

FOREWORD



Publication Rolling Bearings ZVL and ZKL shows a survey of standardized rolling bearings and accessories being produced and delivered under designation ZVL and ZKL.

In the design, production, the storage and sales of the rolling bearings international standards ISO and national standards are used.

Technical section of the publication contains the most important facts concerning calculations, the design data about the arrangement design, lubrication, as well as mounting and dismounting of rolling bearings. The produced standardized rolling bearings and accessories in the basic design and in the main applications from the basic design, as e.g. bearings with tapered bore, shielded bearings or bearings with snap ring groove on outer ring, etc., are shown in the part Rolling Bearings Dimension Tables.

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1. Basic Calculations

Required bearing size is determined by the action of the external forces and according to the bearing required life and its reliability in the arrangement. Magnitude, direction and kind of load acting on the bearing, as well as the operating speed, are decisive for the type and bearing size selection. Other special or important conditions of each individual arrangement must be taken into account, e.g. operating temperature, limited space availability, simplicity of mounting, lubrication requirements, sealing, etc., and all of these can influence selection of the most suitable bearing. For given concrete conditions various bearing types can meet those requirements.

From the point of view of outer load acting and the bearing function in respective arrangement or unit we distinguish two types of the rolling bearing load in the bearing technique :

- when rolling bearing rings are relatively rotating against each other and bearing is under outer load (which is valid for most bearings), this is called **dynamic bearing load**,

- when rolling bearing rings either do not move against each other or they move only very slowly, the bearing carries an oscillating motion or the outer load acts for a shorter time than one bearing revolution, this is called **static bearing load**.

For bearing safety calculation, the life limited by bearing breakdown due to material fatigue of a bearing component is decisive in the first case. In the second case there are durable deformations of functional surfaces on the contact surfaces of rolling elements and raceways.

1.1 Dynamic Load

1.1.1 Basic Dynamic Load Rating

Basic dynamic load rating is a constant invariable load which the bearing can theoretically carry at the nominal life of one million revolutions.

For radial bearings, the radial dynamic load rating C_r refers to constant load. For thrust bearings, the axial dynamic load rating C_a refers to unvariable, purely axial load, acting centrically.

Basic dynamic load ratings C_r and C_a , whose size depends on bearing dimensions, rolling element number, material and bearing design, are shown for each bearing in the dimension tables. Values of the basic dynamic load ratings were stated according to the standard STN ISO 281. These values are verified in testing equipments and by operation results.

1.1.2 Life

Rolling bearing life is defined as the number of revolution carried out by one bearing ring against the other ring, until the first signs of material fatigue occur on one ring or the rolling element.

Great differences in life can occur among bearings of the same type, that is why according to the standard STN ISO 281 the basic life is used as the basis for life calculation, i.e. life shown by the operation time attained or exceeded by a bearing group at 90% reliability.

Life Equation

Nominal bearing life is mathematically defined by the life equation valid for all bearing types.

$$L_{10} = \left(\frac{C}{P} \right)^p \quad \text{or} \quad \frac{C}{P} = (L_{10})^{\frac{1}{p}}$$

L_{10} - nominal life [10^6 rev]

C - basic dynamic load rating
(values C_r, C_a are given in the dimension tables) [kN]

P - equivalent dynamic bearing load
(equations for P_r, P_a calculations are in section 1.1.3
and at each design group of bearings) [kN]

p - exponent for ball bearings $p = 3$
for cylindrical, needle-, spherical- and tapered roller bearings $p = \frac{10}{3}$

Table 1 shows dependence of the life L_{10} in million revolutions and respective ratio C/P .

If the rotational speed does not change, the revised life calculation expressing the nominal life in operation hours can be used:

$$L_{10h} = \left(\frac{C}{P}\right)^p \cdot \frac{10^6}{60 \cdot n} \quad [h]$$

L_{10h} - nominal life
 n - rotational speed

$[h]$
 $[\text{min}^{-1}]$

C/P dependence from the nominal life L_{10} and the rotational speed n is shown for ball bearings in Table 2, for cylindrical roller, needle roller, spherical roller and tapered roller bearings in Table 3.

C/P ratio in dependence on life L_{10}				Table 1			
For ball bearings				For cylindrical roller, needle roller, spherical roller and tapered roller bearings			
Life L_{10}	$\frac{C}{P}$	Life L_{10}	$\frac{C}{P}$	Life L_{10}	$\frac{C}{P}$	Life L_{10}	$\frac{C}{P}$
10^6 rev		10^6 rev		10^6 rev		10^6 rev	
0.5	0.793	600	8.43	0.5	0.812	600	6.81
0.75	0.909	650	8.66	0.75	0.917	650	6.98
1	1	700	8.88	1	1	700	7.14
1.5	1.14	750	9.09	1.5	1.13	750	7.29
2	1.26	800	9.28	2	1.24	800	7.43
3	1.44	850	9.47	3	1.39	850	7.56
4	1.59	900	9.65	4	1.52	900	7.70
5	1.71	950	9.83	5	1.62	950	7.82
6	1.82	1000	10	6	1.71	1000	7.94
8	2	1100	10.3	8	1.87	1100	8.17
10	2.15	1200	10.6	10	2	1200	8.39
12	2.29	1300	10.9	12	2.11	1300	8.59
14	2.41	1400	11.2	14	2.21	1400	8.79
16	2.52	1500	11.4	16	2.30	1500	8.97
18	2.62	1600	11.7	18	2.38	1600	9.15
20	2.71	1700	11.9	20	2.46	1700	9.31
25	2.92	1800	12.2	25	2.63	1800	9.48
30	3.11	1900	12.4	30	2.77	1900	9.63
35	3.27	2000	12.6	35	2.91	2000	9.78
40	3.42	2200	13	40	3.02	2200	10.1
45	3.56	2400	13.4	45	3.13	2400	10.3
50	3.68	2600	13.8	50	3.23	2600	10.6
60	3.91	2800	14.1	60	3.42	2800	10.8
70	4.12	3000	14.4	70	3.58	3000	11
80	4.31	3500	15.2	80	3.72	3500	11.5
90	4.48	4000	15.9	90	3.86	4000	12
100	4.64	4500	16.5	100	3.98	4500	12.5
120	4.93	5000	17.1	120	4.20	5000	12.9
140	5.19	5500	17.7	140	4.40	5500	13.2
160	5.43	6000	18.2	160	4.58	6000	13.6
180	5.65	7000	19.1	180	4.75	7000	14.2
200	5.85	8000	20	200	4.90	8000	14.8
250	6.30	9000	20.8	250	5.24	9000	15.4
300	6.69	10000	21.5	300	5.54	10000	15.8
350	7.05	12500	23.2	350	5.80	12500	16.9
400	7.37	15000	24.7	400	6.03	15000	17.9
450	7.66	17500	26	450	6.25	17500	18.7
500	7.94	20000	27.1	500	6.45	20000	19.5
550	8.19	25000	29.2	550	6.64	25000	20.9

C/P ratio in dependence on life L ₁₀ and rotational speed n for ball bearings														Table 2
Life L _{10h}	Rotational speed n [min ⁻¹]													
	10	16	25	40	63	100	125	160	200	250	320	400	500	630
h														
100	-	-	-	-	-	-	-	-	1.06	1.15	1.24	1.34	1.45	1.56
500	-	-	-	1.06	1.24	1.45	1.56	1.68	1.82	1.96	2.12	2.29	2.47	2.67
1 000	-	-	1.15	1.34	1.56	1.82	1.96	2.12	2.29	2.47	2.67	2.88	3.11	3.36
1 250	-	1.06	1.24	1.45	1.68	1.96	2.12	2.29	2.47	2.67	2.88	3.11	3.36	3.63
1 600	-	1.15	1.34	1.56	1.82	2.12	2.29	2.47	2.67	2.88	3.11	3.36	3.63	3.91
2 000	1.06	1.24	1.45	1.68	1.96	2.29	2.47	2.67	2.88	3.11	3.36	3.63	3.91	4.23
2 500	1.15	1.34	1.56	1.82	2.12	2.47	2.67	2.88	3.11	3.36	3.63	3.91	4.23	4.56
3 200	1.24	1.45	1.68	1.96	2.29	2.67	2.88	3.11	3.36	3.63	3.91	4.23	4.56	4.93
4 000	1.34	1.56	1.82	2.12	2.47	2.88	3.11	3.36	3.63	3.91	4.23	4.56	4.93	5.32
5 000	1.45	1.68	1.96	2.29	2.67	3.11	3.36	3.63	3.91	4.23	4.56	4.93	5.32	5.75
6 300	1.56	1.82	2.12	2.47	2.88	3.36	3.63	3.91	4.23	4.56	4.93	5.32	5.75	6.20
8 000	1.68	1.96	2.29	2.67	3.11	3.63	3.91	4.23	4.56	4.93	5.32	5.75	6.20	6.70
10 000	1.82	2.12	2.47	2.88	3.36	3.91	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23
12 500	1.96	2.29	2.67	3.11	3.36	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81
16 000	2.12	2.47	2.88	3.36	3.91	4.56	4.93	5.23	5.75	6.20	6.70	7.23	7.81	8.43
20 000	2.29	2.67	3.11	3.63	4.23	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11
25 000	2.47	2.88	3.36	3.91	4.56	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83
32 000	2.67	3.11	3.63	4.23	4.93	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6
40 000	2.88	3.36	3.91	4.56	5.32	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5
50 000	3.11	3.63	4.23	4.93	5.75	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4
63 000	3.36	3.91	4.56	5.32	6.20	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4
80 000	3.36	4.23	4.93	5.75	6.70	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5
100 000	3.91	4.56	5.32	6.20	7.23	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6
200 000	4.93	5.75	6.70	7.81	9.11	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6

Life L _{10h}	Rotational speed n [min ⁻¹]															
	800	1000	1250	1600	2000	2500	3200	4000	5000	6300	8000	10000	12500	16000		
h																
100	1.68	1.82	1.96	2.12	2.29	2.47	2.67	2.88	3.11	3.36	3.63	3.91	4.23	4.56		
500	2.88	3.11	3.36	3.63	3.91	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81		
1 000	3.63	3.91	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83		
1 250	3.91	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6		
1 600	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5		
2 000	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4		
2 500	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4		
3 200	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5		
4 000	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6		
5 000	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8		
6 300	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2		
8 000	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6		
10 000	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2		
12 500	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9		
16 000	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7		
20 000	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7		
25 000	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8		
32 000	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1		
40 000	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	-		
50 000	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	-	-		
63 000	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	-	-	-		
80 000	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	-	-	-	-		
100 000	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	-	-	-	-	-		
200 000	21.2	22.9	24.7	26.7	28.8	31.1	-	-	-	-	-	-	-	-		

C/P ratio in dependence on life L₁₀ and rotational speed n for cylindrical roller, spherical roller and tapered roller bearings Table 3

Life L _{10h}	Rotational speed n [min ⁻¹]													
	10	16	25	40	63	100	125	160	200	250	320	400	500	630
h														
100	-	-	-	-	-	-	-	-	1.05	1.1	1.21	1.30	1.39	1.49
500	-	-	-	1.05	1.21	1.39	1.49	1.60	1.71	1.83	1.97	2.11	2.26	2.42
1 000	-	-	1.13	1.30	1.49	1.71	1.83	1.97	2.11	2.26	2.42	2.59	2.78	2.97
1 250	-	1.05	1.21	1.39	1.60	1.83	1.97	2.11	2.26	2.42	2.59	52.78	2.97	3.19
1 600	-	1.13	1.30	1.49	1.71	1.97	2.11	2.26	2.42	2.59	2.78	2.97	3.19	3.42
2 000	1.05	1.21	1.39	1.60	1.83	2.11	2.26	2.42	2.59	2.78	2.97	3.19	3.42	3.66
2 500	1.13	1.30	1.49	1.71	1.97	2.26	2.42	2.59	2.78	2.97	3.19	3.42	3.66	3.92
3 200	1.21	1.39	1.60	1.83	2.11	2.42	2.59	2.78	2.97	3.19	3.42	3.66	3.92	4.20
4 000	1.30	1.49	1.71	1.97	2.26	2.59	2.78	2.97	3.19	3.42	3.66	3.92	4.20	4.50
5 000	1.39	1.60	1.83	2.11	2.42	2.78	2.97	3.19	3.42	3.66	3.92	4.20	4.50	4.82
6 300	1.49	1.71	1.97	2.26	2.59	2.97	3.19	3.42	3.66	3.92	4.20	4.50	4.82	5.17
8 000	1.60	1.83	2.11	2.42	2.78	3.19	3.42	3.66	3.92	4.20	4.50	4.82	5.17	5.54
10 000	1.71	1.97	2.26	2.59	2.97	3.42	3.66	3.92	4.20	4.50	4.82	5.17	5.54	5.94
12 500	1.83	2.11	2.42	2.78	3.19	3.66	3.92	4.20	4.50	4.82	5.17	5.54	5.94	6.36
16 000	1.97	2.26	2.59	2.97	3.42	3.92	4.20	4.50	4.82	5.17	5.54	5.94	6.36	6.81
20 000	2.11	2.42	2.78	3.19	3.66	4.20	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30
25 000	2.26	2.59	2.97	3.42	3.92	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82
32 000	2.42	2.78	3.19	3.66	4.20	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38
40 000	2.59	2.97	3.42	3.92	4.50	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98
50 000	2.78	3.19	3.66	4.20	4.82	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62
63 000	2.97	3.42	3.92	4.50	5.17	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3
80 000	3.19	3.66	4.20	4.82	5.54	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0
100 000	3.42	3.92	4.50	5.17	5.94	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8
200 000	4.20	4.82	5.54	6.36	7.30	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6

Life L _{10h}	Rotational speed n [min ⁻¹]														
	800	1000	1250	1600	2000	2500	3200	4000	5000	6300	8000	10000	12500	16000	
h															
100	1.60	1.71	1.83	1.97	2.11	2.26	2.42	2.59	2.78	2.97	3.19	3.42	3.66	3.92	
500	2.59	2.78	2.97	3.19	3.42	3.66	3.92	4.20	4.50	4.82	5.7	5.54	5.94	6.36	
1 000	3.19	3.42	3.66	3.92	4.20	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	
1 250	3.42	3.66	3.92	4.20	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	
1 600	3.66	3.92	4.20	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	
2 000	3.92	4.20	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	
2 500	4.20	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	
3 200	4.50	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	
4 000	4.82	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8	
5 000	5.17	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8	12.7	
6 300	5.54	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	
8 000	5.94	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6	
10 000	6.36	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6	15.6	
12 500	6.81	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6	15.6	16.7	
16 000	7.30	7.82	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6	15.6	16.7	17.9	
20 000	7.82	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6	15.6	16.7	17.9	19.2	
25 000	8.38	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6	15.6	16.7	17.9	19.2	20.6	
32 000	8.98	9.62	10.3	11.0	11.8	12.7	13.6	14.6	15.6	16.7	17.9	19.2	20.6	-	
40 000	9.62	10.3	11.0	11.8	12.7	13.6	14.6	15.6	16.7	17.9	19.2	20.6	-	-	
50 000	10.3	11.0	11.8	12.7	13.6	14.6	15.6	16.7	17.9	19.2	20.6	-	-	-	
63 000	11.0	11.8	12.7	13.6	14.6	15.6	16.7	17.9	19.2	20.6	-	-	-	-	
80 000	11.8	12.7	13.6	14.6	15.6	16.7	17.9	19.2	20.6	-	-	-	-	-	
100 000	12.7	13.6	14.6	15.6	16.7	17.9	19.2	20.6	-	-	-	-	-	-	
200 000	15.6	16.7	17.9	19.2	20.6	-	-	-	-	-	-	-	-	-	

In arrangements of the axles of road and railway vehicles the nominal life can be expressed by a revised relation in the volume of kilometers travelled.

$$L_{10km} = \left(\frac{C}{P}\right)^p \cdot \frac{\pi D}{1000}$$

L_{10km} - nominal life

D - wheel diameter

[10⁶km]

[m]

Reference Nominal Life Values

In cases, where the life for a given arrangement is not specified in advance, the values in tables 4 and 5 can be considered as adequate

Reference Nominal Life Values in Operating Hours		Table 4
Machine Type	Nominal Life L _{10h}	
	h	
Devices and tools rarely used	1 000	
Household electric appliances, small fans	2 000 to 4 000	
Machines for intermittent operation, hand tools, workshop lifting tackles, agricultural machines	4 000 to 8 000	
Machines with intermittent operation where high reliability is required, auxiliary power station equipment, belt conveyors, trucks, elevators	8 000 to 15 000	
Rolling mills	6 000 to 12 000	
Machines operating 8 - 16 hours - stationary electric motors, gear drives, textile machine spindles, plastic material processing machines, printing machines, cranes	15 000 to 30 000	
Machine tools in general	20 000 to 30 000	
Machines with continuous operation - stationary electric machines, conveying equipment, roller conveyors, pumps, centrifuges, blowers, compressors, hammer mills, crushers, briquetting presses, mine hoists, rope pulleys	40 000 to 60 000	
Machines with continuous operation for high operating reliability - power station plants, water works machinery, paper making machines, ship machines	100 000 to 200 000	

Reference Nominal Life Values in Kilometers		Table 5
Vehicle Type	Nominal Life L _{10km}	
	km	
Road vehicle wheels :		
motor cycles	60 000	
passenger cars	150 000 to 250 000	
trucks, buses	400 000 to 500 000	
Axle box bearings for railway vehicles :		
freight wagons (according to UIC)		
under continuous maximum axle load acting	800 000	
tram cars	1 500 000	
railway passenger carriages	3 000 000	
motor wagons and motor units	3 000 000 to 4 000 000	
locomotives	3 000 000 to 5 000 000	

Equation of Adjusted Life

Adjust life is a corrected nominal life, where by calculation not only the load but the influence of bearing components, material, physical, mechanical, and chemical qualities of lubricants and the temperature regime of the bearing the operating environment’ are taken into account.

$$L_{na}=a_1 \cdot a_{23} \cdot L_{10}$$

L_{na} - adjusted life for (100-n)% reliability
and other usual operation conditions [10⁶ rev]

a₁ - life factor for other than 90% reliability, see Table 6

a₂₃ -life factor of material, lubricant, production technology
and operation conditions, see Pict. 1

L₁₀ - nominal life [10⁶ rev]

Factor a ₁ Values		Table 6
Reliability (%)	L _n	a ₁
90	L ₁₀	1.00
95	L ₅	0.62
96	L ₄	0.53
97	L ₃	0.44
98	L ₂	0.33
99	L ₁	0.21

We can find basic values of a_{23} by using the diagram in Pict.1.

$$\varkappa = \frac{\nu}{\nu_1}$$

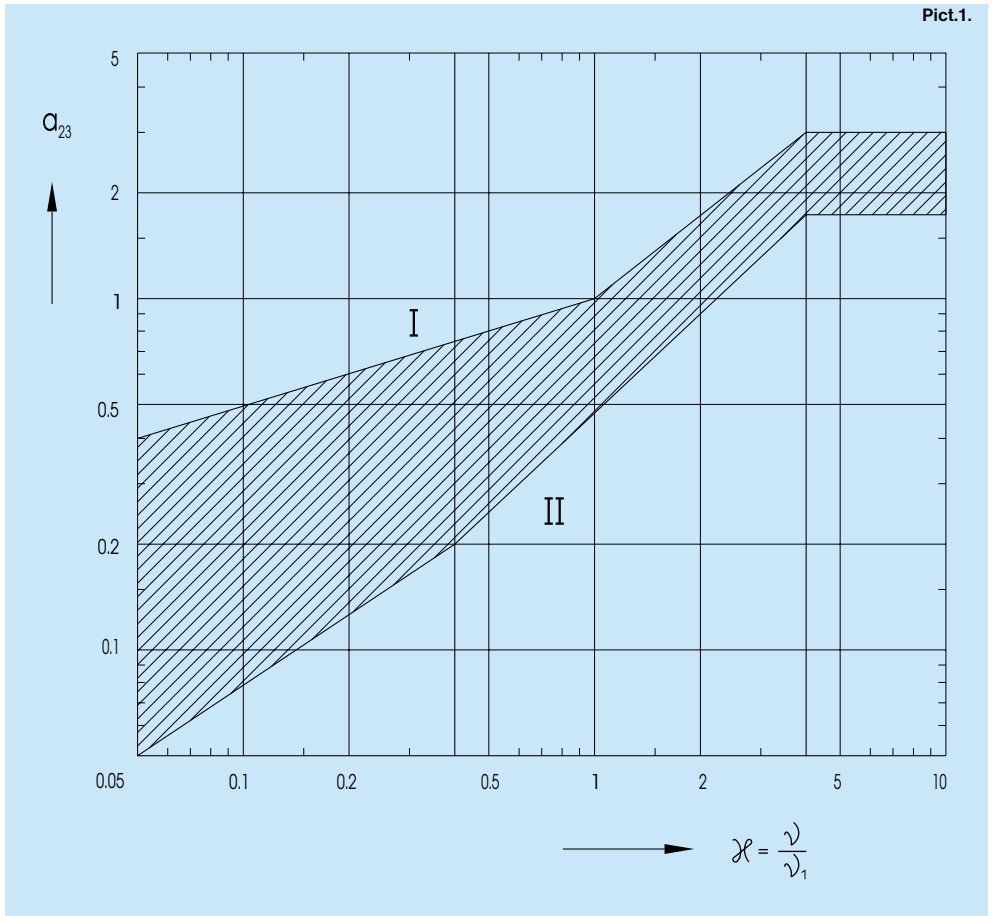
- ν - kinematic lubricant viscosity by operation bearing temperature [mm².s⁻¹]
 ν_1 - kinematic viscosity for defined rotational speed and selected bearing dimensions [mm².s⁻¹]

Values ν and ν_1 are determined according to the diagrams in Pict. 23 or 24.

In the diagram, Pict. 1, the line I is valid for radial ball bearings operating in a very clean environment. In other cases the factor a_{23} is lower, depending on the environment cleanliness, and the decreasing tendency is dependent on the bearing design group in following order :

- angular contact ball bearings
- tapered roller bearings
- cylindrical roller bearings
- double row self-aligning ball bearings
- spherical roller bearings

Line II can be used when stating the factor a_{23} for spherical roller bearings operating in a dusty environment.



1.1.3 Equivalent Dynamic Load

In the arrangement the bearing is subjected to generally acting forces in various magnitudes, at various rotational speeds and with different acting period. From the point of view of calculation methodology the acting forces should be re-calculated into the constant load, by which the bearing will have the same life as it reaches in the conditions of the actual load.

Such a re-calculated constant radial or axial load is called the equivalent load P_r or P_r (radial) or P_a (axial).

Combined Load

Constant Load

The outer forces acting on a bearing are not changed both from the point of view of size and time dependence.

Radial Bearings

If the radial bearings are simultaneously subjected to constant forces in radial and axial directions, the following equation is valid for calculating the radial equivalent dynamic load :

$$P_r = X.F_r + Y.F_a \qquad [kN]$$

- P_r - radial equivalent dynamic load [kN]
- F_r - radial bearing load [kN]
- F_a - axial bearing load [kN]
- X - radial load factor
- Y - axial load factor

Factors X and Y depend on the ratio F_a/F_r . Values X and Y are shown in the dimension tables or in the introduction to each bearing type where closer information regarding bearing calculation of the respective type is given.

Thrust Bearings

Thrust ball bearings can carry only forces acting in axial direction and the following equation is valid for calculating axial equivalent dynamic load :

$$P_a = F_a \qquad [kN]$$

- P_a - axial equivalent dynamic load [kN]
- F_a - axial bearing load [kN]

Spherical roller thrust bearings can also carry some radial load, but only by simultaneous acting of axial load, when condition $F_r \leq 0.55 F_a$ must be fulfilled. Axial equivalent dynamic load is calculated from equation

$$P_a = F_a + 1.2 F_r \qquad [kN]$$

Fluctuating Load

Real fluctuating load, whose time course we know, is for calculation replaced by mean hypothetical load. This hypothetical load has the same influence on the bearing as the fluctuating load.

Change of Load Magnitude by Constant Rotational Speed

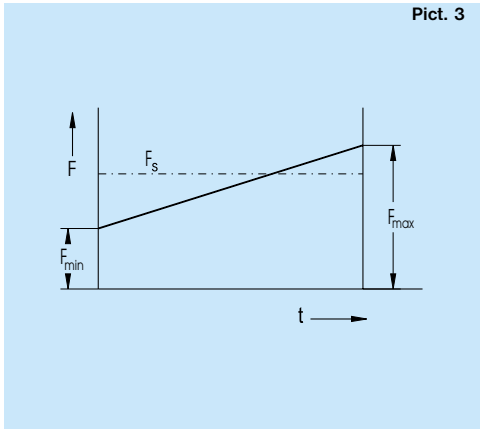
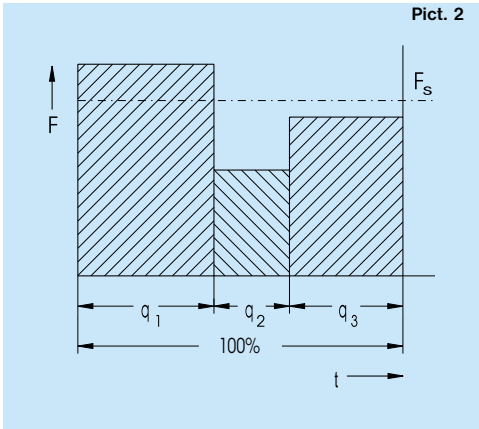
If the bearing is subjected to a load in a constant direction, whose magnitude is changed in dependence on time and the rotational speed is constant (Pict. 2), we can calculate the mean hypothetical load F_s according to the following equation

$$F_s = \left(\sum_{i=1}^n F_i^3 \cdot \frac{q_i}{100} \right)^{\frac{1}{3}} \quad [\text{kN}]$$

F_s - mean hypothetical constant load [kN]
 $F_i = F_1, \dots, F_n$ - constant partial actual load [kN]
 $q_i = q_1, \dots, q_n$ - share of fractional load effects [%]

At constant rotational speed with linear change of the load in constant direction (Pict. 3) the mean hypothetical load can be calculated from equation

$$F_s = \frac{F_{\min} + 2F_{\max}}{3} \quad [\text{kN}]$$



If the actual load has a sine behaviour (Pict. 4), the mean hypothetical load is

$$F_s = 0.75 \cdot F_{\max} \quad [\text{kN}]$$

Change of Load Magnitude by Change of Rotational Speed

If the bearing is subjected in time to a varying load and the rotational speed is being changed, the mean hypothetical load is calculated from equation

$$F_s = \left(\frac{\sum_{i=1}^n F_i^3 \cdot q_i \cdot n_i}{\sum_{i=1}^n q_i \cdot n_i} \right)^{\frac{1}{3}} \quad [\text{kN}]$$

$n_i = n_1, \dots, n_n$ - constant rotational speed in time of partial loads $F_1, \dots, F_n$ acting [min⁻¹]
 $q_i = q_1, \dots, q_n$ - share of partial load and rotational speed acting [%]

If in dependence on time only the rotational speed is changed, the mean hypothetical constant rotational speed is calculated from equation

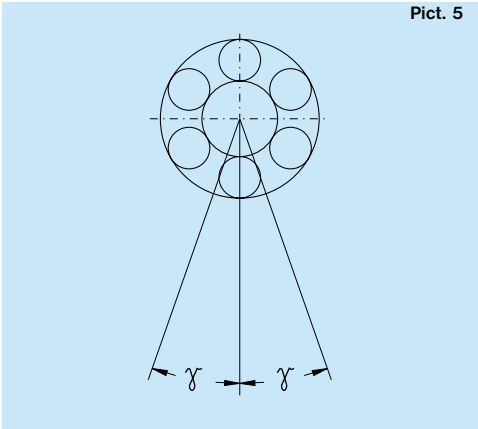
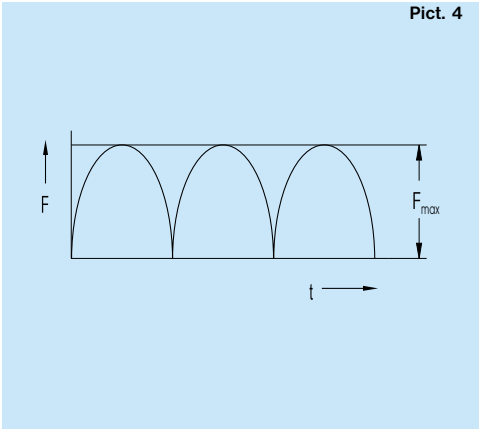
$$n_s = \frac{\sum_{i=1}^n q_i \cdot n_i}{100}$$

[min⁻¹]

n_s= mean rotational speed

[min⁻¹]

Oscillating Motion of Bearing



By oscillating motion with amplitude γ (Fig. 5) it is the simplest way of substituting the oscillating motion by hypothetical rotation, when the rotational speed equals the oscillation frequency. For radial bearings the mean hypothetical load is calculated from the equation :

$$F_s = F_r \left(\frac{\gamma}{90} \right)^{\frac{1}{p}}$$

[kN]

F_s - mean hypothetical load

[kN]

F_r - actual radial load

[kN]

γ - oscillating motion amplitude

[°]

p - exponent p = 3 for ball bearings

$p = \frac{10}{3}$ for cylindrical roller, needle roller, spherical roller and tapered roller bearings

1.1.4 Temperature Influence

Delivered bearing assortment is determined for usage in an environment with operating temperatures up to 120°C. Exceptions are double row spherical roller bearings which can work at temperatures up to 180°C, and single row ball bearings with seals (RS, 2RS, RSR, 2RSR) applicable up to 110°C, with seals RS2, -2RS2 applicable up to 150°C.

For higher operation temperatures the bearings are produced so that their necessary physical and mechanical qualities and dimensional stability can be secured.

Values of the basic dynamic load ratings C_r or C_a shown in the dimension tables of this publication should be multiplied by factor f_t, shown in Table 7.

Values of f _t Factor					Table 7
Operating Temperature to [°C]		150	200	250	300
Factor f _t		0.95	0.9	0.75	0.6

1.2 Static Load

1.2.1 Basic Static Load Rating

Radial basic static load rating C_{or} and axial basic static load rating C_{oa} are shown for each bearing in the dimension tables of this publication. Values C_{or} and C_{oa} were stated by a calculation according to the standard STN ISO 76.

Basic static load rating is the load which corresponds to calculated contact stresses at the most heavily loaded contact zone of the rolling element and bearing raceway :

- 4 600 MP_a for double row self-aligning ball bearings
- 4 200 MP_a for the other ball bearings
- 4 000 MP_a for cylindrical roller, needle roller, spherical roller and tapered roller bearings

1.2.2 Equivalent Static Load

Equivalent static load is a re-calculated radial load P_{or} for radial bearings and axial axis load P_{oa} for thrust bearings.

$$P_{or} = X_o F_r + Y_o F_a \qquad [kN]$$

$$P_{oa} = X_o F_r + Y_o F_a \qquad [kN]$$

- P_{or} - radial equivalent static load [kN]
- P_{oa} - axial equivalent static load [kN]
- F_r - radial load [kN]
- F_a - axial load [kN]
- X_o - radial load factor
- Y_o - axial load factor

Factor s_0		Table 8	
Bearing motion	Type of load, demands on bearing running	s_0 Ball Bearings Cylindrical roller, needle roller, spherical roller, tapered roller bearings	
Rotary	distinct impact load, high demands on smooth running	2	4
	after static loading bearing rotates under smaller load	1.5	3
	normal demands on smooth running		
	normal operating conditions and normal demands on running	1	1.5
	smooth impact-free operating	0.5	1
Oscillating	small oscillation angle with high frequency, with uneven impact loading	2	3.5
	large oscillating angle with low frequency and with approximately constant periodic load	1.5	2.5
Non-rotary	distinct impact load	1.5 to 1	3 to 2
	normal and small load, no special demands on bearing operation	1 to 0.4	2 to 0.8
	spherical roller thrust bearings at all kinds of motions and loads	-	4

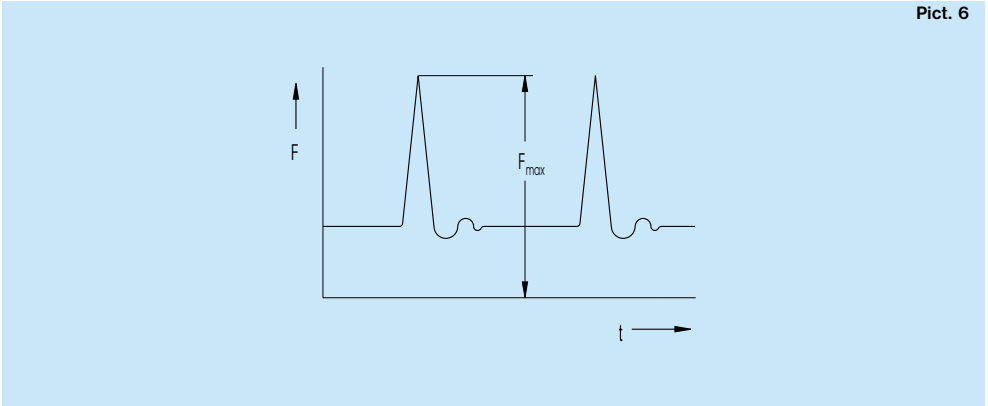
Factors X_o and Y_o are given for individual bearings in the dimensional tables of this publication. Subsequently, closer data for stating the equivalent static load of given bearing type are also given here.

1.2.3 Bearing Safety under Static Load

In practice the bearing safety under static load is found by the ratio C_{or}/P_{or} or C_{oa}/P_{oa} and is compared with data in table 8, where the values of least permissible factors s_o for various operation conditions are shown.

$$s_o = \frac{C_{or}}{P_{or}} \quad \text{or} \quad \frac{C_{oa}}{P_{oa}}$$

- s_o - safety factor under static load
- C_{or} - radial basic static load rating [kN]
- C_{oa} - axial basic static load rating [kN]
- P_{or} - radial equivalent static load or maximum acting impact force
- $F_{r \max}$ (Pict. 6) under distinct impact load [kN]
- P_{oa} - axial equivalent static load or maximum acting impact force
- $F_{a \max}$ (Pict. 6) under distinct impact load [kN]



1.3 Limiting Speed

Limiting speed depends on the bearing type, its accuracy, cage design, internal clearance, operating conditions in arrangement, kind of lubrication and on other factors. This influence summary determines the heat generation in the bearing and also limited rotational speed which is first of all limited by the lubricant operating temperature.

For orientation, limiting rotational speed values are shown in the dimension tables for individual bearings in normal tolerance class, both for grease and oil lubrication. Given values are valid under presumption of adequate load ($L_{10h} \geq 100\,000\text{ h}$), normal operating conditions and cooling.

It is also necessary to reduce the limiting speed values for radial bearings which are permanently loaded by relatively great axial force. The resulting limiting speed values depend on the ratio of axial and radial load F_a/F_r .

The shown limiting speed can be exceeded for ball bearings up to 3 times, cylindrical roller bearings up to 2 times, for other bearings except spherical roller and tapered roller bearings up to 1.5 times and for spherical roller bearings 1.3 times.

This exceeding requires :

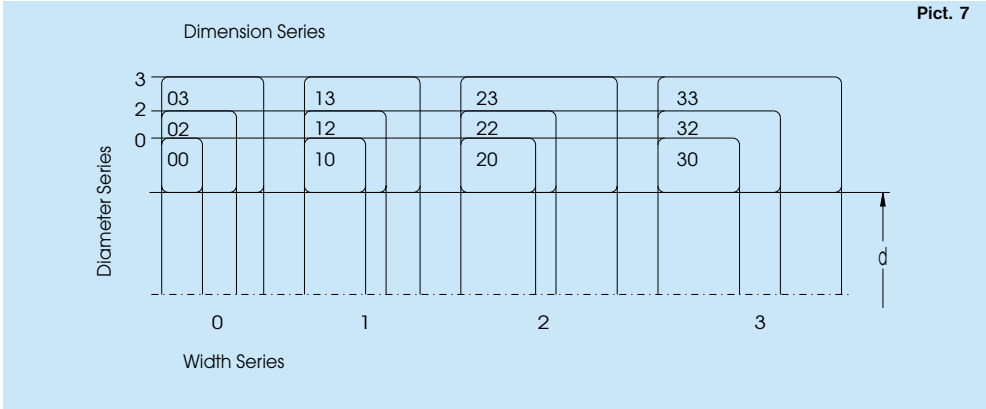
- adaptation of lubrication and cooling
- higher bearing tolerance class and corresponding accuracy of the abutment parts
- higher radial clearance than normal
- cage of suitable design and material

2. Rolling Bearing Design Data

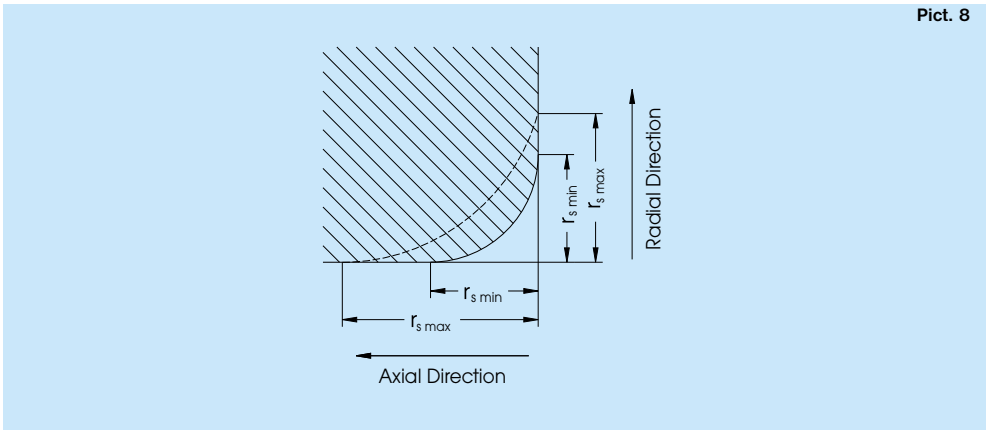
2.1 Boundary Dimensions

Bearings introduced in this publication are made in dimensions complying with the international standards ISO 15, ISO 355 and ISO 104.

In the dimensional plan each bearing bore diameter **d** corresponds to several outer diameters **D** and various widths are added to them - **B** or **T** for radial and **H** for thrust bearings. Bearings having the same bore diameter and outer diameter belong to one diameter series which is designated according to the ascending outer diameter by figures 7,8,9,0,1,2,3,4. Within each diameter series there are bearings of various width series according to the ascending width : 8, 0, 1, 2, 3, 4, 5, 6 for radial bearings and 7,9,1,2 for thrust bearings. Diameter and width series form dimension series which are designated by a two digit number, where the first digit indicates the width series and the second the diameter one, as shown in Pict. 7.



Dimensional plan also includes the bearing ring chamfer dimensions, so called mounting chamfer, see Pict. 8



Overview of chamfer limiting values according to international standard ISO 582 is given in Table 9.

Limiting Dimensions of Mounting Chamfer								Table 9	
r _{s min}	Radial Bearings except Tapered Roller Bearings				Tapered Roller Bearings				Thrust Bearings
	d or D above	to	r _{s max} in radial direction	in axial direction	d or D above	to	r _{s max} in radial direction	in axial direction	r _{s max} in radial and axial direction
mm									
0.15	-	-	0.3	0.6	-	-	-	-	0.3
0.2	-	-	0.5	0.8	-	-	-	-	0.5
0.3	-	40	0.6	1	-	40	0.7	1.4	0.8
	40	-	0.8	1	40	-	0.9	1.6	0.8
0.6	-	40	1	2	-	40	1.1	1.7	1.5
	40	-	1.3	2	40	-	1.3	2	1.5
1	-	50	1.5	3	-	50	1.6	2.5	2.2
	50	-	1.9	3	50	-	1.9	3	2.2
1.1	-	120	2	3.5	-	-	-	-	2.7
	120	-	2.5	4	-	-	-	-	2.7
1.5	-	120	2.3	4	-	120	2.3	3	3.5
	120	-	3	5	120	250	2.8	3.5	3.5
	-	-	-	-	250	-	3.5	4	3.5
2	-	80	3	4.5	-	120	2.8	4	4
	80	220	3.5	5	120	250	3.5	4.5	4
	220	-	3.8	6	250	-	4	5	4
2.1	-	280	4	6.5	-	-	-	-	4.5
	280	-	4.5	7	-	-	-	-	4.5
2.5	-	100	3.8	6	-	120	3.5	5	-
	100	280	4.5	6	120	250	4	5.5	-
	280	-	5	7	250	-	4.5	6	-
3	-	280	5	8	-	120	4	5.5	5.5
	280	-	5.5	8	120	250	4.5	6.5	5.5
	-	-	-	-	250	400	5	7	5.5
	-	-	-	-	400	-	5.5	7.5	5.5
4	-	-	6.5	9	-	120	5	7	6.5
	-	-	-	-	120	250	5.5	7.5	6.5
	-	-	-	-	250	400	6	8	6.5
	-	-	-	-	400	-	6.5	8.5	6.5
5	-	-	8	10	-	180	6.5	8	8
	-	-	-	-	180	-	7.5	9	8
6	-	-	10	13	-	180	7.5	10	10
	-	-	-	-	180	-	9	11	10
7.5	-	-	12.5	17	-	-	-	-	12.5
9.5	-	-	15	19	-	-	-	-	15
12	-	-	18	24	-	-	-	-	18
15	-	-	21	30	-	-	-	-	21

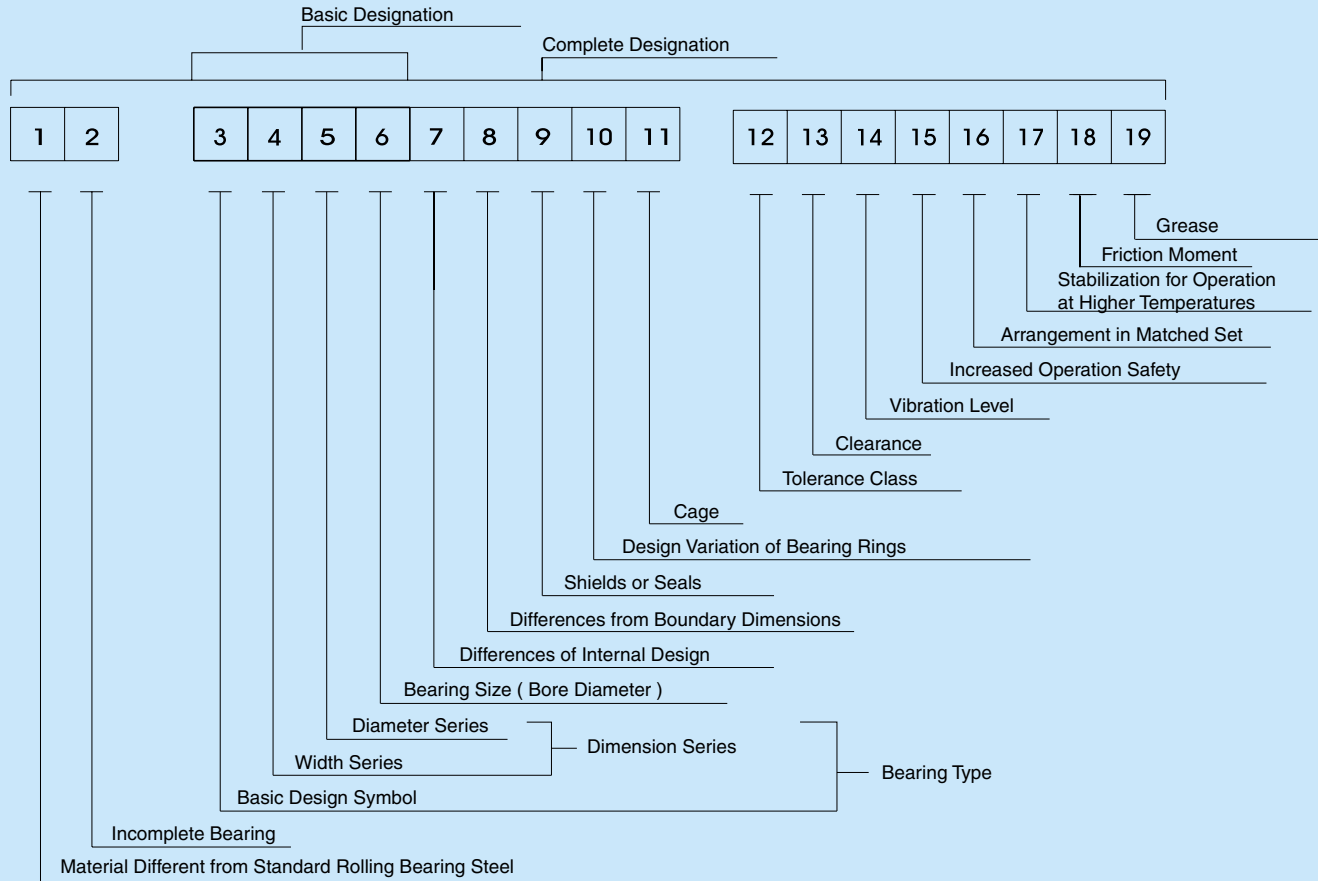
2.2 Designation

Bearing designation is created by numerical and letter symbols indicating the type, size and design of the bearing, see the scheme.

In the basic design the bearings are designated by a basic designation which consists of bearing type and size designation. The type designation is usually created by the symbol indicating the bearing design (see position 3 in the scheme) and the symbol for dimension series or diameter series (positions 4 and 5 in the scheme), e.g. bearing type 223, 302, NJ22, 511, 62, 12, etc. Bearing size designation is created by symbols for the nominal bore diameter **d** (see position 6 in the scheme).

Bearings with bore diameter d<10 mm :

Digit separated by a slash, or the last digit indicates directly the bore dimension in mm, e.g. 619/2, 624.



Bearings with bore diameter $d = 10$ to 17 mm :

double digit number	00 indicates bore	$d = 10$ mm,	e.g. 6200
	01	$d = 12$ mm,	e.g. 51101
	02	$d = 15$ mm,	e.g. 3202
	03	$d = 17$ mm,	e.g. 6303

An exception to the designation are separable single row ball bearings - types E and BO, where the double digit number indicates directly the bore diameter in mm, e.g. E17.

Bearings with bore diameter $d = 20$ to 480 mm :

Bore diameter is a fivefold of the last double digit number, e.g. bearing 1320 has the bore diameter $d = 20 \times 5 = 100$.

An exception create bearings with bore $d = 22, 28$, and 32 mm, where the double digit number separated by a slash indicates directly the bore diameter in mm, e.g. 320/32AX, further separable single row ball bearings - type E and single row cylindrical roller bearings - type NG, where the double digit number, or number indicates directly the bore diameter in mm, e.g. : E20, NG160 C4SO.

Bearings with bore diameter $d \geq 500$ mm :

The last three or four digit number separated by a slash indicates directly the bore diameter in mm, e.g. 230/530M, NU29/1060.

Bearings produced in different design than standard are designated by so called complete designation, see the scheme. It consists of the basic designation and prefixes and suffixes indicating the difference from the basic design.

Meaning of Prefixes and Suffixes

In compliance with complete designation a survey and meaning of used prefixes and suffixes is given in the following part. (Number in brackets at individual groups corresponds to the position number in the scheme).

Prefixes**Material Different from Standard Bearing Steel (1)**

- X corrosion resisiting steel, e.g. X 623
- T case hardened steel, e.g. T 32240

Incomplete Bearing (2)

- L removable ring of separable bearing, e.g. L NU206, for thrust ball bearings without shaft washer, e.g. L 51215
- R separable bearing without removable ring, e.g. R NU206 or R N310
- E single shaft washer of thrust roller bearing, e.g. E 51314
- W single housing washer of thrust ball bearing, e.g. W 51411
- K cage with rolling elements, e.g. K NU320

Suffixes**Difference of Internal Design (7)**

- A single row angular contact ball bearing, contact angle $\alpha = 25^\circ$, e.g. B7205ATB P5
- single row tapered roller bearing with higher load rating and higher limiting speed, e.g. 30206A
- thrust ball bearing with higher limiting speed, e.g. 51105A
- AA single row angular contact ball bearing with contact angle $\alpha = 26^\circ$, e.g. B72010AATB P4
- B single row angular contact ball bearing with contact angle $\alpha = 40^\circ$, e.g. 7304B
- single row tapered roller bearing with contact angle $\alpha > 17^\circ$, e.g. 32315B
- BE single row angular contact ball bearing with contact angle $\alpha = 40^\circ$, in new design, e.g. 7310BETNG

- C Single row angular contact ball bearing with contact angle $\alpha = 15^\circ$, e.g. B7202CTB P4
- double row spherical roller bearing in new design, e.g. 22216C
- CA single row angular contact ball bearing with contact angle $\alpha = 12^\circ$, e.g. B7202CATB P5
- CB single row angular contact ball bearing with contact angle $\alpha = 10^\circ$, e.g. B7206CBTB P4
- CC double row spherical roller bearing in new design, e.g. 23996CCM
- D single row ball bearing - type 160 with higher load rating, e.g. 16004D
- E single row cylindrical roller bearing with higher load rating, e.g. NU209E
- double row spherical roller bearing with higher load rating, e.g. 22215E
- spherical roller thrust bearing with higher load rating, e.g. 29416EJ

Difference of Boundary Dimensions

- X change of boundary dimensions, introduced by new international standards, e.g. 32028AX

Shields or Seals

- RS seal on one side, e.g. 6304RS
- 2RS seals on both sides, e.g. 6204-2RS
- RSN seal on one side and snap ring groove in outer ring opposite to seal side, e.g. 6306RSN
- RSNB seal on one side and snap ring groove in outer ring on the same side as seal, e.g. 6210RSNB
- 2RSN seals on both sides and snap ring groove in outer ring, e.g. 6310-2RSN
- RSR seal on one side adhering to flat surface of inner ring, e.g. 624RSR
- 2RSR seals on both sides adhering to flat surface of inner ring, e.g. 608-2RSR
- Z metal shield on one side, e.g. 6206Z
- 2Z metal shields on both sides, e.g. 6304-2Z
- ZN metal shield on one side and snap ring groove in outer ring opposite to metal shield, e.g. 6208ZN
- ZNB metal shield on one side and snap ring groove in outer ring on the same side as shield, e.g. 6306ZNB
- 2ZN metal shields on both sides and snap ring groove in outer ring, e.g. 6208-2ZN
- ZR metal shield on one side adhering to flat surface of inner ring, e.g. 608ZR
- 2ZR metal shields on both sides adhering to flat surface of inner ring, e.g. 608-2ZR

Bearing Ring Design Variation (10)

- K tapered bore, taper 1:12, e.g. 1207K
- K30 tapered bore, taper 1:30, e.g. 24064K30M
- N snap ring groove in outer ring, e.g. 6308N
- NR snap ring groove in outer ring and inserted snap ring, e.g. 6310NR
- NX snap ring groove in outer ring whose boundary dimensions do not correspond to STN 02 4605, e.g. 6210NX
- D split inner ring, e.g. 3309D
- W33 groove and lubrication holes in bearing outer ring surface, e.g. 23148W33M
- O lubrication grooves in bearing outer ring, e.g. NU1014O

Cages (11)

Cage material for bearings in basic design is not usually indicated.

- J pressed steel cage, rolling element centred, e.g. 6034J
- J2 pressed steel cage, rolling element centred, new design for single row tapered roller bearings, e.g. 30206AJ2

Y	pressed brass cage, rolling elements centred, e.g. 6001Y
F	machined steel cage, rolling elements centred, e.g. 6418F
L	machined light metal cage, rolling elements centred, e.g. NG180L C3S0
M	machined brass or bronze cage, rolling elements centred, e.g. NU330M
T	machined cage made of textite, rolling elements centred, e.g. 6005T P5
TN	machined cage made of polyamide or similar plastic, rolling elements centred, e.g. 6207TN
TNG	machined cage made of polyamide or similar plastic with glass fibres, rolling elements centred, e.g. 2305TNG

Cage design (introduced symbols are always used in connection with cage material symbols).

