Tapered Roller Bearings

Units : μm

Cylindrical Bore		Clearances											
		C1		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max	min	max
–	18	0	10	10	20	20	30	35	45	50	60	65	75
18	24	0	10	10	20	20	30	35	45	50	60	65	75
24	30	0	10	10	20	20	30	40	50	50	60	70	80
30	40	0	12	12	25	25	40	45	60	60	75	80	95
40	50	0	15	15	30	30	45	50	65	65	80	95	110
50	65	0	15	15	35	35	55	60	80	80	100	110	130
65	80	0	20	20	40	40	60	70	90	90	110	130	150
80	100	0	25	25	50	50	75	80	105	105	130	155	180
100	120	5	30	30	55	55	80	90	115	120	145	180	210
120	140	5	35	35	65	65	95	100	130	135	165	200	230
140	160	10	40	40	70	70	100	110	140	150	180	220	260
160	180	10	45	45	80	80	115	125	160	165	200	250	290
180	200	10	50	50	90	90	130	140	180	180	220	280	320
200	225	20	60	60	100	100	140	150	190	200	240	300	340
225	250	20	65	65	110	110	155	165	210	220	270	330	380
250	280	20	70	70	120	120	170	180	230	240	290	370	420
280	315	30	80	80	130	130	180	190	240	260	310	410	460
315	355	30	80	80	130	140	190	210	260	290	350	450	510
355	400	40	90	90	140	150	200	220	280	330	390	510	570
400	450	45	95	95	145	170	220	250	310	370	430	560	620
450	500	50	100	100	150	190	240	280	340	410	470	620	680
500	560	60	110	110	160	210	260	310	380	450	520	700	770
560	630	70	120	120	170	230	290	350	420	500	570	780	850
630	710	80	130	130	180	260	310	390	470	560	640	870	950
710	800	90	140	150	200	290	340	430	510	630	710	980	1060
800	900	100	150	160	210	320	370	480	570	700	790	1100	1200
900	1000	120	170	180	230	360	410	540	630	780	870	1200	1300
1000	1120	130	190	200	260	400	460	600	700	–	–	–	–
1120	1250	150	210	220	280	450	510	670	770	–	–	–	–
1250	1400	170	240	250	320	500	570	750	870	–	–	–	–

Remarks

Axial internal clearance $\Delta a = \Delta r \cdot \cot \alpha \approx \frac{1.5}{e} \Delta r$

where

Δr : Radial internal clearance

α : Contact angle

e : Contact (listed in bearing tables)

Radial Internal Clearances in Spherical Roller Bearings with Cylindrical Bores

Units : μm

Nominal Bore Diameter d (mm)		Clearance									
		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
24	30	15	25	25	40	40	55	55	75	75	95
30	40	15	30	30	45	45	60	60	80	80	100
40	50	20	35	35	55	55	75	75	100	100	125
50	65	20	40	40	65	65	90	90	120	120	150
65	80	30	50	50	80	80	110	110	145	145	180
80	100	35	60	60	100	100	135	135	180	180	225
100	120	40	75	75	120	120	160	160	210	210	260
120	140	50	95	95	145	145	190	190	240	240	300
140	160	60	110	110	170	170	220	220	280	280	350
160	180	65	120	120	180	180	240	240	310	310	390
180	200	70	130	130	200	200	260	260	340	340	430
200	225	80	140	140	220	220	290	290	380	380	470
225	250	90	150	150	240	240	320	320	420	420	520
250	280	100	170	170	260	260	350	350	460	460	570
280	315	110	190	190	280	280	370	370	500	500	630
315	355	120	200	200	310	310	410	410	550	550	690
355	400	130	220	220	340	340	450	450	600	600	750
400	450	140	240	240	370	370	500	500	660	660	820
450	500	140	260	260	410	410	550	550	720	720	900
500	560	150	280	280	440	440	600	600	780	780	1000
560	630	170	310	310	480	480	650	650	850	850	1100
630	710	190	350	350	530	530	700	700	920	920	1190
710	800	210	390	390	580	580	770	770	1010	1010	1300
800	900	230	430	430	650	650	860	860	1120	1120	1440
900	1000	260	480	480	710	710	930	930	1220	1220	1570
1000	1120	290	530	530	780	780	1020	1020	1330	–	–
1120	1250	320	580	580	860	860	1120	1120	1460	–	–
1250	1400	350	640	640	950	950	1240	1240	1620	–	–