A	cage centred on outer ring, e.g. NU226MA
B	cage centred on inner ring, e.g. B7204CATBP5
P	machined window-type cage, e.g. NU1060MAP
H	one-piece open-type cage, e.g. 629TNH
S	cage with lubrication grooves, e.g. NJ418MAS
V	bearing without cage, full rolling element number, e.g. NU209V

Tolerance Class (12)

P0	standard tolerance class (not indicated), e.g. 6204
P6	higher tolerance class than standard, e.g. 6322 P6
P5	higher tolerance class than P6, e.g. 6201 P5
P5A	in some parameters higher tolerance class than P5, e.g. 6006TB P5A
P4	higher tolerance class than P5, e.g. B7204CBTB P4
P4A	in some parameters higher tolerance class than P4, e.g. B7205CATB P4A
P2	higher tolerance class than P4, e.g. B7205CATB P2
P6E	higher tolerance class for rotating electric machines, e.g. 6204 P6E
P6X	higher tolerance class for single row tapered roller bearings, e.g. 30210A P6X
SP	higher tolerance class for cylindrical roller bearings with tapered bore, e.g. NN3022K SPC2NA
UP	higher tolerance class than SP for cylindrical roller bearings with tapered bore, e.g. N1016 UPC1NA

Clearances (13)

C2	clearance less than normal, e.g. 608 C2
	normal clearance (not indicated), e.g. 6204
C3	clearance greater than normal, e.g. 6310 C3
C4	clearance greater than C3, e.g. NU320M C4
C5	clearance greater than C4, e.g. 22330M C5
NA	radial clearance for bearings with non-interchangeable rings (always after radial clearance symbol), e.g. NU215 P63NA
R...	radial clearance in non-standardized range (range in μm), e.g. 6210A R10-20
A...	axial clearance in non-standardized range (range in μm), e.g. 3210 A20-30

Vibration Level (14)

C6 reduced vibration level lower than normal (not indicated) e.g. 6304 C6
C06 reduced vibration level lower than C6, e.g. 6205 C06
C66 reduced vibration level lower than C06, e.g. 6205 C66
Concrete C06 and C66 values are determined after negotiations between customer and supplier.
Note: Bearings in tolerance class P5 and higher have vibration level C6.

Increased Operation Safety

C7, C8, C9 - bearings with increased operation safety determined primarily for aircraft industry,
e.g. 16008 C8

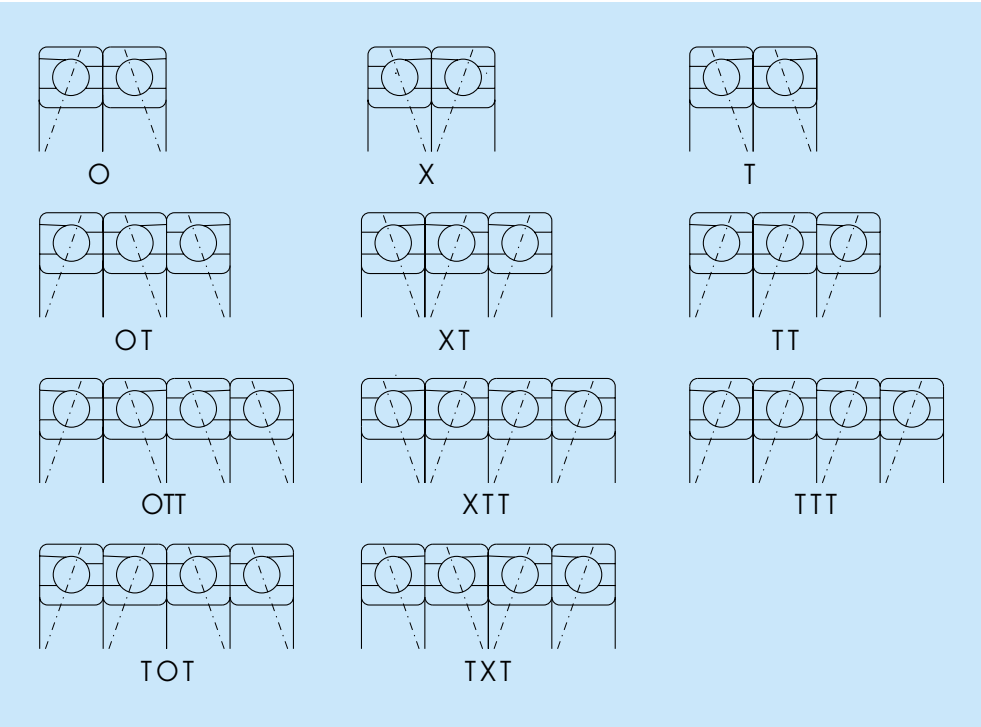
Symbol Combination (12 - 15)

Symbols for tolerance class, bearing internal clearances, vibration levels and increased operation safety are combined, when symbol C is omitted from the second and following special bearing characteristics, e.g.:

- | | |
|-------------------------|--------------------|
| P6 + C3 = P63 | e.g. 6211 P63 |
| P6 + C8 = P68 | e.g. 16002 P68 |
| C3 + C6 = C36 | e.g. 6303-2RS C36 |
| P5 + C3 + C9 = P539 | e.g. 6205MA P539 |
| P6 + C2NA + C6 = P626NA | e.g. NU1038 P626NA |

Bearing Arrangement in Matched Set (16)

Designation of the arrangement in matched sets of two, three or four bearings consists of symbols indicating the bearing arrangement and symbols determining internal clearance, or preload of matched bearings.



Besides symbols shown in the table also U symbol is used and it indicates that respective bearings can be universally matched, e. g. B7003CTA P4UL.

Internal Clearance or Preload

- Introduced symbols are always used in combination with matching symbols.
- A bearing matching with clearance, e.g. 7305OA
 - O bearing matching without clearance, e.g. 7305 P6XO
 - L bearing matching with light preload, e.g. B7205CATB P4UL
 - M bearing matching with medium preload, e.g. B7204CATB P5XM
 - S bearing matching with great preload, e.g. B7304AATB P4OS

Stabilization for Operation at Higher Temperature

- Both rings have stabilized dimensions for operation at higher temperature
- S0 for operating temperature up to 150° C
 - S1 up to 200°C
 - S2 up to 250°C
 - S3 up to 300°C
 - S4 up to 350°C
 - S5 up to 400°C
- Designation example - NG160LB C4S3.

Friction Moment (18)

- JU reduced friction moment, e.g. 619/2 JU
- JUA bearings with determined friction moment for starting up, e.g. 623 JUA
- JUB bearings with determined friction moment for running out, e.g. 623 JUB

Grease (19)

For designation of bearings with shields or seals on both sides, filled with grease different from the standard one, symbol combinations are used for designation. The first two symbols determine the operating temperature range and the third (a letter) the name or type of lubricant, according to producer’s prescription, or another symbol (a digit) determines the grease volume, which the sealed or shielded inner bearing’s space is filled with.

- TL grease for low operating temperatures from -60°C to +100°C,
designation example 6302-2RS TL
- TM grease for medium operating temperatures from -35°C to +140°C,
designation example 6204-2ZR TM
- TH grease for high operating temperatures from -30°C to +200°C,
designation example 6202-2Z TH
- TW grease for both low and high operating temperatures from -40°C to +150°C,
designation example 6310-2Z C4TW

Note: Symbol TM need not be marked on bearings and packages.

Bearings according to Special Technical Terms

- TPF bearings produced according to special technical conditions agreed with the customer, e.g. bearing 6205MA P66 according to special technical conditions TPF 11142-71 is designated: 6205MA P66 TPF142
- TPF 99 double row spherical roller bearing for arrangements of railway vehicle axles, e.g. 23234 C3 TPF99
- TPF204 single row ball bearings for fitting in kiln car wheels, etc., e.g. 6308 TPF204
- TPFK bearings according to special technical conditions agreed with the customer, which have a great number of symbols indicating variations from the basic design.

In this case only the designation TPF..., is given, e.g. bearing NU1015, produced according to technical conditions TPFK 11137-70 is designated NU1015 TPFK137.

Bearings according to Special Drawing Documentation PLC

PLC A-BC-DE-F designation structure

PLC	symbol for special rolling bearing
A	design group
0	single row ball bearings
1	double row ball bearings
2	thrust ball bearings
3	not occupied
4	single row cylindrical roller, spherical roller and needle roller bearings
5	double and multi-row cylindrical roller, spherical roller and needle roller bearings
6	single, double and four-row tapered roller bearings
7	special double row bearings
8	assembly units and separate parts
9	thrust cylindrical roller, spherical roller, tapered roller and needle roller bearings
BC	dimensional group - two digit symbols
DE	series number in dimensional group - two digit symbols
F	variation of design - one digit symbol

2.3 Tolerance

Under bearing tolerance, dimension and operation accuracy is understood. Bearings are manufactured in tolerance classes P0, P6, P5A, P4, P4A, P2, SP and UP.

Tolerance class P0 is the basic one and a decreasing number in designation means the higher bearing tolerance class. Limiting values for dimension and operation accuracy shown in tables 20 to 30 comply with the standard ISO 492 and ISO 199 (STN 02 4612). Designation P5A and P4A are used for bearings manufactured in corresponding tolerance class (P5, P4), or selected parameters are in higher tolerance class than P5 and P4.

Tolerance Symbols and Their Meaning

d	nominal bore diameter
d_1	nominal diameter of larger theoretical tapered bore diameter
d_2	nominal diameter of shaft washer of double direction thrust bearings
Δd_s	deviation of single bore diameter from nominal
Δ_{dmp}	mean cylindrical bore diameter deviation in single radial plane (for tapered bore Δ_{dmp} is valid for theoretical bore diameter)
Δ_{d1mp}	deviation of mean larger theoretical diameter of tapered bore
Δ_{d2mp}	mean shaft washer bore diameter deviation of double direction thrust bearings in single radial plane
V_{dp}	single bore diameter variation in single radial plane
V_{dmp}	mean cylindrical bore diameter variation
V_{d2p}	shaft washer bore diameter variation of double direction thrust bearings in single radial plane
D	nominal outside diameter
Δ_{Ds}	deviation of single outside diameter from the nominal dimension
Δ_{Dmp}	mean outside cylindrical surface diameter deviation in single plane
V_{Dp}	single outside cylindrical surface diameter variation in single radial plane
V_{Dmp}	mean outside cylindrical surface diameter variation
B	inner ring nominal width
T	total nominal width of tapered roller bearings
T_1	nominal effective width of cup sub-unit
T_2	nominal effective width of cone sub-unit
Δ_{Bs}	inner ring single width deviation
Δ_{Cs}	outer ring single width deviation
Δ_{Ts}	bearing single width deviation (total)
Δ_{T1s}	cone sub-unit effective width deviation

Δ_{T2s}	cup sub-unit effective width deviation
C	outer ring nominal width
V_{Bs}	inner ring single width variation
V_{Cs}	outer ring single width variation
K_{ia}	radial runout of assembled bearing inner ring
K_{ea}	radial runout of assembled bearing outer ring
S_i	shaft washer raceway axial runout
S_e	housing washer raceway axial runout
S_{ia}	inner ring flat seat face axial runout of assembled bearing
S_{ea}	outer ring flat seat face axial runout of assembled bearing
S_d	flat seat face axial runout
S_D	runout of outside cylindrical surface towards outer ring face
S_s	runout of supporting face towards seat face for single row tapered roller bearings

Dimension and Running Accuracy of Radial Bearings (except Tapered Roller Bearings)
Tolerance Class P0

Table 10

Inner Ring

d		Cylindrical Bore										Tapered Bore					
		Δ_{dmp}		V_{dp}		V_{dmp}		K_{ia}		Δ_{Bs}		V_{Bs}		Δ_{dmp}	Δ_{d1mp}	$-\Delta_{dmp}$	$V^{(1)}_{dp}$
				Diameter Series													
over	to	max	min	max	max	max	max	max	max	min	max	max	min	max	max	min	max
mm		μm															
2.5	10	0	-8	10	8	6	6	10	0	-120	15	-	-	-	-	-	-
10	18	0	-8	10	8	6	6	10	0	-120	20	-	-	-	-	-	-
18	30	0	-10	13	10	8	8	13	0	-120	20	+21	0	+21	0	13	
30	50	0	-12	15	12	9	9	15	0	-120	20	+25	0	+25	0	15	
50	80	0	-15	19	19	11	11	20	0	-150	25	+30	0	+30	0	19	
80	120	0	-20	25	25	15	15	25	0	200	25	+35	0	+35	0	25	
120	180	0	-25	31	31	19	19	30	0	-250	30	+40	0	+40	0	31	
180	250	0	-30	38	38	23	23	40	0	-300	30	+46	0	+46	0	38	
250	315	0	-35	44	44	26	26	50	0	-350	35	+52	0	+52	0	44	
315	400	0	-40	50	50	30	30	60	0	-400	40	+57	0	+57	0	50	
400	500	0	-45	56	56	34	34	65	0	-450	50	+63	0	+63	0	56	
500	630	0	-50	63	63	38	38	70	0	-500	60	-	-	-	-	-	
630	800	0	-75	-	-	-	-	80	0	-750	70	-	-	-	-	-	
800	1000	0	-100	-	-	-	-	90	0	-1000	80	-	-	-	-	-	
1000	1250	0	-125	-	-	-	-	100	0	-1250	100	-	-	-	-	-	

Outer Ring

D		Δ_{Dmp}		V_{DP}			V_{Dmp}		K_{ea}		Δ_{Cs}, Δ_{Cs}	
				Diameter Series								
				7,8,9 0,1 2,3,4 bearings ²⁾								
over	to	max	min	max	max	max	max	max	max	max		
mm		μm										
6	18	0	-8	10	8	6	10	6	15		Corresponds to Δ_{Bs}, V_{Bs} of the same bearing inner ring	
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	-	-	-	-	-	160			
1250	1600	0	-160	-	-	-	-	-	190			

1) Valid in any bore radial plane
2) Valid only for bearings in diameter series 2, 3 and 4

Dimension and Running Accuracy of Radial Bearings (except Tapered Roller Bearings)
Tolerance Class P6

Table 11

Inner Ring

d		Δ_{dmp}		V_{dp}		V_{dmp}		K_{ia}	Δ_{Bs}		V_{Bs}	
				Diameter Series		7, 8, 9 0, 1 2, 3, 4						
over	to	max	min	max	max	max	max	max	max	min	max	
mm		μm										
2.5	10	0	-7	9	7	5	5	6	0	-120	15	
10	18	0	-7	9	7	5	5	7	0	-120	20	
18	30	0	-8	10	8	6	6	8	0	-120	20	
30	50	0	-10	13	10	8	8	10	0	-120	20	
50	80	0	-12	15	15	9	9	10	0	-150	25	
80	120	0	-15	19	19	11	11	13	0	-200	25	
120	180	0	-18	23	23	14	14	18	0	-250	30	
180	250	0	-22	28	28	17	17	20	0	-300	30	
250	315	0	-25	31	31	19	19	25	0	-350	35	
315	400	0	-30	38	38	23	23	30	0	-400	40	
400	500	0	-35	44	44	26	26	35	0	-450	45	
500	630	0	-40	50	50	30	30	40	0	-500	50	

Outer Ring

D		Δ_{Dmp}		V_{Dp} Diameter Series 7, 8, 9 0, 1 2, 3, 4 bearings ¹⁾ with seals				V_{Dmp}	K_{ea}	Δ_{Cs} V_{Cs}
over	to	max	min	max	max	max	max	max	max	
mm		μm								
6	18	0	-7	9	7	5	9	5	8	Corresponds to Δ_{Bs} , V_{Bs} of the same bearing inner ring
18	30	0	-8	10	8	6	10	6	9	
30	50	0	-9	11	9	7	13	7	10	
50	80	0	-11	14	11	8	16	8	13	
80	120	0	-13	16	16	10	20	10	18	
120	150	0	-15	19	19	11	25	11	20	
150	180	0	-18	23	23	14	30	14	23	
180	250	0	-20	25	25	15	-	15	25	
250	315	0	-25	31	31	19	-	19	30	
315	400	0	-28	35	35	21	-	21	35	
400	500	0	-33	41	41	25	-	25	40	
500	630	0	-38	48	48	29	-	29	50	
630	800	0	-45	56	56	34	-	34	60	
800	1000	0	-50	75	75	45	-	45	75	

1) Valid only for bearings in diameter series 0,1,2, 3 and 4

Dimension and Running Accuracy of Radial Bearings (except Tapered Roller Bearings)
Tolerance Class P5

Table 12

Inner Ring

d		Δ_{dmp}		V_{dp} Diameter Series 7, 8, 9 0, 1, 2, 3, 4		V_{dmp}	K_{ia}	S_{d}	$S_{\text{ia}}^{1)}$	Δ_{Bs}	V_{Bs}	
over	to	max	min	max	max	max	max	max	max	max	min	max
mm		μm										
2.5	10	0	-5	5	4	3	4	7	7	0	-40	5
10	18	0	-5	5	4	3	4	7	7	0	-80	5
18	30	0	-6	6	5	3	4	8	8	0	-120	5
30	50	0	-8	8	6	4	5	8	8	0	-120	5
50	80	0	-9	9	7	5	5	8	8	0	-150	6
80	120	0	-10	10	8	5	6	9	9	0	-200	7
120	180	0	-13	13	10	7	8	10	10	0	-250	8
180	250	0	-15	15	12	8	10	11	13	0	-300	10
250	315	0	-18	18	14	9	13	13	15	0	-350	13
315	400	0	-23	23	18	12	15	15	20	0	-400	15

Outer Ring

D		Δ_{Dmp}		V_{dp} Diameter Series ²⁾ 7, 8, 9 0, 1, 2, 3, 4		V_{Dmp}	K_{ea}	S_{D}	$S_{\text{ea}}^{1)}$	Δ_{Cs}	V_{Cs}
over	to	max	min	max	max	max	max	max	max		max
mm		μm									
6	18	0	-5	5	4	3	5	8	8	Corresponds to Δ_{Bc} of the same bearing inner ring	5
18	30	0	-6	6	5	3	6	8	8		5
30	50	0	-7	7	5	4	7	8	8		5
50	80	0	-9	9	8	5	8	8	10		6
80	120	0	-10	10	8	5	10	9	11		8
120	150	0	-11	11	8	6	11	10	13		8
150	180	0	-13	13	10	7	13	10	14		8
180	250	0	-15	15	11	8	15	11	15		10
250	315	0	-18	18	14	9	18	13	18		11
315	400	0	-20	20	15	10	20	13	20		13
400	500	0	-23	23	17	12	23	15	23		15
500	630	0	-28	28	21	14	25	18	25		18
630	800	0	-35	35	26	18	30	20	30		20

1) Valid only for ball bearings
2) Not valid for shielded or sealed bearings

Dimension and Running Accuracy of Radial Bearings (except Tapered Roller Bearings)
Tolerance Class P4

Table 13

Inner Ring

d		Δ_{dmp}		$\Delta_{ds}^{1)}$		V_{dp} Diameter Series 7, 8, 9 0, 1, 2, 3, 4		V_{dmp}	K_{ia}	S_d	$S_{ia}^{2)}$	Δ_{Bs}	V_{Bs}	
over	to	max	min	max	min	max	max	max	max	max	max	max	min	max
mm		μm												
2.5	10	0	-4	0	-4	4	3	2	2.5	3	3	0	-40	2.5
10	18	0	-4	0	-4	4	3	2	2.5	3	3	0	-80	2.5
18	30	0	-5	0	-5	5	4	2.5	3	4	4	0	-120	2.5
30	50	0	-6	0	-6	6	5	3	4	4	4	0	-120	3
50	80	0	-7	0	-7	7	5	3.5	4	5	5	0	-150	4
80	120	0	-8	0	-8	8	6	4	5	5	5	0	-200	4
120	180	0	-10	0	-10	10	8	5	6	6	7	0	-250	5
180	250	0	-12	0	-12	12	9	6	8	7	8	0	-300	6

Outer Ring

D		Δ_{Dmp}		$V_{Ds1)}$		V_{Dp} Diameter Series ³⁾ 7, 8, 9 0, 1, 2, 3, 4		V_{Dmp}	K_{ea}	S_D	$S_{ea}^{2)}$	Δ_{Cs}	V_{Cs}
over	to	max	min	max	min	max	max	max	max	max	max		max
mm		μm											
6	18	0	-4	0	-4	4	3	2	3	4	5	Corresponds to Δ_{Bs} of the same bearing inner ring	2.5
18	30	0	-5	0	-5	5	4	2.5	4	4	5		2.5
30	50	0	-6	0	-6	6	5	3	5	4	5		2.5
50	80	0	-7	0	-7	7	5	3.5	5	4	5		3
80	120	0	-8	0	-8	8	6	4	6	5	6		4
120	150	0	-9	0	-9	9	7	5	7	5	7		5
150	180	0	-10	0	-10	10	8	5	8	5	8		5
180	250	0	-11	0	-11	11	8	6	10	7	10		7
250	315	0	-13	0	-13	13	10	7	11	8	10		7
315	400	0	-15	0	-15	15	11	8	13	10	13		8

1) Valid only for bearings with diameter series 0, 1, 2, 3 and 4
2) Valid only for ball bearings
3) Not valid for shielded or sealed bearings

Dimension and Running Accuracy of Cylindrical Roller Bearings with Tapered Bore
Tolerance Class SP

Table 14

Inner Ring

d nad	do	Δ_{dmp} max	min	Δ_{d1mp} max	$-\Delta_{\text{dmp}}$ min	V_{dp} max	K_{ia} max	S_{d} max	Δ_{Bs} max	min	V_{Bs} max
mm		μm									
18	30	+10	0	+4	0	3	3	8	0	-100	5
30	50	+12	0	+4	0	4	4	8	0	-120	5
50	80	+15	0	+5	0	5	4	8	0	-150	6
80	120	+20	0	+6	0	5	5	9	0	-200	7
120	180	+25	0	+8	0	7	6	10	0	-250	8
180	250	+30	0	+10	0	8	8	11	0	-300	10
250	315	+35	0	+12	0	9	10	13	0	-350	13
315	400	+40	0	+13	0	12	12	15	0	-400	15
400	500	+45	0	+15	0	14	12	18	0	-450	25

Outer Ring

D over	to	Δ_{Dmp} max	min	V_{Dp} max	K_{ea} max	S_{D} max	$\Delta_{\text{Cs}}, V_{\text{Cs}}$
mm		μm					
50	80	0	-9	5	5	8	Corresponds to Δ_{Bs} a V_{Bs} of the same bearing inner ring
80	120	0	-10	5	6	9	
120	150	0	-11	6	7	10	
150	180	0	-13	7	8	10	
180	250	0	-15	8	10	11	
250	315	0	-18	9	11	13	
315	400	0	-20	10	13	13	
400	500	0	-23	12	15	15	
500	630	0	-28	14	17	18	
630	800	0	-35	18	20	20	

Dimension and Running Accuracy of Cylindrical Roller Bearings with Tapered Bore
Tolerance Class UP
Inner Ring

Table 15

d over to	Δ_{dmp} max min	Δ_{d1mp} max	$-\Delta_{dmp}$ min	V_{dp} max	K_{ia} max	S_d max	Δ_{Bs} max min	V_{Bs} max
mm	μm							
18 30	+6 0	+2	0	3	1.5	3	0 -25	1.5
30 50	+7 0	+3	0	3	2	3	0 -30	2
50 80	+8 0	+3	0	4	2	4	0 -40	3
80 120	+10 0	+4	0	4	3	4	0 -50	3
120 180	+12 0	+5	0	5	3	5	0 -60	4
180 250	+14 0	+6	0	6	4	6	0 -75	5
250 315	+17 0	+8	0	8	5	6	0 -90	6

Outer Ring									
D over to		Δ_{Dmp} max min		V_{Dp} max	K_{ea} max	S_D max	Δ_{CS}, V_{CS}		
mm		μm					Corresponds to Δ_{Bs} a V_{Bs} of the same bearing cone		
50 80	0	-6	3	3	2				
80 120	0	-7	4	3	3				
120 150	0	-8	4	4	3				
150 180	0	-9	5	4	3				
180 250	0	-10	5	5	4				
250 315	0	-12	6	6	4				
315 400	0	-14	7	7	5				

Dimension and Running Accuracy of Tapered Roller Baerings
Tolerance Class P0
Cone and Overall Bearing Width

Table 16

d over to	Δ_{dmp} max min	V_{dp} max	V_{dmp} max	K_{ia} max	Δ_{Bs} max min	Δ_{Ts} max min	Δ_{T1s} max min	Δ_{T2s} max min
mm	μm							
10 18	0 -12	12	9	15	0 -120	+200	0 +100	0 +100
18 30	0 -12	12	9	18	0 -120	+200	0 +100	0 +100
30 50	0 -12	12	9	20	0 -120	+200	0 +100	0 +100
50 80	0 -15	15	11	25	0 -150	+200	0 +100	0 +100
80 120	0 -20	20	15	30	0 -200	+200	-200 +100	-100 +100
120 180	0 -25	25	19	35	0 -250	+350	-250 +150	-150 +200
180 250	0 -30	30	23	50	0 -300	+350	-250 +150	-150 +200

Cup								
D over	to	Δ_{Dmp} max	min	V_{Dp} max	V_{Dmp} max	K_{ea} max	Δ_{Cs} max	min
mm		μm						
18	30	0	-12	12	9	18	0	-120
30	50	0	-14	14	11	20	0	-120
50	80	0	-16	16	12	25	0	-150
80	120	0	-18	18	14	35	0	-200
120	150	0	-20	20	15	40	0	-250
150	180	0	-25	25	19	45	0	-250
180	250	0	-30	30	23	50	0	-300
250	315	0	-35	35	26	60	0	-350
315	400	0	-40	40	30	70	0	-400

Dimension and Running Accuracy of Tapered Roller Bearings
Tolerance Class P6X
Cone and Overall Bearing Width

Table 17

d over	to	Δ_{dmp} max	min	V_{dp} max	V_{dmp} max	K_{ia} max	Δ_{Bs} max	min	Δ_{Ts} max	min	Δ_{T1s} max	min	Δ_{T2s} max	min
mm		μm												
10	18	0	-12	12	9	15	0	-50	+100	0	+50	0	+50	0
18	30	0	-12	12	9	18	0	-50	+100	0	+50	0	+50	0
30	50	0	-12	12	9	20	0	-50	+100	0	+50	0	+50	0
50	80	0	-15	15	11	25	0	-50	+100	0	+50	0	+50	0
80	120	0	-20	20	15	30	0	-50	+100	0	+50	0	+50	0
120	180	0	-25	25	19	35	0	-50	+150	0	+50	0	+100	0

Cup								
D over	to	Δ_{Dmp} max	min	V_{Dp} max	V_{Dmp} max	K_{ea} max	Δ_{Cs} max	min
mm		μm						
18	30	0	-12	12	9	18	0	-100
30	50	0	-14	14	11	20	0	-100
50	80	0	-16	16	12	25	0	-100
80	120	0	-18	18	14	35	0	-100
120	150	0	-20	20	15	40	0	-100
150	180	0	-25	25	19	45	0	-100
180	250	0	-30	30	23	50	0	-100
250	315	0	-35	35	26	60	0	-100

Dimension and Running Accuracy of Tapered Roller Bearings
Tolerance Class P6
Cone and Overall Bearing Width

Table 18

d over	to	Δ_{dmp} max	min	K_{ia} max	Δ_{Bs} max	min	Δ_{Ts} max	min
mm		μm						
10	18	0	-7	7	0	-200	+200	0
18	30	0	-8	8	0	-200	+200	0
30	50	0	-10	10	0	-240	+200	0
50	80	0	-12	10	0	-300	+200	0
80	120	0	-15	13	0	-400	+200	-200
120	180	0	-18	18	0	-500	+350	-250

Cup					
D over to		Δ_{Dmp} max	min	K_{ea} max	Δ_{Cs}
mm		μm			
18	30	0	-8	9	Corresponds to Δ_{Bs} of the same bearing cone
30	50	0	-9	10	
50	80	0	-11	13	
80	120	0	-13	18	
120	150	0	-15	20	
150	180	0	-18	23	
180	250	0	-20	25	
250	315	0	-25	30	

Dimension and Running Accuracy of Tapered Roller Bearings

Table 19

Tolerance Class P5

Cone and Overall Bearing Width

d over	to	Δ_{dmp} max	min	V_{dp} max	V_{dmp} max	K_{ia} max	S_d max	Δ_{Bs} max	min	Δ_{Ts} max	min
mm		μm									
10	18	0	-7	5	5	5	7	0	-200	+200	-200
18	30	0	-8	6	5	5	8	0	-200	+200	-200
30	50	0	-10	8	5	5	8	0	-240	+200	-200
50	80	0	-12	9	6	7	8	0	-300	+200	-200
80	120	0	-15	11	8	8	9	0	-400	+200	-200
120	180	0	-18	14	9	11	10	0	-500	+350	-250

Cup										
D over to		Δ_{Dmp} max	min	V_{Dp} max	V_D max	K_{ea} max	S_D max	Δ_{Cs}		
mm		μm								
18	30	0	-8	6	5	6	8	Corresponds to Δ_{Bs} of the same bearing cone		
30	50	0	-9	7	5	7	8			
50	80	0	-11	8	6	8	8			
80	120	0	-13	10	7	10	9			
120	150	0	-15	11	8	11	10			
150	180	0	-18	14	9	13	10			
180	250	0	-20	15	10	15	11			
250	315	0	-25	19	13	18	13			

Dimension and Running Accuracy of Thrust Bearings

Tolerance Class P0, P6 and P5

Shaft Washer

Table. 20

d _{d2} over	to	Δ_{dmp} Δ_{d2mp} max	min	V_{dp} V_{d2p} max	S_i P0 max	P6 max	1) P5 max
mm		μm					
-	18	0	-8	6	10	5	3
18	30	0	-10	8	10	5	3
30	50	0	-12	9	10	6	3
50	80	0	-15	11	10	7	4
80	120	0	-20	15	15	8	4
120	180	0	-25	19	15	9	5
180	250	0	-30	23	20	10	5
250	315	0	-35	26	25	13	7
315	400	0	-40	30	30	15	7
400	500	0	-45	34	30	18	9
500	630	0	-50	38	35	21	11
630	800	0	-75	-	40	25	13
800	1000	0	-100	-	45	30	15

Housing Washer

D _d over	to	Δ_{Dmp} max	min	V_{Dp} max	S_e 1)
mm		μm			
18	30	0	-13	10	Corresponds to S_i of shaft washer of the same bearing
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	-	
1250	1600	0	-160	-	

1) Not valid for thrust spherical roller bearings

2.4 Internal Clearance

Bearing clearance is the value of one bearing displacement length of assembled bearing with respect to the other ring from one end position to the other one. The displacement can be in radial direction (radial clearance) or axial (axial clearance).

In a mounted bearing smaller radial clearance can be found than the same bearing had before mounting. Radial clearance reduction is caused by interference of the bearing rings on the shaft and in housing bore and thus it is dependent on selected tolerance of bearing seating surface diameters.

Another change of radial clearance, mainly its reduction, arises during operation from temperatures evoked by its own operation and surrounding sources, but also by elastic deformations caused by load.

Clearance for standard designed bearings is determined so that one of the bearing rings can be fixed, what is sufficient for most operation conditions in the arrangement. For special arrangements with different requirement on the radial clearance bearings with various radial clearance designated C1 up to C5 are produced.

Values for various internal clearances according to the standard ISO 5753 are shown for individual bearing types in tables 21 up to 27 and these values are valid for non-mounted bearings by zero measuring load.

For double row angular contact ball bearings instead of radial clearance the axial clearance measured at axial load 100 N is introduced.

Single row angular contact ball bearings and single row tapered roller bearings are usually mounted in pairs and the radial or axial clearance is adjusted during mounting.

Radial Clearance of Single Row Ball Bearings												Table 21		
Bore Diameter		Radial Clearance										Single Row Separable Ball Bearings Type E and BO	Radial Clearance	
d over	to	C2 min	max	normal min	max	C3 min	max	C4 min	max	C5 min	max		min	max
mm		µm										µm		
2.5	10	0	7	2	13	8	23	14	29	20	37	E10, E12	15	30
10	18	0	9	3	18	11	25	18	33	25	45	E15	15	30
18	24	0	10	5	20	13	28	20	36	28	48	BO17, E17	25	45
24	30	1	11	5	20	13	28	23	41	30	53	E20	20	40
30	40	1	11	6	20	15	33	28	46	40	64			
40	50	1	11	6	23	18	36	30	51	45	73			
50	65	1	15	8	28	23	43	38	61	55	90			
65	80	1	15	10	30	25	51	46	71	65	105			
80	100	1	18	12	36	30	58	53	84	75	120			
100	120	2	20	15	41	36	66	61	97	90	140			
120	140	2	23	18	48	41	81	71	114	105	160			
140	160	2	23	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	215			

Axial Clearance of Double Row Angular Contact Ball Bearings										Table 22
Bore Diameter d over to		Axial Clearance C2 min max		normal min max		C3 min max		C4 min max		
mm		µm								
6	10	1	11	5	21	12	28	25	45	
10	18	1	12	6	23	13	31	27	47	
18	24	2	14	7	25	16	34	28	48	
24	30	2	15	8	27	18	37	30	50	
30	40	2	16	9	29	21	40	33	54	
40	50	2	19	11	33	23	44	36	58	
50	65	3	22	13	36	26	48	40	63	
65	80	3	24	15	40	30	54	46	71	

Radial Clearance of Double Row Self-Aligning Ball Bearing																			Table 23					
Bore Diameter			Cylindrical Bore Radial Clearance											Tapered Bore Radial Clearance										
d			C2		normal		C3		C4		C5		C2		normal		C3		C4		C5			
over	to		min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max		
mm			µm											µm										
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	18	30	25	39	34	52	7	17	13	26	20	33	28	42	37	55		
24	30		5	16	11	24	19	35	29	46	40	58	9	20	15	28	23	39	33	50	44	62		
30	40		6	18	13	29	23	40	34	53	46	66	12	24	19	35	29	46	40	59	52	72		
40	50		6	19	14	31	25	44	37	57	50	71	14	27	22	39	33	52	45	65	58	79		
50	65		7	21	16	36	30	50	45	69	62	88	18	32	27	47	41	61	56	80	73	99		
65	80		8	24	18	40	35	60	54	83	76	108	23	39	35	57	50	75	69	98	91	123		
80	100		9	27	22	48	42	70	64	96	89	124	29	47	42	68	62	90	84	116	109	144		
100	120		10	31	25	56	50	83	75	114	105	145	35	56	50	81	75	108	100	139	130	170		
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 Clearance of Single Row Cylindrical Roller Bearings											Table 24
Bore Diameter d over to		Radial Clearance C2		normal		C3		C4		C5	
		min	max	min	max	min	max	min	max	min	max
mm		μm									
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
500	560	120	240	240	360	360	480	480	600	695	815
560	630	140	260	260	380	380	500	500	620	780	900
630	710	145	285	285	425	425	565	565	705	870	1010
710	800	150	310	310	470	470	630	630	790	980	1140
800	900	180	350	350	520	520	690	690	860	1100	1270
900	1000	200	390	390	580	580	770	770	960	1220	1410
1000	1120	220	430	430	640	640	850	850	1060	1360	1570
1120	1250	230	470	470	710	710	950	950	1190	1520	1760

Radial Clearance of Double Row Cylindrical Roller Bearings with Tapered Bore Bearing with Non-Interchangeable Rings Determined for Machine Tool Spindles

Table 25

Bore Diameter d over to		Radial Clearance C1NA min max C2NA min max				Bore Diameter d over to		Radial Clearance C1NA min max C2NA min max			
mm		µm				mm		µm			
24	30	15	25	25	35	160	180	55	85	75	110
30	40	15	25	25	40	180	200	60	90	80	120
40	50	17	30	30	45	200	225	60	95	90	135
50	65	20	35	35	50	225	250	65	100	100	150
65	80	25	40	40	60	250	280	75	110	110	165
80	100	35	55	45	70	280	315	80	120	120	180
100	120	40	60	50	80	315	355	90	135	135	200
120	140	45	70	60	90	355	400	100	150	150	225
140	160	50	75	65	100	400	450	110	170	170	255

Radial Clerance of Single Row Needle Roller Bearings with Interchangeable Rings

Table 26

Bore Diameter d over to		Radial Clearance normal min max		C3 min max	
mm		µm			
10	14	10	50	25	70
14	18	15	55	35	75
18	24	25	65	40	80
24	30	30	65	50	80
30	40	40	75	60	95
40	50	40	85	65	100
50	65	45	90	70	120
65	80	50	110	75	135
80	100	60	115	95	150
100	120	70	125	115	70
120	140	80	155	130	205
140	160	80	160	140	210

Radial Clearance of Double Row Spherical Roller Bearings											Table 27
Bore Diameter		Cylindrical Bore Radial Clearance									
d over	to	C2 min	max	normal min	max	C3 min	max	C4 min	max	C5 min	max
mm		μm									
30	40	15	30	30	45	45	60	60	80	80	100
40	50	20	35	55	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	760
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

Bore Diameter		Tapered Bore Radial Clearance									
d over	to	C2 min	max	normal min	max	C3 min	max	C4 min	max	C5 min	max
mm		μm									
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

2.5 Cages

Cage in the rolling bearing fulfills the following roles :

- separates rolling elements evenly around the periphery
- prevents contact of rolling elements and their sliding
- prevents falling out of the rolling elements from separable or self-aligning bearings when mounting.

From the point of view of design and material the cages are divided into pressed and machined.

Pressed cages are made of steel or brass sheet and are mostly used in dimensionally smaller and medium bearings. Their advantage in comparison with the solid cages is the smaller weight. Machined cages are made of steel, brass, bronze, light metals or plastic in various designs. Cages made of metals are used when there are higher demands on the cage rigidity and the bearing is determined for higher operational temperatures. Cages are radially centered on the rolling elements in bearings, this is the most usual way, or they are centered on the rib of either of the bearing rings.

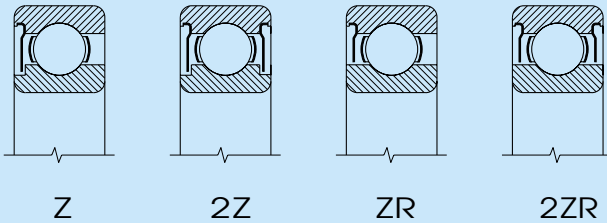
Bearings without cages, i.e. with full complement of rolling elements, are only rarely used, namely only for some bearing types, e.g. single row needle roller bearings.

In the texts about individual bearing types the survey of cages in standard design and delivery possibilities of bearings with cages of non-standard design are given in the section Cages.

2.6 Shields and Seals

Bearings with sealing on one or both sides are manufactured with shields (Z, 2Z, ZR, 2ZR) or seals (RS, 2RS, RSR, 2RSR).

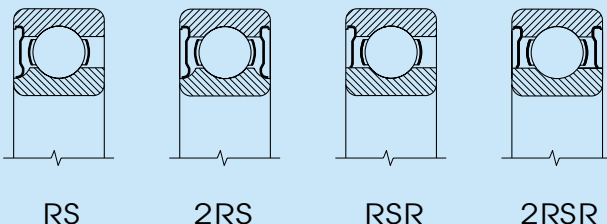
Shields form a non-contact sealing. In design Z and 2Z the fitting for the shield is in the inner ring, in design ZR and 2ZR the shield adheres on the smooth rib of the bearing inner ring.



Sealing is created by sealing rings made of rubber vulcanized on sheet steel reinforcement, which create an effective contact sealing with a chamfered fitting on the inner ring (RS, 2RS) as well as in design with contact on the smooth rib of the inner ring (RSR, 2RSR).

Seals and sealing rings are fastened in the grooves of the outer ring and are unseparable.

Sealing RS, 2RS, RSR, 2RSR can be used for temperature range -30°C to +110°C, sealing RS1, -2RS1, RSR1 and -2RSR1 for temperature range -45°C to +120°C, sealing RS2, -2RS2, RSR2, -RSR2 for temperature range -60°C to +150°C.



Bearings with sealings on both sides in standard design are filled with grease of a temperature range from -30°C to 110°C , whose qualities secure lubrication usually during the whole bearing life at normal operational conditions. Bearings in this design cannot be relubricated.

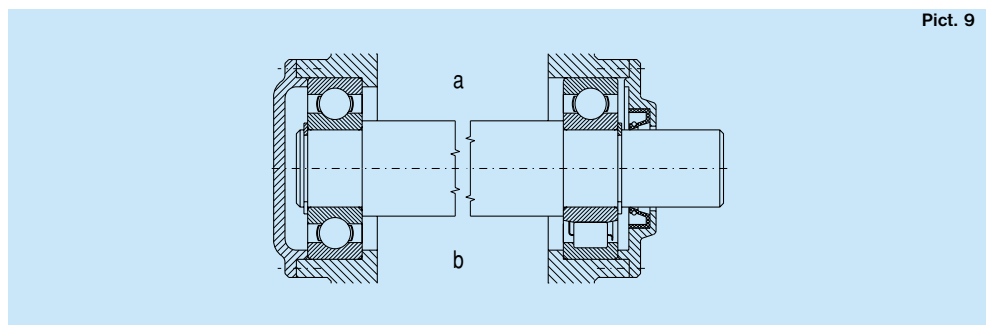
3. Bearing Arrangement Design

3.1 General Principles of Rolling Bearing Arrangement Design

Rotating shaft or another component arranged in rolling bearings is guided by them in radial as well as in axial direction so that the basic condition, the movement uniqueness, can be fulfilled. The component should be, as far as possible, statically determined, i.e. supported in two points radially and in one point axially.

A typical example of such an arrangement is in Pict. 9, where the shaft is radially guided in two bearings, one of which secures it in axial direction. The locating bearing carries the radial load and simultaneously also the axial load in both directions. Radial bearings that can accommodate combined load are mostly used as locating bearings, which carry, e.g. single row ball bearings, double row angular contact ball bearings, double row self aligning ball bearings, double row spherical roller bearings or single row angular contact ball bearings and tapered roller bearings. The two last mentioned bearing types must be mounted in pairs. The non-locating bearing carries only radial load and must permit certain displacement of the shaft in axial direction so that arising of non-desired axial preload caused by environment (temperature dilatations, production inaccuracies of connecting arrangement components, etc.) can be hindered.

Axial displacement can be secured by displacement between one bearing ring and a machine part, which is directly connected with the bearing, e.g. between outer bearing ring and housing bore (Pict. 9a) or directly in the bearing (Pict. 9b).

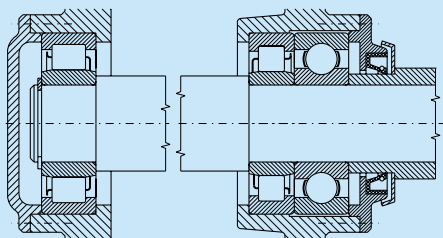


Pict. 9

Arrangements, in which greater radial and axial loads act by higher rotational speed, should be set up so that the bearing can accommodate only radial or axial forces, see Pict. 10. In these cases it is possible to use for radial guidance some of the radial bearings and for axial guidance those radial bearings which are also able to carry axial load or a pair of these bearings, or double direction thrust bearing, or a pair of single direction thrust bearings. There is a condition where the axially locating thrust bearing should be arranged with radial clearance.

Another, often used solution is the arrangement of two bearings, whose design enables the accommodation both radial and axial loads. Both bearings accommodate alternately the axial load, always according to direction of force acting, and simultaneously they carry also the radial load. An example of this arrangement is shown in Pict. 11.

As a verified design the pair of single row tapered roller bearings or single row angular contact ball bearings are used. There can be used other bearing types which are able to carry the load both in radial and axial direction simultaneously, e.g. separable single row ball bearings or single row cylindrical roller bearings in NJ design, etc.



3.2 Bearing Location

Radial and axial bearing location on the shaft and in the housing bore or another part has a direct connection with the whole arrangement design. When selecting the way of location, the character and acting forces magnitude, the operating temperature in the arrangement and material of mating parts must be taken into account.

Mounting, dismounting and maintenance methods must be taken into consideration when designing mating parts dimensions.

3.2.1 Radial Location of Bearing

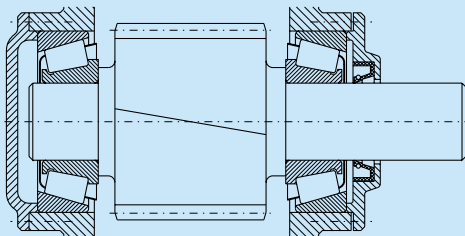
The bearing is located in radial direction on the mating cylindrical shaft and housing bore surface. In some cases, adapter or withdrawal sleeves are used by mounting on the shaft, or the bearing can be mounted directly on the tapered shaft.

The correct radial location of the bearing on the shaft significantly influences utilization of its load rating and correct function in arrangement. The following viewpoints are important :

- safe location and uniform supporting of bearings
- simple mounting and dismounting
- displacement of non-locating bearing in axial direction

Basically, both bearing rings should be mounted in tight fits, because only in this way their reliable supporting around the whole periphery and radial fixing against turning can be achieved. To make mounting and dismounting easier or for moving the non-locating ring, a loose fit of one of the rings is permissible.

When selecting correct radial bearing location, following influences must be taken into account.



Circumferential Load - occurs if the respective bearing ring rotates and the load direction is not changed or if the ring rotates and the load does not rotate. The bearing ring periphery is gradually loaded during one revolution. In this case the loaded bearing ring must be always fitted with necessary interference fit.

Point Load - occurs when the bearing ring does not rotate and the external force is constantly directed into the same ring raceway point or if the ring and load rotate at the same rotating speed. The ring subjected to point load can be mounted with loose fit, if the conditions require it.

Indeterminate Load - occurs if the ring is subjected to varying external forces at which directions and load changes cannot be determined (e.g. unbalanced mass, shocks, etc.). Under these conditions in most applications bearings with greater radial clearance should be used.

Load Magnitude - directly influences selection of the interference fit (higher load - larger interference), especially in cases of impact loads. A firm fitting on the shaft or in the housing causes ring deformation, and as a result reduction of radial clearance arises. To secure the necessary radial clearance in the firm arrangement, it is necessary to use bearings with greater radial clearance. Resulting clearance after mounting depends on the bearing type and its dimension.

Bearing Size and Type - determines the size of necessary interference fit of the fitted ring. For smaller sized bearings smaller interference fits are selected, and vice versa. Relatively smaller interferences are used, e.g. for the same sizes of ball bearings in comparison with the cylindrical roller, tapered roller or spherical roller bearings.

Material and Design of Mating Components must be taken into account when determining their production tolerance. Results of practical experience are shown in the following tables. In cases where bearings are mounted into housings made of light metal alloys or on journals of hollow shafts, arrangements with higher interference are selected.

Split housings are not suitable for arrangements with higher interferences, because there is danger of the bearing pinching in the dividing plane.

Heating generating in the bearing can cause loosening of the interference on the journal and turning of the ring. In the housing a converse case can come into being. The heating causes clearance decreasing and subsequently limiting and even stopping of the axial displacement of the non-locating bearing ring. That is why we pay a great deal of attention to this fact when designing an arrangement.

Fitting Accuracy from the point of view of its tolerances and geometric shapes is important because it can be transmitted towards the bearing ring raceways and defines the arrangement accuracy.

When using bearings with normal tolerance class, the tolerance of journal seating surface IT6 is selected, and for housing seating surface tolerance IT7.

For smaller dimensioned ball and cylindrical roller bearings it is possible to use for the journal tolerance IT5 and housing bore IT6.

For bearings in higher tolerance classes, for arrangements with high requirements on accuracy, e.g. spindles of machine tools, the least tolerance class IT5 is recommended for the shaft and for housing IT6.

Permissible ovality and conicity deviation and permissible lateral bearing runout of supporting surfaces must be in reference to axis smaller than the diameter tolerance of the journal and bore.

With higher bearing tolerance class also requirements on the seating surface accuracy increase. Recommended values are shown in tables 28 and 29.

Mounting and Dismounting of bearings, if one of the rings is arranged with a loose fit it is simple. If, because of operational reasons, it is necessary to arrange both of the rings with an interference, a suitable bearing type should be selected, e.g. a separable bearing (tapered roller, cylindrical roller, needle roller bearing) or a bearing with tapered bore. Journals for sleeve

arrangements of bearings with tapered bore can be in tolerance class h9 or h10, geometric shape should be in tolerance class IT5 or IT7 according to arrangement requirements.

Axial Displacement of Non-Locating Bearing Rings must be secured by all operation conditions. When using a non-separable bearing, displacement of the stationary loaded ring is reached by its fitting with clearance (moveable).

In light metal alloy housings it is necessary, if the outer ring is fitted with clearance, to put a steel bush in the bore.

A reliable displacibility in axial direction is reached by using cylindrical roller bearing type N and NU or radial needle bearing.

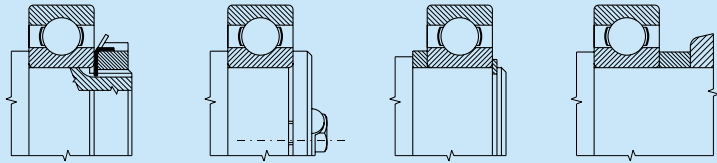
Recommended journal and bore diameter tolerances of the mating components for radial and thrust bearings are shown in tables 30 to 35.

3.2.2 Axial Securing of Bearing

Inner bearing ring with cylindrical bore arranged on the journal with interference fit (fixed) is usually secured in the axial direction by means of a locknut, end-plate or snap ring, when the other face is usually supported by the shaft shoulder. Surrounding parts are used as abutment faces for inner rings, and if necessary, spacing rings are inserted between this component and bearing inner ring. Examples of axial bearing securing are shown in Pict.12.

Recommended Shape Accuracies of Bearing Seating Fits			Table 28
Bearing Tolerance Class	Fitting Location	Permissible Ovality Deviation	Permissible Lateral Runout of Carrying Surfaces in Reference to Axis
P0, P6	shaft	$\frac{IT5}{2}$	IT3
	housing	$\frac{IT6}{2}$	IT4
P5, P4	shaft	$\frac{IT3}{2}$	IT2
	housing	$\frac{IT4}{2}$	IT3

Standard Tolerances IT2 to IT6				Table 29		
Nominal Diameter		Tolerance Class				
over	to	IT2	IT3	IT4	IT5	IT6
mm		μm				
6	10	1.5	2.5	4	6	9
10	18	2	3	5	8	11
18	30	2.5	4	6	9	13
30	50	2.5	4	7	11	16
50	80	3	5	8	13	19
80	120	4	6	10	15	22
120	180	5	8	12	18	25
180	250	7	10	14	20	29
250	315	8	12	16	23	32
315	400	9	13	18	25	36
400	500	10	15	20	27	40



Radial Bearing Shaft Diameter Tolerances (Valid for Solid Steel Shafts)

Table 30

Journal Diameter [mm]					
Operating Conditions	Arrangement Examples	Ball Bearings	Cylindrical, Needle ¹⁾ Tapered Roller Bearings	Spherical Roller Bearings	Tolerance
Inner Ring Point Load					
Light and Normal Load P _r ≤0,15 C _r	Free wheels, sheaves, belt pulleys	All Diameters			g6 ²⁾
Heavy Impact Load P _r >0,15 C _r	Industrial truck wheels, tension pulleys				h6
Inner Ring Circumferential Load or Indeterminate Load					
Light and Variable Load P _r ≤0,07 C _r	transport equipments, ventilators	(18) to 100 (100) to 200	≤40 (40) to 140	- -	j6 k6
Normal and Heavy Load P _r >0,07 C _r	General enginnering, electric motors, turbines, pumps, combustion motors, gear boxes, woodworking machines	≤18 (18) to 100 (100) to 140 (140) to 200	- ≤40 (40) to 100 (100) to 140 (65) to 100 (100) to 140 (140) to 200 >200	- ≤40 (40) to 65 (65) to 100 (100) to 140 >140	j5 k5 (k6) ³⁾ m5 (m6) ³⁾ m6 n6 p6
Extremely Heavy Load, Impacts, Complicated Operating Conditions P _r >0,15 C _r	Axle bearings for railway vehicles, traction motors, rolling mills	- - -	(50) to 140 (140) to 500 >500	(50) to 100 (100) to 500 >500	n6 ⁴⁾ p6 ⁴⁾ r6 (p6) ⁴⁾
High Arrangement Accuracy under Light Load P _r ≤0,07 C _r	Machine tools	≤18 (18) to 100 (100) to 200 (140) to 200	- ≤40 (40) to 140 (140) to 200	- - -	h5 ⁵⁾ j5 ⁵⁾ k5 ⁵⁾ m5
Exclusively Axial Load		All Diameters			j6
Bearings with Tapered Bore and Adapter or Withdrawal Sleeve					
All Kinds of Load	General arrangements, axle bearings for railway vehicles. Not complicated arrangements	All Diameters			h9/IT5 h10/IT7

1) Tolerances for needle roller bearings without rings, see page 133

2) Tolerance f6 can be selected for securing axial displacibility

3) Tolerances in brackets are selected usually for single row tapered roller bearings or at low rotational speeds where tolerance dispersion is not significant

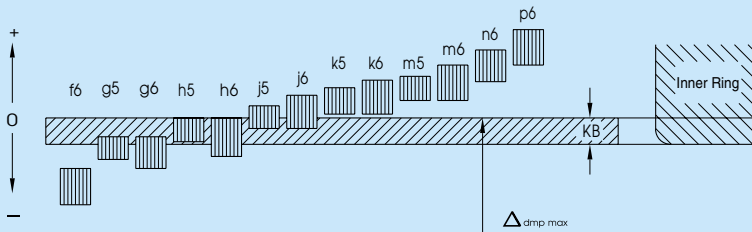
4) It is necessary to use bearings with higher radial clearance than normal

5) Tolerances for single row ball bearings in tolerance classes P5 and P4 are shown on page 89

Housing Bore Diameter Tolerances for Radial Bearings (Valid for Steel, Cast and Cast Steel Housings)				Table 31
Operating Conditions	Displacibility of Outer Ring	Housing	Arrangement Examples	Tolerance
Outer Ring Circumferential Load				
Heavy Impact Load $P_r > 0,15 C_r$ Thin Walled Housings	not dispacable	one-part	Wheel hubs with cylindrical roller bearings, big end bearings	P7
Normal and Heavy Load $P_r > 0,07 C_r$	not dispacable		Wheel hubs with ball bearings, crane travel wheels, crankshaft bearings	N7
Light and Variable Load $P_r \leq 0,07 C_r$	not dispacable		Conveyor rollers, tension pulleys	M7
Indeterminite Load				
Heavy Impact Load $P_r > 0,15 C_r$	not dispacable		Traction motors	M7
Heavy and Normal Load $P_r > 0,07 C_r$	As a rule, not displaceable	one-part	Electric motors, pumps, crankshafts	K7
Light and Varying Load $P_r \leq 0,07 C_r$	As arule, displaceable		Electric motors, pumps, crankshafts	J7
Accurate Arrangement				
Light Load $P_r \leq 0,07 C_r$	As a rule, not displaceable	one-part	Cylindrical roller bearings for machine tools	K6 ¹⁾
	Displaceable		ball bearings for machine tools.	J6 ²⁾
	Easily displaceable		Small electric motors	H6
Outer Ring Point Load				
Any Load			General engineering, axle bearings of railway vehicles	H7 ³⁾
Light and Normal Load $P_r \leq 0,15 C_r$	Easily displaceable	One-part or two-part	General engineering, less complicated engineering	H8
			Drying rollers of paperworking machines, big electric motors	G7 ⁴⁾
1) For heavy loads tighter tolerances are selected - M6 or N6. For cylindrical roller bearings with tapered bore tolerances K5 or M5. 2) Tolerances for single row ball bearings in tolerances P5 and P4 - see page 89. 3) For bearings with outer diameter D < 250 mm, with temperature difference between outer ring and housing over 10°C, tolerance G7 is selected 4) For bearings with outer diameter D > 250 mm, with temperature difference between outer ring and housing over 10°C, tolerance F7 is selected				

Journal Diameter Tolerance for Thrust Bearings				Table 32
Bearing Type	Load		Journal Diameter [mm]	Tolerance
Thrust Ball Bearings	Exclusively Axial Load		All Diameters	j6
Thrust Spherical Roller Bearings				j6
	Simultaneously Axial and Radial Loads	Stationary Load of Shaft Washer or Indeterminate Load	All Diameters	j6
		Rotating Load of Shaft	≤ 200 (200) to 400	k6 m6
		Washer	> 400	n6

Housing Bore Diameter Tolerances for Thrust Bearings				Table 33
Bearing Type	Load		Note	Tolerance
Thrust Ball Bearings	Exclusively Axial Load		In common arrangements housing washer can have clearance	H8
			Housing washer mounted with radial clearance	-
Thrust Spherical Roller Bearings	Simultaneously Axial and Radial Load	Stationary Load or Indeterminate Load of Housing Washer		H7
		Rotating Load of Housing Washer		M7



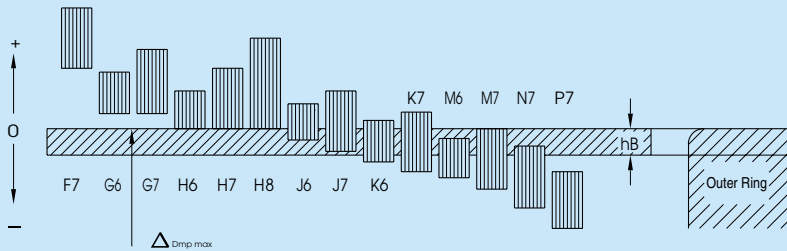
Journal Diameter Tolerance Limiting Deviations

Table 34

Journal Nominal Diameter over to	f6		g5		g6		h5		h6		j5		j6(js6)		k5	
	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower
mm	μm															
1 3	-6	-12	-2	-6	-2	-8	0	-4	0	-6	+2	-2	+4	-2	+4	0
3 6	-10	-18	-4	-9	-4	-12	0	-5	0	-8	+3	-2	+6	-2	+6	+1
6 10	-13	-22	-5	-11	-5	-14	0	-6	0	-9	+4	-2	+7	-2	+7	+1
10 18	-16	-27	-6	-14	-6	-17	0	-8	0	-11	+5	-3	+8	-3	+9	+1
18 30	-20	-33	-7	-16	-7	-20	0	-9	0	-13	+5	-4	+9	-4	+11	+2
30 50	-25	-41	-9	-20	-9	-25	0	-11	0	-16	+6	-5	+11	-5	+13	+2
50 80	-30	-49	-10	-23	-10	-29	0	-13	0	-19	+6	-7	+12	-7	+15	+2
80 120	-36	-58	-12	-27	-12	-34	0	-15	0	-22	+6	-9	+13	-9	+18	+3
120 180	-43	-68	-14	-32	-14	-39	0	-18	0	-25	+7	-11	+14	-11	+21	+3
180 250	-50	-79	-15	-35	-15	-44	0	-20	0	-29	+7	-13	+16	-13	+24	+4
250 315	-56	-88	-17	-40	-17	-49	0	-23	0	-32	+7	-16	+16	-16	+27	+4
315 400	-62	-98	-18	-43	-18	-54	0	-25	0	-36	+7	-18	+18	-18	+29	+4
400 500	-68	-108	-20	-47	-20	-60	0	-27	0	-40	+7	-20	+20	-20	+32	+5
500 630	-76	-120	-	-	-22	-66	-	-	0	-44	-	-	+22	-22	-	-
630 800	-80	-130	-	-	-24	-74	-	-	0	-50	-	-	+25	-25	-	-
800 1000	-86	-142	-	-	-26	-82	-	-	0	-56	-	-	+28	-28	-	-
1000 1250	-98	-164	-	-	-28	-94	-	-	0	-66	-	-	+33	-33	-	-

Journal Nominal Diameter over to	k6		m5		m6		n6		p6		h9 ¹⁾		IT5		h10 ¹⁾		IT7
	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	
mm	μm																
1 3	+6	0	+6	+2	+8	+2	+10	+4	+12	+6	0	-25	4	0	-40	10	
3 6	+9	+1	+9	+4	+12	+4	+16	+8	+20	+12	0	-30	5	0	-48	12	
6 10	+10	+1	+12	+6	+15	+6	+19	+10	+24	+15	0	-36	6	0	-58	15	
10 18	+12	+1	+15	+7	+18	+7	+23	+12	+29	+18	0	-43	8	0	-70	18	
18 30	+15	+2	+17	+8	+21	+8	+28	+15	+35	+22	0	-52	9	0	-84	21	
30 50	+18	+2	+20	+9	+25	+9	+33	+17	+42	+26	0	-62	11	0	-100	25	
50 80	+21	+2	+24	+11	+30	+11	+39	+20	+51	+32	0	-74	13	0	-120	30	
80 120	+25	+3	+28	+13	+35	+13	+45	+23	+59	+37	0	-87	15	0	-140	35	
120 180	+28	+3	+33	+15	+40	+15	+52	+27	+68	+43	0	-100	18	0	-160	40	
180 250	+33	+4	+37	+17	+46	+17	+60	+31	+79	+50	0	-115	20	0	-185	46	
250 315	+36	+4	+43	+20	+52	+20	+66	+34	+88	+56	0	-130	23	0	-210	52	
315 400	+40	+4	+46	+21	+57	+21	+73	+37	+98	+62	0	-140	25	0	-230	57	
400 500	+45	+5	+50	+23	+63	+23	+80	+40	+108	+68	0	-155	27	0	-250	63	
500 630	+44	0	-	-	+70	+26	+88	+44	+122	+78	0	-175	30	0	-280	70	
630 800	+50	0	-	-	+80	+30	+100	+50	+138	+88	0	-200	35	0	-320	80	
800 1000	+56	0	-	-	+90	+34	+112	+56	+156	+100	0	-230	40	0	-360	90	
1000 1250	+66	0	-	-	+106	+40	+132	+66	+186	+120	0	-260	46	0	-420	105	

1) For journals made in tolerance h9 and H10 for bearings with adapter or withdrawal sleeves deviations of roundness and cylindricity must not exceed basic tolerances IT5 and IT7



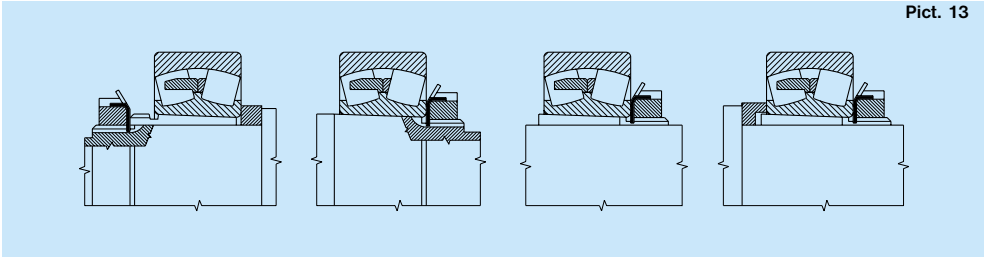
Bore Diameter Tolerance Limiting Deviations

Table 35

Bore Nominal Diameter over to		F7		G6		G7		H6		H7		H8		J6(Js6)	
		upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower
mm		μm													
6	10	+28	+13	+14	+5	+20	+5	+9	0	+15	0	+22	0	+5	-4
10	18	+34	+16	+17	+6	+24	+6	+11	0	+18	0	+27	0	+6	-5
18	30	+41	+20	+20	+7	+28	+7	+13	0	+21	0	+33	0	+8	-5
30	50	+50	+25	+25	+9	+34	+9	+16	0	+25	0	+39	0	+10	-6
50	80	+60	+30	+29	+10	+40	+10	+19	0	+30	0	+46	0	+13	-6
80	120	+71	+36	+34	+12	+47	+12	+22	0	+35	0	+54	0	+16	-6
120	180	+83	+43	+39	+14	+54	+14	+25	0	+40	0	+63	0	+18	-7
180	250	+96	+50	+44	+15	+61	+15	+29	0	+46	0	+72	0	+22	-7
250	315	+108	+56	+49	+17	+69	+17	+32	0	+52	0	+81	0	+25	-7
315	400	+119	+62	+54	+18	+75	+18	+36	0	+57	0	+89	0	+29	-7
400	500	+131	+68	+60	+20	+83	+20	+40	0	+63	0	+97	0	+33	-7
500	630	+146	+76	+66	+22	+92	+22	+44	0	+70	0	+110	0	+22	-22
630	800	+160	+80	+74	+24	+104	+24	+50	0	+80	0	+125	0	+25	-25
800	1000	+176	+86	+82	+26	+116	+26	+56	0	+90	0	+140	0	+28	-28
1000	1250	+203	+98	+94	+28	+133	+28	+66	0	+105	0	+165	0	+33	-33
1250	1600	+235	+110	+108	+30	+155	+30	+78	0	+125	0	+195	0	+39	-39

Bore Nominal Diameter over to		J7(Js7)		K6		K7		M6		M7		N7		P7	
		upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower
mm		μm													
6	10	+8	-7	+2	-7	+5	-10	-3	-12	0	-15	-4	-19	-9	-24
10	18	+10	-8	+2	-9	+6	-12	-4	-15	0	-18	-5	-23	-11	-29
18	30	+12	-9	+2	-11	+6	-15	-4	-17	0	-21	-7	-28	-14	-35
30	50	+14	-11	+3	-13	+7	-18	-4	-20	0	-25	-8	-33	-17	-42
50	80	+18	-12	+4	-15	+9	-21	-5	-24	0	-30	-9	-39	-21	-51
80	120	+22	-13	+4	-18	+10	-25	-6	-28	0	-35	-10	-45	-24	-59
120	180	+25	-14	+4	-21	+12	-28	-8	-33	0	-40	-12	-52	-28	-68
180	250	+30	-16	+5	-24	+13	-33	-8	-37	0	-46	-14	-60	-33	-79
250	315	+36	-16	+5	-27	+16	-36	-9	-41	0	-52	-14	-66	-36	-88
315	400	+39	-18	+7	-29	+17	-40	-10	-46	0	-57	-16	-73	-41	-98
400	500	+43	-20	+8	-32	+18	-45	-10	-50	0	-63	-17	-80	-45	-108
500	630	+35	-35	0	-44	0	-70	-26	-70	-26	-96	-44	-114	-78	-148
630	800	+40	-40	0	-50	0	-80	-30	-80	-30	-110	-50	-130	-88	-168
800	1000	+45	-45	0	-56	0	-90	-34	-90	-34	-124	-56	-146	-100	-190
1000	1250	+52	-52	0	-66	0	-105	-40	-106	-40	-145	-66	-171	-120	-225
1250	1600	+62	-62	0	-78	0	-125	-48	-126	-48	-173	-78	-203	-140	-265

Examples of axial locating of bearings with tapered bore seated directly on the tapered journal or by means of an adapter or withdrawal sleeve are in Pict. 13.

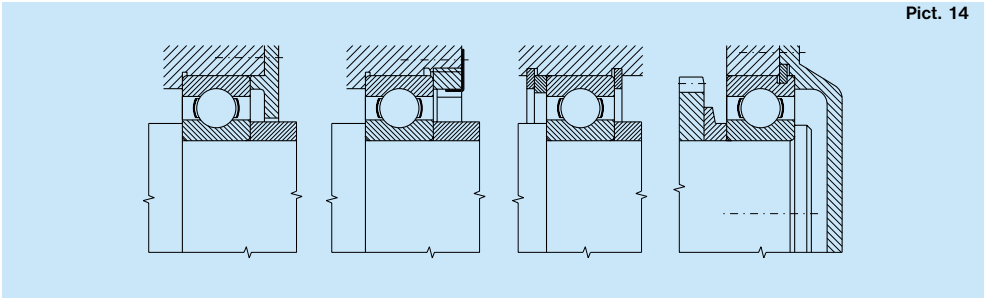


Permissible bearing axial load fixed by an adapter sleeve on smooth shafts without bearing resting on the shaft shoulder is calculated according to equation :

$$F_a = 3Bd \quad [N]$$

F_a - permissible bearing axial load	[N]
B - bearing width	[mm]
d - bearing bore diameter	[mm]

If the axial displacement of the outer ring in the housing is not required, then we can use solution, when the face supporting or seating surface of the bearing cover, nut or snap ring are used. Bearings with grooves for snap ring (NR) do not require much space and their securing is simple. Examples - see Pict. 14.



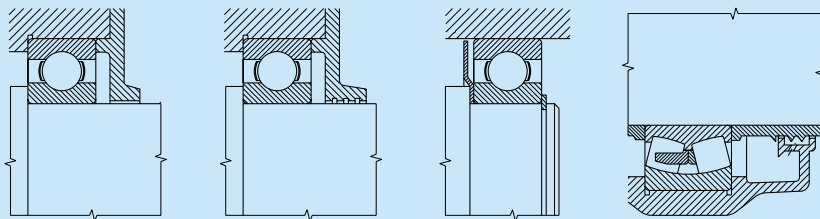
Abutment dimensions for each bearing shown in this publication are in the dimension tables.

3.3 Sealing

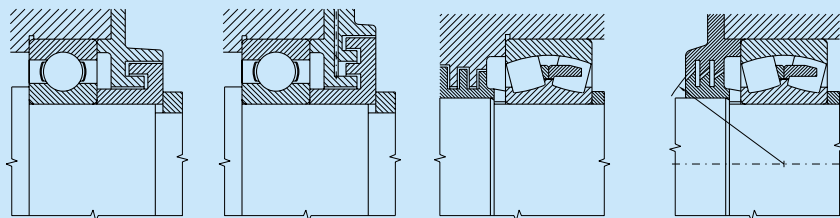
Sealing of the bearing space is very important, because damaging materials which can be found in the bearing environment influence it and often can cause its breakdown. Sealing also has an opposite function - it prevents the lubricant leaking out of the bearing and arrangement space. That is why sealing must always be designed with regard to operating conditions of machines or equipments, arrangement design, lubricating method, maintenance possibility and economic questions concerning production and utilization.

3.3.1 Non-Contact Sealing

Between non-rotating and rotating parts there is only a narrow gap when using this sealing. It is filled with grease. Using this sealing, wear of components from friction does not occur and that is why this sealing can be used for the highest rotational speeds and for high operating temperatures. Examples of a gap sealing are in Pict. 15.



Another very effective sealing is the labyrinth sealing which can improve the sealing effect by a greater number of labyrinths or prolongation of sealing gaps. Examples - see Pict. 16.



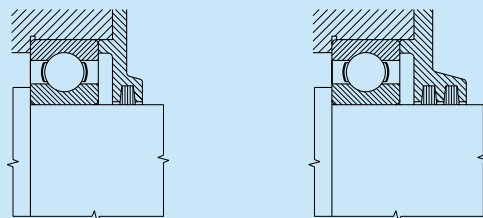
3.3.2 Rubbing Sealing

Rubbing sealing is created of elastic or soft, but sufficiently impermeable material, which is inserted between the rotating and firm part. Such a sealing is usually cheap and is suitable for various designs. The disadvantage is the sliding friction of the contacting surfaces, and therefore there is limited utilization for high rotational speeds.

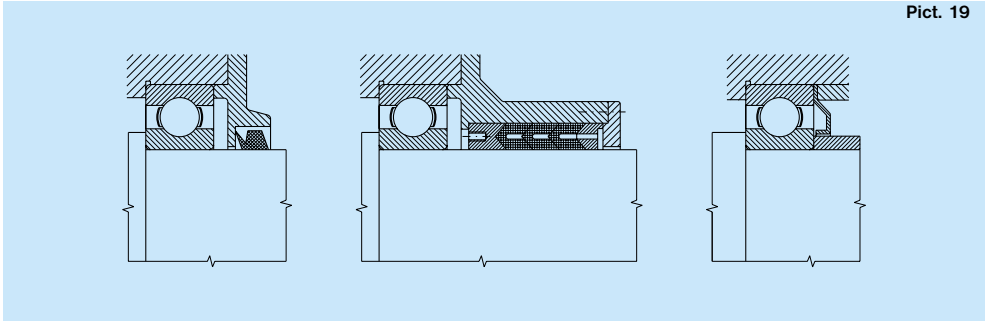
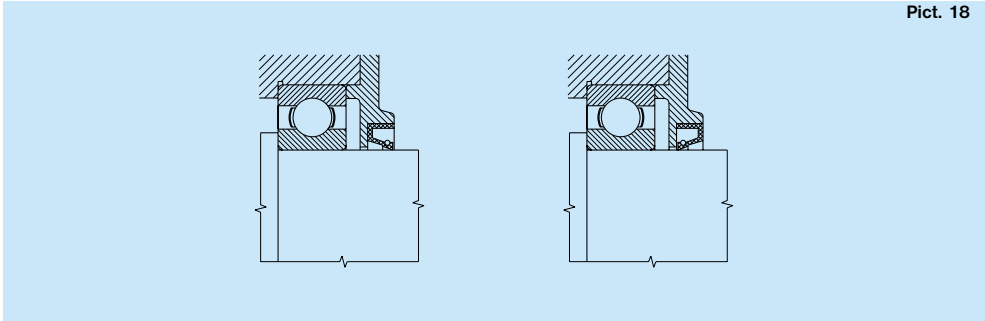
Sealing with a felt ring is the simplest (Pict. 17). It is suitable for operating temperature -40° to $+160^{\circ}\text{C}$ and for peripheral speeds to 7 m.s^{-1} and sliding surface roughness max. $R_a = 0,16$, hardness min. 45 HRC or hard chromium plating. Dimensions of the felt rings are given by corresponding national standards.

A very wide-spread way of sealing is sealing with shaft washers (Pict. 18). Radial shaft seal washers are made of rubber or other suitable plastic reinforced by steel sheet reinforcement. According to the material used they are suitable for operating temperature from -30° to $+160^{\circ}\text{C}$. Permissible peripheral speed depends on sliding surface roughness :

- to 2 m.s^{-1} is roughness max. $R_a = 0,8$
- to 4 m.s^{-1} is roughness max. $R_a = 0,4$
- to 12 m.s^{-1} is roughness max. $R_a = 0,2$

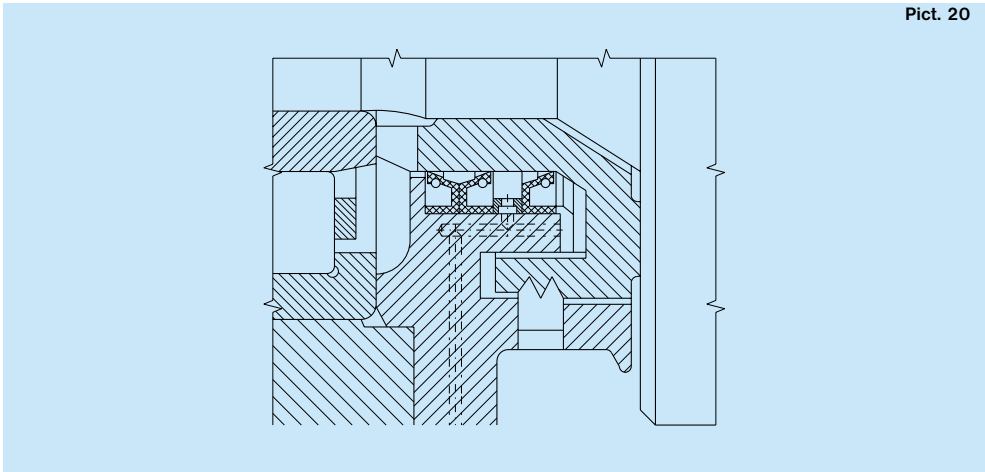


Except for mentioned most commonly used sealing rings there are rubbing sealing designs which use the just formed sealing rings made of rubber, plastic, etc., or special spring rings. This sealing is chosen either for applications with high requirements on bearing space sealing (great environment pollution, high temperature, chemical substance influence), or for economic reasons by mass or series production. Examples - see Pict. 19.



3.3.3 Combined Sealing

Increase sealing effect can be reached by non-contact and rubbing sealing combination. Such a sealing is recommended for wet and polluted environment. Example - see Pict. 20.



4. Bearing Lubrication

The correct bearing lubrication has a direct influence on the bearing life. Lubricant creates between the rolling element and bearing ring a carrying lubricating film which hinders their metal contact. It lubricates surfaces where friction arises, it has cooling effect, it protects the bearing from corrosion and in many cases seals the bearing space.

In the most cases - approximately 90%, bearings are lubricated with grease or oil, in rare exceptions by other lubricating means. When deciding which lubricant and which lubrication type should be used, operating conditions, characteristic qualities of the lubricant, equipment design and operating economy should be taken into account.

4.1 Grease Lubrication

In the design practice grease lubrication is preferred to oil lubrication from the point of view of arrangement simplicity, utilization of the sealing capabilities and simple maintenance.

For reliable bearing operation 1/3 to 1/2 of its free space is filled with grease at the first assembly. A greater grease amount has negative influence on the operation. Higher passive resistances cause the inner bearing space warming up undesirably, which can lead to its breakdown. Bearings making only a small number of revolutions during operation, from the point of view of corrosion protection should be completely filled.

4.1.1 Relubrication Interval

Relubrication interval is the period during which the grease has the necessary lubricating properties. After this period bearing must be relubricated, and old lubricant must be removed from the bearing space completely.

Relubricating period depends on the bearing type and size, rotational speed, operating temperature and grease quality. The recommended relubrication period for individual bearing types at normal load ($P \leq 0.15 C$) and normal operational conditions is shown in diagrams in Pict. 21 and 22. The diagrams are valid for common greases and temperatures to +70°C. For temperatures over +70°C, the relubrication period is shortened for each 15°C on the half of original value. For temperatures under +40°C the relubrication period can be doubled.

For small sized, especially single row ball bearings, the relubrication periods are several times longer than the bearing life, that is why the bearings are, as a rule, not relubricated.

For this reason it is advantageous to use these bearings shielded or sealed on both sides and filled with grease. For some rotational speeds the relubrication period is out of the diagram curve, i.e. the permissible limit for grease lubrication has been reached and oil lubrication should be used.

Necessary grease quantity for relubrication is calculated from the equation :

$$Q = 0.005 DB$$

Q - grease quantity

D - bearing outer diameter

B - bearing width

[g]

[g]

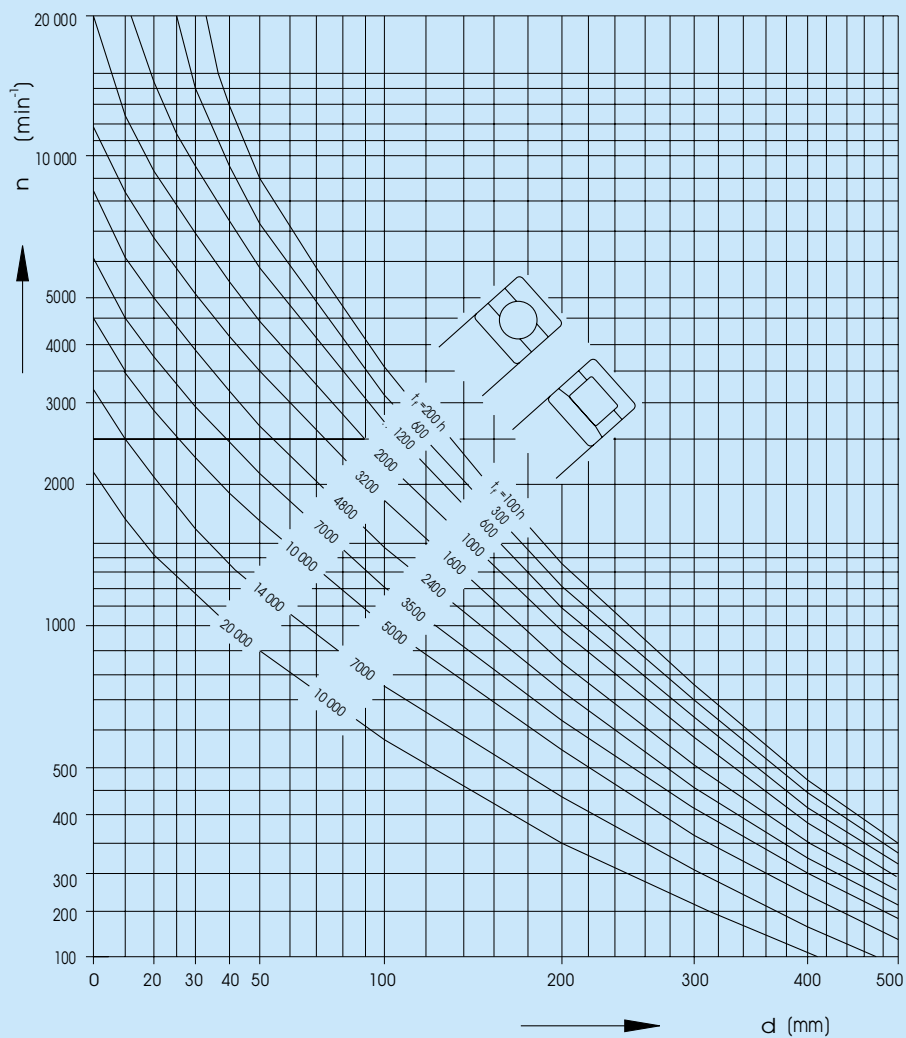
[mm]

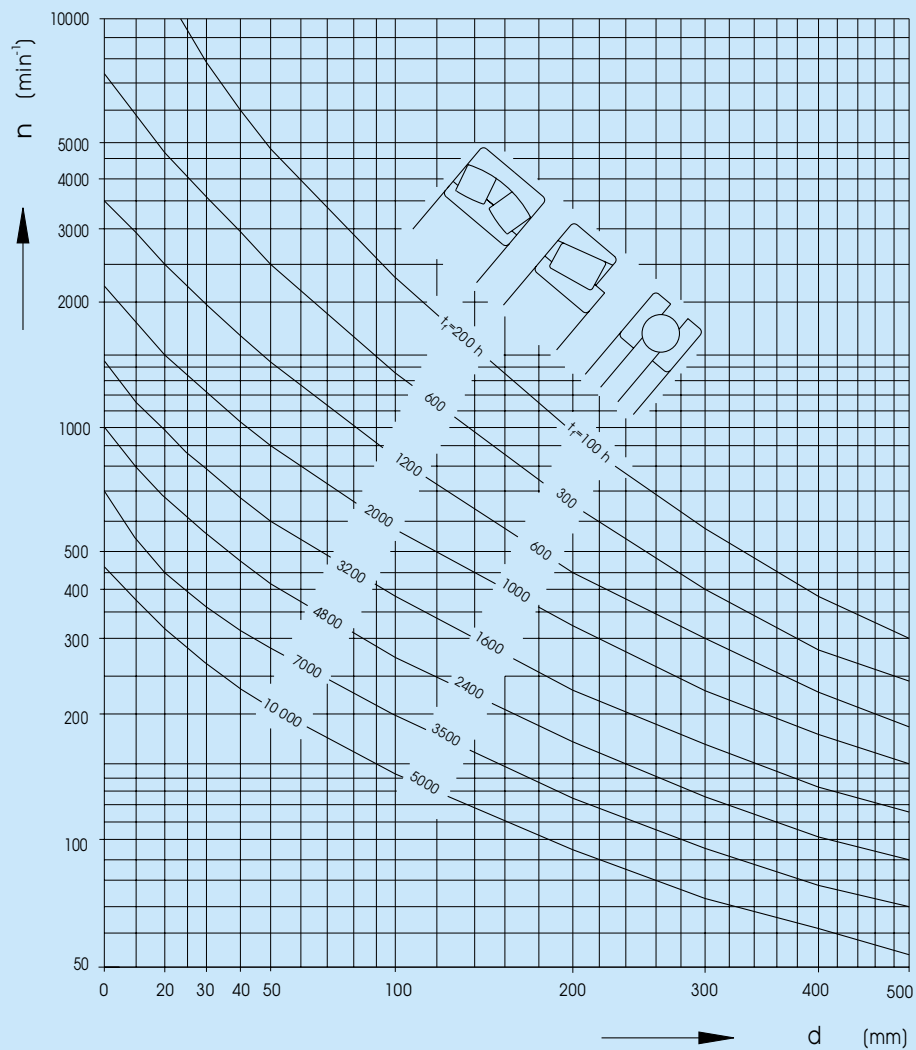
[mm]

For bearings with higher rotational speed requiring a more frequent relubrication, it is necessary to remove the used lubrication from the bearing space so that temperature increase should not occur. For this reason the grease escape valve is suitable.

4.1.2 Bearing Greases

Bearing greases are produced most often of quality mineral or synthetic oils (sometimes with additives), thickened with fatty acid metallic soaps. Greases must have good lubricating properties and high chemical, temperature and mechanical stability. The grease list of bearing lubricants is in Table 36.





Rolling Bearing Grease Properties			Table 36	
Kind of Grease		Properties		
Thickening Agent	Basic Oil	Operating Temperature Extent [°C]	Resistance against Water	Application
lithium soap	mineral	-20 ÷ 130	resistant	multi-purpose lubricant
lime soap	mineral	-20 ÷ 50	high resistance	good sealing effect against water
soda soap	mineral	-20 ÷ 100	irresistant	emulsifies with water
aluminium soap	mineral	-20 ÷ 70	resistant	good sealing effect against water
complex lithium soap	mineral	-20 ÷ 150	resistant	multi-purpose lubricant
complex lime soap	mineral	-30 ÷ 130	high resistance	multi-purpose lubricant suitable for higher temperatures and load
complex soda soap	mineral	-20 ÷ 130	resistant	suitable for higher temperature and load
complex aluminium soap		-20 ÷ 150	mineral	suitable for higher temperature and load
complex barium soap	mineral	-30 ÷ 140	resistant	suitable for higher temperature and load
bentonite	mineral		resistant	suitable for high temperatures at low rotational speed
polyurea	mineral	-20 ÷ 160	resistant	suitable for high temperatures at medium rotational speed
lithium soap	silicon	-40 ÷ 170	high resistance	suitable for wide temperature range at medium rotational speed
complex barium soap	ester	-60 ÷ 140	resistant	suitable for higher temperatures and higher rotational speeds

4.2 Oil Lubrication

Oil lubrication is used, when operating rotational speed is so high that the grease relubrication period is too short. Another reason can also be the necessity of heat transfer from the bearing, or the high temperature of environment, which does not enable utilization of grease, or if surrounding parts are already lubricated by oil (e.g. geared wheels in the gear box). Except for some cases, spherical roller thrust bearings are always lubricated by oil.

When oil lubricating, lubricating must be secured both at starting and during operation. Excess oil increases temperature and bearing temperature.

Oil feed into bearing is secured in various design ways, out of which oil bath lubrication with oil level reaching middle of the lowest rolling element, oil circulation lubrication, jet lubrication, oil mist lubrication etc., are the most common.

4.2.1 Bearing Oils

For bearing lubrication mostly refined oils with good chemical stability which can be improved by antioxidizing agents are used.

The decisive oil property is kinematic viscosity which decreases with increasing temperature. Suitable oil viscosity ν_1 can be stated according to the diagram in Pict. 23 in dependence on the bearing mean diameter $d_s = (d+D)/2$ and rotational speed n . If the operating temperature is known or it can be found out, according to the diagram in Pict. 24 suitable oil and viscosity ν at internationally standardized temperature 40°C being necessary for calculation of ratio α is determined.

By ratio $\alpha < 1$ it is recommended to use EP oil with additives which improve the oil film load rating. By value α decrease under 0.4 oils with EP additives are always used.

If the ratio α is greater than 1, improved arrangement reliability is reached in operation.

Example :

- bearing $d = 180$ mm, $D = 320$ mm, $d_s = 250$ mm

- rotational speed $n = 500$ min⁻¹

- presumed operating temperature 60°C

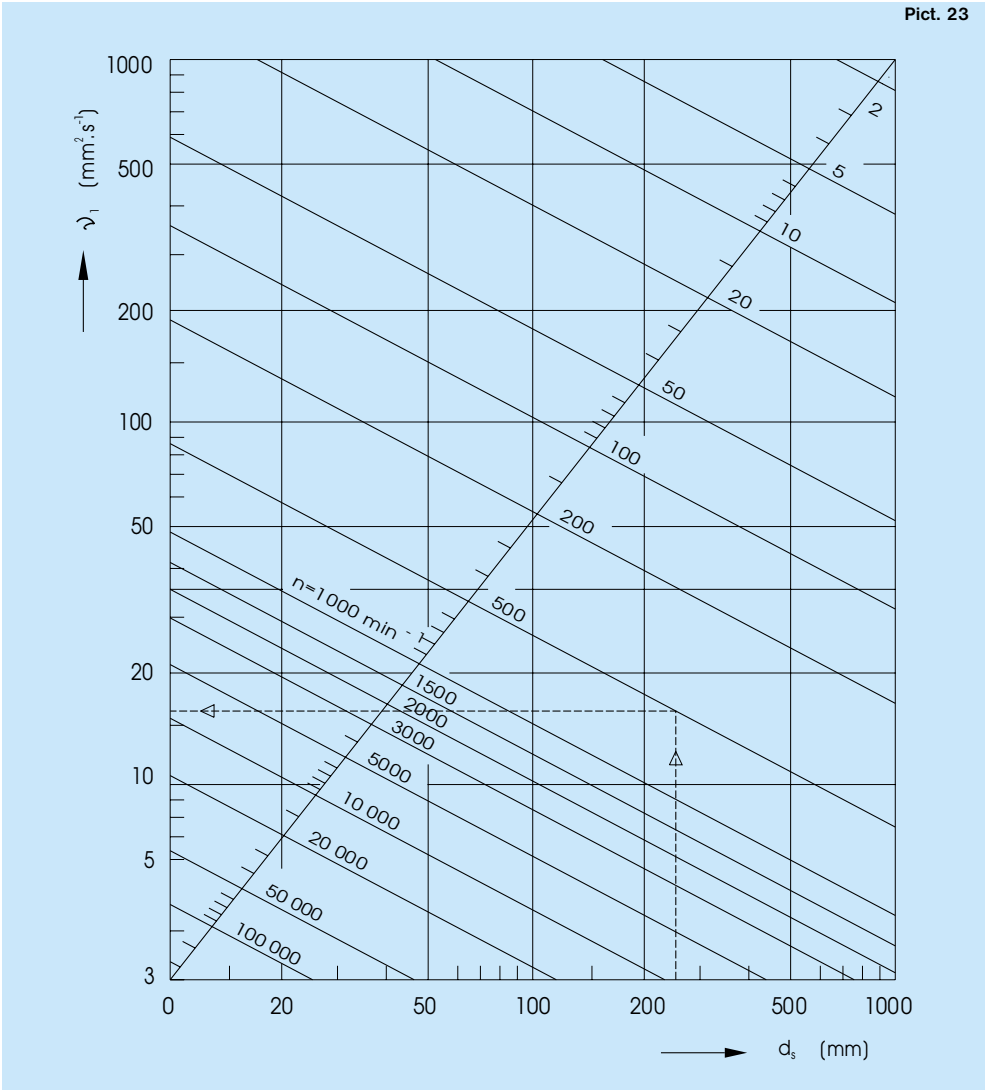
For these conditions according to diagram in Pict. 23 the minimum kinematic viscosity is

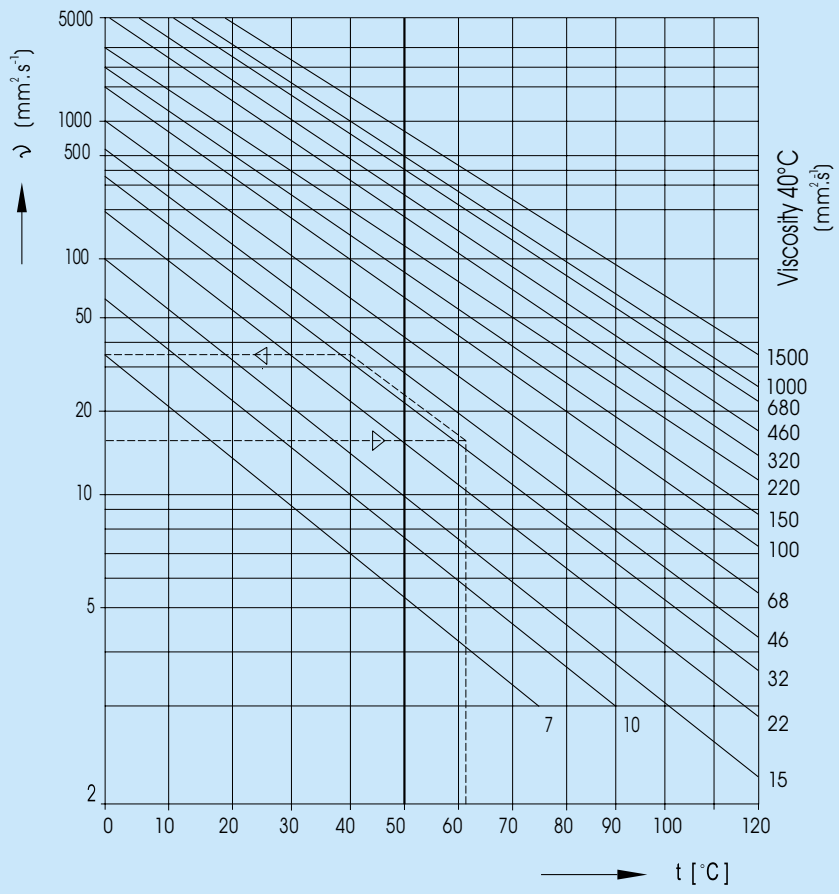
$\nu_1 = 17$ mm².s⁻¹.

If the operating temperature is 60°C, the oil selected according to the diagram in Pict. 24 at standardized temperature 40°C must have kinematic viscosity ν min. 35 mm².s⁻¹.

For thrust spherical roller bearings the lubricating oil kinematic viscosity is approximately stated in dependence on $n \times d$, where n is the bearing rotational speed in revolutions per minute and d is the bore diameter in mm, according to table 37. Lower values are valid for bearings with lower load, for which is valid $P_a \leq 0.1 C_a$. Higher values are valid for $P_a > 0.1 C_a$.

Oil Viscosity for Spherical Roller Thrust Bearings		Table 37
d.n	Kinematic Oil Viscosity	
	mm ² .s ⁻¹ at 40°C	
1 000	250 to 550	
10 000	100 to 250	
100 000	45 to 100	
200 000	30 to 80	





4.3 Lubrication with Solid Lubricants

Solid lubricants are used for bearing lubrication when the grease or oil cannot fulfil the requirements for reliable lubrication in conditions of limiting friction or from the viewpoint of high operating temperatures, chemical influences, etc.

5. Mounting and Dismounting of Rolling Bearings

A very important requirement besides using the suitable mounting or dismounting tool is to make sure these tools are clean and the whole operation can be carried out in clean working environment. If this is not fulfilled, the impurities have decisive influence on the bearing behaviour in operation and can also cause bearing breakdown. In the same way the cleanliness conditions must be fulfilled by the preparation of all lubricating means and components connected with the arrangement.

New bearings are preserved by manufacturer with preservatives which need not be removed before mounting. Bearings should be taken out just before mounting. Rarely the preservative is removed from the bearing. For this operation are used:

- gas with 5 to 10% oil additive
- benzol
- diesel fuel
- water-free oil

After washing the bearing should be oiled, preserved from pollution and mounted as soon as possible.

Before mounting, the seating surfaces dimensions should be checked for cleanliness or damage.

Mounting of Bearings with Cylindrical Bore

Bearings with cylindrical bore are mounted on the shaft at room temperature or heated. Dimensionally smaller bearings are mostly mounted at room temperature.

The force necessary for mounting is reached by hammer blows or more suitably by press. In both cases mounting jig is used. At mounting it is not permissible to transfer the mounting force through rolling elements. That is why the jig must always be placed on the ring or both rings being mounted while the mounting force is acting.

Heat mounting is used for greater bearings whose rings are fitted with a greater interference. Maximum heating temperature of the bearing is 100°C.

Mounting of Bearings with Tapered Bore

Bearings with a tapered bore are mounted on the shaft by means of adapter or withdrawal sleeves or are seated directly on the tapered journal. Reliable mounting is reached either by pressing the inner ring by a nut, or by sufficient inserting of the sleeve. In both cases the inner ring expands and bearing radial clearance decreases.

When mounting double row self aligning ball bearings the adapter sleeve nut can be tightened, but only to such an extent that the outer ring can be easily turned and swivelled.

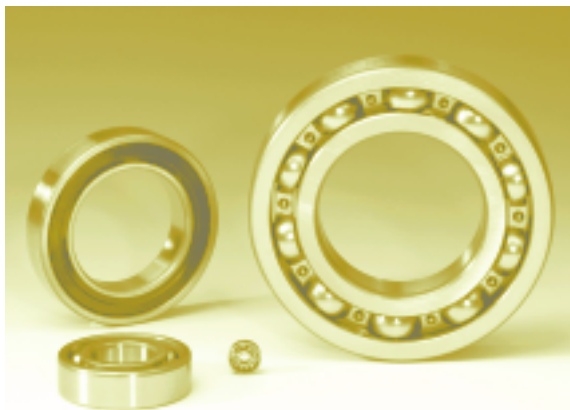
A double row spherical roller bearing is mounted with a greater interference. Mounting reliability is checked according to radial clearance reduction by means of feeler gauges or measuring the axial displacement of the inner ring on the journal or tapered sleeve. Initial position for measuring this displacement is reached, when the contact surfaces (of the ring, sleeve, shaft) seat on each other on the whole seating surface. Values for mounting double row spherical roller bearings with tapered bore are shown in table 38.

Mounting of Double Row Spherical Roller Bearings with Tapered Bore										Table 38
Bore Diameter		Radial Clearance Reduction		Axial Displacement on Taper 1: 12				Bearing Minimum Permissible Radial Clearance		
d over	to	min	max	on Shaft min	max	on Sleeve min	max	normal	with Clearance C3	C4
mm		μm		mm				μm		
30	40	20	25	0.35	0.4	0.35	0.45	15	20	40
40	50	25	30	0.4	0.45	0.45	0.5	20	30	50
50	65	30	40	0.45	0.6	0.5	0.7	25	35	55
65	80	40	50	0.6	0.75	0.7	0.85	25	40	70
80	100	45	60	0.7	0.9	0.75	1	35	50	80
100	120	50	70	0.75	1.1	0.8	1.2	50	65	100
120	140	65	90	1.1	1.4	1.2	1.5	55	80	110
140	160	75	100	1.2	1.6	1.3	1.7	55	90	130
160	180	80	110	1.3	1.7	1.4	1.9	60	100	150
180	200	90	130	1.4	2	1.5	2.2	70	100	160
200	225	100	140	1.6	2.2	1.7	2.4	80	120	180
225	250	110	150	1.7	2.4	1.8	2.6	90	130	200
250	280	120	170	1.9	2.7	2	2.9	100	140	220
280	315	130	190	2	3	2.2	3.2	110	150	240
315	355	150	210	2.4	3.3	2.6	3.6	120	170	260
355	400	170	230	2.6	3.6	2.9	3.9	130	190	290
400	450	200	260	3.1	4.1	3.4	4.4	130	200	310
450	500	210	280	3.3	4.4	3.6	4.8	160	230	350
500	560	240	320	3.7	5	4.1	5.4	170	250	360
560	630	260	350	4	5.4	4.4	5.9	200	290	410
630	710	300	400	4.6	6.2	5.1	6.8	210	310	450
710	800	340	450	5.3	7	5.8	7.6	230	350	510
800	900	370	500	5.7	7.8	6.3	8.5	270	390	570

Rolling Bearings Dimension Tables

Single Row Deep Groove Ball Bearings	
Single Row Angular Contact Ball Bearings	
Double Row Angular Contact Ball Bearings	
Double Row Self-Aligning Ball Bearings	
Single Row Cylindrical Roller Bearings	
Double Row Cylindrical Roller Bearings	
Single Row Needle Roller Bearings	
Double Row Spherical Roller Bearings	
Tapered Roller Bearings	
Thrust Ball Bearings	
Spherical Roller Thrust Bearings	
Insert Ball Bearing Units	
Spherical Plain Bearings	
Accessories of Rolling Bearings	
Rolling Elements	
Special Rolling Bearings	

Single Row Deep Groove Ball Bearings



Single row deep groove ball bearings are the most common bearing type and are designed as non-separable and are without a filling slot. Good conformity to raceways is achieved by optimum size and number of balls and relatively high load ratings are achieved. They accommodate both radial and axial loads in both directions and are suitable for high rotational speeds.

Outer ring design of separable single row ball bearings - type E and BO enables separate mounting of inner ring with cage and rolling elements. The bearings are produced from bore diameter $d = 20$ mm and are suitable for smaller loads and high-rotational applications.

Boundary Dimensions

Boundary dimensions except for separable single row ball bearings - type E and BO correspond to the standard ISO 15.

Snap ring groove dimensions comply with the standard ISO 464.

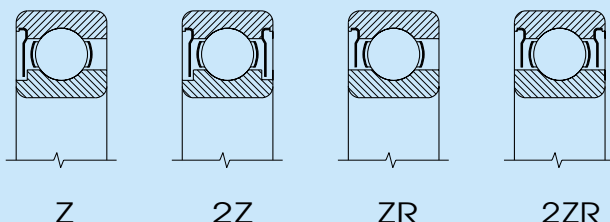
Designation

Bearing designation in standard design and common modifications (Z, RS, 2Z, 2RS, N) are shown in the dimension tables. Deviation from standard design is designated by prefixes and suffixes (section 2.2).

Shielded or Sealed Bearings

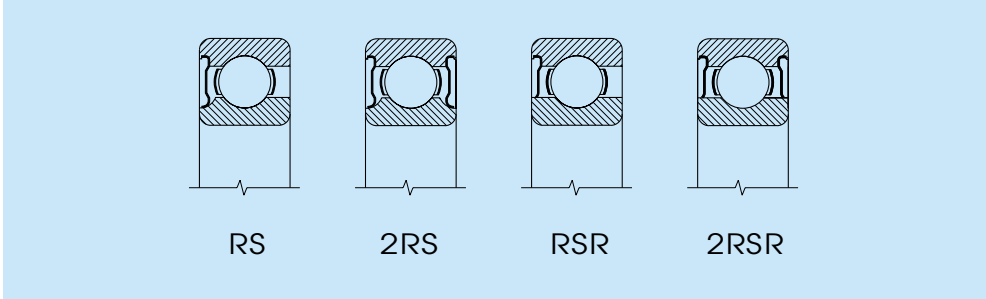
Single row deep groove ball bearings with shields or seals on one or both sides are produced with metal shields (Z, 2Z, ZR, 2ZR) or seals (RS, 2RS, RSR, 2RSR) as non-separable units.

The shields create a non-contact sealing. Sealing rings are made of rubber, vulcanized on a metal reinforcing ring and act in the bearing as an effective friction type sealing.



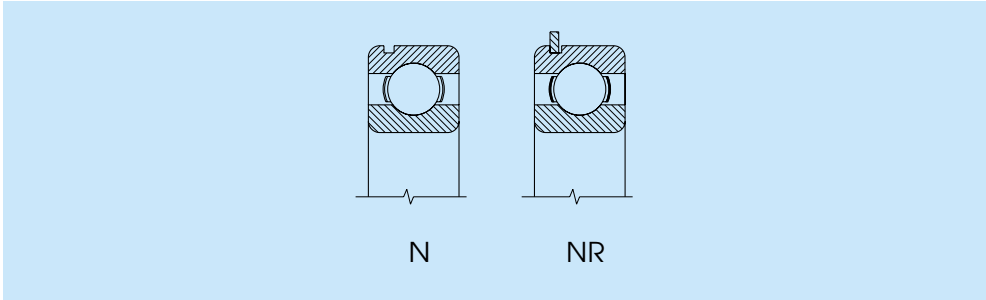
Bearings with sealings on both sides are filled with grease which assures reliable lubricating conditions for the whole bearing life. These bearings are suitable for

temperature ranges of -30°C to +110°C. Delivery of bearings with another grease must be agreed with the supplier in advance.



Bearings with Snap Ring Groove

For simple securing against axial displacement in the housing single row ball bearings with snap groove on outer ring are manufactured (N). When the bearing is delivered with inserted snap ring, it is designated (NR). Bearings with a snap ring groove can also be delivered with assembled seals.



Cage

Single row ball bearings in standard design usually have a cage according to the table. Material symbol (J, Y, M, F) and design of the cage are not mostly indicated.

Bearings with Pressed Steel or Brass Cage	Bearings with Machined Brass or Steel Cage
d<10mm (619/2 to 629) ¹⁾	-
-	61926
16001 to 16030	-
6000 to 6034	6036 to 6040
6200 to 6230	6232 to 6240
6300 to 6324	6326 to 6330
6403 to 6417	6418
E15 to E20, BO17	-

1) Bearing 618/8 is made with a solid cage made of polyamide (TNH)

For special arrangements bearings with different cages made of various materials are produced: polyamide (TNH, TNB) and textite (TB). Using of these bearings should be discussed in advance.

Tolerance

Single row ball bearings are produced in normal tolerance class P0, this symbol is not indicated. Limiting values for dimension and operation accuracy comply with the standard ISO 199 and ISO 492. Exceptions are only separable single row ball bearings - type E and BO, outer diameter of which has limiting deviation D +0.01/0.00 mm.

Radial Clearance

Single row ball bearings delivered without radial clearance designation are produced with normal radial clearance. Radial clearance values comply with the standard ISO 5753.

Vibration Level

Commonly manufactured single row ball bearings have a normal vibration level checked by the manufacturer. Bearings in tolerance class P5 and higher have the vibration level C6. For special arrangements bearings with reduced vibration level C6, C06 and C66 are produced.

Tapered Bore

For some less demanding arrangements some sizes of single row ball bearings - type 62 and 63 with tapered bore, taper 1:12 can be produced. Fixing of bearings on the cylindrical journal is made by means of adapter sleeves or directly on the tapered journal.

Bearings for Arrangements at High Operating Temperatures

For arrangements working at operating temperature to 400°C single row bearings with adequately great radial clearance according to technical conditions between producer and customer are delivered.

These bearings have reduced basic dynamic load rating in average of 50% and basic static load rating of 30% in comparison with bearings in standard design.

Misalignment

For single row ball bearings only small mutual misalignment of bearing rings is permissible, therefore alignment deviation of seating surfaces can be very small. Misalignment causes additional loading of the bearing and thus its life is shortened.

Values of permissible misalignment at normal operating conditions are shown in the table.