Radial Internal Clearances in Spherical Roller Bearings with Tapered Bores

Units : μm

Nominal Bore Diameter d (mm)		Clearance									
		C2		CN		C3		C4		C5	
over	incl	min	max	min	max	min	max	min	max	min	max
24	30	20	30	30	40	40	55	55	75	75	95
30	40	25	35	35	50	50	65	65	85	85	105
40	50	30	45	45	60	60	80	80	100	100	130
50	65	40	55	55	75	75	95	95	120	120	160
65	80	50	70	70	95	95	120	120	150	150	200
80	100	55	80	80	110	110	140	140	180	180	230
100	120	65	100	100	135	135	170	170	220	220	280
120	140	80	120	120	160	160	200	200	260	260	330
140	160	90	130	130	180	180	230	230	300	300	380
160	180	100	140	140	200	200	260	260	340	340	430
180	200	110	160	160	220	220	290	290	370	370	470
200	225	120	180	180	250	250	320	320	410	410	520
225	250	140	200	200	270	270	350	350	450	450	570
250	280	150	220	220	300	300	390	390	490	490	620
280	315	170	240	240	330	330	430	430	540	540	680
315	355	190	270	270	360	360	470	470	590	590	740
355	400	210	300	300	400	400	520	520	650	650	820
400	450	230	330	330	440	440	570	570	720	720	910
450	500	260	370	370	490	490	630	630	790	790	1000
500	560	290	410	410	540	540	680	680	870	870	1100
560	630	320	460	460	600	600	760	760	980	980	1230
630	710	350	510	510	670	670	850	850	1090	1090	1360
710	800	390	570	570	750	750	960	960	1220	1220	1500
800	900	440	640	640	840	840	1070	1070	1370	1370	1690
900	1000	490	710	710	930	930	1190	1190	1520	1520	1860
1000	1120	530	770	770	1030	1030	1300	1300	1670	–	–
1120	1250	570	830	830	1120	1120	1420	1420	1830	–	–
1250	1400	620	910	910	1230	1230	1560	1560	2000	–	–

Mounting of Spherical Roller Bearings on Adapter Sleeves

1. With bearing on bench check clearance using the feeler gauges **over the top of the rollers at the top of the bearing** as shown in Fig. 3 and note the clearance.
2. Before mounting, smear the thread and the side face of the nut with a molybdenum disulphide paste or similar lubricant.
3. Smear the shaft and outside diameter of sleeve with a light oil.
4. Open the sleeve slightly by inserting and twisting a screw driver into the slit in the sleeve and position the sleeve on the shaft.
5. Slide bearing, lockwasher and locknut onto sleeve and tighten nut with a 'C' spanner until all slackness is removed.
6. Further tighten the nut until the clearance has been reduced by the amount shown in the chart in Fig. 2 but when the bearing is mounted on the shaft the clearance should be checked under the rollers at the bottom of the bearing as shown in Fig. 4.
7. Check the clearance has not been reduced below the minimum permissible residual clearance shown in the chart in Fig. 2 for the size and clearance of bearing.
8. Align one tab on the lock washer with a slot in the locknut and bend it into the slot, if no tabs line up with the slots slightly tighten the locknut until one lines up. **NEVER BACK OFF THE NUT TO LINE UP THE TAB WITH THE SLOT.**
9. Check the bearing rotates freely without any binding.