Bearing Type	Load	
	light ($F_r<0.15C_{or}$)	heavy ($F_r\geq0.15C_{or}$)
618, 619, 160, 60	2' to 6'	5'to 10'
62, 63, 64	5'to 10'	8'to 16'

Radial Equivalent Dynamic Load
Single Row Ball Bearings

$$P_r = XF_r + YF_a$$

[kN]

	Radial Clearance														
$\frac{F_a}{C_{or}}$	normal					C3					C4				
	$F_a/F_r \leq e$ $F_a/F_r > e$					$F_a/F_r \leq e$ $F_a/F_r > e$					$F_a/F_r \leq e$ $F_a/F_r > e$				
	e	X	Y	X	Y	e	X	Y	X	Y	e	X	Y	X	Y
	e	X	Y	X	Y	e	X	Y	X	Y	e	X	Y	X	Y
0.025	0.22	1	0	0.56	2.0	0.31	1	0	0.46	1.75	0.4	1	0	0.44	1.42
0.04	0.24	1	0	0.56	1.8	0.33	1	0	0.46	1.62	0.42	1	0	0.44	1.36
0.070	0.27	1	0	0.56	1.6	0.36	1	0	0.46	1.46	0.44	1	0	0.44	1.27
0.13	0.31	1	0	0.56	1.4	0.41	1	0	0.46	1.30	0.48	1	0	0.44	1.16
0.25	0.37	1	0	0.56	1.2	0.46	1	0	0.46	1.14	0.53	1	0	0.44	1.05
0.5	0.44	1	0	0.56	1.0	0.54	1	0	0.46	1.0	0.56	1	0	0.44	1.0

Factor X and Y values are valid, if the bearings on the journal and in the housing will be fitted in tolerances recommended for small and medium loads (tables 28 and 29) and during operation significant reduction of radial clearance due to operating temperature does not come into being (temperature gradient between inner and outer ring max. 10°C).

Separable Single Row Ball Bearings:

$P_r = F_r$	for $F_a / F_r \leq 0.2$	[kN]
$P_r = 0.5 F_r + 2.5 F_a$	for $F_a / F_r > 0.2$	[kN]

Radial Equivalent Static Load :

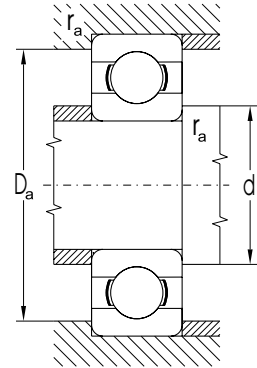
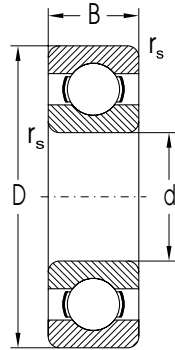
Single Row Deep Groove Ball Bearings :

$P_{or} = 0.6F_r + 0.5F_a$	$(P_{or} \geq F_r)$	[kN]
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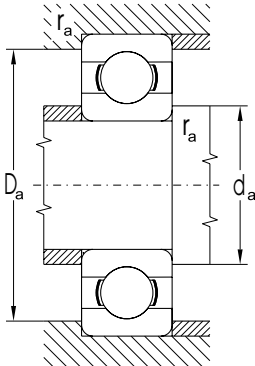
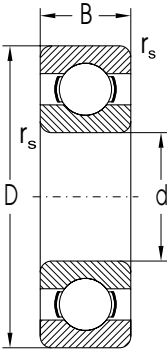
Separable Single Row Ball Bearings:

$P_{or} = 0.9F_r + 0.3F_a$	$(P_{or} \geq F_r)$	[kN]
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d = 2 to 17 mm

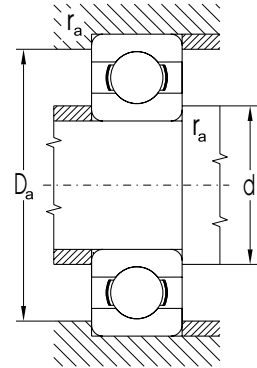
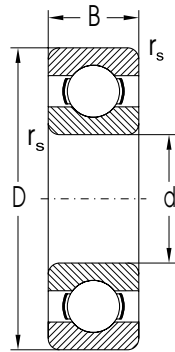
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Single Row Deep Groove Ball Bearings
d = 20 to 50 mm



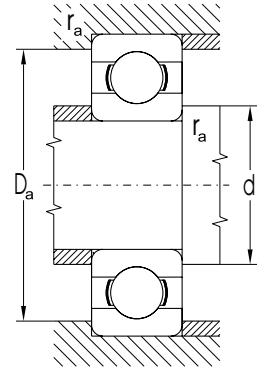
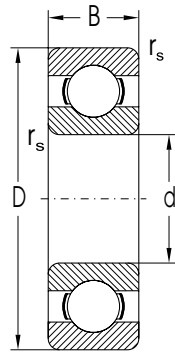
Dimensions				Basic Load Rating		Limiting Speed		Bearing Designation	Abutment and Fillet Dimensions				Weight ~
d	D	B	r _s min	Dynamic C _r	Static C _{or}	for Lubrication with			d	d _a	D _a	r _a	
						Grease	Oil		min		max	max	
mm				kN		min ⁻¹			mm				kg
20	42	8.0	0.3	9.371	4.972	17000	20000	16004D 6004 6204 62204 63204 6304 62304	20	22	40	0.3	0.0500
	42	12.0	0.6	9.371	4.972	17000	20000			24	38	0.6	0.0700
	47	14.0	1.0	12.774	6.553	15000	18000			25	42	1.0	0.1080
	47	18.0	1.0	12.774	6.553	15000	18000			25	42	1.0	0.1300
	47	20.6	1.0	12.774	6.553	15000	18000			25	42	1.0	0.1460
	52	15.0	1.1	15.866	7.811	14000	17000			26	45	1.0	0.1450
	52	21.0	1.1	15.866	7.811	14000	17000			26	45	1.0	0.2000
25	47	8.0	0.3	6.950	4.550	14000	17000	16005 16005D 6005 6205 62205 6305 62305 6405	25	27	43	0.3	0.0530
	47	8.0	0.3	10.070	5.806	14000	17000			27	43	0.3	0.0530
	47	12.0	0.6	10.070	5.806	14000	17000			28	43	0.6	0.0820
	52	15.0	1.0	14.029	7.940	12000	15000			30	47	1.0	0.1290
	52	18.0	1.0	14.029	7.940	12600	15000			30	47	1.0	0.1500
	62	17.0	1.1	21.123	10.806	11000	13000			31	55	1.0	0.2300
	62	24.0	1.1	21.123	10.806	11000	13000			31	55	1.0	0.3200
	80	21.0	1.5	36.000	19.200	9400	11000			34	70	1.5	0.5300
30	55	9.0	0.3	11.200	7.360	12000	14000	16006 6006 6206 62206 6306 6406	30	32	53	0.3	0.0870
	55	13.0	1.0	13.243	8.250	12000	14000			34	50	1.0	0.1190
	62	16.0	1.0	19.443	11.186	11000	13000			35	57	1.0	0.2000
	62	20.0	1.0	19.443	11.186	11000	13000			35	57	1.0	0.2400
	72	19.0	1.1	29.701	15.678	10000	12000			36	65	1.0	0.3310
	90	23.0	1.5	43.000	23.700	8400	10000			39	80	1.5	0.7250
35	62	9.0	0.3	9.960	7.362	10600	12600	16007 6007 6207 6307 6407	35	37	60	0.3	0.1110
	62	14.0	1.0	15.956	10.328	10600	12600			39.5	57	1.0	0.1540
	72	17.0	1.1	25.663	15.227	9400	11000			42	65	1.0	0.2840
	80	21.0	1.5	33.367	19.230	8400	10000			42	71	1.5	0.4470
	100	25.0	1.5	55.200	31.000	7500	8900			44	90	1.5	0.9540
40	68	9.0	0.3	12.667	9.617	9400	11000	16008 6008 6208 6308 6408	40	42	62	0.3	0.1250
	68	15.0	1.0	16.824	11.493	9400	11000			44	63	1.0	0.1910
	80	18.0	1.1	32.633	19.887	8400	10000			47	73	1.0	0.3490
	90	23.0	1.5	40.760	24.170	7900	9400			47	81	1.5	0.6250
	110	27.0	2.0	63.100	36.200	6700	7900			50	97	2.0	1.1230
45	75	10.0	0.6	15.659	12.172	8400	10000	16009 6009 6209 6309 6409	45	49	71	1.0	0.1700
	75	16.0	1.0	21.100	15.300	8400	10000			49	70	1.0	0.2410
	85	19.0	1.1	32.678	20.325	7900	9400			52	78	1.0	0.4040
	100	25.0	1.5	52.804	31.715	7100	8400			52	91	1.5	0.8280
	120	29.0	2.0	76.500	44.700	6000	7100			55	107	2.0	1.5400
50	80	10.0	0.6	16.092	13.147	7900	9400	16010 6010 6210 6310 6410	50	54	76	0.6	0.1880
	80	16.0	1.0	21.720	16.650	7900	9400			54	75	1.0	0.2600
	90	20.0	1.1	35.066	23.226	7100	8400			57	83	1.0	0.4600
	110	27.0	2.0	61.754	37.754	6300	7500			60	100	2.0	1.0600
	130	31.0	2.1	87.400	52.100	5600	6700			63	116	2.0	1.8900

d = 55 to 90 mm

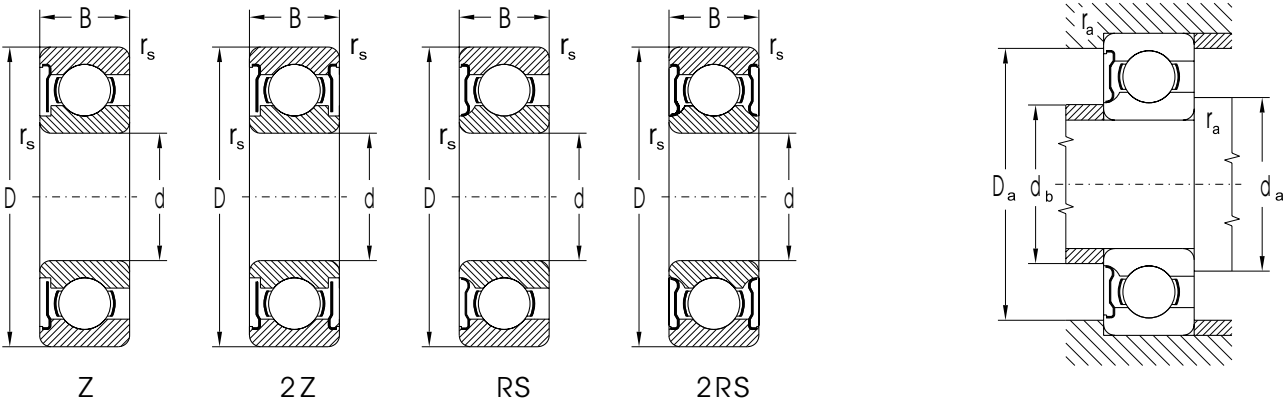


Dimensions				Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation	Abutment and Fillet Dimensions				Weight ~
d	D	B	r _s min	Dynamic C _r	Static C _{or}				d	d _a	D _a	r _a	
						Grease	Oil		minmaxmax				
mm				kN		min ⁻¹			mm				kg
55	90	18.0	1.1	28.216	21.318	7100	8400	6011	55	60	84	1.0	0.3830
	100	21.0	1.5	43.350	29.397	6700	7900	6211		62	91	1.5	0.5970
	120	29.0	2.0	71.000	44.700	5600	6700	6311		65	110	2.0	1.3800
	140	33.0	2.1	100.000	61.900	5300	6300	6411		68	126	2.0	2.2900
60	95	18.0	1.1	29.343	23.256	6700	7900	6012	60	65	88	1.0	0.4110
	110	22.0	1.5	52.846	35.786	6000	7100	6212		67	101	1.5	0.7710
	130	31.0	2.1	81.500	52.100	5300	6300	6312		72	118	2.0	1.7200
	150	35.0	2.1	110.000	69.400	4700	5600	6412		73	136	2.0	2.7600
65	100	11.0	0.6	21.200	19.600	6300	7500	16013	65	69	96	0.6	0.3000
	100	18.0	1.1	30.500	25.100	6300	7500	6013		70	93	1.0	0.4370
	120	23.0	1.5	57.210	40.011	5300	6300	6213		72	111	1.5	0.9970
	140	33.0	2.1	92.600	59.600	5000	6000	6313		76	128	2.0	2.1000
	160	37.0	2.1	117.950	78.329	4500	5300	6413		78	146	2.0	3.2800
70	110	13.0	0.6	27.600	25.100	5600	6700	16014	70	74	106	0.6	0.4330
	110	20.0	1.1	37.960	30.959	5600	6700	6014		75	103	1.0	0.6040
	125	24.0	1.5	62.000	43.800	5300	6300	6214		77	116	1.5	1.0700
	150	35.0	2.1	104.000	63.100	4700	5600	6314		81	138	2.0	2.5400
	180	42.0	3.0	144.000	104.000	4000	4700	6414		85	164	2.5	4.8500
75	115	13.0	0.6	28.700	26.600	5300	6300	16015	75	79	111	0.6	0.4570
	115	20.0	1.1	39.747	33.170	5300	6300	6015		80	108	1.0	0.6380
	130	25.0	1.5	66.179	49.311	5000	6000	6215		82	122	1.5	1.1800
	160	37.0	2.1	114.000	76.400	4200	5000	6315		86	148	2.0	3.0600
	190	45.0	3.0	152.525	112.922	3800	4500	6415		90	174	2.5	5.7400
80	125	14.0	0.6	32.900	31.600	5000	6000	16016	80	84	121	0.6	0.5970
	125	22.0	1.1	47.500	39.800	5000	6000	6016		85	118	1.0	0.8450
	140	26.0	2.0	72.200	53.100	4700	5600	6216		90	130	2.0	1.4000
	170	37.0	2.1	122.850	86.226	4000	4700	6316		91	158	2.0	3.6300
	200	48.0	3.0	163.587	124.984	3500	4200	6416		95	184	2.5	6.7200
85	130	14.0	0.6	34.100	32.900	4700	5600	16017	85	89	126	0.6	0.6260
	130	22.0	1.1	49.794	42.609	4700	5600	6017		90	123	1.0	0.8920
	150	28.0	2.0	83.299	63.675	4200	5000	6217		95	140	2.0	1.8000
	180	41.0	3.0	132.507	96.069	3800	4500	6317		98	166	2.5	4.2000
	210	52.0	4.0	174.000	136.000	3300	4000	6417		105	190	3.0	7.8800
90	140	24.0	1.5	58.400	49.200	4500	5300	6018	90	96	132	1.5	1.1700
	160	30.0	2.0	96.200	70.800	4000	4700	6218		100	150	2.0	2.1600
	190	43.0	3.0	144.000	108.000	3500	4200	6318		103	176	2.5	4.9500
	225	54.0	4.0	192.000	158.000	3200	3800	6418		110	205	3.0	11.4000

d = 95 to 170 mm

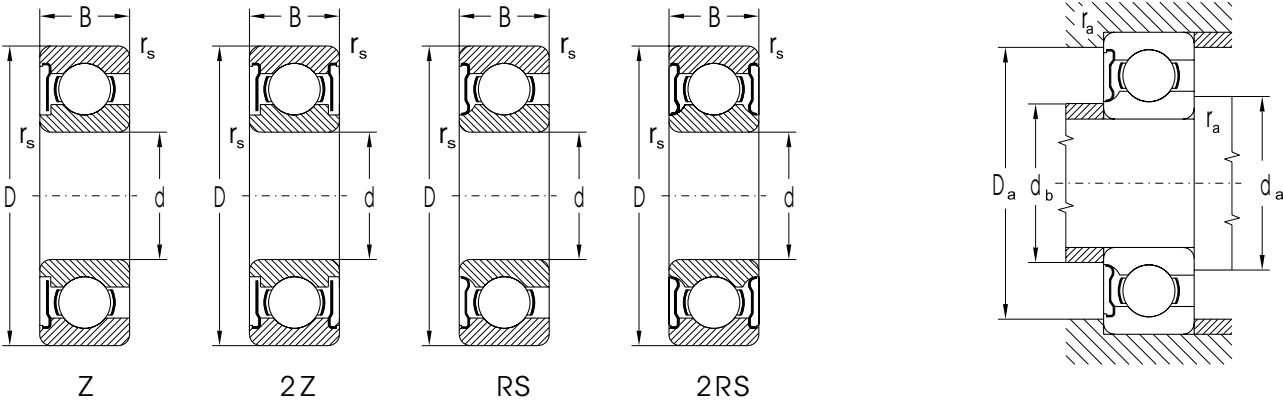
74

Single Row Deep Groove Ball Bearings with Seals or Shields
d = 3 to 25 mm

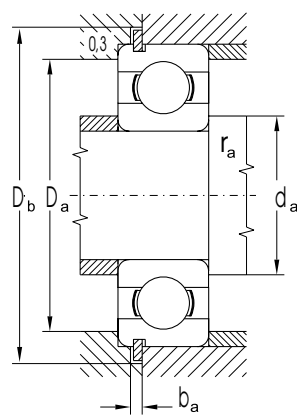


Dimensions				Basic Load Rating		Bearing Designation				Limiting Speed for Lubrication with			Abutment and Fillet Dimensions					Weight
d	D	B	r _s min	C _r	C _{or}	Z, ZR	2Z, 2ZR	RS, RSR	2RS, 2RSR	Z, 2Z	RS, 2RS	Oil Z	d min	d _a max	d _b max	D _a max	r _a	~
mm				kN						min ⁻¹			mm					kg
3	10	4.0	0.15	0.645	0.229	623ZR	623-2ZR			40000		50000	3	4.2	4.8	8.5	0.1	0.0020
4	13	5.0	0.2	1.168	0.412	624ZR	624-2ZR			38000		45000	4	5.5	5.8	11.2	0.2	0.0040
	16	5.0	0.3	1.875	0.677	634ZR	634-2ZR			35000		42000		6.2	6.5	13.4	0.3	0.0050
5	16	5.0	0.3	1.875	0.677	625ZR	625-2ZR			35000		42000	5	7.0	7.0	14.0	0.3	0.0060
	19	6.0	0.3	2.838	1.078	635ZR	635-2ZR			35000		42000		7.2	7.5	15.8	0.3	0.0090
6	19	6.0	0.3	2.838	1.078	626ZR	626-2ZR			35000		42000	6	8.2	8.3	17.0	0.3	0.0100
7	19	6.0	0.3	2.838	1.078	607ZR	607-2ZR			35000		42000	7	9.0	9.0	17.0	0.3	0.0100
	22	7.0	0.3	3.282	1.356	627ZR	627-2ZR			35000		42000		9.2	9.8	19.5	0.3	0.0120
8	22	7.0	0.3	3.282	1.356	608ZR	608-2ZR	608RSR	608-2RSR	35000	24000	42000	8	10.0	10.0	20.0	0.3	0.0150
9	24	7.0	0.3	3.668	1.640	609ZR	609-2ZR	609RSR	609-2RSR	35000	24000	42000	9	11.0	12.0	22.0	0.3	0.0180
	26	8.0	0.3	4.557	1.955	629ZR	629-2ZR	629RSR	629-2RSR	35000	24000	42000		12.0	12.5	22.5	0.3	0.0200
10	26	8.0	0.3	4.557	1.955	6000ZR	6000-2ZR	6000RSR	6000-2RSR	28000	19000	33000	10	12.0	12.5	24.0	0.3	0.0200
	30	9.0	0.6	6.047	2.510	6200ZR	6200-2ZR	6200RSR	6200-2RSR	25000	17000	30000		14.0	14.4	26.0	0.6	0.0320
	30	14.0	0.6	6.047	2.510	62200ZR	62200-2ZR	62200RSR	62200-2RSR	25000	17000	30000		14.0	14.4	26.0	0.6	0.0400
	35	11.0	0.6	8.072	3.430	6300ZR	6300-2ZR	6300RS	6300-2RS	22000	15000	27000		14.0	15.0	31.0	0.6	0.0530
12	28	8.0	0.3	5.094	2.360	6001ZR	6001-2ZR	6001RSR	6001-2RSR	25000	17000	30000	12	14.0	14.5	26.0	0.3	0.0220
	32	10.0	0.6	6.905	3.100	6201ZR	6201-2ZR	6201RSR	6201-2RSR	22000	15000	27000		16.0	16.5	28.0	0.6	0.0370
	32	14.0	0.6	6.905	3.100	62201ZR	62201-2ZR	62201RS	62201-2RS	22000	15000	27000		16.0	16.5	28.0	0.6	0.0450
	37	12.0	1.0	9.759	4.235	6301ZR	6301-2ZR	6301RS	6301-2RS	20000	13000	24000		17.0	17.0	32.0	1.0	0.0600
15	32	9.0	0.3	5.594	2.860	6002ZR	6002-2ZR	6002RS	6002-2RS	21000	14000	25000	15	17.0	18.0	30.0	0.3	0.0310
	35	11.0	0.6	7.718	3.745	6202ZR	6202-2Z	6202RS	6202-2RS	20000	13000	24000		19.0	19.5	31.0	0.6	0.0450
	35	14.0	0.6	7.718	3.745	62202ZR	62202-2ZR	62202RS	62202-2RS	20000	13000	24000		19.0	19.5	31.0	0.6	0.0540
	42	13.0	1.0	11.310	5.335	6302ZR	6302-2ZR	6302RS	6302-2RS	18000	12000	21000		20.0	20.5	36.0	1.0	0.0820
17	35	10.0	0.3	5.999	3.265	6003ZR	6003-2ZR	6003RS	6003-2RS	20000	13000	24000	17	19.0	20.0	33.0	0.3	0.0400
	40	12.0	0.6	9.534	4.734	6203ZR	6203-2Z	6203RS	6203-2RS	18000	12000	21000		21.0	21.4	36.0	0.6	0.0650
	40	16.0	0.6	9.534	4.734	62203ZR	62203-2Z	62203RS	62203-2RS	18000	12000	21000		21.0	21.4	36.0	0.6	0.0830
	47	14.0	1.0	13.565	6.563	6303ZR	6303-2ZR	6303RS	6303-2RS	16000	10600	19000		23.0	23.0	41.0	1.0	0.1160
20	42	12.0	0.6	9.371	4.972	6004ZR	6004-2ZR	6004RS	6004-2RS	17000	11000	20000	20	24.0	24.5	38.0	0.3	0.0700
	47	14.0	1.0	12.774	6.553	6204ZR	6204-2Z	6204RS	6204-2RS	15000	10000	18000		25.0	25.5	42.0	0.6	0.1070
	47	18.0	1.0	12.774	6.553	62204ZR	62204-2Z	62204RS	62204-2RS	15000	10000	18000		25.0	25.5	42.0	0.6	0.1300
	47	20.6	1.0	12.774	6.553	63204ZR	63204-2Z	63204RS	63204-2RS	15000	10000	18000		25.0	25.5	42.0	0.6	0.1540
	52	15.0	1.1	15.866	7.811	6304ZR	6304-2Z	6304RS	6304-2RS	14000	9400	17000		26.0	26.6	45.0	1.0	0.1440
	52	21.0	1.1	15.866	7.811	62304ZR	62304-2Z	62304RS	62304-2RS	14000	9400	17000		26.0	26.6	45.0	1.0	0.2000
25	47	12.0	0.6	10.070	5.806	6005ZR	6005-2ZR	6005RS	6005-2RS	14000	9400	17000	25	28.0	29.0	43.0	0.6	0.0810
	52	15.0	1.0	14.029	7.940	6205ZR	6205-2Z	6205RS	6205-2RS	12600	8400	15000		30.0	30.5	47.0	1.0	0.1280
	52	18.0	1.0	14.029	7.940	62205ZR	62205-2Z	62205RS	62205-2RS	12600	8400	15000		30.0	30.5	47.0	1.0	0.1500
	62	17.0	1.1	21.123	10.806	6305ZR	6305-2Z	6305RS	6305-2RS	11000	7500	13000		31.0	33.0	55.0	1.0	0.2320
	62	24.0	1.1	21.123	10.806	62305ZR	62305-2Z	62305RS	62305-2RS	11000	7500	13000		31.0	33.0	55.0	1.0	0.3200

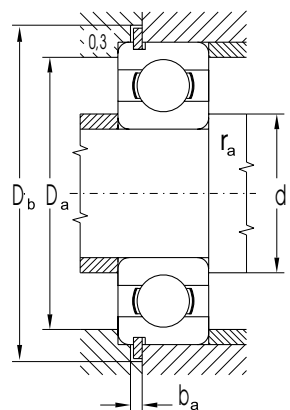
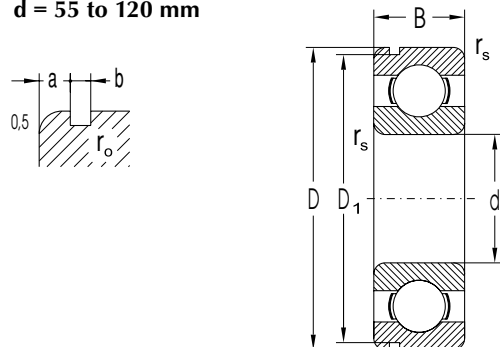
Single Row Deep Groove Ball Bearings with Seals or Shields
d = 30 to 100 mm



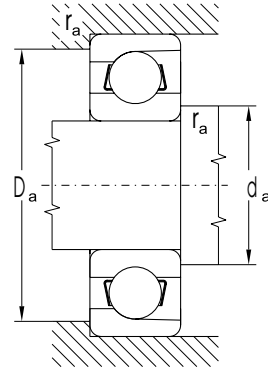
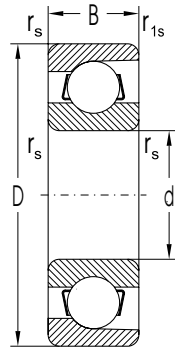
Dimensions				Basic Load Rating		Bearing Designation				Limiting Speed			Abutment and Fillet Dimensions					Weight
d	D	B	r _s min	C _r	C _{or}	Z, ZR	2Z, 2ZR	RS, RSR	2RS, 2RSR	Z, 2Z	RS, 2RS	Oil Z	d min	d _a max	d _b max	D _a max	r _a	~
mm				kN						min ⁻¹			mm					kg
30	55	13.0	1.0	13.243	8.253	6006Z	6006-2Z	6006RS	6006-2RS	12000	7900	14000	30	34.0	35.0	50.0	1.0	0.1190
	62	16.0	1.0	19.443	11.186	6206Z	6206-2Z	6206RS	6206-2RS	11000	7500	13000		35.0	36.7	57.0	1.0	0.2010
	62	20.0	1.0	19.443	11.186	62206Z	62206-2Z	62206RS	62206-2RS	11000	7500	13000		35.0	36.7	57.0	1.0	0.2400
	72	19.0	1.1	29.701	15.678	6306Z	6306-2Z	6306RS	6306-2RS	10000	6700	12000		36.0	38.9	65.0	1.0	0.3500
35	62	14.0	1.0	15.956	10.328	6007Z	6007-2Z	6007RS	6007-2RS	10600	7100	12600	35	39.5	39.5	57.0	1.0	0.1590
	72	17.0	1.1	25.663	15.227	6207Z	6207-2Z	6207RS	6207-2RS	9400	6300	11000		42.0	42.0	65.0	1.0	0.2900
	80	21.0	1.5	33.367	19.230	6307Z	6307-2Z	6307RS	6307-2RS	8400	5600	10000		42.0	44.0	71.0	1.5	0.4600
40	68	15.0	1.0	16.824	11.493	6008Z	6008-2Z	6008RS	6008-2RS	9400	6300	11000	40	44.0	46.0	63.0	1.0	0.1950
	80	18.0	1.1	32.633	19.887	6208Z	6208-2Z	6208RS	6208-2RS	8400	5600	10000		47.0	48.0	73.0	1.0	0.3670
	90	23.0	1.5	40.760	24.017	6308Z	6308-2Z	6308RS	6308-2RS	7900	5300	9400		47.0	50.6	81.0	1.5	0.6350
45	75	16.0	1.0	21.100	15.300	6009Z	6009-2Z	6009RS	6009-2RS	8400	5600	10000	45	49.0	51.5	70.0	1.0	0.2490
	85	19.0	1.1	32.687	20.323	6209Z	6209-2Z	6209RS	6209-2RS	7900	5300	9400		52.0	52.5	78.0	1.0	0.4100
	100	25.0	1.5	52.804	31.715	6309Z	6309-2Z	6309RS	6309-2RS	7100	4700	8400		52.0	56.0	91.0	1.5	0.8330
50	80	16.0	1.0	21.720	16.650	6010Z	6010-2Z	6010RS	6010-2RS	7900	5300	9400	50	54.0	56.5	75.0	1.0	0.2640
	90	20.0	1.1	35.066	23.266	6210Z	6210-2Z	6210RS	6210-2RS	7100	4700	8400		57.0	58.0	83.0	1.0	0.4640
	110	27.0	2.0	61.754	37.745	6310Z	6310-2Z	6310RS	6310-2RS	6300	4200	7500		60.0	61.8	100.0	2.0	1.0800
55	90	18.0	1.1	28.216	21.318	6011Z	6011-2Z	6011RS	6011-2RS	7100	4700	8400	55	60.0	62.5	84.0	1.0	0.3900
	100	21.0	1.5	43.350	29.397	6211Z	6211-2Z	6211RS	6211-2RS	6700	4500	7900		62.0	65.0	91.0	1.5	0.6110
	120	29.0	2.0	71.000	44.700	6311Z	6311-2Z	6311RS	6311-2RS	5600	3800	6700		65.0	67.0	110.0	2.0	1.3800
60	95	18.0	1.1	29.343	23.256	6012Z	6012-2Z	6012RS	6012-2RS	6700	4500	7900	60	65.0	68.0	88.0	1.0	0.4200
	110	22.0	1.5	52.486	35.786	6212Z	6212-2Z	6212RS	6212-2RS	6000	4000	7100		67.0	70.2	101.0	1.5	0.7870
	130	31.0	2.1	81.500	52.100	6312Z	6312-2Z	6312RS	6312-2RS	5300	3500	6300		72.0	75.0	118.0	2.0	1.7200
65	100	18.0	1.1	30.500	25.100	6013Z	6013-2Z	6013RS	6013-2RS	6300	4200	7500	65	70.0	73.0	93.0	1.0	0.4400
	120	23.0	1.5	57.210	40.011	6213Z	6213-2Z	6213RS	6213-2RS	5300	3500	6300		72.0	77.0	111.0	1.5	0.9950
	140	33.0	2.1	92.600	59.600	6313Z	6313-2Z	6313RS	6313-2RS	5000	3300	6000		76.0	78.0	128.0	2.0	2.1000
70	110	20.0	1.1	37.960	30.959	6014Z	6014-2Z	6014RS	6014-2RS	5600	3800	6700	70	75	78	103	1.0	0.6180
	125	24.0	1.5	62.000	43.800	6214Z	6214-2Z	6214RS	6214-2RS	5300	3500	6300		77	82	116	1.5	1.0900
	150	35.0	2.1	104.000	68.100	6314Z	6314-2Z	6314RS	6314-2RS	4700	3200	5600		81	85	138	2.0	2.5300
75	115	20.0	1.1	39.747	33.170	6015Z	6015-2Z	6015RS	6015-2RS	5300	3500	6300	75	80	83	108	1.0	0.6400
	130	25.0	1.5	66.179	49.311	6215Z	6215-2Z	6215RS	6215-2RS	5000	3300	6000		82	85	121	1.5	1.1900
	160	37.0	2.1	114.000	76.400	6315Z	6315-2Z	6315RS	6315-2RS	4200	2800	5000		86	93	148	2.0	3.0300
80	125	22.0	1.1	47.500	39.800	6016Z	6016-2Z	6016RS	6016-2RS	5000	3300	6000	80	85	90	118	1.0	0.8600
	140	26.0	2.0	72.200	53.100	6216Z	6216-2Z	6216RS	6216-2RS	4700	3200	5600		90	92	130	2.0	1.4100
	170	39.0	2.1	122.850	86.226	6316Z	6316-2Z			4000		4700		91	99	158	2.0	3.6200
85	130	22.0	1.1	49.794	42.609	6017Z	6017-2Z			4700		5600	85	90	95	123	1.0	0.8900
	150	28.0	2.0	83.299	63.675	6217Z	6217-2Z	6217RS	6217-2RS	4200	2800	5000		95	99	140	2.0	1.7900
	180	41.0	3.0	132.507	96.069	6317Z	6317-2Z			3800		4500		98	103	166	2.5	4.2600
90	160	30.0	2.0	96.200	70.800	6218Z	6218-2Z			4000		4700						2.1600
	190	43.0	3.0	143.000	104.000	6318Z	6318-2Z			3400		4200		103	108	176	2.5	5.1500
	150	24.0	1.5	60.000	54.000	6020Z	6020-2Z			4200		5000	100	106	110	142	1.5	1.2700
100																		

81

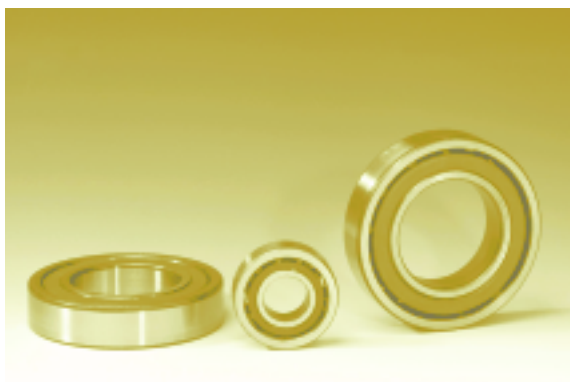
d = 55 to 120 mm

82

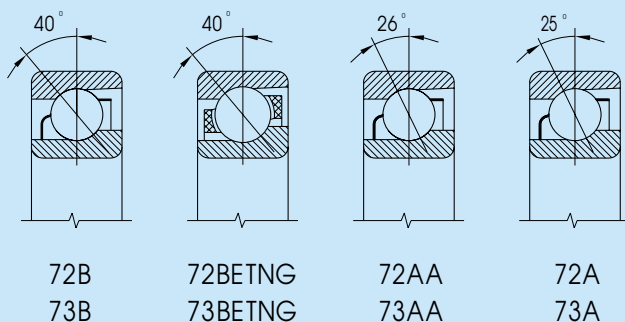
d = 10 to 20 mm

84

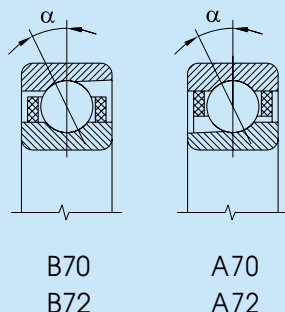
Single Row Angular Contact Ball Bearings



Raceways of single row angular contact ball bearings are designed in such a way that the connecting line of their contact points with the balls creates with the perpendicular line to the bearing axis an acute angle, so called contact angle and are non-separable. Bearings in B and BE design have contact angle $\alpha = 40^\circ$. This design allows the bearings to accommodate radial loads, acting simultaneously with a relative great axial load in one direction. For axial load accommodation in both directions, the bearings are arranged in pairs against each other. In the production programme there are bearings in AA design where the contact angle is $\alpha = 26^\circ$, in A design the contact angle is $\alpha = 25^\circ$.



Single row angular contact bearings - type A70 and A72 or B70 and B72 are determined for high rotational speeds. They differ from standard bearings of this type by internal design, bearing ring



design, contact angle size, cage design and high tolerance class. Bearings are non-separable. Bearings with CB designation have contact angle $\alpha = 10^\circ$. They are usually produced in tolerance class P4, P4A and are determined for very precision arrangements with high rotational speed, e.g. grinding electric spindles and appliances.

Bearings with designation CA have contact angle $\alpha = 12^\circ$.

Bearings in C design have contact angle $\alpha = 15^\circ$, they are produced in tolerance classes P5, P5A and P4, P4A and are predominately used for machine tool spindle arrangements and similar devices.

Bearings in AA design are produced in tolerance classes P5 and P4 and are determined for machine tool spindle arrangement and similar devices with relatively higher axial load.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design is a part of the data in the dimension tables. Difference from standard design is designated by additional symbols (section 2.2).

Cage

Bearings - type 72 and 73 in B and AA design have a sheet cage which is not indicated. Bearings - type 72 and 73 in BE design have a solid cage made of polyamide strengthened by glass fibres (TNG).

Bearings - type A70 and A72 determined for high rotational speeds have a solid cage made of textite, centered on outer ring (TA) and bearings - type B70 and B72 have a solid textite cage centered on inner ring (TB), besides the bearing B7014AA which has a solid brass cage centered on inner ring (MB).

Tolerance

Single row angular contact ball bearings - Type 72 and 73 are commonly produced in normal tolerance class P0 which is not indicated. For more demanding arrangements bearings in tolerance class P6 are delivered.

Bearings - type A70, A72, B70 and B72 in CA, C and A design are produced and delivered in tolerance classes P5, P5A and P4, P4A.

Bearings - type A72 and B72 in CB design are produced only in tolerance class P4, P4A. Deliveries of bearings in higher tolerance classes should be discussed with the supplier in advance.

Limiting deviation values of dimension and running accuracy comply with the standards ISO 199 and ISO 492 and are shown in tables 10 to 13.

Internal Clearance

Usual utilization of single row ball bearings is in pairs. Suitable operating clearance or preload is adjusted at mounting and depends on arrangement design and operating conditions.

Bearing Arrangement in Pairs

Bearings in A70, A72, B70 and B72 design are determined for high rotational speeds and are delivered in pairs.

Pair in "O" Arrangement (back to back)

This pair is significant by its high rigidity against tilting and carries axial forces in both directions always only by one bearing. It is used for accommodation of tilting moments.

Arrangement scheme - see section 2.2 .

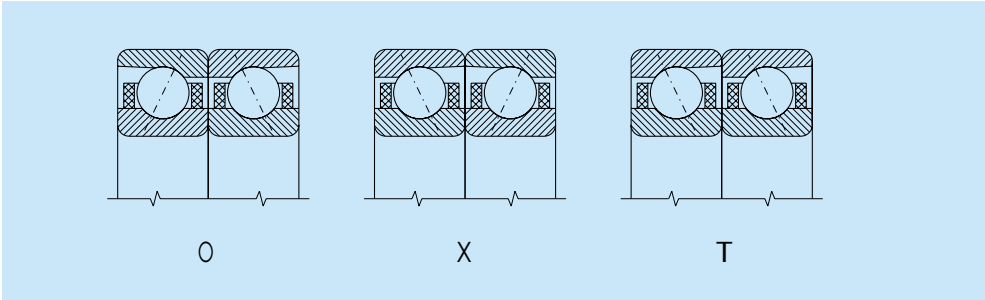
Pair in "X" Arrangement (face to face)

From the point of view of carrying axial forces this pair has the same properties as pair "O", but it has smaller rigidity for accommodating the tilting moment.

Arrangement scheme - see section 2.2 .

Pair in "T" Arrangement (tandem)

This pair is significant by its rigidity against tilting, but it is capable of carrying the axial load in one direction only.



Arrangement scheme - see section 2.2 .
The matched bearing pair is delivered in a common package to prevent interchange. Position of the greatest runout is marked by a line on ring faces. Mutual ring position is designated by converging lines in "V" shape on the outer cylindrical surface of the matched pair. Bearings are mounted in the arrangemet so that the lines indicating the place of the greatest runout can lie on a line parallel to the shaft axis.
Matched pairs "X" and "O" are delivered with small (L), medium (M) and heavy (S) preload.
Designation example of such a pair - B7204CBTB P4OL or A7201AATA P5XM.
Axial preload is determined from relation :

$F_p = k \cdot C_r \cdot 10^{-2}$ [kN]

F_p - axial preload [kN]
 C_r - radial basic dynamic load [kN]
 k - axial preload factor according to the table

Axial Preload		Factor k			
Magnitude	Designation	Contact Angle α			
		10°	12°	15°	26°
		Bearing Design CB	CA	C	AA
Small	L	0.4	0.5	0.7	1.2
Medium	M	1.4	1.6	2.0	3.5
Heavy	S	2.8	3.2	4.0	7.0

Radial basic dynamic load rating of matched pair C_{rs} is :

$C_{rs} = 1.62 \cdot C_r$ [kN]

Radial basic static load rating of matched pair C_{ors} is:

$C_{ors} = 2 \cdot C_{or}$ [kN]

Values C_r and C_{or} are shown in the dimension tables of this publication.
Limiting rotational speed for matched pair is smaller than for individual bearing (shown in dimension tables) :
- pair with small preload (L) of 20%

- pair with medium preload (M) of 35%
- pair with heavy preload (S) of 60%

Bearings Matching in Sets of Three and Four Bearings

For special accurate arrangement requiring high accuracy, rigidity, load rating and high rotational speed bearings - type A70, A72, B70 and B72 matched in sets of three or four bearings are delivered. Scheme of this arrangement - see section 2.2 .

Universal Bearing Matching

Single row angular contact ball bearings B70. .CTA in universal design (U) are determined for matching in pairs, in "X", "O" or "T" arrangements, or for matching in sets of three or four bearings. They are manufactured with a light preload (UL) by "X" and "O" matching. Bearing deliveries in universal design should be discussed with the supplier in advance.

Misalignment

Single row angular contact ball bearings mounted in pairs are sensitive to mutual bearing ring misalignment. Tolerance of the arrangement surfaces for bearings in tolerance class P5 and P4 are :

Tolerance Class	Shaft		Housing Bore		Circumferential
	Inner Ring Load	Point	Outer Ring Load	Non-Locating Bearing	
P5	js5	h5	JS5	H5	M5
P4	js4	h4	JS5	H5	M5

Radial Equivalent Dynamic Load

Bearings with contact angle $\alpha = 40^\circ$, B and BE design :

Single bearings :

$$\begin{array}{lll} P_r = F_r & \text{for } F_a/F_r \leq 1.14 & [\text{kN}] \\ P_r = 0.35F_r + 0.57F_a & \text{for } F_a/F_r > 1.14 & [\text{kN}] \end{array}$$

Bearings with contact angle $\alpha = 26^\circ$, AA design

Bearings with contact angle $\alpha = 25^\circ$, A design

Single bearings and matched pairs, "T" arrangement :

$$\begin{array}{lll} P_r = F_r & \text{for } F_a/F_r \leq 0.68 & [\text{kN}] \\ P_r = 0.41F_r + 0.87F_a & \text{for } F_a/F_r > 0.68 & [\text{kN}] \end{array}$$

Matched pairs, "O" and "X" arrangement :

$$\begin{array}{lll} P_r = F_r + 0.92F_a & \text{for } F_a/F_r \leq 0.68 & [\text{kN}] \\ P_r = 0.67F_r + 1.14F_a & \text{for } F_a/F_r > 0.68 & [\text{kN}] \end{array}$$

Bearings with contact angle $\alpha = 15^\circ$, C design :

Single bearings and matched pairs, "T" arrangement :

$$\begin{array}{lll} P_r = F_r & \text{for } F_a/F_r \leq e & [\text{kN}] \\ P_r = 0.44F_r + YF_a & \text{for } F_a/F_r > e & [\text{kN}] \end{array}$$

$\frac{F_a}{iC_{or}}$	e	Y
0.015	0.38	1.47
0.029	0.40	1.40
0.058	0.43	1.30
0.087	0.46	1.23
0.12	0.47	1.19
0.17	0.50	1.12
0.29	0.55	1.02
0.44	0.56	1.00
0.58	0.56	1.00

i - number of bearings

C_{or} - radial basic load rating of individual bearing from dimensional tables [kN]

Matched pairs, "O" and "X" arrangement :

$$P_r = F_r + Y_1 F_a$$

$$P_r = 0.72 F_r + Y_2 F_a$$

for $F_a / F_r \leq e$

for $F_a / F_r > e$

[kN]

[kN]

$\frac{F_a}{C_{or}}$	e	Y ₁	Y ₂
0.015	0.38	1.65	2.39
0.029	0.40	1.57	2.28
0.058	0.43	1.46	2.11
0.087	0.46	1.38	2.00
0.12	0.47	1.34	1.93
0.17	0.50	1.26	1.82
0.29	0.55	1.14	1.66
0.44	0.56	1.12	1.63
0.58	0.56	1.12	1.63

Bearings with contact angle $\alpha = 12^\circ$, CA design :

Single bearings and matched pairs, "T" arrangement :

$$P_r = F_r$$

$$P_r = 0.45 F_r + Y F_a$$

for $F_a / F_r \leq e$

for $F_a / F_r > e$

[kN]

[kN]

$\frac{F_a}{iC_{or}}$	e	Y
0.014	0.30	1.81
0.029	0.34	1.62
0.057	0.37	1.46
0.086	0.41	1.34
0.11	0.45	1.22
0.17	0.48	1.13
0.29	0.52	1.04
0.43	0.54	1.01
0.57	0.54	1.00

i - number of bearings

C_{or} - radial basic load rating of individual bearing from dimensional tables [kN]

Matched pairs, "O" and "X" arrangement :

$$P_r = F_r + Y_1 F_a$$
$$P_r = 0.74 F_r + Y_2 F_a$$

$$\text{for } F_a / F_r \leq e$$
$$\text{for } F_a / F_r > e$$

$\frac{F_a}{C_{or}}$	e	Y ₁	Y ₂
0.014	0.30	2.08	2.94
0.029	0.34	1.84	2.63
0.057	0.37	1.69	2.37
0.086	0.41	1.52	2.18
0.11	0.45	1.39	1.98
0.17	0.48	1.30	1.84
0.29	0.52	1.20	1.69
0.43	0.54	1.16	1.64
0.57	0.54	1.16	1.62

Bearings with contact angle $\alpha = 10^\circ$, CB design :
Single bearings and matched pairs, "T" arrangement :

$$P_r = F_r$$
$$P_r = 0.46 F_r + Y F_a$$

$$\text{for } F_a / F_r \leq e$$
$$\text{for } F_a / F_r > e$$

$$[\text{kN}]$$
$$[\text{kN}]$$

$\frac{F_a}{i C_{or}}$	e	Y
0.014	0.29	1.88
0.029	0.32	1.71
0.057	0.36	1.52
0.086	0.38	1.41
0.11	0.40	1.34
0.17	0.44	1.23
0.29	0.49	1.10
0.43	0.54	1.01
0.57	0.54	1.00

i - number of bearings
C_{or} - radial basic load rating of individual
radial basic load rating of individual [kN]

Matched pairs, "O" and "X" arrangement :

$$P_r = F_r + Y_1 F_a$$
$$P_r = 0.46 F_r + Y_2 F_a$$

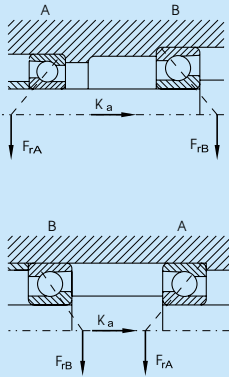
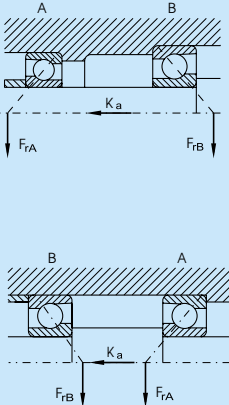
$$\text{for } F_a / F_r \leq e$$
$$\text{for } F_a / F_r > e$$

$$[\text{kN}]$$
$$[\text{kN}]$$

$\frac{F_a}{C_{or}}$	e	Y ₁	Y ₂
0.014	0.29	2.18	3.06
0.029	0.32	1.94	2.78
0.057	0.36	1.76	2.47
0.086	0.38	1.63	2.29
0.11	0.40	1.55	2.18
0.17	0.44	1.42	2.00
0.29	0.49	1.27	1.79
0.43	0.54	1.17	1.64
0.54	0.54	1.16	1.63

If the shaft is arranged in two single row angular contact ball bearings, the acting radial load is resolved into radial and axial components. The axial load of one bearing depends on the load and contact angle magnitude of the other bearing. These additional inner forces must be taken into account when calculating the bearing.

The following table shows relations for various bearing arrangements, when outer axial force K_a , radial force F_{rA} , or F_{rB} act. Radial forces act in the intersection point of the contact line with the shaft axis (dimension "a" in the dimension tables). Force magnitude is considered only in absolute values in calculations. Calculated force F_a is given into the calculation of radial equivalent dynamic load P_r .

Bearing Arrangement	Force Conditions	Bearing Axial Load	
		Bearing A	Bearing B
	$\frac{F_{rA}}{Y_A} \leq \frac{F_{rB}}{Y_B}$ $K_a \geq 0$	$F_{aA} = F_{aB} + K_a$	$F_{aB} = e F_{rB}$
	$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$ $K_a \geq e (F_{rA} - F_{rB})$	$F_{aA} = F_{aB} + K_a$	$F_{aB} = e F_{rB}$
	$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$ $K_a < e (F_{rA} - F_{rB})^1$	$F_{aA} = e F_{rA}$	$F_{aB} = F_{aA} - K_a$
	$\frac{F_{rA}}{Y_A} \geq \frac{F_{rB}}{Y_B}$ $K_a \geq 0$	$F_{aA} = e F_{rA}$	$F_{aB} = F_{aA} + K_a$
	$\frac{F_{rA}}{Y_A} < \frac{F_{rB}}{Y_B}$ $K_a \geq e (F_{rB} - F_{rA})$	$F_{aA} = e F_{rA}$	$F_{aB} = F_{aA} + K_a$
	$\frac{F_{rA}}{Y_A} < \frac{F_{rB}}{Y_B}$ $K_a < e (F_{rB} - F_{rA})^1$	$F_{aA} = F_{aB} - K_a$	$F_{aB} = e F_{rB}$

¹⁾ Valid for $K_a = 0$
 For bearings with contact angle $\alpha = 40^\circ$ (BE a B)
 For bearings with contact angle $\alpha = 26^\circ$ (AA)
 For other bearings e and Y according to tables - pages 90 to 91

$e = 1.14; Y = 0.57$
 $e = 0.68; Y = 0.87$

Radial Equivalent Static Load

Bearings with contact angle $\alpha = 40^\circ$, BE and B design :

$$P_{or} = 0.5F_r + 0.26F_a \quad (P_{or} \geq F_r) \quad [kN]$$

Bearings with contact angle $\alpha = 26^\circ$, design AA and $\alpha = 25^\circ$, A design :

Single bearings and matched pairs, "T" arrangement :

$$P_{or} = 0.5F_r + 0.37F_a \quad (P_{or} \geq F_r) \quad [kN]$$

Matched pairs, "O" and "X" arrangements :

$$P_{or} = F_r + 0.74F_a \quad [kN]$$

Bearings with contact angle $\alpha = 15^\circ$, C design :

Single bearings and matched pairs, "T" arrangement :

$$P_{or} = 0.5F_r + 0.46F_a \quad (P_{or} \geq F_r) \quad [kN]$$

Matched pairs, "O" and "X" arrangement :

$$P_{or} = F_r + 0.92F_a \quad [kN]$$

Bearings with contact angle $\alpha = 12^\circ$, CA design :

Single bearings and matched pairs, "T" arrangement :

$$P_{or} = 0.5F_r + 0.47F_a \quad (P_{or} \geq F_r) \quad [kN]$$

Mateched pairs, "O" and "X" arrangement :

$$P_{or} = F_r + 0.94F_a \quad [kN]$$

Bearings with contact angle $\alpha = 10^\circ$, CB design :

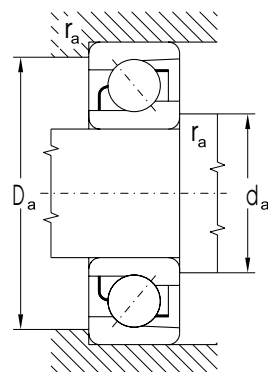
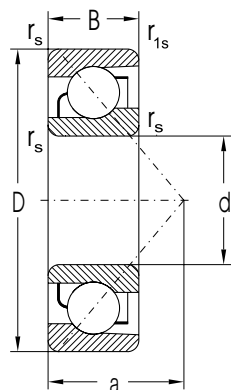
Single bearings and matched pairs, "T" arrangement „

$$P_{or} = 0.6F_r + 0.5F_a \quad (P_{or} \geq F_r) \quad [kN]$$

Matched pairs, "O" and "X" arrangement :

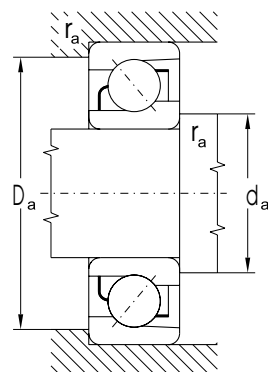
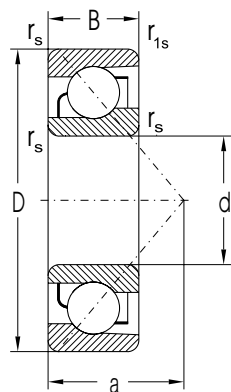
$$P_{or} = F_r + 0.97F_a \quad [kN]$$

d = 10 to 50 mm

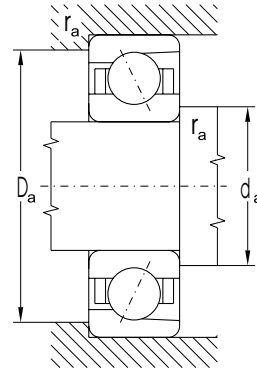
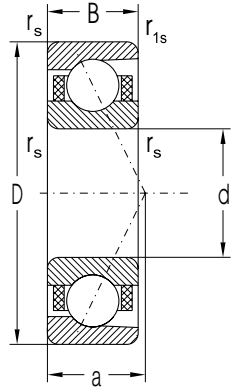


Dimensions						Basic Load Rating		Limiting Speed		Bearing Designation	Abutment and Fillet Dimensions				Weight	
d	D	B	r _s min	r _{1s} min	a	C _r Dynamic	C _{or} Static	for Lubrication with			d	d _a min	D _a max	r _a max		~
								Grease	Oil							
mm						kN		min ⁻¹			mm				kg	
10	30	9.0	0.60	0.30	13.0	6.963	3.290	21000	28000	7200BETNG	10	14.5	25.5	0.6	0.0300	
	12	32	10.0	0.60	0.30	7.530	3.778	19000	26000	7201BETNG		12	16.5	27.5	0.6	0.0370
15	35	11.0	0.60	0.30	12.0	8.970	4.875	17000	20000	7202AA	15	19.0	31.0	0.6	0.0500	
	35	11.0	0.60	0.30	16.0	8.040	4.368	17000	20000	7202B		19.0	31.0	0.6	0.0500	
	35	11.0	0.60	0.30	16.0	8.520	4.765	17000	20000	7202BETNG		19.0	31.0	0.6	0.0430	
	42	13.0	1.00	0.60	18.0	13.034	6.575	14000	17000	7302BETNG		21.0	36.0	1.0	0.0800	
17	40	12.0	0.60	0.30	13.0	10.400	6.190	15000	18000	7203AA	17	21.0	36.0	0.6	0.0700	
	40	12.0	0.60	0.30	18.0	11.000	6.070	17000	20000	7203BETNG		21.0	36.0	0.6	0.0700	
	47	14.0	1.00	0.60	15.0	15.115	7.890	12600	15000	7303AA		23.0	41.0	1.0	0.1200	
	47	14.0	1.00	0.60	20.0	13.795	7.200	12600	15000	7303B		23.0	41.0	1.0	0.1200	
	47	14.0	1.00	0.60	20.0	14.798	8.000	12600	15000	7303BETNG		23.0	41.0	1.0	0.1070	
20	47	14.0	1.00	0.60	15.0	14.858	8.535	12600	15000	7204AA	20	25.0	42.0	1.0	0.1100	
	47	14.0	1.00	0.60	21.0	13.307	7.645	12600	15000	7204B		25.0	42.0	1.0	0.1100	
	47	14.0	1.00	0.60	21.0	15.080	8.645	12600	15000	7204BETNG		25.0	42.0	1.0	0.1000	
	52	15.0	1.10	0.60	23.0	17.400	9.620	12600	15000	7304B		26.0	45.0	1.0	0.1500	
	52	15.0	1.10	0.60	23.0	18.800	10.400	13000	16000	7304BETNG		26.0	45.0	1.0	0.1430	
25	52	15.0	1.00	0.60	17.0	16.200	10.600	10600	12600	7205AA	25	30.0	47.0	1.0	0.1350	
	52	15.0	1.00	0.60	24.0	15.800	9.810	12600	15000	7205BETNG		30.0	47.0	1.0	0.1350	
	62	17.0	1.10	0.60	27.0	24.380	14.570	9400	11000	7305B		31.0	55.0	1.0	0.2400	
	62	17.0	1.10	0.60	19.0	25.600	13.900	9400	11000	7305AMB		31.0	55.0	1.0	0.2640	
30	62	16.0	1.00	0.60	27.0	20.700	13.600	9400	11000	7206B	30	36.0	56.0	1.0	0.2000	
	62	16.0	1.00	0.60	27.0	22.400	14.700	10600	12000	7206BETNG		35.0	56.0	1.0	0.1900	
35	80	21.0	1.50	1.00	35.0	36.650	24.100	7100	8400	7307B	35	42.0	71.0	1.5	0.4800	
40	80	18.0	1.10	0.60	23.0	37.600	26.600	7100	8400	7208AA	40	47.0	73.0	1.0	0.3700	
	80	18.0	1.10	0.60	34.0	36.900	24.600	7900	9400	7208BETNG		47.0	73.0	1.0	0.3700	
	90	23.0	1.50	1.00	27.2	48.200	33.600	6300	7500	7308AA		47.0	81.0	1.5	0.6600	
	90	23.0	1.50	1.00	39.0	44.700	30.400	7100	8400	7308BETNG		47.0	81.0	1.5	0.6600	
45	85	19.0	1.10	0.60	25.5	39.800	29.300	6300	7500	7209AA	45	52.0	78.0	1.0	0.4250	
	85	19.0	1.10	0.60	37.0	38.300	27.100	7500	8900	7209BETNG		52.0	78.0	1.0	0.4250	
	100	25.0	1.50	1.00	43.0	58.300	40.386	5600	6700	7309B		52.0	91.0	1.5	0.8800	
50	90	20.0	1.10	0.60	27.0	42.429	32.400	6000	7100	7210AA	50	57.0	83.0	1.0	0.4800	
	90	20.0	1.10	0.60	39.0	39.800	29.900	6700	7900	7210BETNG		57.0	83.0	1.0	0.4800	

d = 55 to 75 mm

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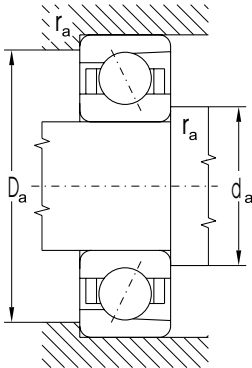
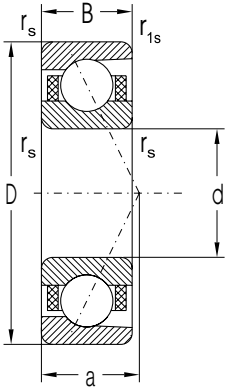
Single Row Angular Contact Ball Bearings for High Rotational Speed d = 7 to 40 mm



Dimensions						Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation	Abutment and Fillet Dimensions				Weight
d	D	B	r _s min	r _{1s} min	a	C _r	C _{or}	Grease Oil			d	d _a min	D _a max	r _a max	
mm						kN		min ⁻¹			mm				kg
7	22	7.0	0.30	0.15	5.0	2.220	0.900	94000	140000	A727CBTA	7	9.2	19.5	0.3	0.0134
9	26	8.0	0.60	0.30	5.5	3.650	1.640	71000	106000	A729CBTA	9	12.0	22.5	0.6	0.0197
10	30	9.0	0.60	0.30	6.0	5.000	2.290	60000	89000	B7200CBTB	10	14.0	26.0	0.6	0.0270
	30	9.0	0.60	0.30	6.5	6.670	2.900	42000	63000	B7200CATB		14.0	26.0	0.6	0.0280
12	32	10.0	0.60	0.30	7.0	5.480	2.655	56000	84000	B7201CBTB	12	16.0	28.0	0.6	0.0350
	32	10.0	0.60	0.30	7.5	7.430	3.465	38000	56000	B7201CATB		16.0	28.0	0.6	0.0360
	32	10.0	0.60	0.30	10.5	7.045	3.210	33000	50000	AC7201ATA		16.0	28.0	0.6	0.3060
15	35	11.0	0.60	0.30	7.5	6.480	3.450	50000	75000	B7202CBTB	15	19.0	31.0	0.6	0.0420
	35	11.0	0.60	0.30	8.0	8.265	4.180	33000	50000	B7202CATB		19.0	31.0	0.6	0.0420
17	35	10.0	0.60	0.15	9.0	6.240	3.470	30000	45000	A7003CTA	17	19.0	33.0	0.3	0.0390
	40	12.0	0.60	0.30	8.5	7.830	4.250	45000	67000	B7203CBTB		21.0	36.0	0.6	0.0600
	40	12.0	0.60	0.30	9.0	10.206	5.290	28000	42000	B7203CATB		21.0	36.0	0.6	0.0610
20	42	12.0	0.60	0.30	10.0	9.830	5.450	28000	42000	A7004CTA	20	24.0	38.0	0.6	0.0680
	47	14.0	1.00	0.60	10.0	9.600	5.540	40000	60000	B7204CBTB		25.0	42.0	1.0	0.0980
	47	14.0	1.00	0.60	10.5	13.670	7.322	25000	38000	B7204CATB		25.0	42.0	1.0	0.1000
	47	14.0	1.00	0.60	15.0	13.000	6.990	22000	33000	B7204AATB		25.0	42.0	1.0	0.1020
25	47	12.0	0.60	0.30	11.0	11.080	6.870	25000	38000	A7005CTA	25	28.0	43.0	0.6	0.0800
	52	15.0	1.00	0.60	11.0	13.125	7.960	33000	50000	B7205CBTB		30.0	47.0	1.0	0.1190
	52	15.0	1.00	0.60	11.5	14.815	8.630	22000	33000	B7205CATB		30.0	47.0	1.0	0.1220
	52	15.0	1.00	0.60	17.0	13.960	8.155	20000	30000	B7205AATB		30.0	47.0	1.0	0.1240
30	55	13.0	1.00	0.60	12.0	14.400	9.550	22000	30000	A7006CTA	30	34.0	50.0	1.0	0.1160
	62	16.0	1.00	0.60	12.0	16.810	10.720	28000	42000	B7206CBTB		35.0	57.0	1.0	0.1840
	62	16.0	1.00	0.60	13.0	20.570	12.420	20000	30000	B7206CATB		35.0	57.0	1.0	0.1890
	62	16.0	1.00	0.60	19.0	19.420	11.580	17000	25000	B7206AATB		35.0	57.0	1.0	0.1920
35	62	14.0	1.00	0.60	14.0	18.290	12.700	17000	25000	A7007CTA	35	39.5	57.0	1.0	0.1550
	62	14.0	1.00	0.60	18.5	17.300	12.050	9400	11000	B7007AATB		39.5	57.0	1.0	0.1480
	72	17.0	1.10	0.60	13.0	21.015	14.345	25000	38000	B7207CBTB		42.0	65.0	1.0	0.2680
	72	17.0	1.10	0.60	14.0	28.935	18.600	16000	24000	B7207CATB		42.0	65.0	1.0	0.2750
	72	17.0	1.10	0.60	15.0	30.660	20.295	16000	24000	B7207CAMB		42.0	65.0	1.0	0.3230
40	68	15.0	1.00	0.60	20.5	18.560	14.135	8400	10000	B7008AATB	40	47.0	61.0	1.0	0.1850
	80	18.0	1.10	0.60	14.0	24.500	17.300	22000	33000	B7208CBTB		47.0	73.0	1.0	0.3370
	80	18.0	1.10	0.60	15.50	36.730	23.775	13000	20000	B7208CATB		47.0	73.0	1.0	0.3470

Single Row Angular Contact Ball Bearings
for High Rotational Speed

d = 45 to 130 mm



Dimensions						Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation	Abutment and Fillet Dimensions				Weight ~
d	D	B	r _s min	r _{1s} min	a	Dynamic C _r	Static C _{0r}	Grease	Oil		d	d _a min	D _a max	r _a max	
mm						kN		min ⁻¹			mm				kg
45	75	16.0	1.00	0.60	16.0	23.410	18.140	13000	20000		45	49	70	1.0	0.2420
	85	19.0	1.10	0.60	15.0	28.295	20.310	20000	30000			52	78	1.0	0.3810
	85	19.0	1.10	0.60	16.5	36.855	24.645	12600	19000			52	78	1.0	0.3910
	100	25.0	1.50	1.00	28.0	60.330	38.775	5600	6700			54	91	1.5	0.7710
50	80	16.0	1.0	0.60	20.0	22.660	18.520	9500	11000	B7010AATB	50	57	73	1.0	0.4310
	90	20.0	1.10	0.60	16.0	32.330	23.560	18000	27000			57	83	1.0	0.4430
	90	20.0	1.10	0.60	17.5	38.990	27.260	12000	18000			57	83	1.0	0.4430
	90	20.0	1.10	0.60	26.0	36.560	25.920	10600	16000			57	83	1.0	0.4470
55	90	18.0	1.10	0.60	26.5	30.990	25.380	6300	7500	B7011AATB	55	62	83	1.0	0.3950
	100	21.0	1.50	1.00	17.0	38.460	29.120	17000	25000			62	91	1.5	0.5670
	100	21.0	1.50	1.00	18.5	48.200	34.500	11000	17000			62	91	1.5	0.5820
60	110	22.0	1.50	1.00	18.0	42.980	33.800	15000	22000	B7212CBTB	60	67	101	1.5	0.7350
	110	22.0	1.50	1.00	20.0	58.260	42.600	10000	15000			67	101	1.5	0.7540
	110	22.0	1.50	1.00	32.0	54.820	39.960	8900	13000			67	101	1.5	0.7590
65	120	23.0	1.50	1.00	21.5	70.500	54.780	8900	13000	B7213CATB	65	72	111	1.5	0.9940
70	110	20.0	1.10	0.60	32.0	41.153	36.460	7900	12000	B7014AATB	70	75	103	1.0	0.5970
	125	24.0	1.50	1.00	20.5	58.560	47.660	12600	19000			77	116	1.5	1.0400
	125	24.0	1.50	1.00	22.5	76.650	60.135	7900	12000			77	116	1.5	1.0700
75	130	25.0	1.50	1.00	23.5	76.530	61.390	7500	11000	B7215CATB	75	82	121	1.5	1.1600
	130	25.0	1.50	1.00	37.5	71.525	58.325	6700	10000			82	121	1.5	1.2600
	130	25.0	1.50	1.00	37.5	74.900	62.490	6700	10000			82	121	1.5	1.3900
80	125	22.0	1.10	0.60	22.0	55.360	50.013	7500	11000	B7016CATB	80	85	118	1.0	0.8410
	125	22.0	1.10	0.60	36.0	53.440	49.440	6700	10000			85	118	1.0	0.8480
	140	26.0	2.00	1.00	24.5	89.500	73.050	6700	10000			90	130	2.0	1.4100
	140	26.0	2.00	1.00	40.0	84.070	68.040	6300	9400			90	130	2.0	1.4200
85	130	22.0	1.10	0.60	37.0	54.440	52.690	6300	9400	B7017AATA	85	90	123	1.0	0.9120
	130	22.0	1.10	0.60	37.0	56.240	55.330	6300	9400			90	123	1.0	1.0600
	150	28.0	2.00	1.00	26.5	100.520	86.080	6300	9400			95	140	2.0	1.8000
	150	28.0	2.00	1.00	42.5	94.260	80.670	6000	8900			95	140	2.0	1.8200
90	140	24.0	1.50	1.00	24.0	67.630	62.470	6300	9400	B7018CATB	90	96	132	1.5	1.1500
	140	24.0	1.50	1.00	40.0	65.290	61.755	4000	4700			98	130	1.5	1.1600
100	180	34.0	2.10	1.10	51.0	141.100	120.960	5300	7900	B7220AATB	100	112	168	2.0	3.3200
120	180	28.0	2.00	1.00	30.0	101.100	103.660	5000	7500	B7024CATB	120	128	171	2.0	2.1000
	180	28.0	2.00	1.00	50.5	96.100	101.280	3000	3500			132	168	2.0	2.0900
130	165	11.0	1.00	0.50	41.5	13.475	19.100	3200	3800	B70826AAMB	130	138	158	2.0	0.6350

Double Row Angular Contact Ball Bearings



Double row angular contact ball bearings principally correspond to a matched pair of single row angular contact ball bearings in an "O" arrangement. At the same size (d and D) the matched pair has a smaller width.

The bearing has a filling slot on one side. If axial forces, which act in one direction, prevail, the bearing should be mounted so that the forces should not act against the filling slot.

Bearing design enables the contact angle $\alpha = 32^\circ$. That is why they can carry tilting moments in the axial plane. If there is lack of space only one bearing is sufficient for arranging a rotating part.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design is a part of data in the dimension tables. The difference from standard design is designated by additional symbols (section 2.2).

Cage

Double row angular contact ball bearings have cages pressed of steel sheet. They are not indicated.

Tolerance

Bearings are commonly produced in normal tolerance class P0, it is not indicated. For more demanding arrangements bearings in higher tolerance class P6 are produced.

Limiting values of dimension and running accuracy are in tables 10 and 11 and comply with standards ISO 199 and ISO 492.

Axial Clearance

Bearings are commonly produced with normal axial clearance, it is not indicated. For special arrangements bearings with smaller C2 and greater C3 and C4 axial clearance are delivered.

Misalignment

Bearings form a very rigid arrangement especially sensitive to rings misalignment caused by mounting inaccuracies.

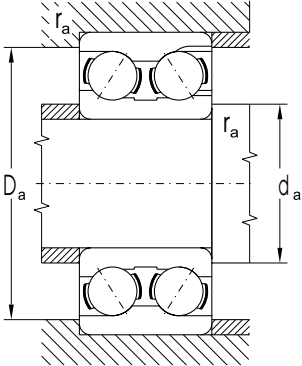
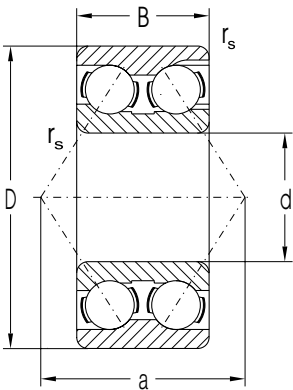
Radial Equivalent Dynamic Load

$$\begin{array}{ll} P_r = F_r + 0.73F_a & \text{for } F_a/F_r \leq 0.86 \\ P_r = 0.62F_r + 1.17F_a & \text{for } F_a/F_r > 0.86 \end{array}$$

Radial Equivalent Static Load

$$P_{or} = F_r + 0.63F_a$$

Double Row Angular Contact Ball Bearings
d = 10 to 75 mm



Dimensions					Basic Load Rating		Limiting Speed		Bearing Designation	Abutment and Fillet Dimensions				Weight
d	D	B	r _s min	a	Dynamic C _r	Static C _{0r}	for Lubrication with			d	d _a min	D _a max	r _a max	~
mm					kN		min ⁻¹			mm				kg
10	30	14.0	0.60	20	8.410	5.840	16000	19000	3200X	10	14	25	0.6	0.0500
	30	14.3	0.60	20	8.410	5.840	16000	19000	3200		14	25	0.6	0.0500
12	32	15.9	0.60	22	10.000	7.080	14000	17000	3201	12	16	27	0.6	0.0600
15	35	15.9	0.60	23	9.440	7.500	13000	16000	3202	15	19	30	0.6	0.0700
	42	19.0	1.00	27	15.800	11.900	10600	12600	3302		21	36	1.0	0.1300
17	40	17.5	0.60	27	13.100	10.600	11000	13000	3203	17	21	35	0.6	0.1000
	47	22.2	1.00	31	21.500	16.200	9400	11000	3303		23	41	1.0	0.1900
20	47	20.6	1.00	31	18.100	15.000	9400	11000	3204	20	25	42	1.0	0.1700
	52	22.2	1.10	34	21.500	18.500	8400	10000	3304		27	45	1.0	0.2300
25	52	20.6	1.00	35	19.600	18.100	8400	10000	3205	25	30	46	1.0	0.1900
	62	25.4	1.10	40	29.900	26.600	7100	8400	3305		32	55	1.0	0.3700
30	62	23.8	1.00	41	28.200	27.100	7100	8400	3206	30	35	56	1.0	0.3100
	72	30.2	1.10	47	39.800	36.200	6000	7100	3306		37	65	1.0	0.5800
35	72	27.0	1.10	47	38.300	37.600	6000	7100	3207	35	41	65	1.0	0.4800
	80	34.9	1.50	54	51.100	47.300	5300	6300	3307		44	71	1.5	0.7800
40	80	30.2	1.10	52	43.800	43.800	5300	6300	3208	40	46	73	1.0	0.6500
	90	36.5	1.50	58	54.000	59.600	4700	5600	3308		49	81	1.5	1.0500
45	85	30.2	1.10	56	47.300	51.100	5000	6000	3209	45	51	78	1.0	0.7000
	100	39.7	1.50	64	75.000	73.600	4200	5000	3309		54	91	1.5	1.4100
50	90	30.2	1.10	59	54.100	58.400	4500	5300	3210	50	56	83	1.0	0.7400
	110	44.4	2.00	73	90.900	96.200	3800	4500	3310		60	100	2.0	1.9000
55	100	33.3	1.50	64	60.700	66.800	4200	5000	3211	55	62	91	1.5	1.0500
	120	49.2	2.00	80	100.000	108.000	3300	4000	3311		65	110	2.0	2.4800
60	110	36.5	1.50	71	75.000	85.800	3800	4500	3212	60	67	101	1.5	1.3600
	130	54.0	2.10	86	117.000	128.000	3200	3800	3312		72	118	2.0	3.1700
65	120	38.1	1.50	76	82.500	94.400	3500	4200	3213	65	72	111	1.5	1.7600
	140	58.7	2.10	94	133.000	147.000	3000	3500	3313		77	128	2.0	4.0100
70	125	39.7	1.50	81	79.400	98.100	3200	3800	3214	70	77	116	1.5	1.9300
75	130	41.3	1.50	84	87.400	110.000	3200	3800	3215	75	82	121	1.5	2.0800

Double Row Self-Aligning Ball Bearings



These bearings are designed with two rows of balls and a spherical raceway in the outer ring. This allows certain misalignment of the inner ring against outer ring around bearing centre without the bearing function being threatened. Bearings are produced with cylindrical and tapered bore and are non-separable. Misalignment ability by not changed functionality determine this bearings to utilize where some bore misalignment in housings or deflection and shaft oscillation are presumed. With respect to a small contact angle and imperfect conformity of balls to raceways they are not suitable for accommodating larger axial forces.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design and in design with tapered bore is in the dimension tables. Difference from standard design is designated by additional symbols (section 2.2).

Tapered Bore

Bearings with tapered bore have taper 1:12. Bearings are fixed on cylindrical shafts by means of adapter sleeves. Adapter sleeves designation corresponding to individual bearings is in the dimension tables of this publication.

Cage

Bearings have the standard design cages according to the following table (material symbol and cage design are mostly not indicated).

Bearings with Pressed Steel or Brass Cage	Bearings with Machined Brass or Steel Cage
d<10mm, 126	-
1200 to 1222	1224 to 1230
2200 to 2222	-
1300 to 1322	1324
2304 to 23201 ¹⁾	2322

¹⁾ Bearing 2305 is produced with a solid cage with filling (TNGN)

Tolerance

Bearings are commonly produced in normal tolerance class P0 which is not indicated. Bearings for more demanding arrangements are delivered in tolerance class P6. Limiting values of dimension and running accuracy are shown in tables 10 abd 11 and comply with the standards ISO 199 and ISO 492.

Radial Clearance

Bearings commonly produced have a normal clearance which is not indicated. For special arrangements bearings with smaller radial clearance C2 or greater radial clearance C3, C4 and C5 are delivered.

Misalignment

Values of permissible bearing misalignment for keeping its functionality are shown in the following table.

Bearing Type	Permissible Misalignment
d<10mm 126, 13, 23	3°
12, 22	2°30'

Radial Equivalent Dynamic Load

$$P_r = F_r + Y_1 F_a$$
$$P_r = 0.65 F_r + Y_2 F_a$$

for $F_a / F_r \leq e$

for $F_a / F_r > e$

[kN]

[kN]

Factor values e, Y₁ and Y₂ for individual bearings are shown in the dimension tables of this publication.

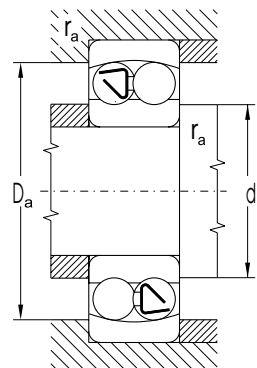
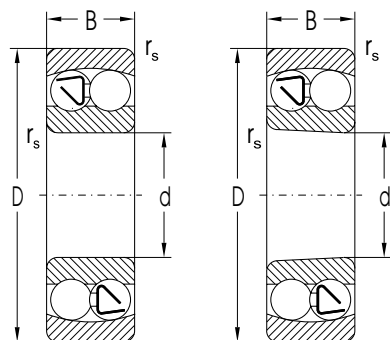
Radial Equivalent Static Load

$$P_{or} = F_r + Y_0 F_a$$

[kN]

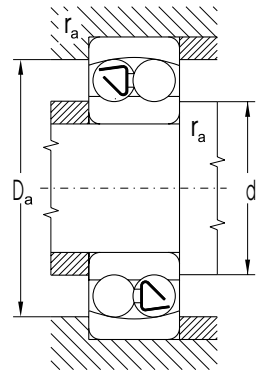
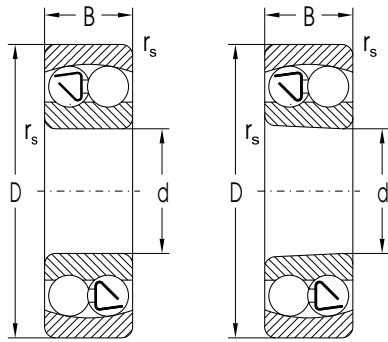
Factor values Y₀ for individual bearings are shown in the dimension tables of this publication.

d = 6 to 60 mm



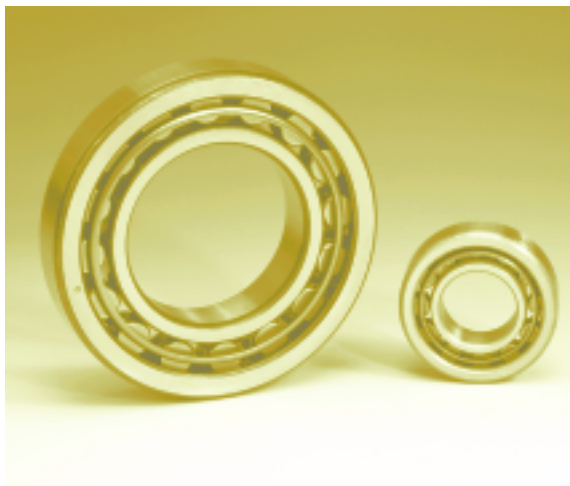
Dimensions				Basic Load Rating		Limiting Speed		Bearing Designation		Abutment and Fillet Dimensions				Weight		Corresponding Adapter Sleeve	Factors			
d	D	B	r _s	Dynamic C _r	Static C _{0r}	for Lubrication with				d	d _{a min}	D _{a max}	r _{a max}	~	K		e	Y ₁	Y ₂	Y ₀
mm				kN		min ⁻¹				mm				kg						
6	19	6.0	0.30	2.150	0.240	27000	32000	126		6	8.2	17	0.3	0.0090			0.34	1.90	2.90	2.00
10	30	14.0	0.60	7.280	1.580	25000	30000	2200		10	14	26	0.6	0.0470			0.65	1.00	1.50	1.00
12	32	10.0	0.60	5.590	1.260	24000	28000	1201		12	16	18	0.6	0.0400			0.34	1.90	2.90	2.00
15	35	11.0	0.60	7.410	1.740	21000	25000	1202		15	19	31	0.6	0.0490			0.33	1.90	2.90	2.00
	35	14.0	0.60	7.610	1.810	21000	25000	2202			19	31	0.6	0.0600			0.49	1.30	2.00	1.30
17	40	12.0	0.60	7.930	2.030	17000	20000	1203	1203K	17	21	36	0.6	0.0730	0.0710	H203	0.31	2.10	3.20	2.20
20	47	14.0	1.00	9.950	2.660	14000	17000	1204	1204K	20	25	42	1.0	0.1200	0.1180	H204	0.27	2.30	3.60	2.40
25	52	15.0	1.00	12.100	3.350	12600	15000	1205	1205K	25	30	47	1.0	0.1410	0.1380	H205	0.27	2.30	3.60	2.40
	52	18.0	1.00	12.400	3.480	12600	15000	2205	2205K		30	47	1.0	0.1630	0.1580	H305	0.43	1.50	2.30	1.50
	62	24.0	1.10	24.200	6.560	10000	12000	2305TNGN	2305KTNGN		31	55	1.0	0.3350	0.3270	H2305	0.47	1.30	2.10	1.40
30	62	16.0	1.00	15.600	4.730	11000	13000	1206	1206K	30	35	57	1.0	0.2200	0.2160	H206	0.250	2.600	4.000	2.700
	62	20.0	1.00	15.300	4.550	11000	13000	2206	2206K		35	57	1.0	0.2600	0.2540	H306	0.400	1.600	2.500	1.700
	72	19.0	1.10	21.200	6.310	9400	11000	1306	1306K		36	65	1.0	0.3870	0.3810	H306	0.260	2.500	3.800	2.600
	72	27.0	1.10	31.200	8.740	8400	10000	2306	2306K		36	65	1.0	0.5000	0.4890	H2306	0.440	1.400	2.200	1.500
35	72	17.0	1.10	15.900	5.110	9400	11000	1207	1207K	35	42	65	1.0	0.3230	0.3170	H207	0.230	2.700	4.200	2.900
	72	23.0	1.10	21.600	6.680	9400	11000	2207	2207K		42	65	1.0	0.4030	0.3960	H307	0.370	1.700	2.600	1.800
40	80	18.0	1.10	19.000	6.560	7900	9400	1208	1208K	40	47	73	1.0	0.4170	0.4110	H208	0.220	2.900	4.400	3.000
	90	23.0	1.50	29.600	9.810	7100	8400	1308	1308K		47	81	1.5	0.7150	0.7040	H308	0.240	2.600	4.100	2.700
	90	33.0	1.50	44.900	13.300	6700	7900	2308	2308K		47	81	1.5	0.9250	0.9030	H2308	0.430	1.500	2.300	1.500
45	85	19.0	1.10	21.600	7.360	7500	8900	1209	1209K	45	52	78	1.0	0.4650	0.4590	H209	0.210	3.000	4.600	3.100
	85	23.0	1.10																	

d = 65 to 150 mm



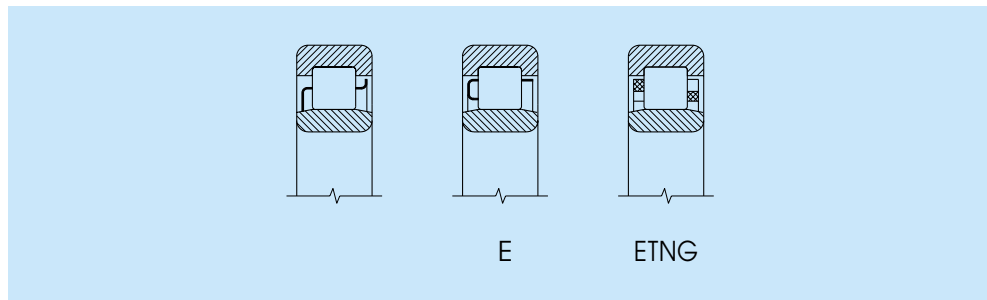
Dimensions					Basic Load Dynamic C _r	Rating Static C _{or}	Limiting Speed for Lubrication with		Bearing Designation		Abutment and Fillet Dimensions				Weight		Corres- ponding Adap- ter Sleeve	Factors			
d	D	B	B ₁ ¹⁾	r _s min			Grease	Oil	with Cylindrical Bore	with Tapered Bore	d	d _a min	D _a max	r _a max	~	K		e	Y ₁	Y ₂	Y ₀
mm					kN	min ⁻¹				mm				kg							
65	120	23.0		1.50	31.200	12.300	5300	6300	1213	1213K	65	72	111	1.5	1.1500	1.1300	H213	0.170	3.700	5.700	3.900
	120	31.0		1.50	43.600	16.500	5300	6300	2213	2213K		72	111	1.5	1.4600	1.4300	H313	0.280	2.200	3.500	2.300
70	125	31.0		1.50	44.200	17.100	5000	6000	2214		70	77	116	1.5	1.5200			0.270	2.400	3.700	2.500
	150	51.0		2.10	111.000	37.600	3800	4500	2314			81	138	2.0	3.9000			0.380	1.700	2.600	1.800
75	130	25.0		1.50	39.000	15.500	4700	5600	1215	1215K	75	82	121	1.5	1.3600	1.3400	H215	0.180	3.600	5.600	3.800
	130	31.0		1.50	44.200	17.800	4700	5600	2215	2215K		82	121	1.5	1.6200	1.5800	H315	0.250	2.500	3.900	2.600
	160	37.0		2.10	79.300	29.900	3800	4500	1315	1315K		86	148	2.0	3.5600	3.5100	H315	0.220	2.800	4.400	3.000
	160	55.0		2.10	124.000	43.000	3500	4200	2315	2315K		86	148	2.0	4.7200	4.6100	H2315	0.380	1.700	2.600	1.700
80	140	26.0		2.00	39.700	16.800	4500	5300	1216	1216K	80	90	130	2.0	1.6700	1.6400	H216	0.160	3.900	6.100	4.100
	140	33.0		2.00	48.800	20.000	4500	5300	2216	2216K		90	130	2.0	2.0100	1.9700	H316	0.250	2.500	3.900	2.600
85	150	28.0		2.00	48.800	20.300	4000	4700	1217	1217K	85	95	140	2.0	2.0700	2.0400	H217	0.170	3.700	5.700	3.900
	180	41.0		3.00	97.500	37.600	3300	4000	1317	1317K		98	166	2.5	4.9800	4.9100	H317	0.220	2.900	4.500	3.000
	180	60.0		3.00	140.000	51.100	3200	3800	2317	2317K		98	166	2.5	6.7100	6.5500	H2317	0.370	1.700	2.700	1.800
90	160	30.0		2.00	57.200	23.300	3800	4500	1218	1218K	90	100	150	2.0	2.5200	2.4800	H218	0.170	3.800	5.800	3.900
	160	40.0		2.00	70.200	28.700	3800	4500	2218	2218K		100	150	2.0	3.2000	3.1300	H318	0.270	2.400	3.600	2.500
	190	64.0		3.00	153.000	57.300	3000	3500	2318	2318K		103	176	2.5	7.9600	7.7700	H2318	0.380	1.700	2.600	1.800
95	170	32.0		2.10	63.700	27.100	3500	4200	1219	1219K	95	107	158	2.0	3.1000	3.0500	H219	0.170	3.700	5.700	3.900
	170	43.0		2.10	83.200	34.100	3500	4200	2219	2219K		107	158	2.0	3.9500	3.8500	H319	0.270	2.400	3.600	2.500
	200	45.0	48.0	3.00	133.000	51.100	3000	3500	1319	1319K		109	186	2.5	6.6900	6.5900	H319	0.230	2.800	4.300	2.900
	200	67.0		3.00																	

Single Row Cylindrical Roller Bearings



These bearings are separable and are produced in several designs.

Design NU has cylindrical rollers guided between guiding ribs of the outer ring, the design N between guiding ribs of the inner ring. Both designs enable mutual bearing rings displacement in both directions.



Design NJ has two guiding ribs on the outer ring and one on the inner ring, which enables to carry the axial forces in one direction.

NUP design has a loose inner rib creating the second guiding rib of the inner ring and this enables the bearing to carry limited axial forces in both directions. Axial guiding in both directions can be achieved by means of angle rings HJ for bearings in NJ design and in one direction in NU design. Single row cylindrical roller bearings have in comparison with single row ball bearings of the same size higher basic load rating and are suitable for arrangements with high radial load, high rotational speed and when light fitting of both rings is desirable.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design is in the dimension tables of this publication. Difference from standard design is designated by additional symbols (section 2.2).

Cages

Bearings in standard design have cage according to dimension tables. Material symbol and symbol of the cage design are not indicated by bearings with pressed steel cage and bearings NU29 and NUP29 with solid cage. For special arrangements bearings with plastic or brass cages which can be coated with silver are produced. This delivery should be discussed in advance.

Tolerance

Bearings are commonly produced in normal tolerance class P0 which is not indicated. Bearings for more demanding arrangements are delivered in tolerance classes P6, P5 and P4.

Bearing Type	Bearings with Pressed Steel Cage	Bearings with Reinforced Solid Plastic Cage	Bearings with Machined Brass or Steel Cage
	Bearing Size		
NU/NUP29	-	-	/ 800 to / 1800
NU10	-	-	80 to 80
NU/NJ/NUP/N2	05 to 28	-	48
NU/NJ/NUP/N2E	09, 15	04 to 24	22 to 40
NU/NJ/NUP22	05 to 07, 10, 11, 13, 14, 19	-	36, 80
NU/NJ/NUP22E	09, 15, 17	40 to 20	22 to 30
NU/NJ/NUP/N3	05 to 24	-	26 to 30
NU/NJ/NUP/N3E	-	04 to 17	18 to 30
NU/NJ/NUP23	07, 12, 13, 15	-	-
NU/NJ/NUP23E	09	04 to 17	07, 08, 10, 14 18 to 30
NU/NJ/NUP/N4	06 to 12, 14 to 16	-	13, 17 to 24

Limiting deviation values of dimension and running accuracy are shown in tables 10 and 11 and comply with standards ISO 199 and ISO 492.

Radial Clearance

Commonly produced bearings have normal radial clearance which is not indicated. For special arrangements bearings with smaller clearance C2 or greater radial clearance C3, C4 and C5 are delivered. Radial clearance values comply with the standard ISO 5753 and are shown in table 24.

Vibration Level

Commonly produced single row cylindrical roller bearings have normal vibration level checked by the producer. Bearings in tolerance class P5 and P4 have vibration level C6. For special arrangements bearings with reduced vibration level C6 are manufactured.

Bearings with Angle Rings

Angle rings - type HJ10, HJ2, HJ2E, HJ3, HJ3E and HJ4 can be used for bearings in NJ and NU designs.

Examples of bearing designation :

NJ10 + HJ10 = NH10

NJ2 + HJ2 = NH2

NJ3 + HJ3 = NH3

NJ4 + HJ4 = NH4

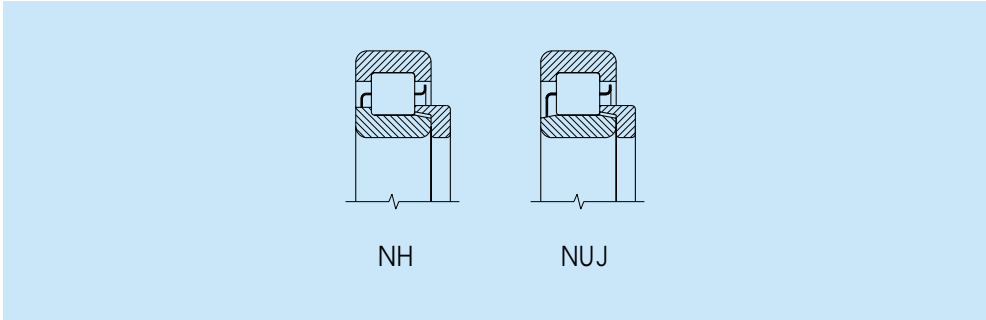
NU10 + HJ10 = NUJ10

NU2 + HJ2 = NUJ2

NU3 + HJ3 = NUJ3

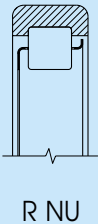
NU4 + HJ4 = NUJ4

Pictures of individual basic designs and combinations are in the dimension tables of the publication.



Bearings without Inner Ring

For arrangements with limited space for bearing mounting, single row cylindrical roller bearings without inner ring designated R NU are delivered. The inner bearing ring raceway is created directly by the hardened and ground journal.



Dimension tolerance on the journal is usually "g6" for normal radial clearance, "f6" for greater radial clearance and "h5" for smaller radial clearance. Ovality and cylindricity deviations of the "raceway" on this journal must not be greater than deviations for tolerance class IT3. Surface roughness for this surface should be $R_a = 0.2$ and for less demanding arrangements $R_a = 0.4$.

Basic load rating C_r and C_{or} values shown in the dimension tables, are valid for bearings R NU if the journal surface hardness will be in the range 59 to 65 HRC. With decreasing hardness value also load rating values C_r decrease. It must be multiplied by the factor f_h from following table. Minimum depth of journal hardening after grinding depends on the cylindrical roller diameter and load magnitude and should be 1 to 3 mm.

Hardness HRC	58	56	54	51	48	45	40	35	30
Factor f_h	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.25	0.2

Misalignment

Mutual bearing ring misalignment of single row cylindrical roller bearings is very small. Permissible misalignment values are in the table.

Bearing Type	Load	
	small ($F_r < 0,1C_{or}$)	great ($F_r \geq 0,1C_{or}$)
NU10, NU2, NU3, NU4	2' to 3'	5' to 7'
NU29, NU22, NU23	1' to 3'	3' to 4'
Designs NJ, NUP, N ¹⁾	1' to 2'	3' to 4'
of all dimension series		

1) Smaller values of the number pair are valid for bearings of width series 2 and higher

Radial Equivalent Dynamic Load

$P_r = F_r$

[kN]

Axial Dynamic Load Rating

Bearings with ribs on both rings can carry, besides the radial load, also a limited axial load. Because permissible bearing load in axial direction depends on many factors, which cannot be expressed only by a simple calculation, the following relations have only an informative character.

The axial load in this case is not limited by the material fatigue but by the carrying capacity of the lubrication film on the contact surface between the cylindrical roller face and guiding rib and lubrication conditions and operating temperature and cooling possibilities of the bearing. At common working conditions when the difference of the bearing and environment temperature does not exceed 60°C, by slight heat transfer (0.5mWmm⁻² °C⁻¹), by viscosity relation ≈ 1.5 (section 4.2.1) it is possible to calculate maximum permissible axial load with sufficient accuracy from equation :

$$F_{a \max} = \frac{0.5 C_{or} \cdot 10^4}{n (d + D)} - 0.05 F_r \quad [\text{kN}]$$

- for oil lubrication

$$F_{a \max} = \frac{0.35 C_{or} \cdot 10^4}{n (d + D)} - 0.03 F_r \quad [\text{kN}]$$

- for grease lubrication

$F_{a \max}$ - maximum permissible axial load	[kN]
C_{or} - radial basic static load rating	[kN]
F_r - radial bearing load	[kN]
n - rotational speed	[min ⁻¹]
d - bearing bore diameter	[mm]
D - bearing outside diameter	[mm]

Values $F_{a \max}$ calculated according to the above introduced equations are valid under assuming of continuously acting axial force. For intermittent or impact load the permissible axial load can be two- or three times greater in comparison with calculated value. For reliable bearing function it is important that ratio $F_a/F_r \leq 0.4$.

Radial Equivalent Static Load

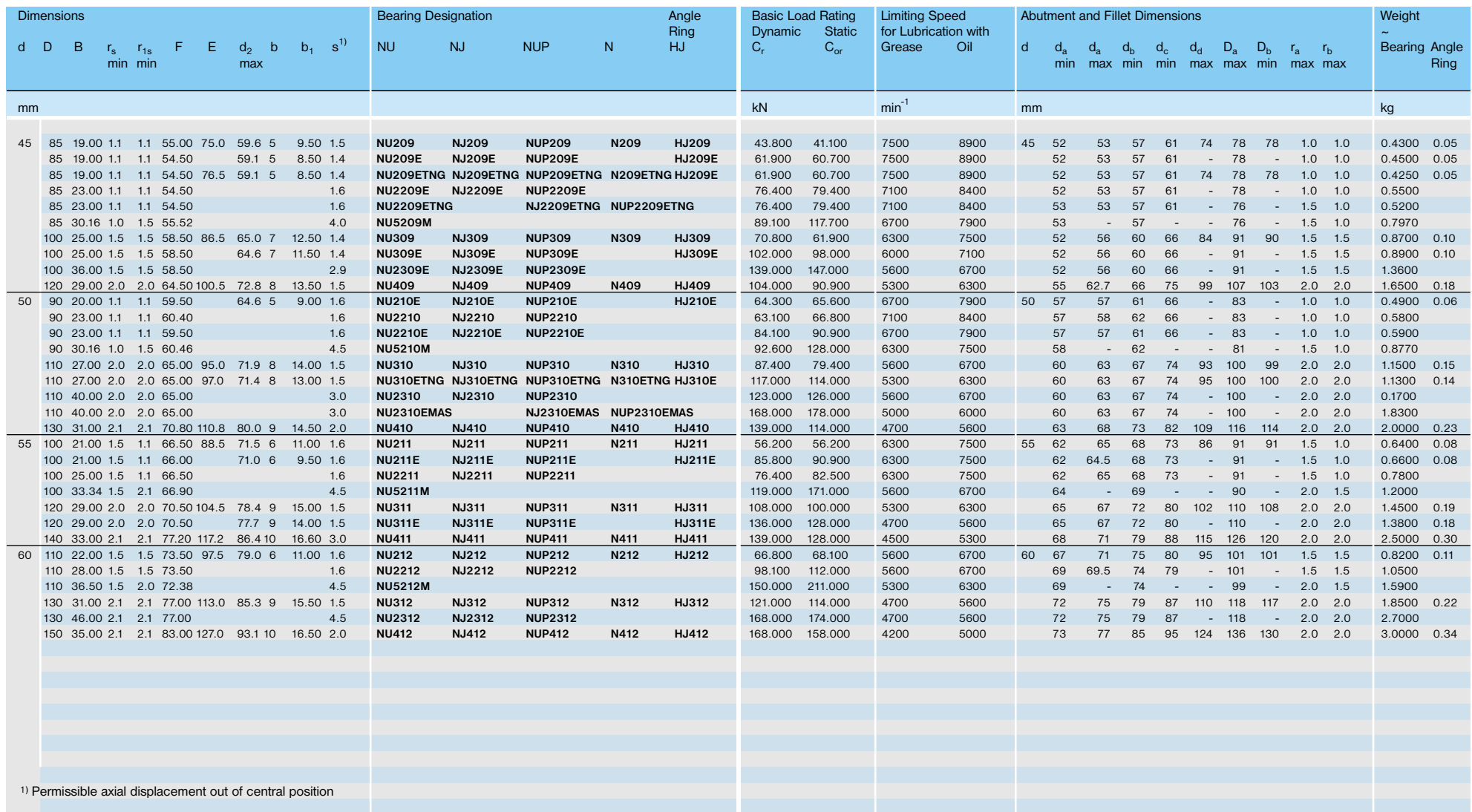
$$P_{or} = F_r \quad [\text{kN}]$$

d = 20 to 40 mm

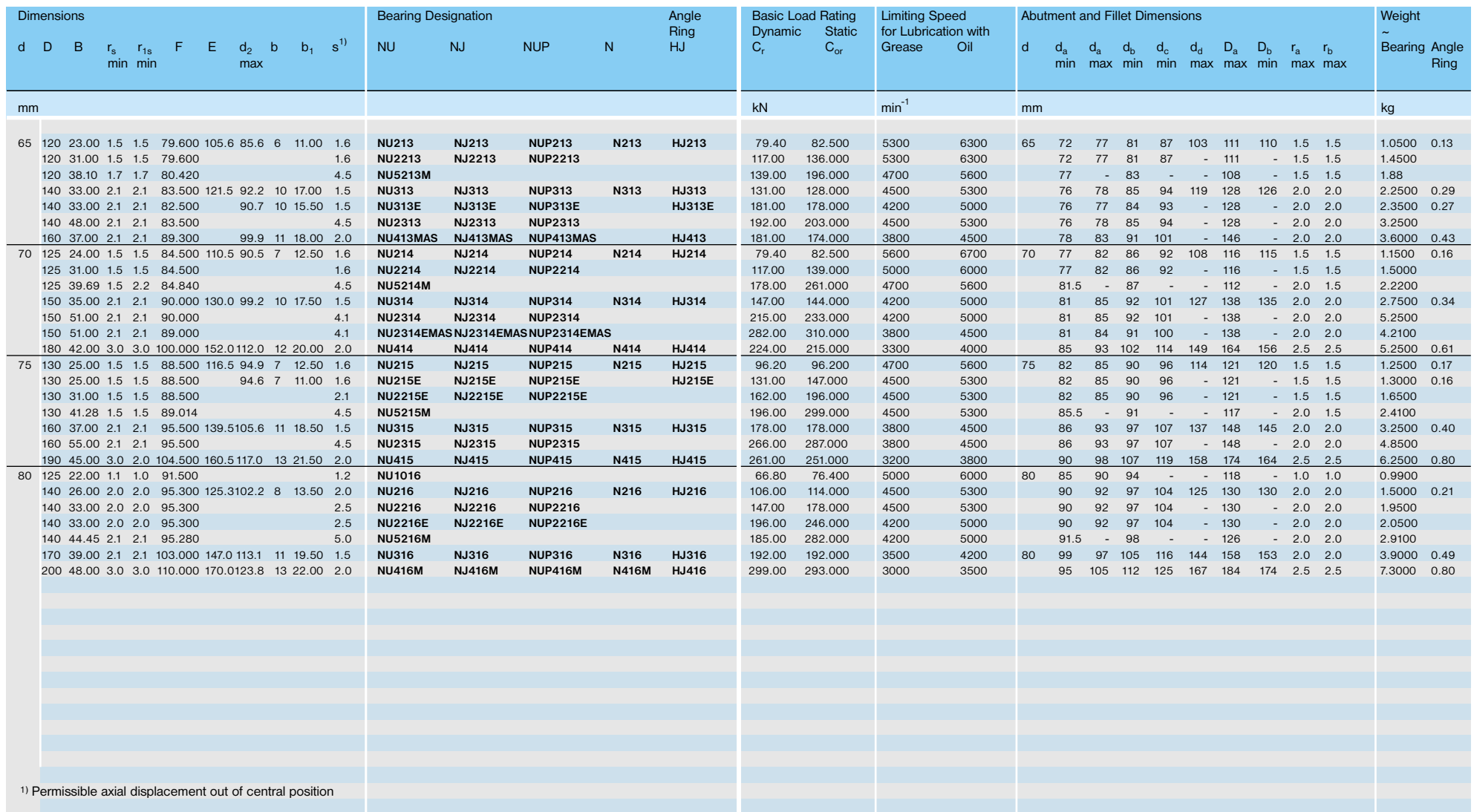


Dimensions											Bearing Designation				Angle Ring HJ	Basic Load Rating Dynamic C _r		Limiting Speed for Lubrication with Grease Oil		Abutment and Fillet Dimensions										Weight ~ Bearing Angle Ring			
d	D	B	r _s min	r _{1s} min	F	E	d ₂ max	b	b ₁	s ¹⁾	NU	NJ	NUP	N				d	d _a min	d _a max	d _b min	d _c min	d _d max	D _a max	D _b min	r _a max	r _b max						
mm																kN		min ⁻¹		mm										kg			
20	47	14.0	1.00	0.6	27.0	40.0	30.0	3	6.75	1.4	NU204	NJ204	NUP204	N204	HJ204	13.900	10.200	14000	17000	20	25	25.5	29	32	39	42	42	1.0	0.6	0.1100	0.01		
25	52	15.0	1.00	0.6	32.0	45.0	35.0	3	7.25	1.5	NU205	NJ205	NUP205	N205	HJ205	15.800	12.600	12600	15000	25	30	30.5	34	37	43	47	47	1.0	0.6	0.1300	0.02		
	52	15.0	1.00	0.6	31.5		34.9	3	6.00	1.4	NU205E	NJ205E	NUP205E		HJ205E	29.300	25.600	12600	15000		30	30	34	37	-	47	-	1.0	0.6	0.1280	0.02		
	52	15.0	1.00	0.6	31.5	46.5	34.9	3	6.00	1.4	NU205ETNG	NJ205ETNG	NUP205ETNG	N205ETNGHJ205E		29.300	25.600	12600	15000		30	30	34	37	44	47	47	1.0	0.6	0.1280	0.02		
	52	18.0	1.00	0.6	32.0					1.6	NU2205	NJ2205	NUP2205			22.400	19.600	12600	15000		30	30.5	34	37	-	47	-	1.0	0.6	0.1600			
	62	17.0	1.10	1.1	35.0	53.0	39.3	4	8.00	1.4	NU305	NJ305	NUP305	N305	HJ305	27.600	21.500	10000	12000		31	33	37	40	51	55	55	1.0	1.0	0.2400	0.03		
	62	17.0	1.10	1.1	34.0		38.3	4	7.00	1.4	NU305EMAS	NJ305EMAS	NUP305EMAS		HJ305E	43.000	36.200	10000	12000		31	32	37	40	-	55	-	1.0	1.0	0.2550	0.03		
	62	17.0	1.10	1.1	34.0	54.0	38.3	4	7.00	1.4	NU305ETNG	NJ305ETNG	NUP305ETNG	N305ETNGHJ305E		43.000	36.200	10000	12000		31	32	36	39	52	55	55	1.0	1.0	0.2370	0.03		
	80	21.0	1.50	1.5	38.8					1.4	NU405	NJ405				43.800	34.100	8400	10000		32	38	39	40	-	73	-	1.0	1.0	0.5650			
30	62	16.0	1.00	0.6	38.5	53.5	42.2	4	8.25	1.5	NU206	NJ206	NUP206	N206	HJ206	21.500	17.800	10600	12600	30	35	37	40	44	52	57	56	1.0	0.6	0.2000	0.03		
	62	16.0	1.00	0.6	37.5	55.5	41.4	4	7.00	1.4	NU206ETNG	NJ206ETNG	NUP206ETNG	N206ETNGHJ206E		39.100	35.500	10600	12600		35	37	40	43	54	57	57	1.0	0.6	0.1980	0.03		
	62	20.0	1.00	0.6	38.5					1.6	NU2206	NJ2206	NUP2206			31.600	29.300	10600	12600		35	37	40	44	-	57	-	1.0	0.6	0.2600			
	72	19.0	1.10	1.1	42.0	62.0	46.6	5	9.50	1.4	NU306	NJ306	NUP306	N306	HJ306	36.200	31.000	8900	10600		36	39	44	48	60	65	64	1.0	1.0	0.3600	0.04		
	72	19.0	1.10	1.1	40.5		45.1	5	8.50	1.4	NU306E	NJ306E	NUP306E		HJ306E	53.100	46.400	8400	10000		36	37.5	43	47	-	65	-	1.0	1.0	0.3570	0.04		
	72	19.0	1.10	1.1	40.5	62.5	45.1	5	8.50	1.4	NU306ETNG	NJ306ETNG	NUP306ETNG	N306ETNGHJ306E		53.100	46.400	8400	10000		36	37.5	43	47	60	65	64	1.0	1.0	0.3570	0.04		
	90	23.0	1.50	1.5	40.5		51.4	7	11.50	1.5	NU406	NJ406	NUP406		HJ406	59.600	48.200	7100	8400		39	41	47	53	-	80	-	1.5	1.5	0.7500	0.08		
	32	65	21.0	1.00	0.6	38.5				1.6	NU22/32ETNG					51.100	50.100	10000	12000	32	35	37	39	43	-	60	-	1.0	1.0	0.3090			
35	72	17.0	1.10	0.6	43.8	61.8	48.1	4	8.00	1.5	NU207	NJ207	NUP207	N207	HJ207	31.600	27.100	9400	11000	35	42	42	46	50	60	65	64	1.0	0.6	0.2900	0.04		
	72	17.0	1.10	0.6	44.0		48.3	4	7.00	1.4	NU207E	NJ207E	NUP207E		HJ207E	51.100	48.200	8900	10600		42	42	46	50	-	65	-	1.0	0.6	0.2920	0.04		
	72	17.0	1.10	0.6	44.0	64.0	48.3	4	7.00	1.4	NU207ETNG	NJ207ETNG	NUP207ETNG	N207ETNGHJ207E		51.100	48.200	8900	10600		42	42	46	50	62	65	65	1.0	0.6	0.2920	0.04		
	72	23.0	1.10	0.6	43.8					1.6	NU2207	NJ2207	NUP2207			48.200	47.300	9400	11000		42	42	46	50	-	65	-	1.0	0.6	0.4000			
	72	23.0	1.10	0.6	44.0					1.6	NU2207ETNG	NJ2207ETNG	NUP2207ETNG			64.300	64.300	8900	10600		42	42	46	50	-	65	-	1.0	0.6	0.3850			
	80	21.0	1.50	1.1	46.2	68.2	51.2	6	11.00	1.4	NU307	NJ307	NUP307	N307	HJ307	43.000	36.200	7900	9400		42	44	48	53	66	71	71	1.5	1.0	0.4800	0.06		
	80	21.0	1.50	1.1	46.2		51.2	6	9.50	1.4	NU307E	NJ307E	NUP307E		HJ307E	66.800	61.900	7500	8900		42	44	48	53	-	71	-	1.5	1.0	0.4660	0.06		
	80	31.0	1.50	1.1	46.2					2.7	NU2307EMAS	NJ2307EMAS	NUP2307EMAS			92.600	92.600	7100	8400		42	44	48	53	-	71	-	1.5	1.0	0.7510			
	100	25.0	1.50	1.5	53.0	83.0	59.9	8	13.00	1.5	NU407	NJ407	NUP407	N407	HJ407	75.000	64.300	6300	7500		44	52	55	62	81	90	86	1.5	1.5	1.0000	0.13		
	40	80	18.0	1.10	1.1	50.0	70.0	54.6	5	9.00	1.5	NU208	NJ208	NUP208	N208	HJ208	42.200	37.600	7900	9400	40	47	48	52	56	68	73	72	1.0	1.0	0.3700	0.05	
80		18.0	1.10	1.1	49.5		54.1	5	8.50	1.4	NU208E	NJ208E	NUP208E		HJ208E	54.100	50.100	7900	9400		47	47	51	56	-	73	-	1.0	1.0	0.3800	0.05		
80		23.0	1.10	1.1	50.0					1.6	NU2208	NJ2208E	NUP2208E			57.300	56.200	7900	9400		47	48	52	56	-	73	-	1.0	1.0	0.7380			
80		30.16	1.00	1.5	49.3					3.0	NU5208M					57.000	98.100	7500	8900		48	-	51.5	-	72	-	1.5	1.5	0.7380				
90		23.0	1.50	1.5	53.5	77.5	59.0	7	12.50	1.4	NU308	NJ308	NUP308	N308	HJ308	55.200	48.200	7100	8400		47	51	55	61	75	81	81	1.5	1.5	0.6600	0.09		
90		23.0	1.50	1.5	52.0		57.7	7	11.00	1.4	NU308E	NJ308E	NUP308E		HJ308E	84.100	77.900	6700	7900		47	50	54	60	-	81	-	1.5	1.5	0.6700	0.08		
90		23.0	1.50	1.5	52.0	80.0	57.7	7	11.00	1.4	NU308ETNG	NJ308ETNG	NUP308ETNG	N308ETNGHJ308E		84.100	77.900	6700	7900		47	50	54	60	77	81	81	1.5	1.5	0.8290	0.08		
90		33.0	1.50	1.5	52.0					2.9	NU2308EMAS	NJ2308EMAS	NUP2308EMAS			119.000	123.000	6300	7500		47	50	54	60	-	81	-	1.5	1.5	1.0000			
110		27.0	2.00	2.0	58.0	92.0	65.8	8	13.00	1.5	NU408	NJ408	NUP408	N408	HJ408	92.600	79.400	5600	6700		50	55	60	68	90	97	95	2.0	2.0	1.3000	0.14		
1) Permissible axial displacement out of central position																																	