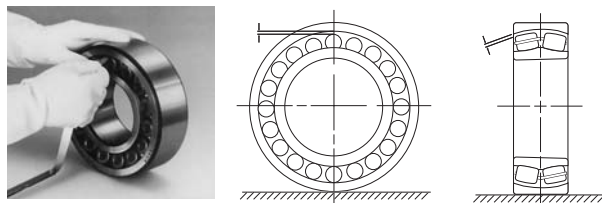


Fig 3. Checking bearing clearance with bearing on bench

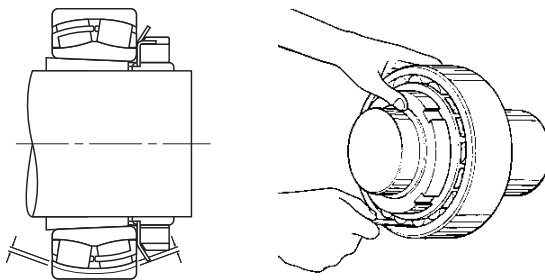


Fig 4. Checking bearing clearance with bearing mounted on shaft

Mounting of Spherical Roller Bearings on an Adapter Sleeve using the Axial Drive-Up Method

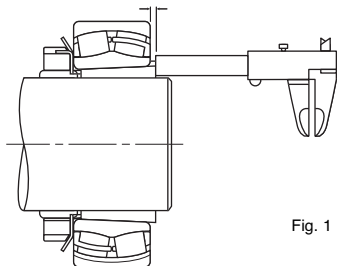


Fig. 1

1. Before mounting, smear the thread and the side face of the nut with a molybdenum disulphide paste or similar lubricant.
2. Smear the shaft and outside diameter of sleeve with a light oil.
3. Open the sleeve slightly by inserting and twisting a screw driver into the slit in the sleeve and position the sleeve on the shaft.
4. Slide bearing, lockwasher and locknut onto sleeve and tighten nut with a 'C' spanner until all slackness is removed.
5. Measure dimension 'X' as shown above in Fig. 1.
6. Tighten the nut and DECREASE dimension 'X' by the amount of axial drive-up shown in the chart in Fig. 2 for the correct size of bearing.
7. Check bearing clearance as shown in Fig.4 to ensure the clearance is not less than the minimum permissible residual clearance shown in the chart in Fig. 2 for the size and clearance of bearing.
8. Align one tab on the lock washer with a slot in the locknut and bend it into the slot, if no tabs line up with the slots slightly tighten the locknut until one lines up. **NEVER BACK OFF THE NUT TO LINE UP THE TAB WITH THE SLOT.**
9. Check the bearing rotates freely without binding.

Mounting of Spherical Roller Bearings with Adapter Sleeves

Bearing Bore Diameter mm		Reduction in Radial Clearance		Axial Drive-Up		Nominal tightening angle	Minimum Permissible Residual Clearance		
over	incl.	min	max	min	max		nominal	CN	C3
1:12 taper									
30	40	0.025	0.030	0.40	0.45	100°	0.010	0.025	0.035
40	50	0.030	0.035	0.45	0.55	120°	0.015	0.030	0.045
50	65	0.030	0.035	0.45	0.55	90°	0.025	0.035	0.060
65	80	0.040	0.045	0.60	0.70	120°	0.030	0.040	0.075
80	100	0.045	0.055	0.70	0.85	140°	0.035	0.050	0.085
100	120	0.050	0.060	0.75	0.90		0.045	0.065	0.110
120	140	0.060	0.070	0.90	1.10		0.055	0.080	0.130
140	160	0.065	0.080	1.00	1.30		0.060	0.100	0.150
160	180	0.070	0.090	1.10	1.40		0.070	0.110	0.170
180	200	0.080	0.100	1.30	1.60		0.070	0.110	0.190
200	225	0.090	0.110	1.40	1.70		0.080	0.130	0.210
225	250	0.100	0.120	1.60	1.90		0.090	0.140	0.230
250	280	0.110	0.140	1.70	2.20		0.100	0.150	0.250
280	315	0.120	0.150	1.90	2.40		0.110	0.160	0.280
315	355	0.140	0.170	2.20	2.70		0.120	0.180	0.300
355	400	0.150	0.190	2.40	3.00		0.130	0.200	0.330
400	450	0.170	0.210	2.70	3.30		0.140	0.220	0.360
450	500	0.190	0.240	3.00	3.70		0.160	0.240	0.390
500	560	0.210	0.270	3.40	4.30		0.170	0.270	0.410
560	630	0.230	0.300	3.70	4.80		0.200	0.310	0.460
630	710	0.260	0.330	4.20	5.30		0.220	0.330	0.520
710	800	0.280	0.370	4.50	5.90		0.240	0.390	0.590
800	900	0.310	0.410	5.00	6.60		0.280	0.430	0.660
900	1000	0.340	0.460	5.50	7.40		0.310	0.470	0.730
1000	1120	0.370	0.500	5.90	8.00		0.360	0.530	0.800