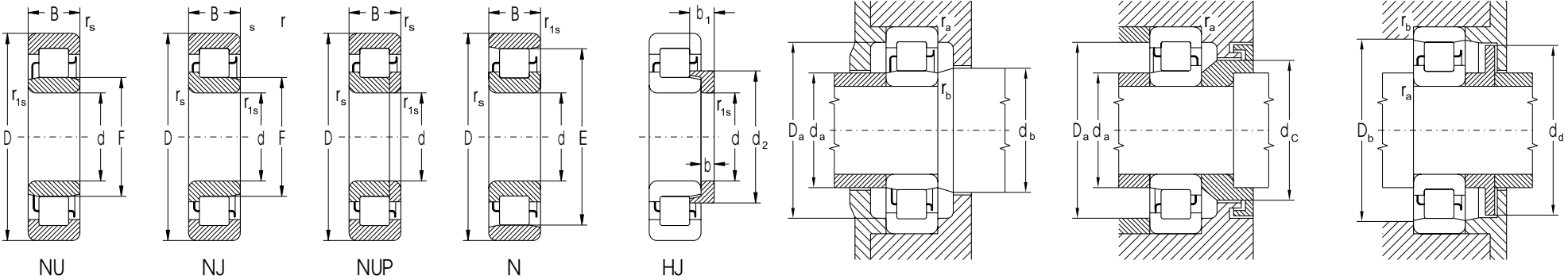
d = 45 to 60 mm



d = 65 to 80 mm

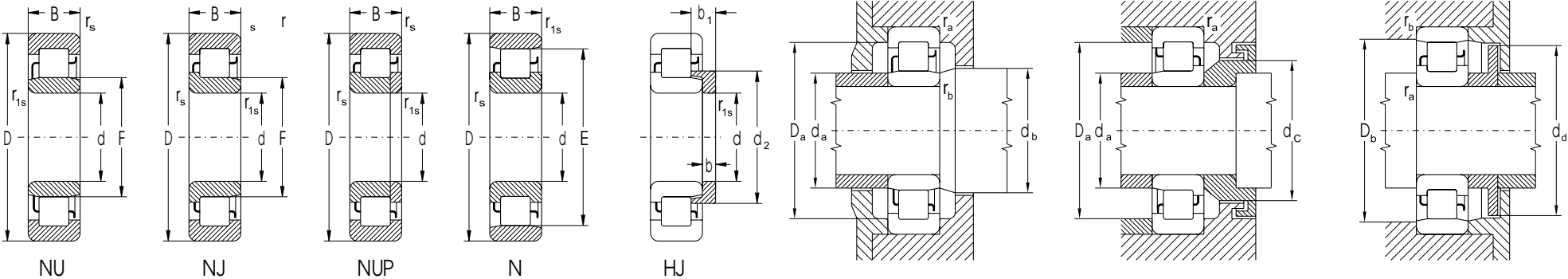


Single Row Cylindrical Roller Bearings
d = 85 to 105 mm



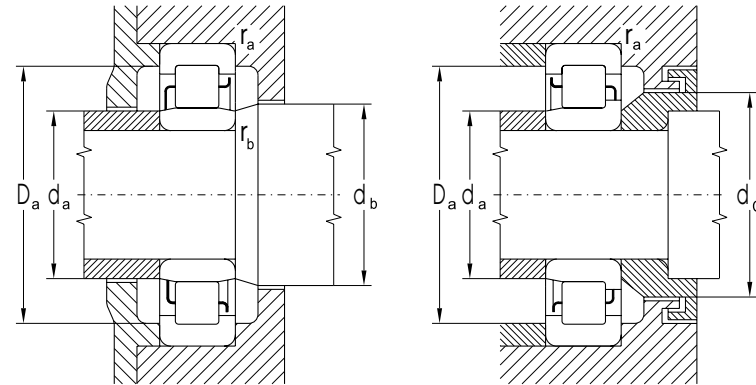
Dimensions											Bearing Designation					Angle Ring HJ	Basic Load Rating		Limiting Speed for Lubrication with Grease Oil		Abutment and Fillet Dimensions										Weight ~ Bearing Angle Ring		
d	D	B	r _s min	r _{1s} min	F	E	d ₂ max	b	b ₁	s ¹⁾	NU	NJ	NUP	N		C _r	C _{or}			d	d _a min	d _a max	d _b min	d _c min	d _d max	D _a max	D _b min	r _a max	r _b max				
mm																		kN		min ⁻¹		mm										kg	
85	150	28.0	2.0	2.0	101.800	133.8	109.2	8	14.00	2.0	NU217	NJ217	NUP217	N217	HJ217	121.000	131.000	4200	5000	85	95	99	104	111	131	140	138	2.0	2.0	1.9000	0.25		
	150	36.0	2.0	2.0	100.500					2.0	NU2217E	NJ2217E	NUP2217E			220.000	261.000	3800	4500		95	98	103	110	-	140	-	2.0	2.0	2.5200			
	150	49.21	2.1	2.1	102.000					5.5	NU5217M					211.000	316.000	3800	4500		98	-	105	-	-	135	-	2.0	2.0	3.6900			
	180	41.0	3.0	3.0	108.000	156.0	119.0	12	20.50	2.0	NU317	NJ317	NUP317	N317	HJ317	215.000	215.000	3300	4000		98	103	110	121	174	166	162	2.5	2.5	4.5000	0.57		
	210	52.0	4.0	4.0	113.000		127.7	14	24.00	2.5	NU417	NJ417	NUP417		HJ417	362.000	362.000	3000	3500		105	108	115	129	-	190	-	3.0	3.0	8.7000	0.89		
90	160	30.0	2.0	2.0	107.000	143.0	115.3	9	15.00	2.0	NU218	NJ218	NUP218	N218	HJ218	147.000	158.000	4000	4700	90	100	105	109	117	140	150	147	2.0	2.0	2.3000	0.31		
	160	52.4	2.1	3.0	107.218					6.0	NU5218M					237.000	355.000	3500	4200		103	-	110	-	-	144	-	2.5	2.0	4.4800			
	190	43.0	3.0	3.0	115.000	165.0	126.5	12	21.00	2.0	NU318	NJ318	NUP318	N318	HJ318	233.000	242.000	3200	3800		103	111	117	128	162	176	172	2.5	2.5	5.4000	0.65		
	190	43.0	3.0	3.0	113.500		124.2	12	18.50	2.0	NU318E	NJ318E	NUP318E		HJ318E	316.000	329.000	3000	3500		103	110	116	127	-	176	-	2.5	2.5	5.5000	0.60		
	225	54.0	4.0	4.0	123.500		139.1	14	24.00	2.5	NU418	NJ418	NUP418		HJ418	391.000	406.000	2700	3200		110	117	125	140	-	205	-	3.0	3.0	11.7000	1.05		
95	225	54.0	4.0	4.0	123.500		139.1	14	24.00	2.5	NU418MAS	NJ418MAS	NUP418MAS		HJ418	391.000	406.000	2700	3200		110	117	125	140	-	205	-	3.0	3.0	11.7000	1.05		
	170	32.0	2.1	2.1	113.500	151.5	122.2	9	15.50	2.0	NU219	NJ219	NUP219	N219	HJ219	162.000	181.000	3800	4500	95	107	111	116	124	149	158	155	2.0	2.0	2.8000	0.35		
	170	43.0	2.1	2.1	113.500					3.0	NU2219	NJ2219	NUP2219			233.000	282.000	3800	4500		107	111	116	124	-	158	-	2.0	2.0	3.8500			
	170	55.56	2.5	3.0	113.520					6.0	NU5219M					335.000	511.000	3300	4000		110	-	117	-	-	153	-	2.5	2.0	5.6500			
	200	45.0	3.0	3.0	121.500	173.5				2.0	NU319	NJ319	NUP319	N319		256.000	266.000	3200	3800		109	119	124	135	170	186	178	2.5	2.5	6.2000			
100	200	45.0	3.0	3.0	121.500					1.9	NU319EM	NJ319EM	NUP319EM			329.000	362.000	2800	3300		109	119	124	135	-	186	-	2.5	2.5	6.5000			
	240	55.0	4.0	4.0	133.500					2.5	NU419M	NJ419M	NUP419M			430.000	447.000	2500	3000		115	125	136	151	-	220	-	3.0	3.0	13.5000			
	180	34.0	2.1	2.1	120.000	160.0	129.2	10	17.00	2.0	NU220	NJ220	NUP220	N220	HJ220	178.000	203.000	3500	4200	100	112	117	122	131	157	168	165	2.0	2.0	3.4000	0.45		
	180	46.0	2.1	2.1	120.000					3.0	NU2220	NJ2220	NUP2220			261.000	322.000	3500	4200		112	117	122	131	-	168	-	2.0	2.0	4.6500			
	180	60.32	2.1	2.1	121.005					7.0	NU5220M					304.000	473.000	3200	3800		116.5	-	124	-	-	162	-	2.0	2.0	6.4900			
105	215	47.0	3.0	3.0	129.500	185.5	142.4	13	22.50	2.0	NU320	NJ320	NUP320	N320	HJ320	299.000	310.000	2800	3300		113	125	132	145	182	201	190	2.0	2.0	7.7000	0.91		
	215	73.0	3.0	3.0	127.500					4.9	NU2320EMAS	NJ2320EMAS	NUP2320EMAS			596.000	694.000	2500	3000		113	123	130	144	-	201	-	2.5	2.5	12.5000			
	250	58.0	4.0	4.0	139.000		155.9	16	27.00	2.5	NU420	NJ420	NUP420		HJ420	473.000	501.000	2400	2800		120	130	141	158	-	230	-	3.0	3.0	14.0000	1.55		
	190	36.0	2.1	2.1	126.800	168.8	136.5	10	17.50	2.0	NU221	NJ221	NUP221	N221	HJ221	200.000	224.000	3300	4000	105	117	122	129	138	166	178	175	2.0	2.0	4.0000	0.51		
	190	65.1	2.1	2.1	126.520					7.0	NU5221M					362.000	573.000	3000	3500		121.5	-	130	-	-	171	-	2.0	2.0	7.9400			
	225	49.0	3.0	3.0	135.000	195.0	148.8	13	22.50	4.5	NU321	NJ321	NUP321	N321	HJ321	341.000	362.000	2700	3200		119	132	137	150	192	211	199	2.5	2.5	8.7500	1.00		
	260	60.0	4.0	4.0	144.500		162.0	16	27.00	2.5	NU421	NJ421	NUP421		HJ421	531.000	562.000	2200	2700		125	135	147	164	-	240	-	3.0	3.0	19.0000	1.65		

Single Row Cylindrical Roller Bearings
d = 110 to 150 mm



Dimensions											Bearing Designation					Basic Load Rating		Limiting Speed		Abutment and Fillet Dimensions										Weight		
d	D	B	r _s min	r _{1s} min	F	E	d ₂ max	b	b ₁	s ¹⁾	NU	NJ	NUP	N	Angle Ring HJ	C _r	C _{0r}	for Lubrication with Grease	Oil	d	d _a min	d _a max	d _b min	d _c min	d _d max	D _a max	D _b min	r _a max	r _b max	~ Bearing	Angle Ring	
mm																kN		min ⁻¹		mm										kg		
110	200	38.0	2.1	2.1	132.500	178.5	143.1	11	18.50	2.5	NU222	NJ222	NUP222	N222	HJ222	237.000	271.000	3200	3800	110	122	125	135	145	175	188	182	2.0	2.0	4.6500	0.62	
	200	53.0	2.1	2.1	132.500					5.0	NU2222	NJ2222	NUP2222			341.000	422.000	3200	3800		122	125	135	145	-	188	-	2.0	2.0	6.9500		
	200	69.85	2.1	4.0	132.951					7.0	NU5222M					464.000	736.000	3000	3500		128	-	137	-	-	180	-	3.0	2.0	10.0000		
	240	50.0	3.0	3.0	143.000	207.0	157.5	14	23.00	2.7	NU322	NJ322	NUP322	N322	HJ322	391.000	414.000	2500	3000		124	135	145	160	204	226	211	2.5	2.5	10.5000	1.17	
	240	50.0	3.0	3.0	143.000					2.9	NU322E	NJ322E	NUP322E			447.000	492.000	2400	2800		124	135	145	160	-	226	-	2.5	2.5	11.0000		
	280	65.0	4.0	4.0	155.000		173.4	17	29.50	2.7	NU422	NJ422	NUP422		HJ422	584.000	631.000	2100	2500		130	140	157	175	-	260	-	3.0	3.0	20.0000	2.16	
120	180	28.0	2.0	1.1	135.000					2.0	NU1024					131.000	168.000	3300	4000	120	128	131	138	-	-	171	-	2.0	1.0	2.4500		
	215	40.0	2.1	2.1	143.500	191.5	154.5	11	19.00	2.5	NU224	NJ224	NUP224	N224	HJ224	261.000	299.000	3000	3500		132	138	146	157	188	203	196	2.0	2.0	5.6500	0.72	
	215	58.0	2.1	2.1	143.500					5.4	NU2224	NJ2224	NUP2224			369.000	473.000	3000	3500		132	138	146	157	-	203	-	2.0	2.0	8.5500		
	215	76.2	2.1	2.1	145.140					7.0	NU5224M					482.000	794.000	2700	3200		140	-	149	-	-	194	-	2.0	2.0	11.8000		
	260	55.0	3.0	3.0	154.000		170.5	14	23.50	2.7	NU324	NJ324	NUP324		HJ324	447.000	473.000	2400	2800		134	145	156	172	-	246	-	2.5	2.5	13.0000	1.40	
	260	86.0	3.0	3.0	154.000					6.4	NU2324EMAS	NJ2324EMAS	NUP2324EMAS			810.000	981.000	2100	2500		134	145	156	172	-	246	-	2.5	2.5	24.5000		
130	310	72.0	5.0	6.0	170.000		188.0	17	30.50	2.7	NU424	NJ424	NUP424		HJ424	736.000	810.000	1900	2200		144	155	172	192	-	286	-	4.0	4.0	28.0000	2.60	
	200	33.0	2.0	1.1	148.000					2.0	NU1026					162.000	203.000	3200	3800	130	138	143	151	-	-	191	-	2.0	1.0	3.7500		
	230	40.0	3.0	3.0	156.000	204.0	167.0	11	19.00	2.5	NU226	NJ226	NUP226	N226	HJ226	271.000	322.000	2700	3200		144	150	158	169	201	216	208	2.5	2.5	6.5000	0.84	
	230	79.38	4.0	4.0	155.000					8.0	NU5226M					511.000	841.000	2500	3000		149	-	159	-	-	207	-	3.0	2.0	13.8000		
140	280	58.0	4.0	4.0	167.000		182.3	14	23.00	2.9	NU326E	NJ326E	NUP326E		HJ326E	619.000	694.000	2000	2400		148	155	169	186	-	262	-	3.0	3.0	17.0000	1.65	
	250	42.0	3.0	3.0	169.000	221.0	181.0	11	19.00	2.5	NU228	NJ228	NUP228	N228	HJ228	310.000	369.000	2500	3000	140	154	160	171	182	218	236	255	2.5	2.5	8.2500	1.00	
	250	82.55	4.0	4.0	168.460					10.0	NU5228M					596.000	981.000	2200	2700		162	-	173	-	-	225	-	3.0	3.0	17.1000		
	300	62.0	4.0	4.0	180.000		198.4	15	26.00	2.7	NU328	NJ328	NUP328		HJ328	619.000	708.000	2000	2400		158	166	182	198	-	282	-	3.0	3.0	20.0000	2.05	
150	225	35.0	2.1	1.5	169.500					2.0	NU1030					192.000	251.000	2700	3200	150	159	165	173	-	-	213	-	2.0	1.5	4.8500		
	270	45.0	3.0	3.0	182.000		194.7	12	20.50	2.4	NU230	NJ230	NUP230		HJ230	369.000	455.000	2200	2700		164	170	184	196	-	256	-	2.5	2.5	10.5000	1.35	
	270	45.0	3.0	3.0	182.000		193.7	12	19.50	2.4	NU230E	NJ230E	NUP230E		HJ230E	447.000	552.000	2200	2700		164	170	184	196	-	256	-	2.5	2.5	11.0000	1.30	
	270	88.9	2.3	2.3	181.544					10.0	NU5230M					736.000	1260.000	2000	2400		174	-	187	-	-	243	-	5.0	2.0	22.9000		
	320	65.0	4.0	4.0	193.000		212.3	15	26.50	2.7	NU330	NJ330	NUP330		HJ330	681.000	779.000	1900	2200		168	185	195	213	-	302	-	3.0	3.0	27.0000	2.37	
	1) Permissible axial displacement out of central position																															

d = 160 to 1180 mm



Dimensions											Bearing Designation				Angle Ring HJ	Basic Load Rating Dynamic C _r		Static C _{or}	Limiting Speed for Lubrication with Grease Oil		Abutment and Fillet Dimensions								Weight ~ Bearing Angle Ring		
d	D	B	r _s min	r _{1s} min	F	E	d ₂ max	b ₁	s ¹⁾	NU	NJ	NUP	N					d	d _a min	d _a max	d _b min	d _c min	d _d max	D _a max	D _b min	r _a max	r _b max				
mm																kN		min ⁻¹	mm								kg				
160	290	48.0	3.00	3.0	195.000		207.4	12	20.00	2.5	NU232M	NJ232M	NUP232M		HJ232		511.000	631.000	2000	2400	160	174	180	197	210	276	2.5	2.5	14.7000	1.50	
	290	98.42	2.50	6.3	193.634					10.0	NU5232M						764.000	1310.000	1900	2200		186	-	199	-	261	5.0	2.0	28.9000		
170	260	42.0	2.10	2.1	193.000					3.0	NU1034						276.000	376.000	2200	2700	170	179	190	197	-	248	2.0	2.0	7.9000		
	310	52.0	4.00	4.0	207.000	228.8	12	20.00	2.9	NU234M	NJ234M	NUP234M		HJ234		607.000	750.000	1900	2200		188	195	211	223	293	3.0	3.0	16.6000	1.70		
	310	104.77	3.20	6.3	205.483					10.0	NU5234M						891.000	1470.000	1800	2100		197	-	211	-	279	5.0	3.0	35.5000		
180	280	46.0	2.10	2.1	205.000					3.6	NU1036						329.000	447.000	2100	2500	180	189	196	209	-	268	2.0	2.0	10.5000		
	320	52.0	4.00	4.0	217.000	230.8	12	20.00	2.9	NU236M	NJ236M	NUP236M		HJ236		631.000	794.000	1800	2100		198	207	220	233	302	3.0	3.0	19.5000	1.80		
	320	86.0	4.00	4.0	218.000	230.5	12	29.00	6.9	NU2236M	NJ2236M	NUP2236M		HJ2236		736.000	1060.000	1800	2100		198	208	221	233	302	3.0	3.0	31.2000	1.90		
200	310	51.0	2.10	2.1	229.000					4.2	NU1040						383.000	531.000	1900	2200	200	212	220	233	-	298	2.0	2.0	14.0000		
	360	58.0	4.00	4.0	243.000	258.2	14	23.00	2.9	NU240E	NJ240E	NUP240E		HJ240E		779.000	1000.000	1500	1800		218	227	246	261	342	3.0	3.0	28.4000	2.70		
220	340	56.0	3.00	3.0	250.000					4.1	NU1044						501.000	694.000	1700	200	220	234	240	254	-	326	2.5	2.5	18.5000		
240	360	56.0	3.00	3.0	270.000					4.1	NU1048						531.000	764.000	1600	1900	240	254	260	275	-	346	2.5	2.5	20.0000		
	440	72.0	5.00	5.0	295.000					4.0	NU248	NJ248					944.000	1280.000	1300	1600		258	293	298	316	422	3.0	3.0	50.5000		
	440	72.0	5.00	5.0	295.000	315.0	16	25.90	4.0	NUJ248	NH248			HJ248		944.000	1280.000	1300	1600		258	293	298	316	422	3.0	3.0	50.5000	4.68		
260	400	65.0	4.00	4.0	296.000					2.0	NU1052		NUP1052				643.000	962.000	1400	1700	260	278	280	300	-	382	3.0	3.0	29.0000		
	480	130.0	5.00	5.0	320.000					4.3	NU2252						1760.000	2900.000	1100	1400		280	309	324	-	460	4.0	4.0	90.0000		
280	420	65.0	4.00	4.0	316.000					5.0	NU1056						681.000	1020.000	1300	1600	280	296	311	320	-	404	3.0	3.0	32.5000		
300	460	74.0	5.00	5.0	340.000					4.5	NU1060	NJ1060					891.000	1310.000	1200	1400	300	318	325	344	360	442	3.0	3.0	43.6000		
	460	74.0	5.00	5.0	340.000	357.6	19	36.00	4.5	NUJ1060	NH1060			HJ1060		891.000	1310.000	1200	1400		318	325	344	360	442	3.0	3.0	43.6000	5.63		
320	480	74.0	4.00	4.0	360.000					5.0	NU1064						909.000	1390.000	1100	1300	320	336	355	364	-	464	3.0	3.0	48.5000		
360	540	82.0	6.00	6.0	480.000					5.0	NU1072						1076.000	1753.000	950	1100	360	382	390	410	-	518	4.0	4.0	67.5000		
	540	82.0	6.00	6.0	480.000	423.0	21	39.50	5.0		NH1072			HJ1072		1076.000	1753.000	950	1100		382	390	410	427	518	4.0	4.0	67.5000	10.00		
380	560	82.0	5.00	5.0	425.000					6.0	NU1076						1166.000	1982.000	850	1000	380	400	420	430	-	540	4.0	4.0	71.0000		
400	600	90.0	5.00	5.0	450.000		470	19.6	42.6	5.0	NU1080	NUJ1080			HJ1080		1470.000	2330.000	840	1000	400	422	435	455	-	578	4.0	4.0	89.0000	10.50	
	600	148.0	5.00	5.0	450.000					5.0	NU3080						2255.000	4900.000	760	910		422	435	455	-	578	4.0	4.0	150.5000		
	720	185.0	6.00	6.0	480.000					16.0	NU2280						3410.000	5960.000	710	840		426	460	485	-	694	5.0	5.0	350.0000		
600	800	118.0	5.00	5.0	650.000					12.0	NU29/600		NUP29/600				2230.000	4853.000	560	700	600	614	644	654	675	750	4.0	4.0	173.0000		
850	1120	155.0	8.00	8.0	925.000					15.0	NU29/850		NUP29/850				3760.000	8740.000	380	450	850	878	920	930	952	1092	5.0	5.0	430.0000		
900	1180	165.0	8.00	8.0	982.000					17.0	NU29/900		NUP29/900				4220.000	9810.000	300	400	900	928	977	987	1011	1152	5.0	5.0	500.0000		
950	1250	175.0	10.00	10.0	1032.000					17.0	NU29/950		NUP29/950				4577.000	11452.000	300	370	950	978	1027	1041	1066	1220	5.0	5.0	597.0000		
1000	1320	185.0	10.00	10.0	1090.000					17.0	NU29/1000		NUP29/1000				4920.000	11600.000	300	350	1000	1036	1085	1095	1122	1284	6.0	6.0	720.0000		
1060	1400	195.0	10.00	10.0	1155.000					20.0	NU29/1060		NUP29/1060				5410.000	12800.000	280	330	1060	1096	1150	1160	1189	1364	6.0	6.0	850.0000		
1180	1540	206.0	10.00	10.0	1280.000					21.0	NU29/1180		NUP29/1180				6310.000	15300.000	250	300	1180	1216	1275	1285	1316	1504	6.0	6.0	1050.0000		

Double Row Cylindrical Roller Bearings



Double row cylindrical roller bearings in NN design have two rows of cylindrical rollers guided by three ribs on inner ring. The outer ring is without ribs, that is why these bearings cannot carry axial forces. Double row cylindrical roller bearings - type NN30K are commonly produced with tapered bore, taper 1:12 (K). These bearings can be also delivered with cylindrical bore (must be agreed in advance). Double row cylindrical roller bearings are significant for their great rigidity and are predominately used for spindle arrangements of machine tools and similar equipment. Double row cylindrical roller bearings - type NNU49 have three guiding ribs on outer ring and smooth inner ring. Bearings can carry only radial loads. Bearings - type NNU4920 and NNU4924 are also delivered matched in pairs according to the technical conditions TPF 11322-80. In this way matched bearing pairs fulfil in the arrangement the role of four-row cylindrical roller bearings and are suitable for arrangement of rolls in rolling mills, etc.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design is in the dimension tables of this publication.

Difference from standard design is designated by additional symbols according to STN 02 4608 (section 2.2).

Lubrication Groove and Holes on Outer Ring

All sizes of double row cylindrical roller bearings with tapered bore - type NN30K can be delivered with groove and lubrication holes on outer ring (W33). This bearing design allows the introduction of the lubricant directly into the bearing between two cylindrical roller rows. In this way better bearing lubrication and higher operating reliability are reached.

Cages

Cylindrical roller bearings are commonly produced with a machined brass cage which is usually not designated. Bearings type NNU49 are produced with machined brass cage (M) which is designated.

Tolerance

Cylindrical roller bearings with tapered bore are produced only in higher tolerance classes P5 and P4. Limiting values for dimension and operation accuracy for tolerance classes P5 and P4 are in tables 12 and 13.

Bearings NNU49 and NN39 are produced in normal tolerance class. Bearing delivery in tolerance class P6 should be agreed with the supplier in advance.

Radial Clearance

Cylindrical roller bearings with a tapered bore are produced with reduced radial clearance and with mutually non-interchangeable rings C1NA and C2NA. Symbols C1NA and C2NA are connected with tolerance class symbols P5 and P4, e.g. P5 + C1NA is designated P51NA. Values of radial clearance are shown in table 25. Bearings - type NNU49 are produced with normal radial clearance. Bearings delivery with radial clearance greater than C3 should be discussed with the supplier.

Misalignment

Double row cylindrical roller bearings are not suitable for arrangements where alignment of inner and outer bearing rings is not secured.

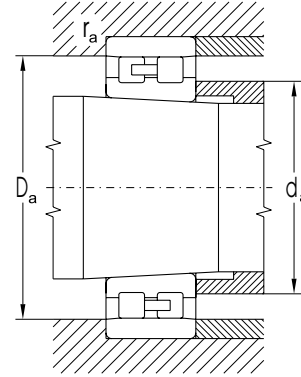
Radial Equivalent Dynamic Load

$$P_r = F_r \qquad [kN]$$

Radial Equivalent Static Load

$$P_{or} = F_r \qquad [kN]$$

d = 100 to 630 mm

[illegible]

Single Row Needle Roller Bearings



Single row needle roller bearings have needle rollers guided in axial direction by outer ring ribs and the inner ring is smooth as well as by single row cylindrical roller bearings in NU design. That is why these bearings cannot carry axial loads. Single row needle roller bearings have a small height of the cross section and relatively high basic load rating and are especially suitable for arrangements with limited space in radial direction. Bearings have a groove and lubrication holes on the outer ring periphery. Single row needle roller bearings are produced without cage. Bearings without cage (V) have a full complement of cylindrical rollers which results in higher load rating, but smaller limiting rotational speed in comparison with bearings of the same size with cage. Bearings are also delivered without inner ring (R NA). In this case the inner raceway is created directly on the journal.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design is in the dimension tables of this publication.

Difference from standard design is designated by additional symbols (section 2.2).

Tolerance

Single row needle roller bearings are commonly produced in normal tolerance class P0 (symbol P0 is not indicated). For special arrangements demanding accuracy, bearings in higher tolerance class P6 are delivered. Delivery of these bearings should be discussed in advance. Limiting values of dimension and running accuracy are shown in table 10.

Radial Clearance

Commonly produced single row needle roller bearings have normal radial clearance which is not indicated. For special arrangements bearings with greater radial clearance (C3) are delivered. Radial clearance values are shown in table 26.

Bearings without Inner Rings

For arrangements with limited mounting space single row needle roller bearings without inner ring are delivered (R NA). Needle rollers of these bearings roll directly on the ground journal. Inner raceways diameter tolerances for single row needle roller bearings without inner ring are shown in following table.

Journal Diameter F _w	Radial Clearance Smaller	Normal to 80 mm	over 80 mm	Greater to 65 mm	over 65 mm
Inner Raceway Diameter Tolerance	k5	h5	g6	g6	f6

Raceway deviations of roundness and cylindricity must not be greater than deviations for tolerance class IT3. Values of basic load ratings C_r and C_{or} , shown in dimension tables are valid for bearings without inner ring if inner raceway hardness on the journal will be in the range 59 to 65 HRC. With decreasing raceway hardness also the load rating values decrease and the table value C_r should be multiplied by factor f_t (Table 7). Minimum depth of hardened layer after grinding should be 1 to 3 mm according to bearing dimension and load. Raceway surface roughness for common arrangements $R_a = 0.2$, for less demanding arrangements $R_a = 0.4$.

Misalignment

Mutual ring misalignment of single row needle roller bearings is small. Permissible misalignment values are to 2'.

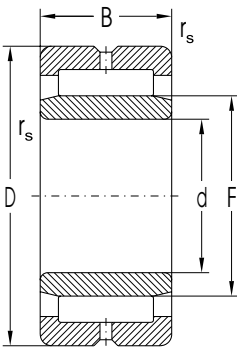
Radial Equivalent Dynamic Load

$$P_r = F_r \qquad [kN]$$

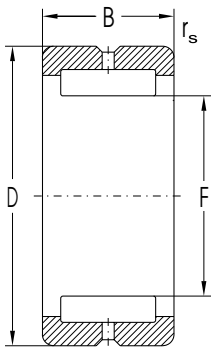
Radial Equivalent Static Load

$$P_{or} = F_r \qquad [kN]$$

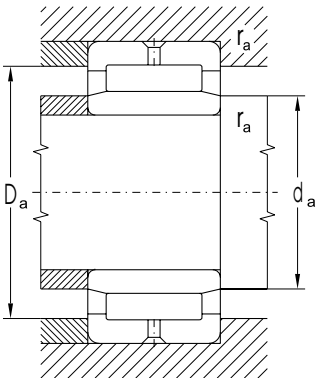
Single Row Needle Roller Bearings
d = 20 to 50 mm



NA

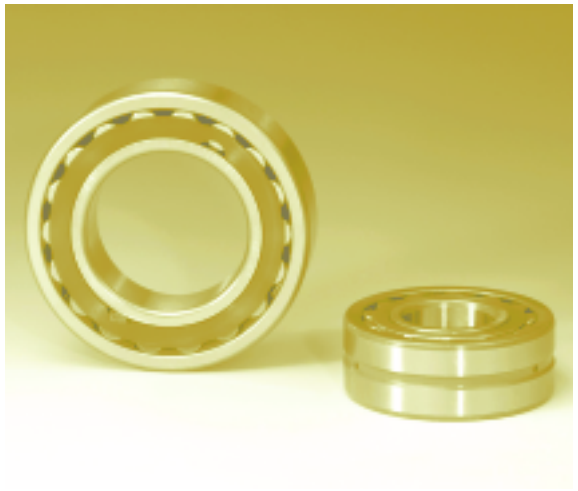


RNA

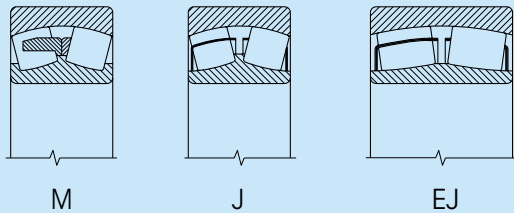


Dimensions						Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation		Abutment and Fillet Dimensions					Weight	
d	D	B	r _s min	F	s ¹⁾	Dynamic C _r	Static C _{0r}			NA	R NA	d	d _a min	d _a max	D _a max	r _a max	~ NA	R NA
mm						kN		min ⁻¹				mm					kg	
20	42	22	0.6	28	2	30.4	55.2	3800	5600	NA4004V	R NA4004V	20	24	26	38	0.6	0.176	0.124
25	47	22	0.6	34	2	36.2	65.6	3300	5000	NA4005V	R NA4005V	25	28	32	43	0.6	0.200	0.134
30	55	25	1.0	40	2	44.7	89.1	2600	4200	NA4006V	R NA4006V	30	34	38	50	1.0	0.311	0.202
35	62	27	1.0	46	2	52.1	114	2400	3500	NA4007V	R NA4007V	35	39.5	44	57	1.0	0.419	0.272
40	68	28	1.0	52	2	55.2	128	2100	3200	NA4008V	R NA4008V	40	44	49	63	1.0	0.495	0.306
50	72	22	0.6	58	2	43.5	116	1900	2800	NA4910V	R NA4910V	50	54	56.5	68	0.6	0.373	0.260
	80	30	1.0	62	2	59.6	153	1800	2700	NA4010V	R NA4010V		54	59	75	1.0	0.687	0.440
1) Permissible axial displacement																		

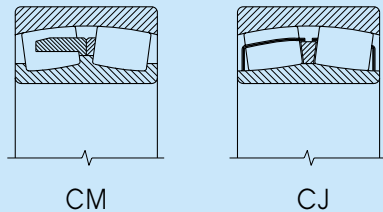
Double Row Spherical Roller Bearings



Double row spherical roller bearings have two rows of spherical rollers with a common sphered raceway in the outer ring. This design enables mutual misalignment of rings. They can



simultaneously carry great radial and axial load in both directions. These bearings are produced with both cylindrical and tapered bore. These bearings are suitable for arrangements where great loads are acting and misalignment should be secured.



Heat Treatment

Bearings are specially heat treated, which allows their operating temperature to be to 180°C without any impermissible dimension changes occurring.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design and in design with tapered bore is in the dimension tables of this publication.

Difference from standard design is designated by additional symbols (section 2.2).

Tapered Bore

Bearings with tapered bore have taper 1:12, for type 240 the taper size is 1:30 (K30). Bearings with tapered bore are fixed on the cylindrical shafts by means of adapter sleeves. Sleeve designation corresponding to individual bearings is in the dimension tables of this publication.

Lubrication Groove and Holes on Outer Ring

All types and sizes of double row spherical roller bearings are delivered besides the standard design also design W33 with groove and lubricating holes along the pheriphery that provides better lubricating and higher reliability.

Cage

Bearings have cage material and design as shown in the dimension tables of this publication. Bearings with symbols J and E have pressed steel cage, bearings with symbol M have machined brass cage.

Tolerance

Double row spherical roller bearings are commonly produced in normal tolerance class P0 which is not indicated. Bearing delivery with higher tolerance class should be discussed with the supplier in advance.

Radial Clearance

Commonly produced bearings have normal radial clearance which is not indicated. For special arrangements bearings with smaller clearance C2 and greater radial clearance C3, C4 and C5 are delivered. Radial clearance values comply with standard ISO 5753 and are shown in table 27.

Misalignment

Bearings can misalign from the central position without affecting their correct function. The following table shows permissible misalignment values according to bearing type.

Bearing Type	Permissible Misalignment
239, 230, 231, 222	1°30'
223	2°
232	2°30'

Radial Equivalent Dynamic Load

$$P_r = F_r + Y_1 F_a$$
$$P_r = 0.67 F_r + Y_2 F_a$$

for $F_a/F_r \leq e$

for $F_a/F_r > e$

[kN]

[kN]

Factor values e , Y_1 , and Y_2 for individual bearings are indicated in dimension tables of this publication.

Radial Equivalent Static Load

$$P_{or} = F_r + Y_0 F_a$$

[kN]

Factor values Y_0 for individual bearings are indicated in the dimensional tables of this publication.

d = 40 to 95 mm



Dimensions						Basic Load Rating		Limiting Speed		Bearing Designation		Abutment and Fillet Dimensions				Weight		Corresp.	Corresp.	Corresp.	Factors			
d	D	B	r _s min	a	b	C _r	Static C _{0r}	for Lubrication with				d	d _a min	D _a max	r _a max	~	K	Adapter Sleeve	Withdrawal Sleeve	Nut	e	Y ₁	Y ₂	Y ₀
mm						kN		min ⁻¹				mm				kg								
40	90	33	1.5	3.0	5.5	100	108	4000	4700	22308J	22308KJ	40	47	81	1.5	1.00	0.98	H2308	AH2308	KM9	0.420	1.600	2.400	1.600
45	100	36	1.5	3.0	5.5	116	132	3800	4500	22309J	22309KJ	45	52	91	1.5	1.40	1.37	H2309	AH2309	KM10	0.420	1.600	2.400	1.600
50	110	40	2.0	3.0	5.5	156	180	3300	4000	22310J	22310KJ	50	60	100	2.0	1.90	1.86	H2310	AH2310X	KM11	0.420	1.600	2.400	1.600
55	120	43	2.0	3.0	5.5	173	200	2800	3300	22311J	22311KJ	55	65	110	2.0	2.40	2.35	H2311	AH2311X	KM12	0.420	1.600	2.400	1.600
60	130	46	2.1	3.0	5.5	213	237	2800	3300	22312J	22312KJ	60	72	118	2.0	3.10	3.03	H2312	AH2312X	KM13	0.410	1.600	2.350	1.550
	130	46	2.1	3.0	5.5	209	230	2800	3300	22312M	22312KM		72	118	2.0	3.27	3.20	H2312	AH2312X	KM13	0.410	1.630	2.350	1.550
65	140	48	2.1	3.0	5.5	230	268	2700	3200	22313J	22313KJ	65	76	128	2.0	3.31	3.23	H2313	AH2313	KM15	0.380	1.800	2.540	1.670
	140	48	2.1	3.0	5.5	222	252	2700	3200	22313M	22313KM		76	128	2.0	3.70	3.62	H2313	AH2313	KM15	0.380	1.800	2.540	1.670
70	125	31	1.5	3.0	5.5	153	180	2800	3300	22214J	22214KJ	70	77	116	1.5	1.67	1.64	H314	AH314	KM16	0.240	2.800	4.200	2.800
	150	51	2.1	3.0	5.5	297	342	2400	3000	22314J	22314KJ		81	138	2.0	4.35	4.24	H2314	AH2314X	KM16	0.370	1.800	2.600	1.720
	150	51	2.1	3.0	5.5	289	330	2400	3000	22314M	22314KM		81	138	2.0	4.50	4.40	H2314	AH2314X	KM16	0.370	1.800	2.600	1.720
75	130	31	1.5	3.0	5.5	157	191	2700	3200	22215J	22215KJ	75	82	121	1.5	1.76	1.72	H315	AH315	KM17	0.230	3.000	4.400	2.900
	130	31	1.5	3.0	5.5	157	191	2700	3200	22215CJ	22215CKJ		82	121	1.5	1.76	1.72	H315	AH315	KM17	0.230	3.000	4.400	2.900
	160	55	2.1	4.5	8.3	304	368	2200	2800	22315J	22315KJ		86	148	2.0	5.40	5.29	H2315	AH2315X	KM17	0.380	1.761	2.600	1.670
	160	55	2.1	4.5	8.3	295	354	2200	2800	22315M	22315KM		86	148	2.0	5.65	5.54	H2315	AH2315X	KM17	0.380	1.761	2.600	1.670
80	140	33	2.0	3.0	5.5	186	240	2400	3000	22216CJ	22216CKJ	80	90	130	2.0	2.20	2.16	H316	AH316	KM18	0.220	3.000	4.500	3.000
	140	33	2.0	3.0	5.5	168	208	2400	3000	22216J	22216KJ		90	130	2.0	2.20	2.16	H316	AH316	KM18	0.240	2.835	4.000	2.700
	140	33	2.0	3.0	5.5	154	197	2400	3000	22216M	22216KM		90	130	2.0	2.28	2.23	H316	AH316	KM18	0.260	2.600	3.800	2.500
	170	58	2.1	4.5	8.3	359	425	2200	2800	22316J	22316KJ		91	158	2.0	6.60	6.47	H2316	AH2316X	KM18	0.370	1.840	2.766	1.755
	170	58	2.1	4.5	8.3	349	411	2200	2800	22316M	22316KM		91	158	2.0	6.57	6.44	H2316	AH2316X	KM18	0.370	1.840	2.766	1.755
85	150	36	2.0	3.0	5.5	206	261	2200	2800	22217CJ	22217CKJ	85	95	140	2.0	2.84	2.79	H317	AH317X	KM19	0.240	2.700	4.000	2.700
	150	36	2.0	3.0	5.5	186	223	2200	2800	22217J	22217KJ		95	140	2.0	2.80	2.74	H317	AH317X	KM19	0.240	2.800	4.000	2.650
	150	36	2.0	3.0	5.5	171	214	2200	2800	22217M	22217KM		95	140	2.0	2.84	2.79	H317	AH317X	KM19	0.260	2.600	3.700	2.500
	180	60	3.0	4.5	8.3	383	456	2000	2500	22317J	22317KJ		98	166	2.5	7.40	7.20	H2317	AH2317X	KM19	0.370	1.900	2.700	1.800
	180	60	3.0	4.5	8.3	377	447	2000	2500	22317M	22317KM		98	166	2.5	7.70	7.50	H2317	AH2317X	KM19	0.370	1.900	2.700	1.800
90	160	40	2.0	4.5	8.3	209	265	2000	2500	22218M	22218KM	90	100	150	2.0	3.65	3.58	H318	AH318X	KM20	0.260	2.600	3.700	2.500
	160	40	2.0	4.5	8.3	222	272	2000	2500	22218J	22218KJ		100	150	2.0	3.55	3.48	H318	AH318X	KM20	0.260	2.600	3.800	2.500
	160	40	2.0	4.5	8.3	257	335	2000	2500	22218CM	22218CKM		100	150	2.0	3.55	3.48	H318	AH318X	KM20	0.260	2.600	3.700	2.500
	160	52.4	2.0	3.0	5.5	303	412	1900	2400	23218M	23218KM		100	150	2.0	4.70	4.57	H2318	AH3218X	KM20	0.330	2.000	3.000	2.000
	190	64	3.0	4.5	8.3	443	532	1900	2400	22318J	22318KJ		103	176	2.5	8.58	8.42	H2318	AH2318X	KM20	0.370	1.800	2.600	1.700
	190	64	3.0	4.5	8.3	437	520	1900	2400	22318M	22318KM		103	176	2.5	9.30	9.14	H2318	AH2318X	KM20	0.370	1.800	2.600	1.700
95	170	43	2.1	4.5	8.3	257	321	2000	2500	22219J	22219KJ	95	107	158	2.0	4.31	4.23	H319	AH319X	KM21	0.260	2.600	3.700	2.500
	170	43	2.1	4.5	8.3	259	329	2000	2500	22219M	22219KM		107	158	2.0	4.44	4.36	H319	AH319X	KM21	0.270	2.500	3.600	2.400
	200	67	3.0	4.5	8.3	473	566	1800	2200	22319M	22319KM		109	186	2.5	10.30	10.10	H2319	AH2319X	KM21	0.370	1.800	2.700	1.800

d = 100 to 150 mm



KM

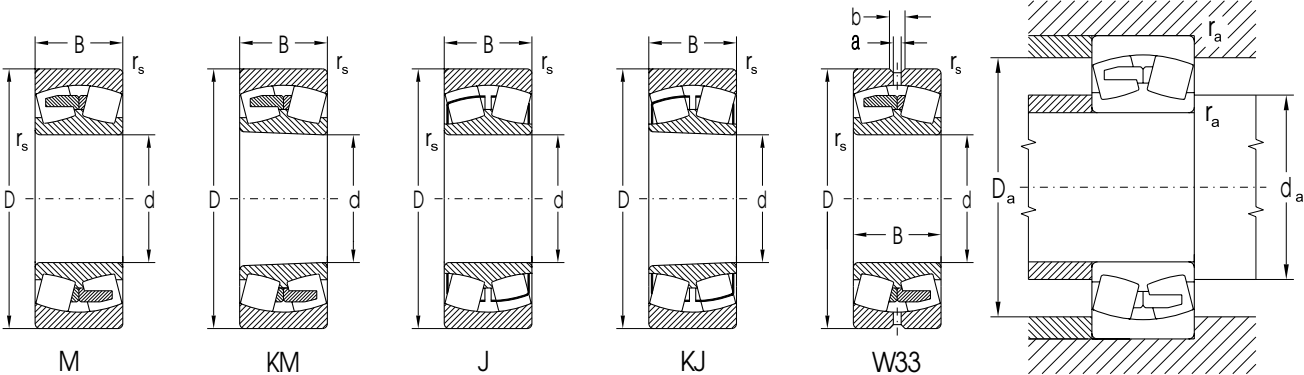
J

KJ

W3.3

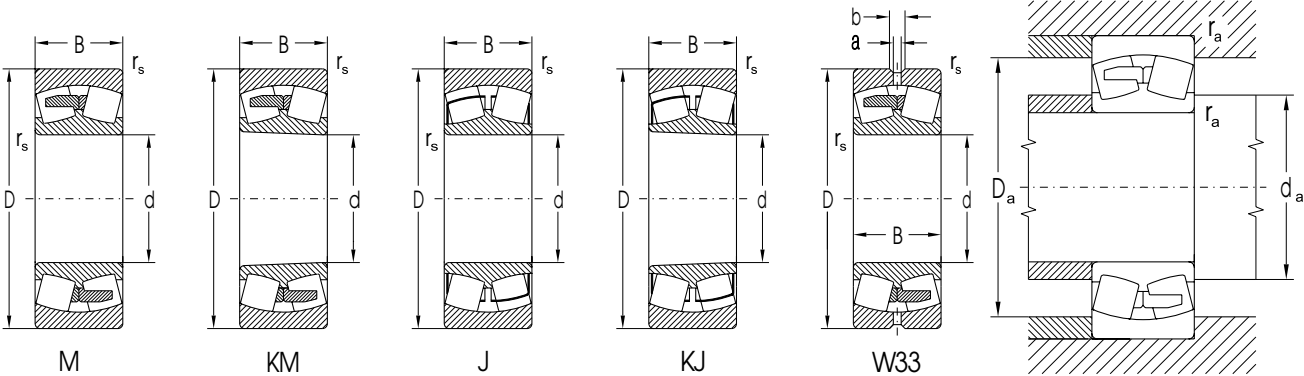
142

Double Row Spherical Roller Bearings
d = 160 to 200 mm



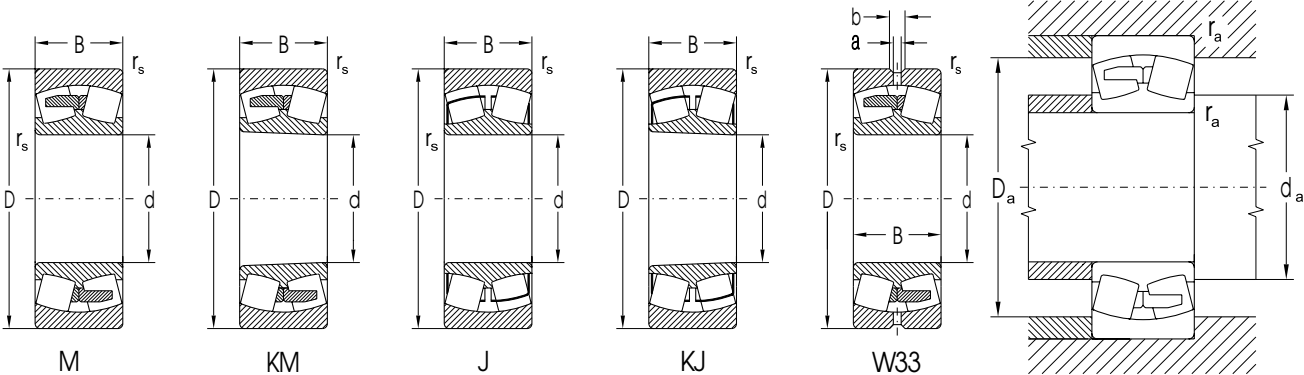
Dimensions						Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation		Abutment and Fillet Dimensions				Weight		Corresp.	Corresp.	Corresp.	Factors					
d	D	B	r _s min	a	b	C _r	C _{or}	Grease	Oil	with Cylindrical Bore	with Tapered Bore	d	d _a min	D _a max	r _a max	~	K	Adapter Sleeve	Withdrawal Sleeve	Nut	e	Y ₁	Y ₂	Y ₀		
mm						kN		min ⁻¹				mm				kg										
160	240	60	2.1	4.5	8.3	496	848	1200	1500	23032M	23032KM	160	169	228	2.0	10.30	10.00	H3032	AH3032	KM34	0.240	2.800	4.100	2.700		
	270	86	2.1	6.0	11.1	784	1238	1100	1400	23132M	23132KM		172	258	2.0	20.80	20.20	H3132	AH3132	KM36	0.320	2.100	3.100	2.000		
	290	80	3.0	7.5	13.9	814	1141	1200	1500	22232M	22232KM		174	276	2.5	23.40	22.90	H3132	AH3132	KM36	0.300	2.300	3.300	2.200		
	290	104	3.0	7.5	13.9	1144	1860	1000	1300	23232CM	23232CKM		174	276	2.5	31.00	30.10	H2332	AH3232	KM36	0.360	1.900	2.800	1.800		
	290	104	3.0	7.5	13.9	1100	1169	1000	1300	23232M	23232KM		174	276	2.5	31.00	30.10	H2332	AH3232	KM36	0.360	1.900	2.800	1.800		
	340	114	4.0	9.0	16.7	1246	1682	1000	1300	22332M	22332KM		178	322	3.0	51.90	50.80	H2332	AH2332	KM36	0.380	1.800	2.600	1.700		
170	260	67	2.1	6.0	11.1	618	1047	1100	1400	23034M	23034KM	170	179	248	2.0	13.40	13.00	H3034	AH3034	KM36	0.250	2.700	3.800	2.600		
	260	90	2.1	4.5	8.3	840	1580	1100	1400	24034CM	24034CK30M		182	248	2.0	17.50	17.00		AH24034	KM36	0.320	2.100	3.100	2.100		
	280	88	2.1	6.0	11.1	826	1352	1000	1300	23134M	23134KM		182	268	2.0	22.40	21.70	H3134	AH3134	KM38	0.320	2.100	3.100	2.100		
	310	86	4.0	7.5	13.9	921	1310	1100	1400	22234M	22234KM		188	293	3.0	29.00	28.40	H3134	AH3134	KM38	0.300	2.300	3.200	2.160		
	310	110	4.0	7.5	13.9	1230	1900	940	1200	23234M	23234KM		188	292	3.0	37.70	36.70	H2334	AH3234	KM38	0.340	2.000	3.000	2.000		
	310	110	4.0	7.5	13.9	1280	1880	1100	1400	23234CM	23234CKM		188	293	3.0	37.70	36.70	H2334	AH3234	KM38	0.370	1.900	2.800	1.800		
	360	120	4.0	9.0	16.7	1402	1966	940	1200	22334M	22334KM		188	342	3.0	62.00	58.70	H2334	AH2334	KM38	0.370	1.800	2.600	1.700		
	180	280	74	2.1	6.0	11.1	725	1229	1000	1300	23036M		23036KM	180	189	268	2.0	17.60	17.10	H3036	AH3036	KM38	0.260	2.600	3.700	2.500
280		100	2.1	4.5	8.3	1020	1960	1150	1500	24036CM	24036CK30M	192	268		2.0	23.00	22.0		AH24036	KM38	0.340	2.000	2.900	1.900		
300		96	3.0	6.0	11.1	957	1539	940	1200	23136M	23136KM	194	286		2.5	28.40	27.50	H3136	AH3136	KM40	0.320	2.100	2.900	2.000		
300		118	4.0	6.0	11.1	1250	2400	700	850	24136CJ		194	286		2.5	27.70					0.370	1.800	2.700	1.800		
320		86	4.0	9.0	16.7	943	1383	1000	1300	22236M	22236KM	198	302		3.0	30.50	29.80	H3136	AH2236	KM40	0.290	2.400	3.500	2.300		
320		112	4.0	7.5	13.9	1305	2080	890	1100	23236M	23236KM	198	302		3.0	39.80	38.60	H2336	AH3236	KM40	0.310	2.200	3.200	2.100		
320		112	4.0	7.5	13.9	1360	2110	890	1100	23236CM	23236CKM	198	302		3.0	39.80	38.60	H2336	AH3236	KM40	0.360	1.900	2.800	1.900		
380		126	4.0	12.0	22.3	1542	2127	890	1100	22336M	22336KM	198	362		3.0	71.40	69.90	H2336	AH2336	KM40	0.370	1.800	2.600	1.700		
190		290	75	2.1	6.0	11.1	759	1311	940	1200	23038M	23038KM	190		202	278	2.0	18.80	18.30	H3038	AH3038	HML41T	0.250	2.700	3.800	2.500
		290	100	2.1	4.5	8.3	1070	2060	1100	1400	24038CM	24038CK30M			202	278	2.0	24.00	22.0		AH24038	KM40	0.320	2.100	3.100	2.100
	320	104	3.0	7.5	13.9	1126	1838	890	1100	23138M	23138KM	204		306	2.5	35.50	34.40	H3138	AH3138	HM42T	0.330	2.100	3.000	2.000		
	340	92	4.0	9.0	16.7	1040	1550	940	1200	22238M	22238KM	208		322	3.0	37.40	36.60	H3138	AH2238	HM42T	0.290	2.300	3.300	2.200		
	340	120	4.0	9.0	16.7	1460	2360	840	1000	23238M	23238KM	208		322	4.0	48.50	47.10	H2338	AH3238	HM42T	0.320	2.100	3.200	2.100		
	340	120	4.0	9.0	16.7	1550	2420	840	1000	23238CM	23238CKM	208		322	3.0	48.50	47.10	H2338	AH3238	HM42T	0.360	1.900	2.800	1.800		
	400	132	5.0	12.0	22.3	1750	2545	840	1000	22338M	22338KM	212		378	4.0	84.10	80.50	H2338	AH2338	HM42T	0.310	2.200	3.200	2.100		
	400	132	5.0	12.0	22.3	1920	2710	840	1000	22338CM	22338CKM	212		378	4.0	84.10	82.50	H2338	AH2338	HM42T	0.360	1.900	2.800	1.900		
	200	310	82	2.1	6.0	11.1	880	1800	890	1100	23040CM	23040CKM		200	212	298	2.0	23.80	23.40	H3040	AH3040	HML43T	0.250	2.700	4.000	2.700
		310	109	2.1	6.0	11.1	1205	2150	1050	1300	24040CM	24040CK30M			212	298	2.0	30.5	29.00		AH24040	HM42T	0.340	2.000	3.000	2.000
340		112	3.0	9.0	16.7	1236	2006	840	1000	23140M	23140KM	214	326		2.5	43.70	42.40	H3140	AH3140	HM44T	0.330	2.000	3.000	2.000		
360		98	4.0	9.0	16.7	1164	1756	890	1100	22240M	22240KM	218	342		3.0	45.00	44.10	H3140	AH2240	HM44T	0.290	2.300	3.300	2.200		
360		128	4.0	9.0	16.7	1620	2560	790	940	23240M	23240KM	218	342		3.0	58.40	56.7	H2340	AH3240	HM44T	0.320	2.100	3.200	2.100		
360		128	4.0	9.0	16.7	1710	2760	790	940	23240CM	23240CKM	218	342		3.0	58.40	56.7	H2340	AH3240	HM44T	0.360	1.900	2.800	1.900		
420		138	5.0	12.0	22.3	1823	2648	790	940	22340M	22340KM	222	398		4.0	95.40	93.40	H2340	AH2340	HM44T	0.360	1.900	2.700	1.800		

Double Row Spherical Roller Bearings
d = 220 to 340 mm



Dimensions						Basic Load Rating		Limiting Speed		Bearing Designation		Abutment and Fillet Dimensions				Weight		Corresp.	Corresp.	Corresp.	Factors			
d	D	B	r _s	a	b	D _r	C _{or}	Grease	Oil	with Cylindrical Bore	with Tapered Bore	d	d _a	D _a	r _a	~	K	Adapter Sleeve	Withdrawal Sleeve	Nut	e	Y ₁	Y ₂	Y ₀
mm			min				kN		min ⁻¹			mm				kg								
220	340	90	3.0	7.5	13.9	1020	1900	790	940	23044CM		220	234	326	2.5	31.50					0.260	2.600	3.900	2.500
	340	90	3.0	7.5	13.9	1057	1863	790	940	23044M	23044KM		234	326	2.5	31.50	0.60	H3044	AH3044	HML47T	0.260	2.600	3.800	2.500
	340	118	3.0	6.0	11.4	1340	2420	900	1200	24044CM	24044CK30M		234	326	2.5	39.0	38.1		AH24044	HM46T	0.330	2.100	3.100	2.000
	370	120	4.0	9.0	16.7	1476	2468	750	890	23144M	23144KM		238	352	3.0	54.80	53.20	H3144	AH3144	HM48T	0.330	2.000	3.000	2.000
	400	108	4.0	9.0	16.7	1378	2075	790	940	22244M	22244KM		238	382	3.0	63.00	61.70	H3144	AH2244	HM48T	0.290	2.400	3.400	2.200
	400	144	4.0	9.0	16.7	1967	3138	710	840	23244M	23244KM		238	382	3.0	82.00	79.60	H2344	AH2344	HM48T	0.370	1.800	2.600	1.700
	400	144	4.0	9.0	16.7	2040	3750	710	840	23244CM			238	382	3.0	83.00					0.370	1.900	2.600	1.700
240	460	145	5.0	12.0	22.3	2111	3126	750	890	22344M	22344KM	240	242	438	4.0	128.00	126.00	H2344	AH2344	HM48T	0.350	1.900	2.800	1.800
	360	92	3.0	7.5	13.9	1080	2320	750	890	23048CM			254	346	2.5	34.00					0.250	2.800	4.200	2.800
	360	92	3.0	7.5	13.9	1073	1950	750	890	23048M	23048KM		254	346	2.5	35.50	35.40	H3048	AH3048	HML52T	0.250	2.700	4.100	2.600
	360	118	3.0	6.0	11.1	1500	2990	800	1000	24048CM	24048CK30M		254	346	2.5	42.50	41.00		AH24048	HM50T	0.330	2.100	3.100	2.000
	400	128	4.0	9.0	16.7	1685	2864	710	840	23148M	23148KM		258	382	3.0	67.60	65.60	H3148	AH3148	HM52T	0.320	2.100	3.000	1.900
	440	120	4.0	12.0	22.3	1663	2559	750	890	22248M	22248KM		258	422	3.0	85.00	83.20	H3148	AH2248	HM52T	0.290	2.300	3.400	2.300
	440	160	4.0	12.0	22.3	2302	3710	630	750	23248M	23248KM		258	422	3.0	111.00	108.00	H2348	AH2348	HM52T	0.380	1.800	2.500	1.700
260	500	155	5.0	12.0	22.3	2438	3689	670	790	22348M	22348KM	260	262	478	4.0	157.00	154.00	H2348	AH2348	HM52T	0.340	1.900	2.800	1.800
	400	104	4.0	9.0	16.7	1460	2700	670	790	23052CM			278	382	3.0	50.70					0.250	2.700	4.000	2.700
	400	104	4.0	9.0	16.7	1350	2410	670	790	23052M	23052KM		278	382	3.0	50.70	49.20	H3052	AH3052	HML56T	0.250	2.500	3.900	2.600
	400	140	4.0	6.0	11.1	1915	3730	700	900	24052CM	24052CK30M		278	382	3.0	64.50	63.00		AH24052	HM54T	0.350	1.900	2.900	1.900
	440	144	4.0	9.0	16.7	2095	3030	630	750	23152M	23152KM		278	422	3.0	93.60	90.80	H3152	AH3152	HM58T	0.330	2.000	2.900	1.900
	440	144	4.0	9.0	16.7	2240	2700	670	790	23152CM			278	422	3.0	93.60					0.330	2.000	3.100	2.000
	480	130	5.0	12.0	22.3	1945	3033	670	790	22252M	22252KM		282	458	4.0	110.00	108.00	H3152	AH2252	HM58T	0.290	2.300	3.300	2.200
280	480	174	5.0	12.0	22.3	2707	4428	600	710	23252M	23252KM	280	282	458	4.0	144.00	140.00	H2352	AH2352	HM58T	0.380	1.800	2.600	1.700
	540	165	6.0	12.0	22.3	2755	4222	600	710	22352M	22352KM		288	512	5.0	196.00	192.00	H2352	AH2352	HM58T	0.340	2.000	2.900	1.900
	380	75	2.1	6.0	11.1	840	1900	670	790	23956M			292	368	2.0	26.40					0.180	3.800	5.700	3.700
	420	106	4.0	9.0	16.7	1439	2694	630	750	23056M	23056KM		298	402	3.0	54.50	52.90	H3056	AH3056	HML60T	0.250	2.700	3.900	2.600
	420	140	4.0	6.0	11.1	2080	3650	700	900	24056CM	24056CK30M		298	402	3.0	68.50	67.50		AH24056	HM58T	0.330	2.000	3.000	2.000
	460	146	5.0	9.0	16.7	2179	3904	600	710	23156M	23156KM		302	438	4.0	100.00	96.90	H3156	AH3156	HM62T	0.320	2.100	3.000	2.000
	500	130	5.0	12.0	22.3	2012	3204	630	750	22256M	22256KM		302	478	4.0	114.00	112.00	H3156	AH2256	HM62T	0.280	2.400	3.500	2.300
300	500	176	5.0	12.0	22.3	2844	4767	560	670	23256M	23256KM	300	302	478	4.0	154.00	150.00	H2356	AH2356	HM62T	0.360	1.900	2.600	1.800
	580	175	6.0	12.0	22.3	3138	4886	560	670	22356M	22356KM		308	522	5.0	239.00	235.00	H2356	AH2356	HM62T	0.330	2.000	2.900	1.900
	580	175	6.0	12.0	22.3	3300	5600	600	750	22356CM	22356CKM		308	522	5.0	227.00	223.00	H2356	AH2356	HM62T	0.310	2.000	3.200	2.100
	460	118	4.0	9.0	16.7	1784	3239	560	670	23060M	23060KM		318	442	3.0	75.80	73.60	H3060	AH3060	HML64T	0.250	2.700	3.800	2.500
	500	160	5.0	12.0	22.3	2561	4488	530	630	23160M	23160KM		322	478	4.0	132.00	128.00	H3160	AH3160	HM66T	0.320	2.100	3.100	2.000
	540	140	5.0	12.0	22.3	2352	3809	560	670	22260M	22260KM		322	518	4.0	145.00	142.00	H3160	AH2260	HM66T	0.270	2.500	3.600	2.400
	540	192	5.0	12.0	22.3	3348	5569	500	600	23260M	23260KM		322	518	4.0	198.00	192.00	H3260	AH3260	HM66T	0.370	1.800	2.700	1.800
320	480	121	4.0	9.0	16.7	1890	3514	530	630	23064M	23064KM	320	338	462	3.0	81.20	78.80	H3064	AH3064	HML69T	0.250	2.700	4.000	2.600
	540	176	5.0	12.0	22.3	3019	5386	500	600	23164M	23164KM		342	518	4.0	171.00	166.00	H3164	AH3164	HM70T	0.330	2.000	3.000	1.900
	580	150	5.0	12.0	22.3	2698	4426	530	630	22264M	22264KM		342	558	4.0	177.00	173.00	H3164	AH2264	HM70T	0.270	2.500	3.600	2.300
	580	208	5.0	12.0	22.3	3876	6523	450	530	23264M	23264KM		342	558	4.0	249.00	242.00	H3264	AH3264	HM70T	0.370	1.800	2.600	1.700
340	520	133	5.0	12.0	22.3	2269	4207	500	600	23068M	23068KM	340	362	498	4.0	109.00	106.00	H3068	AH3068	HML73T	0.250	2.700	3.900	2.550
	520	180	5.0	9.0	16.7	3055	6135	560	700	24068CM	24068CK30M		362	498	4.0	140.00	138.00		AH24068	HM3072	0.330	2.000	3.000	2.000
	580	190	5.0	12.0	22.3	3448	6098	450	530	23168M	23168KM		362	558	4.0	216.00	210.00	H3168	AH3168	HM74T	0.330	2.000	3.000	1.900
	620	224	6.0	12.0	22.3	4429	7558	420	500	23268M	23268KM		368	592	5.0	310.00	300.00	H3268	AH3268	HM74T	0.370	1.800	2.600	1.700

Double Row Spherical Roller Bearings
d = 360 to 850 mm



Dimensions						Basic Load Rating		Limiting Speed		Bearing Designation		Abutment and Fillet Dimensions				Weight		Corresp.	Corresp.	Corresp.	Factors			
d	D	B	r _s	a	b	D _r	C _{or}	Grease	Oil	with Cylindrical Bore	with Tapered Bore	d	d _a	D _a	r _a	~	K	Adapter Sleeve	Withdrawal Sleeve	Nut	e	Y ₁	Y ₂	Y ₀
mm			min			kN		min ⁻¹				mm				kg								
360	540	134	5.0	12.0	22.3	2362	4457	450	530	23072M	23072KM	360	382	518	4.0	115.00	112.00	H3072	AH3072	HML77T	0.240	2.800	4.000	2.700
	600	192	5.0	12.0	22.3	3625	6554	420	500	23172M	23172KM		382	578	4.0	228.00	221.00	H3172	AH3172	HM80T	0.320	2.000	3.000	2.000
380	560	135	5.0	12.0	22.3	2413	4702	420	500	23076M	23076KM	380	402	538	4.0	122.00	118.00	H3076	AH3076	HML82T	0.240	2.900	4.200	2.700
	620	194	5.0	12.0	22.3	3734	6974	400	470	23176M	23176KM		402	598	2.0	240.00	233.00	H3176	AH3176	HM84T	0.310	2.100	3.100	2.100
400	680	240	6.0	12.0	22.3	5160	8922	380	480	23276M	23276KM	400	471	581	5.0	375.00	370.00	H3276	AH3276	HM84T	0.370	1.800	2.700	1.800
	600	148	5.0	12.0	22.3	2863	5494	400	470	23080M	23080KM		422	578	5.0	155.00	150.00	H3080	AH3080	HML86T	0.240	2.800	4.000	2.700
	600	200	5.0	12.0	22.3	3735	7790	450	560	24080CM			422	578	5.0	205.00					0.30	2.300	3.400	2.200
	650	200	6.0	12.0	22.3	4041	7579	380	450	23180M	23180KM		428	622	5.0	273.00	265.00	H3180	AH3180	HM88T	0.310	2.200	3.100	2.100
420	720	256	6.0	12.0	22.3	5801	10120	350	420	23280M	23280KM	420	428	692	5.0	464.00	450.00	H3280	AH3280	HM88T	0.370	1.800	2.700	1.750
	620	150	5.0	12.0	22.3	2949	5853	380	450	23084M	23084KM		442	598	4.0	164.00	159.00	H3084	AH3084	HML90T	0.240	2.900	4.300	2.800
	700	224	6.0	12.0	22.3	4940	9217	350	420	23184M	23184KM		448	672	5.0	361.00	350.00	H3184	AH3184	HM92T	0.320	2.100	3.000	2.000
	650	157	6.0	12.0	22.3	3210	6411	350	420	23088M	23088KM	440	468	622	5.0	188.00	182.00	H3088	AH3088X	HML94T	0.240	2.900	4.100	2.700
440	720	226	6.0	12.0	22.3	5300	8380	330	400	23188M	23188KM		468	692	5.0	378.00	366.00	H3188	AH3188X	HM96T	0.310	2.100	3.100	2.000
	790	280	7.5	12.0	22.3	6815	12030	320	380	23288M	23288KM		476	754	6.0	610.00	592.00	H3288	AH3288X	HM96T	0.370	1.800	2.700	1.800
	680	163	6.0	12.0	22.3	3483	6997	330	400	23092M	23092KM	460	488	652	5.0	216.00	210.00	H3092	AH3092X	HML98T	0.230	2.900	4.200	2.800
460	760	240	7.5	12.0	22.3	5717	10950	320	380	23192M	23192KM		496	724	6.0	447.00	433.00	H3192	AH3192X	HM102T	0.320	2.100	3.000	2.000
	650	128	5.0	12.0	22.3	2900	6430	500	630	23996CCM		480	502	628	4.0	130					0.170	3.900	5.800	3.800
480	790	248	7.5	12.0	22.3	6118	11770	300	350	23196M	23196KM		516	754	6.0	503.00	488.00	H3196	AH3196X	HM106	0.310	2.200	3.100	2.100
	670	128	5.0	12.0	22.3	2930	6680	470	600	239/500CCM		500	522	648	4.0	133					0.170	4.000	3.900	3.900
500	720	167	6.0	12.0	22.3	3754	7779	300	350	230/500M	230/500KM		528	692	5.0	235.00	228.00	H30/500	AH30/500X	HML108T	0.230	3.000	4.300	2.900
	830	264	7.5	12.0	22.3	6741	12893	280	330	231/500M	231/500KM	530	536	794	6.0	595.00	577.00	H31/500	AH31/500X	HL110T	0.320	2.100	3.000	2.000
	530	780	185	6.0	12.0	22.3	4436	9236	280	330	230/530M	230/530KM	558	752	5.0	303.00	294.00	H30/530	AH30/530	HML112T	0.230	3.000	4.200	2.800
560	820	195	6.0	12.0	22.3	5000	10437	280	330	230/560M	230/560KM	560	588	792	5.0	383.00	372.00	H30/560	AH30/560	HML118T	0.230	3.000	4.200	2.800
600	870	200	6.0	12.0	22.3	5500	12900	260	300	230/600CM		600	633	838	5.0	405					0.220	2.900	4.200	2.800
630	920	212	7.5	12.0	22.3	6273	13361	240	300	230/630M	230/630KM	630	666	884	6.0	495.00	481.00	H30/630	AH30/630	HM30/630	0.220	3.000	4.500	2.900
800	1150	258	7.5	12.0	22.3	8617	19648	180	220	230/800M	230/800KM	800	836	1114	6.0	939.00	911.00	H30/800	AH30/800	HM30/800	0.220	3.100	4.500	3.000
850	1220	272	7.5	12.0	22.3	9608	22080	160	200	230/850M	230/850KM	850	886	1184	6.0	1110.00	1080.00				0.220	3.100	4.500	3.000

Single Row Tapered Roller Bearings



Single Row Tapered Roller Bearings

A design with a great number of tapered rollers in one row enables these bearings to reach high load ratings both in radial and axial directions. Axial load can be applied only in one direction and its size depends on the contact angle size. Bearings with a greater contact angle (type 313 and 323B) are suitable for greater axial forces.

Single row tapered roller bearing arrangement is usually created by a pair of bearings because of bidirectional accommodation of axial load.

Bearings are produced in design with higher utilization parameters - designation A. Besides bearings in metric dimensions bearings in inch dimensions are also produced.

Boundary Dimensions

Boundary dimensions of metric single row tapered roller bearings comply with the standard ISO 355.

Boundary dimensions of single row tapered roller bearings in inch dimensions are according to the standard AFBMA Standard 19 (USA) from 1974.

Designation

Bearing designation of standard bearings is in the dimension tables of this publication.

Difference from basic design is indicated by additional symbols shown in section 2.2 .

According to the dimensional plan ISO 355 the metric single row tapered roller bearing designation consists of letter and numerical symbols expressing following :

T	bearing type
2, 3, 4, 5, 7	angle series of bearing
B, C, D, E, F, G	diameter series of bearing
B, C, D, E	width series of bearing
000	bore diameter in mm

For customer's and producer's orientation previous the designation is retained in the dimension tables and designation according to ISO is also shown.

The bearings designation in inch dimensions corresponds to usual way of designation of most producers of these bearings. The number preceding the slash indicates the cone with tapered rollers and cage, the number after the slash indicates the cup.

Cage

Single row tapered roller bearings have pressed steel cage which is not designated. Additional symbol J2 indicates a new cage design.

Tolerance

Bearings are commonly produced in normal tolerance class P0 which is not indicated. For arrangements demanding more accuracy or working with high rotational speed, bearings in higher tolerance class P6, P6X and P5 are delivered. Delivery of bearings in P6X and P5 should be discussed in advance.

Internal Clearance

Single row tapered roller bearings are mounted in pairs, in which required clearance, or preload are adjusted at mounting. Clearance or preload size is determined according to arrangement's requirements.

Misalignment

Seating surface for single row tapered roller bearings must be aligned only with small deviations because ring misalignment is very small. By common operating conditions the misalignment is

- at small load ($F_r < 0.1C_{or}$) 1' to 1.5'
- at great load ($F_r \geq 0.1C_{or}$) 2' to 4'

Radial Equivalent Dynamic Load

$$\begin{array}{ll} P_r = F_r & \text{for } F_a/F_r \leq e \quad [\text{kN}] \\ P_r = 0.4F_r + YF_a & \text{for } F_a/F_r > e \quad [\text{kN}] \end{array}$$

Values of factors e and Y for individual bearings are shown in the dimension tables of this publication.

If the shaft is arranged in two single row tapered roller bearings additional inner axial force rises. Load magnitude of one bearing depends on load and contact angle of the second bearing. Additional inner forces must be taken into account by calculation. In the table relations for various bearing arrangements at acting outer axial force K_a , radial F_{rA} , F_{rB} loading bearing A and B are shown.

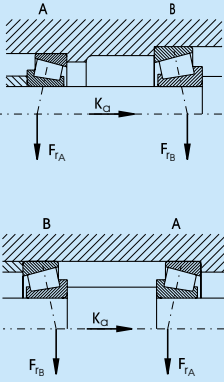
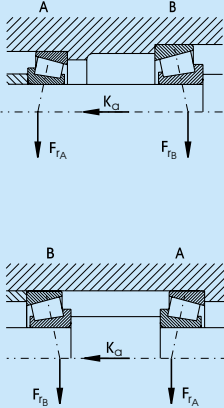
Radial forces act in the intersection of the contact line with bearing axis (dimensions „a“, „s“ are in the dimension tables) and in calculation are considered for positive even then, when they have reverse direction than in the picture.

Calculated force F_a is introduced to the calculation of radial equivalent dynamic load.

Radial Equivalent Static Load

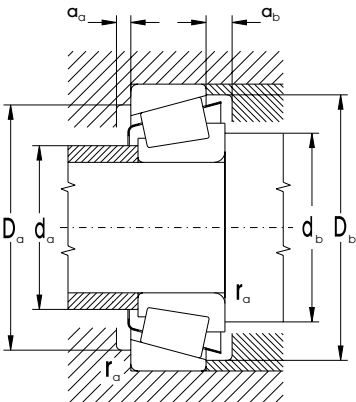
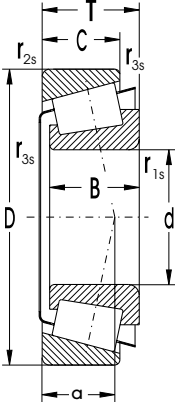
$$P_{or} = 0.5F_r + Y_0F_a \quad (P_{or} \geq F_r) \quad [\text{kN}]$$

Values of Y_0 factor for individual bearings are shown in the dimension tables of this publication.

Bearing Arrangement	Force Conditions	Bearing Axial Load	
		Bearing A	Bearing B
	$\frac{F_{rA}}{Y_A} \leq \frac{F_{rB}}{Y_B}$ $K_a \geq 0$	$F_{aA} = F_{aB} + K_a$ $F_{aB} = \frac{0.5 F_{rB}}{Y_B}$	
	$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$ $K_a \geq 0.5 \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B} \right)$	$F_{aA} = F_{aB} + K_a$ $F_{aB} = \frac{0.5 F_{rB}}{Y_B}$	
	$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$ $K_a < 0.5 \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B} \right)^{1)}$	$F_{aA} = \frac{0.5 F_{rA}}{Y_A}$ $F_{aB} = F_{aA} - K_a$	
	$\frac{F_{rA}}{Y_A} \leq \frac{F_{rB}}{Y_B}$ $K_a \geq 0$	$F_{aA} = \frac{0.5 F_{rA}}{Y_A}$ $F_{aB} = F_{aA} + K_a$	
	$\frac{F_{rA}}{Y_A} < \frac{F_{rB}}{Y_B}$ $K_a \geq 0.5 \left(\frac{F_{rB}}{Y_B} - \frac{F_{rA}}{Y_A} \right)$	$F_{aA} = \frac{0.5 F_{rA}}{Y_A}$ $F_{aB} = F_{aA} + K_a$	
	$\frac{F_{rA}}{Y_A} < \frac{F_{rB}}{Y_B}$ $K_a < 0.5 \left(\frac{F_{rB}}{Y_B} - \frac{F_{rA}}{Y_A} \right)^{1)}$	$F_{aA} = F_{aB} - K_a$ $F_{aB} = \frac{0.5 F_{rB}}{Y_B}$	

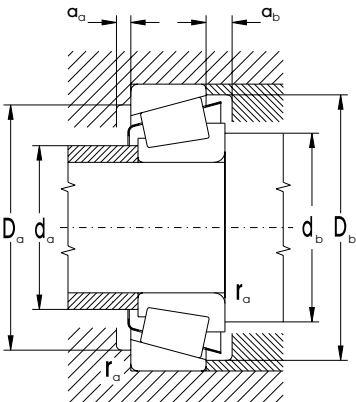
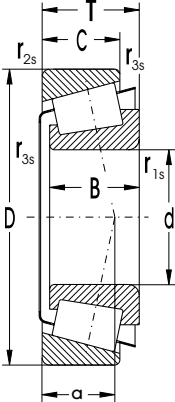
1) Valid for $K_a = 0$

Single Row Tapered Roller Bearings
d = 17 to 45 mm

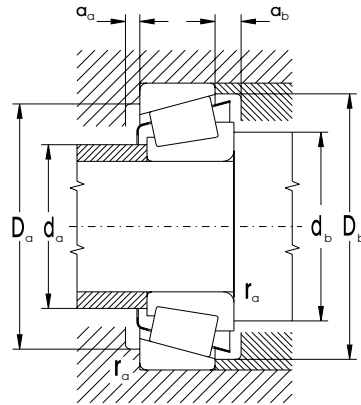
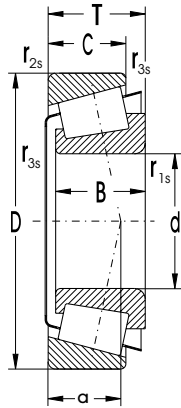


Dimensions									Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation		Abutment and Fillet Dimensions										Weight	Factors		
d	D	B	C	T	r _{1s} min	r _{2s} min	r _{3s} min	a	C _r	C _{or}			STN	ISO	d	d _a max	d _b min	D _a min	D _a max	D _b min	a _a min	a _b min	r _a max		e	Y	Y ₀	
mm									kN		min ⁻¹				mm										kg			
17	47	14	12.0	15.25	1.0	1.0	0.3	11	25.1	22.8	10000	13000	30303AJ2	T2FB017	17	25	23	39	41	42	2	3	1	0.140		0.290	2.100	1.200
20	42	15	12.0	15.00	0.6	0.6	0.3	10	22.8	29.0	9000	13000	32004AX	T3CC020	20	25	25	36	37	39	3	3	0.6	0.102		0.370	1.600	0.900
	47	14	12.0	15.25	1.0	1.0	0.3	11	25.1	26.1	8900	12000	30204A	T2DB020		26	26	39	41	43	2	3	1	0.136		0.350	1.700	1.000
	52	15	13.0	16.25	1.5	1.5	0.6	11	30.4	29.9	8400	11000	30304A	T2FB020		27	27	43	45	47	2	3	1	0.179		0.300	2.000	1.100
	52	21	18.0	22.25	1.5	1.5	0.6	13	43.8	45.5	8400	11000	32304A	T2FD020		27	27	43	45	47	2	4	1	0.267		0.300	2.000	1.100
25	47	15	11.5	15.00	0.6	0.6	0.3	12	24.2	28.7	8400	11000	32005AX	T4CC025	25	30	31	40.5	42	44	3	3.5	0.6	0.117		0.430	1.400	0.800
	52	15	13.0	16.25	1.0	1.0	0.3	12	29.9	33.5	7500	10000	30205A	T3CC025		31	31	43	46	48	2	3	1	0.167		0.370	1.600	0.900
	62	17	15.0	18.25	1.5	1.5	0.6	13	43.8	42.1	6900	9200	30305A	T2FB025		33	32	53	55	57	2	3	1	0.288		0.300	2.000	1.100
	62	17	15.0	18.25	1.5	1.5	0.6	13	39.8	38.3	7100	9400	30305AJ2	T2FB025		33	32	53	55	57	2	3	1	0.265		0.300	2.000	1.100
	62	17	13.0	18.25	1.5	1.5	0.6	20	36.2	39.1	6700	8900	31305A	T7FB025		33	32	46	55	59	2	5	1	0.271		0.830	0.700	0.400
	62	24	20.0	25.25	1.5	1.5	0.6	15	57.3	60.7	6700	8900	32305A	T2FD025		33	32	53	55	57	2	5	1	0.404		0.300	2.000	1.100
30	55	17	13.0	17.00	1.0	1.0	0.3	13	35.5	43.8	7100	9400	32006AX	T4CC030	30	35	36	47.5	49	52	3	4	1	0.181		0.430	1.400	0.800
	62	16	14.0	17.25	1.0	1.0	0.3	14	39.3	42.8	6500	8700	30206A	T3DB030		37	36	52	56	57	2	3	1	0.252		0.370	1.600	0.900
	62	16	14.0	17.25	1.0	1.0	0.3	14	40.6	44.7	6700	8900	30206AJ2	T3DB030		37	36	52	56	57	2	3	1	0.252		0.370	1.600	0.900
	62	20	17.0	21.25	1.0	1.0	0.3	15	50.1	59.6	6700	8900	32206A	T3DC030		37	36	52	56	58.5	2	4	1	0.320		0.370	1.600	0.900
	72	19	16.0	20.75	1.5	1.5	0.6	15	53.1	53.1	5600	7500	30306A	T2FB030		38	37	61	65	66	2	4.5	1	0.419		0.320	1.900	1.100
	72	19	14.0	20.75	1.5	1.5	0.6	23	46.4	50.1	5300	7100	31306AJ2	T7FB030		39	37	55	65	68	2	6.5	1	0.390		0.830	0.700	0.400
	72	27	23.0	28.75	1.5	1.5	0.6	20	76.4	85.8	5600	7500	32306A	T2FD030		38	37	61	65	66	2	5.5	1	0.628		0.320	1.900	1.100
	32	58	17	13.0	17.00	1.0	1.0	0.3	14	39.8	48.2	7100	9400	320/32AX		T4CC032	32	38	38	50	52	55	3	4	1	0.196		0.450
35	62	18	14.0	18.00	1.0	1.0	0.3	15	43.0	53.1	6300	8400	32007AX	T4CC035	35	40	41	54	56	59	4	4	1	0.243		0.450	1.300	0.700
	72	17	15.0	18.25	1.5	1.5	0.6	15	46.4	51.1	5300	7100	30207A	T3DB035		43	42	61	65	67	3	3	1	0.361		0.370	1.600	0.900
	72	23	19.0	24.25	1.5	1.5	0.6	17	64.3	76.4	5300	7100	32207A	T3DC035		43	42	61	65	68.5	3	5	1	0.480		0.370	1.600	0.900
	80	21	18.0	22.75	2.0	1.5	0.6	16	65.6	69.4	5000	6700	30307A	T2FB035		43	44	68	71	74	3	4.5	1.5	0.551		0.320	1.900	1.100
	80	21	15.0	22.75	2.0	1.5	0.6	26	57.3	63.1	4700	6300	31307AJ2	T7FB035		43	44	61	71	76	3	7.5	1.5	0.520		0.830	0.700	0.400
	80	31	25.0	32.75	2.0	1.5	0.6	20	94.4	110.0	4700	6300	32307A	T2FE035		43	44	68	71	74	3	7.5	1.5	0.827		0.320	1.900	1.100
40	68	19	14.5	19.00	1.0	1.0	0.3	15	48.2	64.3	5300	7100	32008AX	T3CD040	40	45	46	60	62	65	4	4.5	1	0.290		0.380	1.600	0.900
	80	18	16.0	19.75	1.5	1.5	0.6	17	55.2	60.7	4700	6300	30208A	T3DB040		48	47	68	73	75.5	3	3.5	1	0.452		0.370	1.600	0.900
	80	23	19.0	24.75	1.5	1.5	0.6	18	70.8	85.5	4700	6300	32208A	T3DC040		48	47	68	73	75	3	5.5	1	0.594		0.370	1.600	0.900
	90	23	20.0	25.25	2.0	1.5	0.6	18	84.3	93.2	4500	6000	30308A	T2FB040		50	49	76	81	82	3	5	1.5	0.773		0.350	1.700	1.000
	90	23	20.0	25.25	2.0	1.5	0.6	19	82.5	94.4	4500	6000	30308AJ2	T2FB040		50	49	76	81	82	3	5	1.5	0.773		0.350	1.700	1.000
	90	23	17.0	25.25	2.0	1.5	0.6	29	76.4	85.8	4000	5300	31308A	T7FB040		50	49	70	81	86	3	8	1.5	0.776		0.830	0.700	0.400
	90	33	27.0	35.25	2.0	1.5	0.6	22	114.0	141.0	4200	5600	32308A	T2FD040		50	49	76	81	82	3	8	1.5	1.120		0.350	1.700	1.000
	90	33	27.0	35.25	2.0	1.5	0.6	27	104.2	136.6	4100	5400	32308BA	T5FD040		50	49	70	81	85	4	8	1.5	1.110		0.540	1.100	0.600
	90	33	27.0	35.25	2.0	1.5	0.6	27	104.0	144.0	4200	5600	32308BAJ2	T5FD040		50	49	70	81	85	4	8	1.5	0.990		0.540	1.100	0.600
	90	33	27.0	35.25	2.0	1.5	0.6	27	104.0	144.0	4200	5600	32308BAJ2	T5FD040		50	49	70	81	85	4	8	1.5	0.990		0.540	1.100	0.600
45	75	20	15.5	20.00	1.0	1.0	0.3	17	57.3	79.4	4700	6300	32009AX	T3CC045	45	50	51	66	69	72	4	4.5	1	0.355		0.390	1.500	0.800
	85	19	16.0	20.75	1.5	1.5	0.6	18	61.9	70.8	4500	6000	30209A	T3DB045		53	52	73	78	80	3	4.5	1	0.527		0.410	1.500	0.800
	85	23	19.0	24.75	1.5	1.5	0.6	20	73.6	90.9	4500	6000	32209A	T3DC045		53	52	73	78	81.5	3	5.5	1	0.641		0.410	1.500	0.800
	100	25	22.0	27.25	2.0	1.5	0.6	21	107.0	118.0	4000	5300	30309A	T2FB045		56	54	85	91	92	3	5	1.5	1.040		0.350	1.700	1.000
	100	25	22.0	27.25	2.0	1.5	0.6	21	104.0	117.0	4000	5300	30309AJ2	T2FB045		56	54	85	91	92	3	5	1.5	1.040		0.350	1.700	1.000
	100	25	18.0	27.25	2.0	1.5	0.6	32	92.6	104.0	3800	5000	31309A	T7FB045		55	54	78	91	95	3	9	1.5	1.030		0.830	0.700	0.400
	100	36	30.0	38.25	2.0	1.5	0.6	25	144.0	181.0	3800	5000	32309A	T2FD045		56	54	85	91	93	3	8	1.5	1.530		0.350	1.700	1.000
	100	36	30.0	38.25	2.0	1.5	0.6	31	131.0	174.0	3800	5000	32309BAJ2	T5FD045		55	54	76	91	94	5	8	1.5	1.540		0.540	1.100	0.600
	100	36	30.0	38.25	2.0	1.5	0.6	31	131.0	174.0	3800	5000	32309BAJ2	T5FD045		55	54	76	91	94	5	8	1.5	1.540		0.540	1.100	0.600

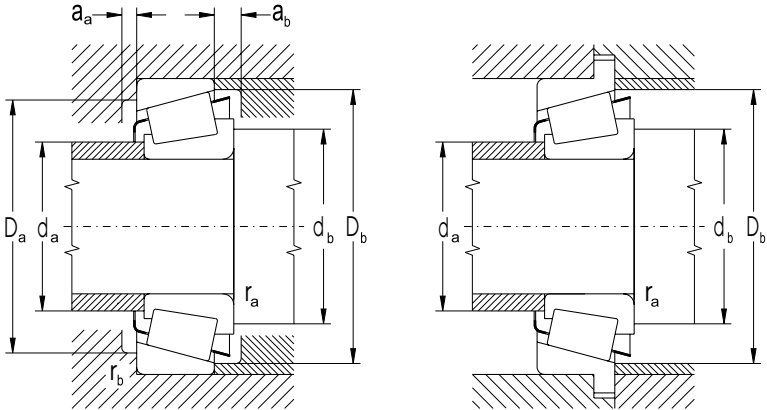
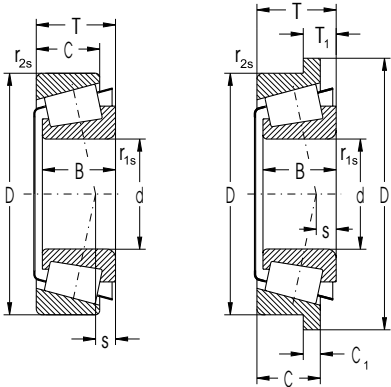
Single Row Tapered Roller Bearings
d = 50 to 75 mm



Dimensions									Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation		Abutment and Fillet Dimensions										Weight	Factors		
d	D	B	C	T	r _{1s} min	r _{2s} min	r _{3s} min	a	C _r	C _{or}	Grease	Oil	STN	ISO	d	d _a max	d _b min	D _a min	D _a max	D _b min	a _a min	a _b min	r _a max	~	e	Y	Y ₀	
mm									kN		min ⁻¹				mm										kg			
50	80	20	15.5	20.00	1.0	1.0	0.3	18	59.6	87.4	4500	6000	32010AX	T3CC050	50	55	56	71	74	77	4	4.5	1	0.395		0.420	1.400	0.800
	90	20	17.0	21.75	1.5	1.5	0.6	20	70.8	87.4	4200	5600	30210A	T3DB050		58	57	78	83	86.5	3	4.5	1	0.602		0.420	1.400	0.800
	90	23	19.0	24.75	1.5	1.5	0.6	21	81.0	102.0	4200	5600	32210A	T3DC050		58	57	78	83	85	3	5.5	1	0.667		0.420	1.400	0.800
	110	27	23.0	29.25	2.5	2.0	0.6	23	121.0	141.0	3800	5000	30310A	T2FB050		62	60	94	100	102	3	6	2	1.320		0.350	1.700	1.000
	110	27	19.0	29.25	2.5	2.0	0.6	35	102.0	114.0	3300	4500	31310A	T7FB050		61	60	85	100	104	3	10	2	1.290		0.830	0.700	0.400
	110	40	33.0	42.25	2.5	2.0	0.6	27	174.0	224.0	3300	4500	32310A	T2FD050		62	60	94	100	102	3	9	2	2.010		0.350	1.700	1.000
	110	40	33.0	42.25	2.5	2.0	0.6	33	156.0	212.0	3200	4400	32310BA	T5FD050		62	60	83	100	103	5	9	2	1.990		0.540	1.100	0.600
55	90	23	17.5	23.00	1.5	1.5	0.6	20	76.4	108.0	4000	5300	32011AX	T3CC055	55	61	62	80	83	86	4	5.5	1	0.592		0.410	1.500	0.800
	100	21	18.0	22.75	2.0	1.5	0.6	21	81.0	96.2	3800	5000	30211A	T3DB055		63	64	87	91	94	4	4.5	1.5	0.759		0.410	1.500	0.800
	100	25	21.0	26.75	2.0	1.5	0.6	22	102.0	128.0	3800	5000	32211A	T3DC055		63	64	87	91	95	4	5.5	1.5	0.915		0.410	1.500	0.800
	120	29	25.0	31.50	2.5	2.0	0.6	25	136.0	162.0	3300	4500	30311A	T2FB055		67	65	103	110	111	4	6.5	2	1.710		0.350	1.700	1.000
	120	29	21.0	31.50	2.5	2.0	0.6	38	117.0	136.0	3000	4000	31311A	T7FB055		67	65	92	110	113	4	10.5	2	1.630		0.830	0.700	0.400
	120	43	35.0	45.50	2.5	2.0	0.6	29	200.0	256.0	3300	4500	32311A	T2FD055		67	65	103	110	111	4	10.5	2	2.500		0.350	1.700	1.000
60	95	23	17.5	23.00	1.5	1.5	0.6	21	81.0	119.0	3800	5000	32012AX	T4CC060	60	66	67	85	88	91	4	5.5	1	0.632		0.430	1.400	0.800
	110	22	19.0	23.75	2.0	1.5	0.6	22	94.4	117.0	3300	4500	30212A	T3EB060		69	69	95	101	105.5	4	4.5	1.5	0.967		0.410	1.500	0.800
	110	28	24.0	29.75	2.0	1.5	0.6	25	126.0	162.0	3300	4500	32212A	T3EC060		69	69	95	101	104	4	5.5	1.5	1.270		0.410	1.500	0.800
	130	31	26.0	33.50	3.0	2.5	1.0	26	162.0	188.0	3000	4000	30312A	T2FB060		73	72	112	118	120	4	7.5	2	2.090		0.350	1.700	1.000
	130	31	22.0	33.50	3.0	2.5	1.0	41	136.0	158.0	2800	3800	31312A	T7FB060		72	72	103	118	123	4	11.5	2	2.030		0.830	0.700	0.400
	130	46	37.0	48.50	3.0	2.5	1.0	31	228.0	299.0	2800	3800	32312A	T2FD060		73	72	112	118	120	4	11.5	2	3.070		0.350	1.700	1.000
	130	46	37.0	48.50	3.0	2.5	1.0	39	200.0	293.0	2500	3300	32312B	T5FD060		73	72	99	118	122	6	11.5	2	3.160		0.540	1.100	0.600
65	100	23	17.5	23.00	1.5	1.5	0.6	23	81.0	123.0	3300	4500	32013AX	T4CC065	65	71	72	90	93	97	4	5.5	1	0.675		0.460	1.300	0.700
	110	34	26.5	34.00	1.5	1.5	0.6	26	136.0	207.0	3800	5300	33113A	T3DE065		74	72	96	103	106	6	7.5	1	1.300		0.390	1.500	0.800
	120	23	20.0	24.75	2.0	1.5	0.6	24	112.0	136.0	3000	4000	30213A	T3EB065		75	74	105	111	113	4	4.5	1.5	1.230		0.410	1.500	0.800
	120	31	27.0	32.75	2.0	1.5	0.6	28	150.0	200.0	3000	4000	32213A	T3EC065		75	74	105	111	115	4	5.5	1.5	1.660		0.410	1.500	0.800
	120	41	32.0	41.00	2.0	1.5	0.6	30	191.0	267.0	3000	4000	33213A	T3EE065		75	74	102	111	115	6	9	1.5	2.060		0.390	1.500	0.900
	140	33	28.0	36.00	3.0	2.5	1.0	28	185.0	220.0	2800	3800	30313A	T2GB065		80	77	121	128	130	4	8	2	2.550		0.350	1.700	1.000
	140	33	23.0	36.00	3.0	2.5	1.0	44	150.0	178.0	2800	3800	31313A	T7GB065		78	77	109	128	132	4	13	2	2.450		0.830	0.700	0.400
	140	48	39.0	51.00	3.0	2.5	1.0	33	261.0	331.0	2800	3800	32313A	T2GD065		80	77	121	128	130	4	12	2	3.770		0.350	1.700	1.000
70	110	25	19.0	25.00	1.5	1.5	0.6	24	98.1	147.0	3300	4500	32014AX	T4CC070	70	77	77	98	103	105	5	6	1.5	0.893		0.440	1.400	0.800
	125	24	21.0	26.25	2.0	1.5	0.6	26	121.0	153.0	3000	4000	30214A	T3EB070		80	79	108	116	118	4	5	1.5	1.370		0.420	1.400	0.800
	125	31	27.0	33.25	2.0	1.5	0.6	29	155.0	203.0	2800	3800	32214A	T3EC070		80	79	108	116	119	4	6	1.5	1.730		0.420	1.400	0.800
	150	35	30.0	38.00	3.0	2.5	1.0	30	211.0	251.0	2700	3500	30314A	T2GB070		85	82	129	138	140	4	8	2	3.070		0.350	1.700	1.000
	150	35	25.0	38.00	3.0	2.5	1.0	47	178.0	211.0	2700	3500	31314A	T7GB070		83	82	118	138	141	4	13	2	3.010		0.830	0.700	0.400
	150	51	42.0	54.00	3.0	2.5	1.0	36	293.0	398.0	2700	3500	32314A	T2GD070		85	82	129	138	140	4	12	2	4.550		0.350	1.700	1.000
75	115	25	19.0	25.00	1.5	1.5	0.6	25	104.0	158.0	3000	4000	32015AX	T4CC075	75	82	82	103	108	110	5	6	1	0.955		0.460	1.300	0.700
	130	25	22.0	27.25	2.0	1.5	0.6	28	128.0	165.0	2800	3800	30215A	T4DB075		85	84	113	121	124	4	5	1.5	1.470		0.440	1.400	0.800
	130	31	27.0	33.25	2.0	1.5	0.6	30	162.0	220.0	2800	3800	32215A	T4DC075		85	84	113	121	121	4	6	1.5	1.820		0.440	1.400	0.800
	130	41	31.0	41.00	2.0	1.5	0.6	32	196.0	299.0	2800	3800	33215A	T3EE075		85	84	111	121	125	6	10	1.5	2.300		0.430	1.400	0.800
	160	37	31.0	40.00	3.0	2.5	1.0	32	242.0	287.0	2500	3300	30315A	T2GB075		91	87	138	148	149	4	9	2	3.720		0.350	1.700	1.000
	160	55	45.0	58.00	3.0	2.5	1.0	38	341.0	464.0	2400	3200	32315A	T2GD075		91	87	138	148	149	4	13	2	5.620		0.350	1.700	1.000
	160	55	45.0	58.00	3.0	2.5	1.0	47	304.0	464.0	2000	2700	32315B	T5GD075		90	87	128	148	150	7	12.5	2	5.600		0.540	1.100	0.600

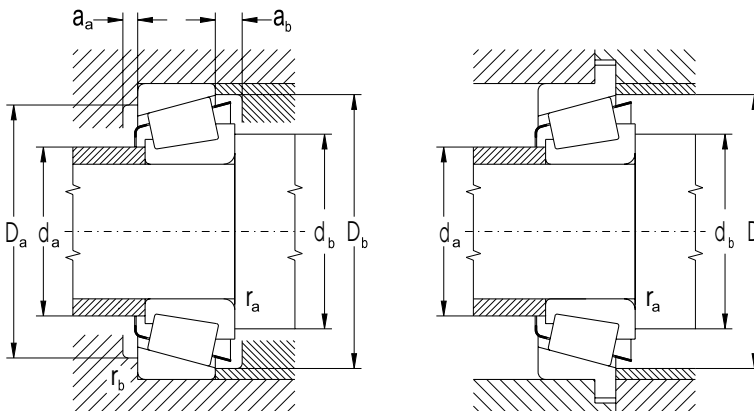
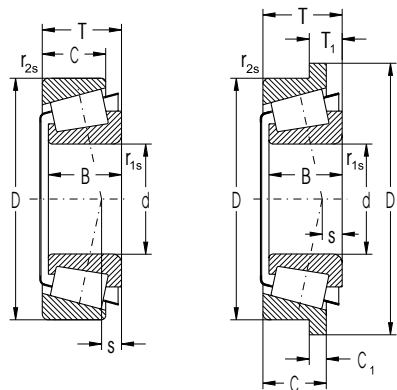
159