Fig. 2

Mounting of Self-Aligning Ball Bearings on an Adapter Sleeve

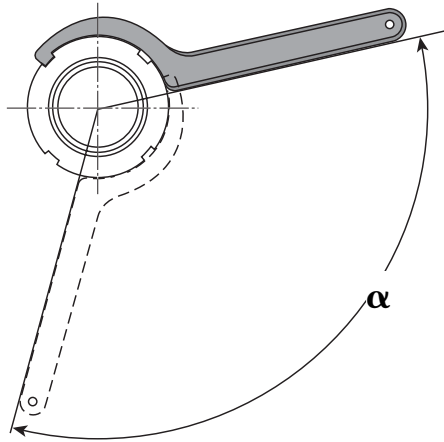
Axial Drive-Up Method

1. Before mounting, smear the thread and the side face of the nut with a molybdenum disulphide paste or similar lubricant.
2. Smear the shaft and outside diameter of sleeve with a light oil.
3. Open the sleeve slightly by inserting and twisting a screw driver into the slit in the sleeve and position the sleeve on the shaft.
4. Slide bearing, lockwasher and locknut onto sleeve and tighten nut with a 'C' spanner until all slackness is removed.
5. Measure distance from end of tapered sleeve to the face of locknut or to the face of the inner ring and note the dimension.
6. From the chart note the required "axial drive up" and tighten the locknut until the bearing has moved the required distance up the taper of the sleeve indicated by the reduction or increase in the measured distance originally noted. If the original dimension was from the end of the tapered sleeve to the face of the locknut then the dimension will increase but if the measurement was from the end of the tapered sleeve to the face of the inner ring the dimension will be reduced.
7. A self-aligning ball bearing with normal clearance when adjusted correctly should rotate freely but should have some resistance to swivelling.
8. Align one tab on the lock washer with a slot in the locknut and bend it into the slot, if no tabs line up with the slots slightly tighten the locknut until one lines up. **NEVER BACK OFF THE NUT TO LINE UP THE TAB WITH THE SLOT.**

Tightening Angle Method

1. Before mounting, smear the thread and the side face of the nut with a molybdenum disulphide paste or similar lubricant.
2. Smear the shaft and outside diameter of sleeve with a light oil.
3. Open the sleeve slightly by inserting and twisting a screw driver into the slit in the sleeve and position the sleeve on the shaft.
4. Slide bearing, lockwasher and locknut onto sleeve and tighten nut with a 'C' spanner until all slackness is removed.
5. Tighten locknut through the required angle α , taken from chart, and then reposition the 'C' spanner to 180° from its original position and give it a sharp tap with the hammer to straighten the bearing on its seating.
6. A self-aligning ball bearing with normal clearance when adjusted correctly should rotate freely but should have some resistance to swivelling.
7. Align one tab on the lock washer with a slot in the locknut and bend it into the slot, if no tabs line up with the slots slightly tighten the locknut until one lines up. **NEVER BACK OFF THE NUT TO LINE UP THE TAB WITH THE SLOT.**

Mounting of Double Row Self-Aligning Ball Bearings with 1:12 Tapered Bores on to Adapter Sleeves



Bearing Bore Diameter mm		Tightening Angle (α) degrees	Approximate Axial Drive-Up mm
over	inclusive		
24	30	70	0.22
30	40	70	0.30
40	50	70	0.30
50	65	90	0.40
65	80	90	0.45
80	100	90	0.45
100	120	120	0.55
120	140	120	0.65
140	160	120	0.75

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