Single Row Tapered Roller Bearings in Inch Dimensions
d = 15.875 to 38.100 mm



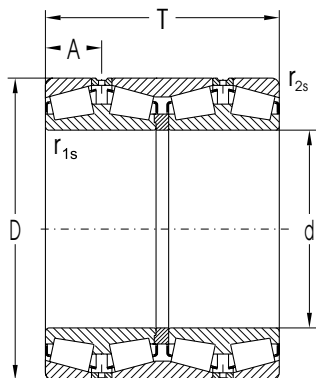
Dimensions										Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation	Abutment and Fillet Dimensions										Weight	Dimension Deviations					Factors				
d	D	D ₁	B	C	C ₁	T	T ₁	r _{1s} min	r _{2s} min	s	C _r	C _{or}	Grease	Oil	Cone Cup	d _a max	d _b min	D _a min	D _a max	D _b min	a _a min	a _b min	r _a max	r _b max	~	Δdmp max	Δdmp min	ΔDmp max	ΔDmp min	ΔTs max	ΔTs min	e	Y	Y ₀	
mm										kN	min ⁻¹			mm										kg	μm										
15.875	42.863		14.288	9.525		14.288		1.5	1.5	1.3	17.3	18.6		9500	14000	K-11590/ K-11520	22.5	24.5	34.5	35	39.5	2	4.5	1.5	1.5	0.063	+13	0	+25	0	+200	0	0.700	0.900	0.500
16.000	47.000		21.000	16.000		21.000		1.00	2.00	6.00	36.9	40.6		8400	11000	K-HM81649/ K-HM81610	23	22	36	39	43	2	4	1	1.5	0.199	0	-13	0	-25	+200	0	0.550	1.100	0.600
17.462	39.878		14.605	10.670		13.843		1.30	1.30	4.80	21.1	21.5		10000	13000	K-LM11749/ K-HM11710	23	24	33.5	35	37	2	3	1	1	0.186	+13	0	+15	0	+200	0	0.290	2.100	1.200
19.050	45.237		16.637	12.065		15.494		1.30	1.30	5.60	25.6	26.6		8900	12000	K-LM11949/ K-LM11910	25	25.5	38	38.5	41	3	3	1	1	0.121	+20	0	+25	0	+356	0	0.300	2.000	1.100
21.986	45.237		16.637	12.065		15.494		1.20	1.20	5.30	28.7	29.9		8400	11000	K-LM12749/ K-LM12710	26	27.5	38	38.5	42.5	3	3	1.2	1.2	0.119	+13	0	0	+15	+200	0	0.310	1.960	1.000
22.000	45.000	51.5	16.637	12.065	3.000	15.494	6.429	1.20	1.20	5.40	28.7	29.9		8400	11000	K-LM12749/ K-LM12712B	26	27.5	-	-	46	1.2	3.5	1.3	-	0.129	-13	0	0	-15	+200	0	0.310	1.960	1.100
25.400	50.292		14.732	10.668		14.224		1.30	1.30	3.30	24.6	28.7		7500	10000	K-L44643/ K-L44610	33	32	43.5	43.5	47	2	3.5	1	1	0.128	+13	0	+25	0	+200	0	0.370	1.600	0.900
*	50.292		14.732	10.668		14.224		1.30	1.30	3.30	24.6	28.7		7500	10000	K-L44643/ K-L44610/ K-L44600LA	33	32	43.5	43.5	-	2	-	1	1	0.130	+13	0	+25	0	+200	0	0.370	1.600	0.900
	59.930		23.114	18.288		23.368		0.80	1.57	5.10	44.7	66.8		5600	7500	K-M84249/ K-M84210	33	32	46	53	56	3	4.5	0.6	1	0.327	+13	0	+25	0	+200	0	0.550	1.100	0.600
26.988	50.292		14.732	10.668		14.224		3.56	1.30	3.30	24.6	28.7		7500	10000	K-L44649/ K-L44610	33	38	43.5	45	47	3	3.5	3	1	0.120	+20	0	+25	0	+356	0	0.370	1.600	0.900
29.000	50.292		14.732	10.668		14.224		3.60	1.20	3.20	25.6	33.5		7100	9400	K-L45449/ K-L45410	34	40	43.5	45	47	3	3.5	3	1	0.113	+13	0	+15	0	+200	0	0.370	1.600	0.900
30.000	62.000	68.5	18.100	15.536	3.556	17.250	5.270	1.00	1.50	3.30	44.7	44.7		6700	8900	K-JXC25640CB/ K-JXC25640D	34.5	37	-	-	59	1.15	1.7	1.5	-	0.269	0	-12	+20	0	+200	0	0.370	1.600	0.900
30.162	64.292		21.433	16.670		21.433		1.57	1.57	3.30	44.7	59.6		5600	7500	K-M86649/ K-M86610	38	38	51	56.5	60	3	4.5	1	1	0.341	+13	0	+25	0	+200	0	0.550	1.100	0.600
31.750	59.131		16.764	11.811		15.875		4.75	1.30	2.90	31.6	38.3		6700	8900	K-LM67048/ K-LM67010	38	44.5	51	52	55	3	4	3	1	0.180	+13	0	+25	0	+356	0	0.410	1.500	0.800
	62.000		19.050	14.288		18.161		4.75	1.30	5.20	47.3	58.4		6300	8400	K-15123/ K-15245	38	43.5	54	55	58	4	3.5	3	1	0.248	+13	0	+25	0	+203	0	0.350	1.700	0.900
	34.925	65.088	18.288	13.970		18.034		4.75	1.30	3.70	43.0	53.1		5600	7500	K-LM48548/ K-LM48510	42	47	57	58	61	3	4	3	1	0.244	+20	0	+25	0	+356	0	0.380	1.600	0.900
	73.025	24.608	19.050		23.813		3.56	2.36	6.60		57.3	76.4		5300	6700	PLC65-3	43	45	62	64	68	3	3	5	2	0.495	+13	0	+25	0	+200	0	0.370	1.600	0.900
	35.000	60.000	16.764	11.938		15.875		4.75	1.30	2.50	31.6	42.2		6300	8400	K-L68149/ K-L68111	40	46	52	54	56	3	3.5	3	1	0.176	0	-20	0	-25	+356	0	0.420	1.400	0.800
38.000	63.000		17.000	13.500		17.000		1.50	1.50	2.30	42.2	55.2		6700	8900	K-JL69349/ K-JL69310	41	49	56.5	57	60	1.5	3.5	1.5	1.5	0.204	+13	0	+25	0	+200	0	0.420	1.440	0.790
38.100	65.088		18.288	13.970		18.034		2.30	1.10	5.00	49.2	60.7		5600	7500	K-LM29749/ K-LM29710	42.5	46	58	60	62	4	4	2.3	1.3	0.240	+13	0	+25	0	+200	0	0.330	1.800	1.000
Bearing K-LM67048/K-LM67010 has also designation PLC 64-8										* Bearing with Seals																									

d = 39.688 to 146.05 mm



Dimensions											Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation Cone Cup	Abutment and Fillet Dimensions										Weight ~	Dimension Deviations						Factors		
d	D	D ₁	B	C	C ₁	T	T ₁	r _{1s} min	r _{2s} min	s	C _r Dynamic	C _{or} Static	Grease	Oil		d _a max	d _b min	D _a min	D _a max	D _b min	a _a min	a _b min	r _a max	r _b max	Δdmp max min		ΔDmp max min	ΔTs max min	e	Y	Y ₀				
mm											kN		min ⁻¹			mm										kg	μm								
39.688	80.167		30.391	23.813		29.370		0.80	3.20	11.10	81.0	104.0		5600	K-3386/ K-3320	48	47	68	70	75	3	4	0.6	3	0.704	+13	0	+25	0	+200	0	0.270	2.200	1.200	
40.000	80.000		22.403	17.826		21.000		0.80	1.30	6.00	70.8	73.6		6300	K-344A/ K-322	48	47	68	73	75	3	4	0.6	1	0.514	+13	0	+25	0	+203	0	0.270	2.200	1.200	
40.100	67.975		18.000	13.500		17.500		3.60	1.50	3.60	47.3	59.6		7100	K-LM300849/ K-LM300811	45	52	58	61	63	4	4	0.6	1.5	0.230	+13	0	+25	0	+200	0	0.350	1.700	1.000	
44.450	83.058		25.400	19.050		23.813		3.56	3.2	6.10	59.6	87.4		5600	K-25580/ K-25521	53	56.5	71	74	73	5	4.5	3	3	0.541	+13	0	+25	0	+200	0	0.330	1.800	1.000	
45.242	77.788		19.842	15.8		19.842		1.0	1.0	2.3	59.6	77.9		6500	LM603049/ LM603011	50	57	71	72	74	4.5	5.5	1	1	0.378	+13	0	+25	0	+100	0	0.430	1.410	0.770	
50.000	82.000		21.500	17.0		21.500		3.0	0.5	5.3	75.2	104.0		6000	K-JLM104948/ K-JLM104910	55	60	76	77	78	4	4.5	3	0.5	0.410	-12	0	-18	0	+100	0	0.310	1.09701	0.80	
50.800	101.600		36.068	29.988		34.925		0.80	3.2	12.70	123.0	162.0		4200	K-529/ K-522	61	63.5	87	89.5	94	6	7.5	0.6	3	1.220	+13	0	+25	0	+200	0	0.280	2.100	1.200	
57.15	127.000		44.450	34.925		44.450		3.5	3.3	9.4	228.0	276.0		4000	K-65225/ K-65500	71	80	104	107	119	10	10	3.5	3.3	2.790	+13	0	+25	0	+200	0	0.490	1.200	0.700	
65.000	110.000		28.000	22.500		28.000		3.00	2.5	4.00	133.0	188.0		4500	K-JM511946/ K-JM511910	71	77	93	96	101	9.5	9.5	3	2.5	1.050	-15	0	-15	0	+200	0	0.390	1.500	0.900	
88.900	152.400		39.688	30.162		39.688		6.40	3.3	35.0	230.0	344.0		3000	K-HM518445/ K-HM518410	98	112	124	135	142	6	10	3.5		2.880	+25	0	+25	0	+200	0	0.440	1.360	0.740	
89.974	146.975		40.000	32.500		40.000		7.00	3.5	31.0	243.0	365.0		3300	K-HM218248/ K-HM218210	99	112	128	133	141	6	7.5	3.5		2.590	+25	0	+25	0	+200	0	0.330	1.800	0.990	
90.000	145.000		34.000	27.000		35.000		6.00	2.5	33.0	213.0	315.0		3200	K-JM718149/ K-JM718110	99	111	126	131	140	6	8	2.5		2.150	+25	0	+25	0	+200	0	0.440	1.350	0.740	
146.05	193.675		28.575	23.020		28.575		5.8	1.5	34.0	181.0	390.0		2200	K-36691/ K-36620	155	162	176	182	187	6	6.5	1.5		2.310	+25	0	+25	0	+356-254		0.37	1.6	0.9	
												</																							

d = 160 to 630 mm

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Thrust Ball Bearings



From the point of view of design, thrust ball bearings are divided into single direction and double direction.

Single direction thrust ball bearings consist of two washers with raceways and balls guided by a cage. Washers have flat seating surfaces, and that is why they must be supported so that all balls can be evenly loaded. Bearings carry the axial load only in one direction. They are not able to carry radial forces.

Double direction thrust ball bearings have two cages with balls between the central shaft washer and two housing washers with flat seating surfaces. The shaft washer has raceways on both sides and is fixed on the journal. Bearings are able to carry only axial forces in both directions.

Bearings up to the outer diameter $D = 150\text{ mm}$ are produced in new design and have higher utilization parameters.

Boundary Dimensions

Boundary dimensions comply with the standard ISO 15 and are shown in the dimension tables of this publication.

Designation

Bearing designation in standard design is in the dimension tables of this publication. Difference from standard design is designated by additional symbols (section 2.2).

Cage

Thrust ball bearings have in basic design cage a according to the table. Material and design designations are not indicated.

Bearings with Pressed Steel Cage	Bearings with Machined Brass or Steel Cage
51100 to 51144	51148 to 511/1000
51200 to 51236	51238 to 51260
51305 to 51324	51326 to 51330
51405 to 51418 ¹⁾	51420 to 51430
52202 to 52232	-
52305 to 52324	-
52405 to 52418 ¹⁾	52420
1) Bearings 51408 and 52408 are produced with solid cage made of polyamide with filling (TNGN)	

Customer’s requiring special arrangements should be discuss this in advance with the supplier.

Tolerance

Bearings are commonly manufactured in tolerance class P0 which is not indicated. Bearings for more demanding arrangements are delivered in tolerance classes P6 and P5. Limiting values of dimension and running accuracy are shown in Table 20.

Misalignment

Bearings require keeping the tolerance for seating surfaces alignment, because misalignment causes increased stress at the contact of the balls with raceways. Therefore where alignment conditions cannot be kept, the use of thrust ball bearings is not recommended.

Axial Equivalent Dynamic Load

$$P_a = F_a \qquad [kN]$$

Minimum Axial Load

At higher rotational speeds danger of ball sliding between ring raceways can occur because of centrifugal forces, if axial load F_a drops under minimum value. Minimum value $F_{a \min}$ is calculated from equation :

$$F_{a \min} = M \left(\frac{n_{\max}}{1000} \right)^2 \qquad [kN]$$

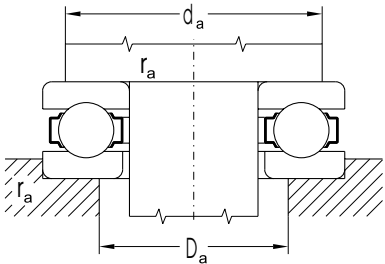
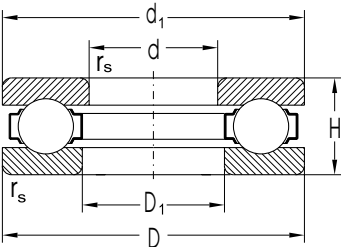
- $F_{a \min}$ - minimum axial load [kN]
 - $n_{\max}$ - maximum rotational speed [min⁻¹]
 - M - minimum axial load factor
- (values are in dimension tables)

If the axial load is smaller than $F_{a \min}$, or if bearing relieving comes into being during operation, e.g. of one ball row in double direction bearing, or of one bearing when using a pair of single direction thrust bearings, it is necessary to secure minimum load, e.g. by means of springs.

Axial Equivalent Static Load

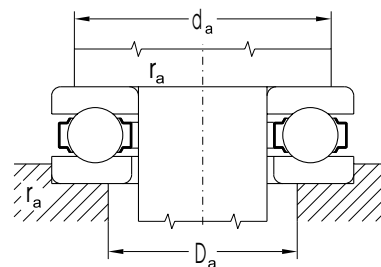
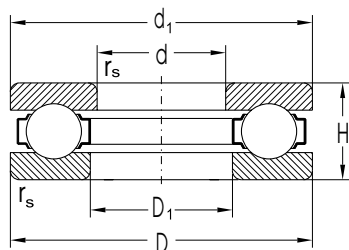
$$P_{oa} = F_a \qquad [kN]$$

Single Direction Thrust Ball Bearings
d = 10 to 70 mm

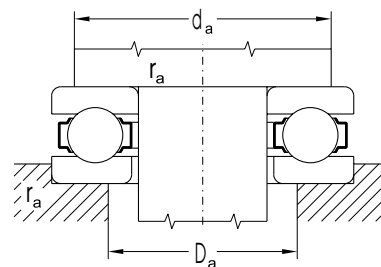
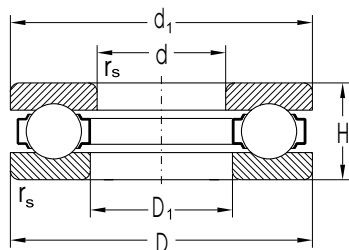


Dimensions						Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation	Abutment and Fillet Dimensions				Weight	Minimum Axial Load Factor
d	D	d ₁	D ₁	H	r _s min	C _a Dynamic	C _{oa} Static	Grease	Oil		d	d _a min	D _a max	r _a max	~	
mm						kN		min ⁻¹			mm				kg	
10	24	24	11	9	0.3	10.0	9.09	7900	10600		10	19	15	0.3	0.02	
12	26	26	13	9	0.3	10.4	10.40	7500	10000	51101A	12	21	17	0.3	0.02	0.002
15	28	28	16	9	0.3	10.6	11.90	7100	9400	51102A	15	23	20	0.3	0.02	0.002
	32	13	17	12	0.6	15.8	16.50	6000	7900	51202A		25	22	0.6	0.05	0.004
17	30	30	18	9	0.3	11.4	14.40	7100	9400	51103A	17	25	22	0.3	0.03	0.003
	35	35	19	12	0.6	16.2	18.80	5600	7500	51203A		28	24	0.6	0.05	0.004
20	35	35	21	10	0.3	15.0	19.60	6300	8400	51104A	20	29	26	0.3	0.04	0.004
	40	40	22	14	0.6	22.4	26.10	5000	6700	51204A		32	28	0.6	0.08	0.008
25	42	42	26	11	0.6	18.1	27.10	5300	7100	51105A	25	35	32	0.6	0.06	0.006
	47	47	27	15	0.6	27.6	36.20	4500	6000	51205A		38	34	0.6	0.12	0.015
	52	52	27	18	1.0	35.5	42.20	3800	5000	51305A		41	36	1.0	0.180	0.020
	60	60	27	24	1.0	55.2	55.20	3200	4200	51405A		46	39	1.0	0.34	0.035
30	47	47	32	11	0.6	18.8	31.60	5000	6700	51106A	30	40	37	0.6	0.07	0.008
	52	52	32	16	0.6	29.3	43.80	4000	5300	51206A		43	39	0.6	0.14	0.018
	60	60	32	21	1.0	43.0	55.20	3300	4500	51306A		48	42	1.0	0.27	0.030
	70	70	32	28	1.0	72.2	81.00	2700	3500	51406A		54	46	1.0	0.53	0.085
35	52	52	37	12	0.6	20.0	38.30	4700	6300	51107A	35	45	42	0.6	0.08	0.012
	62	62	37	18	1.0	39.1	58.40	3500	4700	51207A		51	46	1.0	0.22	0.032
	68	68	37	24	1.0	55.2	73.60	2800	3800	51307A		55	48	1.0	0.39	0.050
	80	80	37	32	1.1	87.4	100.00	2200	3000	51407A		62	53	1.0	0.79	0.120
40	60	60	42	13	0.6	27.1	51.10	4200	5600	51108A	40	52	48	0.6	0.12	0.018
	68	68	42	19	1.0	43.8	70.80	3200	4200	51208A		57	51	1.0	0.27	0.047
	78	78	42	26	1.0	69.4	94.40	2700	3500	51308A		63	55	1.0	0.55	0.095
	90	90	42	36	1.1	112.0	133.00	2000	2700	51408ATNGN		70	60	1.0	1.14	0.190
45	65	65	47	14	0.6	27.6	57.30	4000	5300	51109A	45	57	53	0.6	0.15	0.025
	73	73	47	20	1.0	46.4	81.00	3000	4000	51209A		62	56	1.0	0.32	0.060
	85	85	47	28	1.0	79.4	117.00	2400	3200	51309A		69	61	1.0	0.69	0.130
	100	100	47	39	1.1	131.0	158.00	1900	2500	51409A		78	67	1.0	1.47	0.350
50	70	70	52	14	0.6	28.7	63.10	3800	5000	51110A	50	62	58	0.6	0.16	0.035
	78	78	52	22	1.0	47.3	87.40	2800	3800	51210A		67	61	1.0	0.39	0.082
55	78	78	57	16	0.6	34.8	77.90	3300	4500	51111A	55	69	64	0.6	0.24	0.040
	90	90	57	25	1.0	69.4	123.00	2500	3300	51211A		76	69	1.0	0.61	0.110
	105	105	57	35	1.1	119.0	174.00	1900	2500	51311A		85	75	1.0	1.34	0.270
	120	120	57	48	1.5	207.0	251.00	1600	2100	51411A		94	81	1.5	2.64	0.650
60	85	85	62	17	1.0	41.4	94.40	3200	4200	51112A	60	75	70	1.0	0.29	0.066
	110	110	62	35	1.1	123.0	192.00	1900	2500	51312A		90	80	1.0	1.43	0.350
65	100	100	67	27	1.0	75.0	150.00	2400	3200	51213A	65	86	79	1.0	0.77	0.170
	115	115	67	36	1.1	128.0	211.00	1800	2400	51313A		95	85	1.0	1.57	0.450
70	95	95	72	18	1.0	43.0	110.00	2800	3800	51114A	70	85	80	1.0	0.36	0.110
	105	105	72	27	1.0	76.4	162.00	2200	3000	51214A		91	84	1.0	0.81	0.210
	125	125	72	40	1.1	147.0	251.00	1700	2200	51314A		103	92	1.0	2.06	0.540
	150	150	73	60	2.0	251.0	369.00	1200	1600	51414A		118	102	2.0	5.48	1.600

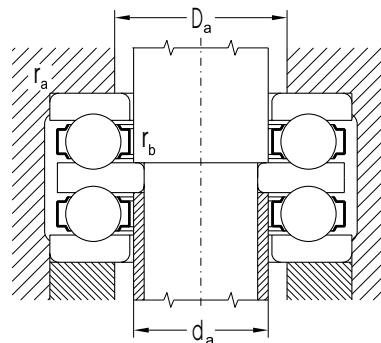
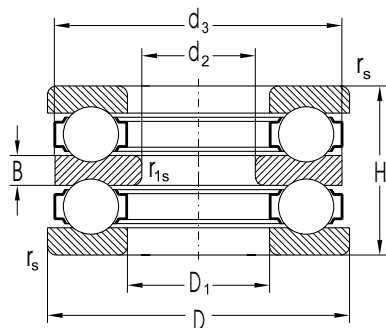
d = 75 to 150 mm

[illegible]

d = 160 to 1000 mm

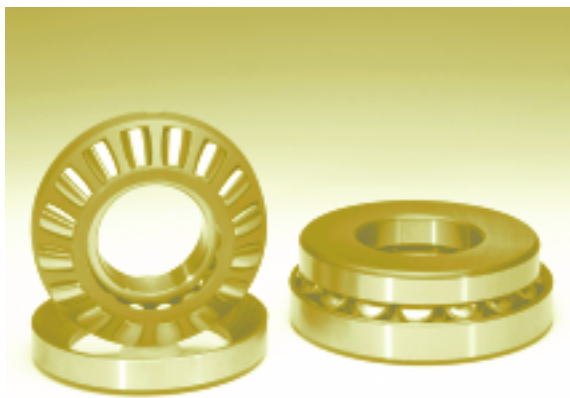
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$d_2 = 10$ to 140 mm



Dimensions								Basic Load Rating		Limiting Speed for Lubrication with		Bearing Designation	Abutment and Fillet Dimensions					Weight	Minimum Axial Load Factor
d ₂	D	d ₃	D ₁	H	B	r _s min	r _{1s} min	C _a	Static C _{0a}	Grease	Oil		d ₂	d _a max	D _a max	r _a max	r _b max		
mm								kN		min ⁻¹			mm					kg	
10	32	32.0	17	22	5	0.6	0.3	15.8	16.5	6000	7900	52202A	10	15	22	0.6	0.3	0.08	0.004
15	40	40.0	22	26	6	0.6	0.3	22.4	26.1	5000	6700	52204A	15	20	28	0.6	0.3	0.15	0.008
	60	60.0	27	45	11	1.0	0.6	55.2	55.2	3200	4200	52405A		25	39	1.0	0.6	0.63	0.035
20	47	47.0	27	28	7	0.6	0.3	27.6	36.2	4500	6000	52205A	20	25	34	0.6	0.3	0.23	0.015
	52	52.0	27	34	8	1.0	0.3	35.5	42.2	3800	5000	52305A		25	36	1.0	0.3	0.33	0.020
	70	70.0	32	52	12	1.0	0.6	72.2	81.0	2700	3500	52406A		30	46	1.0	0.6	1.00	0.085
25	52	52.0	32	29	7	0.6	0.3	29.3	43.8	4000	5300	52206A	25	30	39	0.6	0.3	0.27	0.018
	60	60.0	32	38	9	1.0	0.3	43.0	55.2	3300	4500	52306A		30	42	1.0	3.0	0.49	0.030
	80	80.0	37	59	14	1.1	0.6	87.4	100.0	2200	3000	52407A		35	53	1.0	0.6	1.44	0.120
30	62	62.0	37	34	8	1.0	0.3	39.1	58.4	3500	4700	52207A	30	35	46	1.0	0.3	0.42	0.032
	68	68.0	37	44	10	1.0	0.3	55.2	73.6	2800	3800	52307A		35	48	1.0	0.3	0.71	0.050
	68	68.0	42	36	9	1.0	0.6	43.8	70.8	3200	4200	52208A		40	51	1.0	0.6	0.54	0.047
	78	78.0	42	49	12	1.0	0.6	69.4	94.4	2700	3500	52308A		40	55	1.0	0.6	1.06	0.095
	90	90.0	42	65	15	1.1	0.6	112.0	133.0	2000	2700	52408ATNG		40	60	1.0	0.6	2.03	0.190
35	73	73.0	47	37	9	1.0	0.6	46.4	81.0	3000	4000	52209A	35	45	56	1.0	0.6	0.62	0.060
	85	85.0	47	52	12	1.0	0.6	79.4	117.0	2400	3200	52309A		45	61	1.0	0.6	1.29	0.130
	100	100.0	47	72	17	1.1	0.6	131.0	158.0	1900	2500	52409A		45	67	1.0	0.6	2.71	0.350
40	78	78.0	52	39	9	1.0	0.6	47.3	87.4	2800	3800	52210A	40	50	61	1.0	0.6	0.71	0.082
45	90	90.0	57	45	10	1.0	0.6	69.4	123.0	2500	3300	52211A	45	55	69	1.0	0.6	1.12	0.110
	105	105.0	57	64	15	1.1	0.6	91.5	174.0	1900	2500	52311A		55	75	1.0	0.6	2.51	0.270
	120	120.0	57	87	20	1.5	0.6	156.0	251.0	1600	2100	52411A		55	81	1.5	0.6	4.70	0.650
50	110	110.0	62	64	15	1.1	0.6	95.0	192.0	1900	2500	52312A	50	60	80	1.0	0.6	2.68	0.350
55	100	100.0	67	47	10	1.0	0.6	75.0	150.0	2400	3200	52213A	55	65	79	1.0	0.6	1.36	0.170
	115	115.0	67	65	15	1.1	0.6	128.0	211.0	1800	2400	52313A		65	85	1.0	0.6	2.90	0.450
	105	105.0	72	47	10	1.0	1.0	76.4	162.0	2200	3000	52214A		70	84	1.0	0.6	1.48	0.210
	125	125.0	72	72	16	1.1	1.0	147.0	251.0	1700	2200	52314A		70	92	1.0	1.0	3.90	0.540
	150	150.0	73	107	24	2.0	1.0	251.0	369.0	1200	1600	52414A		70	102	2.0	1.0	9.71	1.600
60	110	110.0	77	47	10	1.0	1.0	77.9	171.0	2200	3000	52215A	60	75	89	1.0	1.0	1.57	0.270
	135	135.0	77	79	18	1.5	1.0	185.0	310.0	1600	2100	52315A		75	99	1.5	1.0	4.83	0.760
65	115	115.0	82	48	10	1.0	1.0	79.4	181.0	2000	2700	52216A	65	80	95	1.0	1.0	1.69	0.350
	170	170.0	83	120	27	2.1	1.0	316.0	482.0	890	1200	52416		80	117	2.0	1.0	14.00	2.700
70	125	125.0	88	55	12	1.0	1.0	96.2	215.0	1900	2500	52217A	70	85	101	1.0	1.0	2.34	0.430
	150	150.0	88	87	19	1.5	1.0	224.0	376.0	1300	1800	52317A		85	111	1.5	1.0	6.43	1.200
	190	189.5	93	135	30	2.1	1.1	383.0	619.0	790	1060	52418		90	131	2.0	1.0	19.60	4.100
75	155	155.0	93	88	19	1.5	1.0	233.0	406.0	1100	1500	52318	75	90	116	1.5	1.0	6.60	1.500
100	210	209.5	123	123	27	2.1	1.1	348.0	708.0	790	1060	52324	100	120	157	2.0	1.0	17.20	4.100
140	225	224.5	163	90	20	1.5	1.1	276.0	722.0	890	1200	52232	140	160	186	1.5	1.0	12.20	3.200

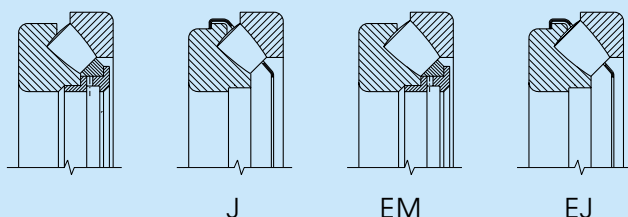
Spherical Roller Thrust Bearing



Spherical roller thrust bearings have a great number of asymmetrical spherical rollers with a good conformity to the raceway of the shaft and housing washers and that is why they are suitable for accommodating great axial load as well as certain radial load at relatively high rotational speed. Bearings are separable which can be utilized when mounting.

The internal bearing design requires oil lubrication. An exception is created by conditions where the bearing is working at very small rotational speed.

Bearings are produced in several designs, see picture. Delivery of bearings in "J" design should be discussed with the supplier in advance.



Boundary Dimensions

Boundary dimensions of spherical roller thrust bearings comply with the standard ISO 104 and are shown in dimension tables.

Designation

Bearing designation of standard bearings is in the dimension tables of this publication.

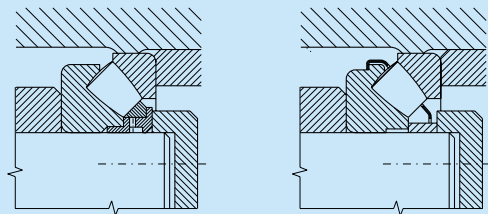
Difference from basic design is indicated by additional symbols shown in section 2.2 .

Cage

Spherical roller thrust bearings in "M" design have brass cages guided by a steel sleeve on the shaft washer.

Bearings in "J" design have pressed steel cages guided on the shaft washer.

Bearings in "J" design are interchangeable with bearings with machined brass cage. If the bearing with machined brass cage is to be replaced in arrangement, where the shaft washer rests on the shaft on the face of steel sleeve which guides the cage by the bearing in "J" design, it is necessary to insert a spacer between the shaft washer and original shaft shoulder, as shown in the picture.



Tolerance

Bearings are commonly produced in normal tolerance class P0 which is not indicated. Limiting values of dimension and running deviations are shown in table 20.

Misalignment

Spherical raceway of the bearing housing washer enables, at common operation conditions ($P_a \leq 0.1C_a$) misalignment from the central position without damaging the correct bearing function of values according to the table below.

Bearing Type	Permissible Misalignment
292	2°
293	2°30'
294	3°

Arrangement Design

Abutment and fillet dimensions shown in the dimension tables of this publication are suitable for bearings where the load $P_a \leq 0.1C_a$. At higher load it is suitable to support bearing washers along the face surface, i.e. $d_a = d_1$ and $D_a = D_1$.

Axial Equivalent Dynamic Load

$$P_a = F_a + 1.2F_r \quad (F_r \leq 0.55F_a) \quad [\text{kN}]$$

Minimum Axial Load

At higher rotational speed by spherical roller thrust bearings arises the danger of rolling element sliding. A potential problem exist in the use of spherical roller thrust bearings at higher rotational speed. the danger arises from the possibility of the rolling element sliding between raceways due to centrifugal forces acting in such cases when the axial load F_a drops under minimum value. For calculation of minimum value $F_{a \min}$ following relation is used:

$$\frac{C_{oa}}{2000} \leq F_{a \min} = 1,8 F_r M \left(\frac{n_{\max}}{1000} \right)^2 \quad [\text{kN}]$$

$F_{a \min}$ - minimum axial load [kN]

F_r - radial bearing load [kN]

C_{oa} - axial basic static load rating [kN]
(values are in dimension tables)

$n_{\max}$ - maximum rotational speed [min⁻¹]

M - minimum axial load factor
(values are in dimension tables)

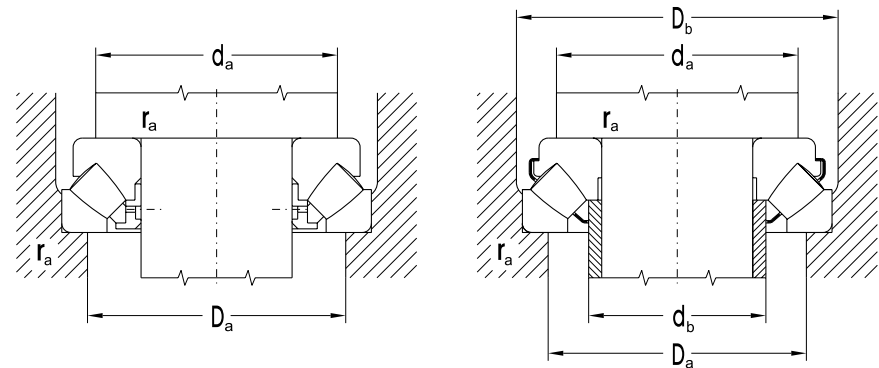
If the external axial bearing load is too small, or if the bearing is relieved in operation, e.g. in a bearing pair, it is necessary to create axial load, e.g. with springs. If also radial load acts the simultaneously, following condition must be fulfilled :

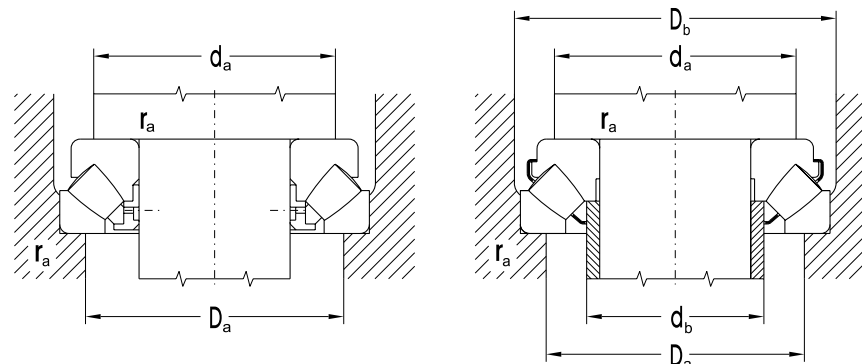
$$F_r \leq 0.55F_a$$

Axial Equivalent Static Load

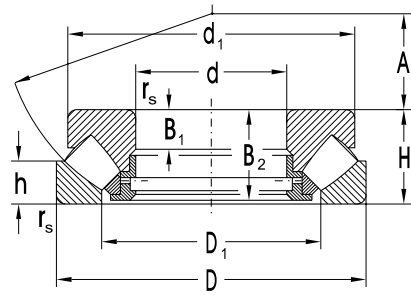
$$P_{oa} = F_a + 2.7F_r \quad (F_r \leq 0.55F_a) \quad \text{[kN]}$$

Static safety factor for spherical roller thrust bearings must be $s_o \geq 4$.

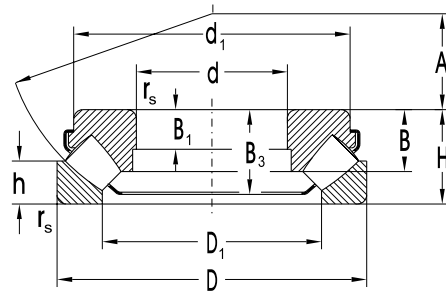
180 181



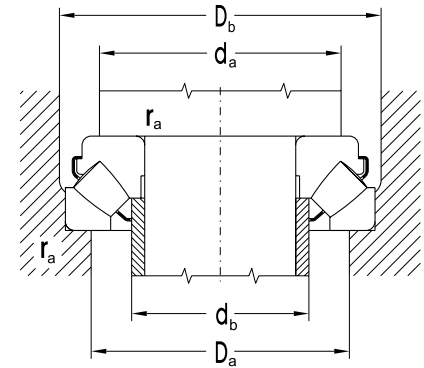
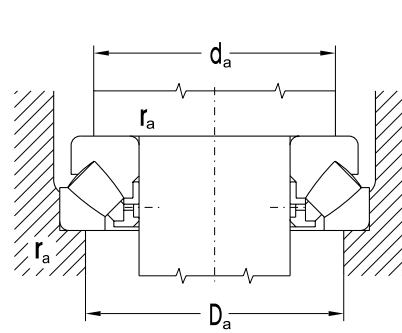
d = 400 to 800 mm



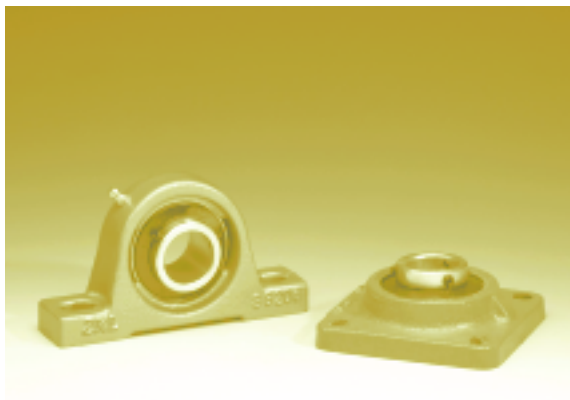
M, EM



J, EJ

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Insert Ball Bearings and Insert Ball Bearing Units



Insert ball bearings are single row deep groove ball bearings with double sealing on both sides. The outer ring has a spherical surface and that is why it can tilt in the housing with the same spherical surface. It can accommodate eventual misalignments. The inner bearing ring is wider than the outer one and it is fixed on the shaft :

- by means of eccentric locking collar, design UA
- by means of screws, design UC

Bearings are filled with grease for the whole bearing life. Housing designs allow eventual relubrication by means of a lubricating nipple.

Bearings are suitable for arrangements on short shafts and for arrangements where small thermal contraction occur which are compensated by bearing axial clearance or design adaptability, on which bearing housings are fixed.

The material of insert ball bearing housings are grey cast iron or steel sheet and from the point of view of design the housings can be in pillow block - designation SG, SA or flanged - designation FG, FM, FB, FE. In the housing there is a spherical hollow and they form together a unit which enables an economic solution with a simple arrangement design. They are used in agricultural machines, transportation equipments, food-making machines, etc.

Boundary Dimensions

Boundary dimensions of insert ball bearings correspond to the standard ISO 2264, ISO 3228 and bearing housings and eccentric locking collars to the standard ISO 3145.

Designation

Designation of insert ball bearings, corresponding housings and complete units is in the dimension tables of this publication.

Cage

Bearings have cages pressed of steel which are not designated.

Tolerance

Bearings have a uniform bore diameter tolerance H6. This tolerance secures by shaft machining in the tolerance h always a loose fit. For shaft manufacturing usually tolerances h8 and h11 are sufficient. For greater loads and rotational speeds it is necessary to select tolerances h6, h7.

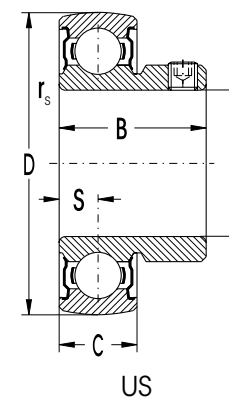
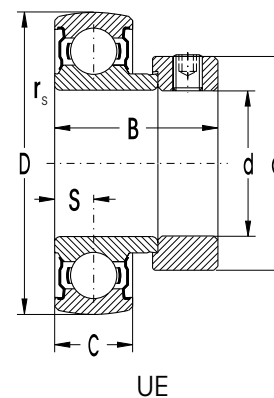
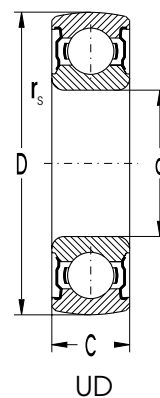
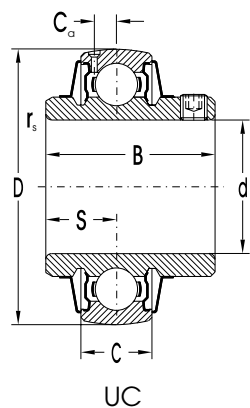
Radial Clearance

Commonly manufactured insert ball bearings have normal radial clearance which is not indicated and its size and extent is the same as for single row deep groove ball bearings of the same dimensions. Delivery of bearings with different radial clearance should be discussed with the supplier in advance.

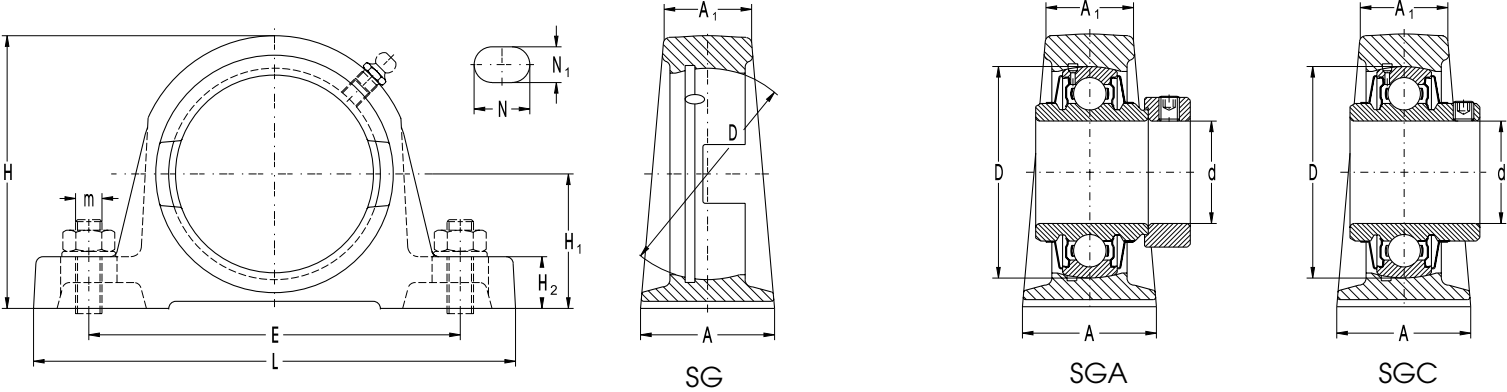
Limiting Rotational Speed

This parameter is dependent on the arrangement on the shaft and from the point of view of shaft diameter the dependence in the dimension tables is worked out.

d = 20 to 40 mm

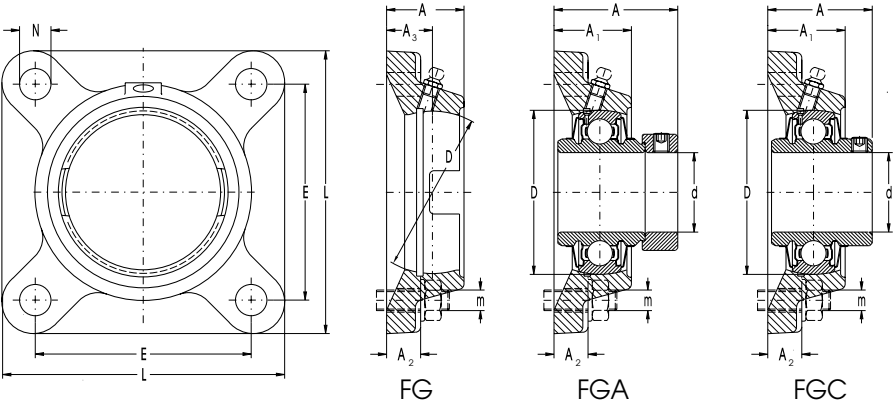
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Pillow Block Units with Insert Ball Bearing
d = 25 to 40mm



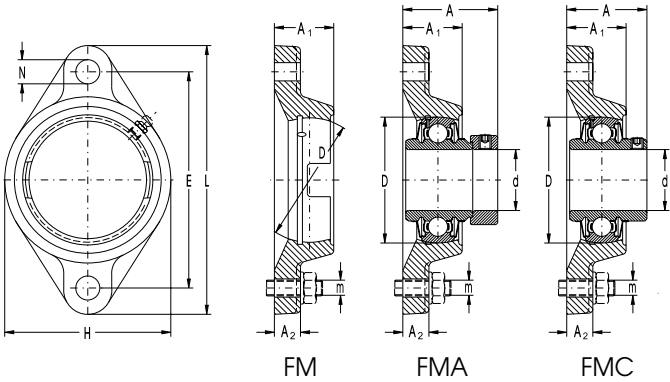
Dimensions												Basic Load Rating		Designation of			Weight	
d	D	L	E	H	H ₁	H ₂	A	A ₁	N	N ₁	m	dynamic C _r	static C _{0r}	Unit	Housing	Bearing	~	
mm												kN					kg	
25	52	130	102	70.5	36.5	14	34	22	17	12	M10	14.0	7.90	SGA205	SG205	UA205	0.74	
	52	130	102	70.5	36.5	14	34	22	17	12	M10	14.0	7.90	SGC205	SG205	UC205	0.68	
30	62	155	118	84.0	42.9	17	39	24	20	15	M12	19.4	11.20	SGA206	SG206	UA206	1.20	
	62	155	118	84.0	42.9	17	39	24	20	15	M12	19.4	11.20	SGC206	SG206	UC206	1.12	
35	72	160	128	93.0	47.6	19	44	29	20	15	M12	25.6	15.20	SGA207	SG207	UA207	1.60	
	72	160	128	93.0	47.6	19	44	29	20	15	M12	25.6	15.20	SGC207	SG207	UC207	1.46	
40	80	175	133	100.0	49.2	19	50	32	20	15	M12	32.6	19.80	SGA208	SG208	UA208	1.95	
	80	175	133	100.0	49.2	19	50	32	20	15	M12	32.6	19.80	SGC208	SG208	UC208	1.80	
When using bearings - type UE into housings SG designation of unit is SGE																		
When using bearings - type US into housings SG designation of unit is SGS																		

Square Flanged Units with Insert Ball Bearing
d = 25 to 40 mm



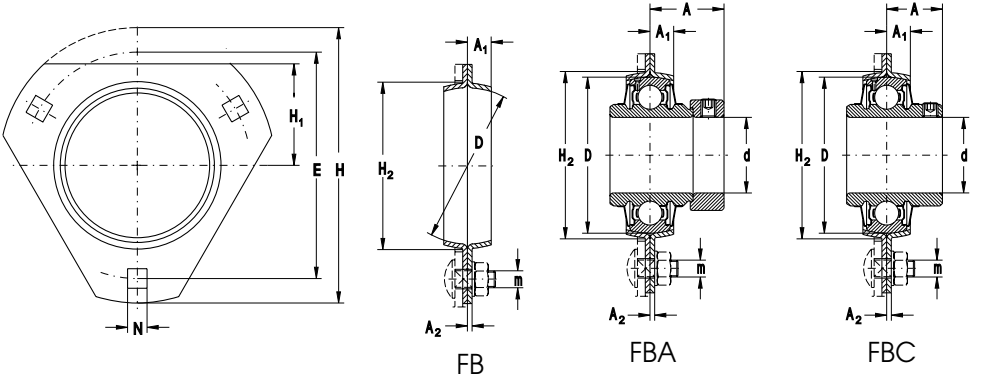
Dimensions										Basic Load Rating		Weight	Designation of		
d	D	L	E	A	A ₁	A ₂	A ₃	N	m	C _r	C _{or}		Unit	Housing	Bearing
mm										kN		kg			
25	52	95	70.0	45.9	29.5	13	19.0	12	M10	14.0	7.9	0.83	FGA205	FG205	UA205
	52	95	70.0	38.8	29.5	13	19.0	12	M10	14.0	7.9	0.77	FGC205	FG205	UC205
30	62	108	82.5	50.1	31	13	20.0	12	M10	19.4	11.2	1.20	FGA206	FG206	UA206
	62	108	82.5	42.2	31	13	20.0	12	M10	19.4	11.2	1.12	FGC206	FG206	UC206
35	72	118	92.0	52.8	33.5	14	20.5	15	M12	25.6	15.2	1.55	FGA207	FG207	UA207
	72	118	92.0	45.9	33.5	14	20.5	15	M12	25.6	15.2	1.41	FGC207	FG207	UC207
40	80	130	101.5	57.9	36.5	14	23.0	15	M12	32.6	19.8	2.05	FGA208	FG208	UA208
	80	130	101.5	53.5	36.5	14	23.0	15	M12	32.6	19.8	1.90	FGC208	FG208	UC208
When using bearings - type UE into housings FG designation of unit is FGE															
When using bearings - type UD into housings FG designation of unit is FGD															
When using bearings - type US into housings FG designation of unit is FGS															

Oval Flanged Units with Insert Ball Bearing
d = 25 to 40 mm



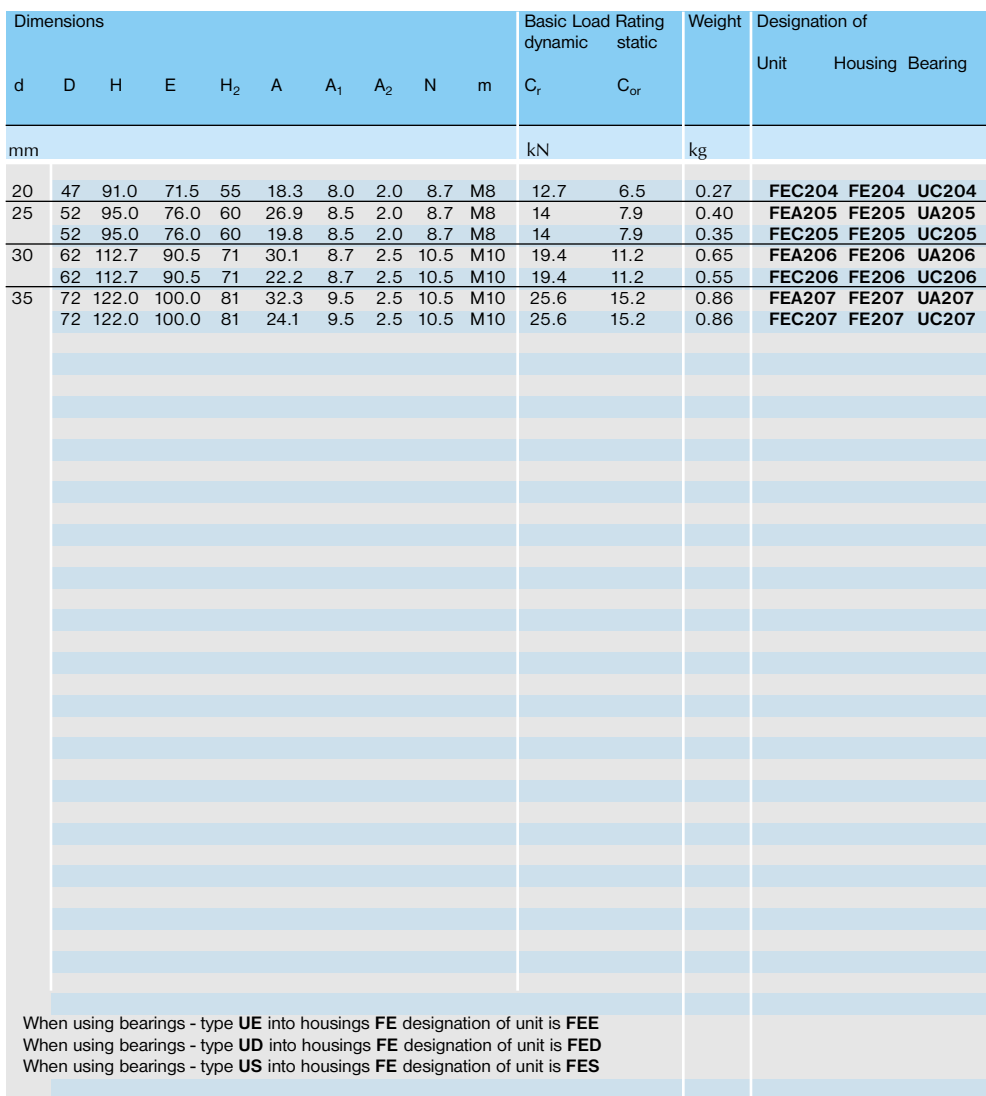
Dimensions										Basic Load Rating		Weight	Designation of		
d	D	L	H	E	A	A ₁	A ₂	N	m	C _r	C _{or}		Unit	Housing	Bearing
mm										kN		kg			
25	52	123	70	99.0	45.9	29.5	13	12	M10	14.0	7.9	0.64	FMA205	FM205	UA205
	52	123	70	99.0	38.8	29.5	13	12	M10	14.0	7.9	0.58	FMC205	FM205	UC205
30	62	142	83	116.5	50.1	31.0	13	12	M10	19.4	11.2	1.08	FMA206	FM206	UA206
	62	142	83	116.5	42.2	31.0	13	12	M10	19.4	11.2	1.00	FMC206	FM206	UC206
35	72	156	92	130.0	53.3	33.5	14	14	M12	25.6	15.2	1.45	FMA207	FM207	UA207
	72	156	92	130.0	46.4	33.5	14	14	M12	25.6	15.2	1.31	FMC207	FM207	UC207
40	80	172	102	143.8	58.9	37.0	14	15	M12	32.6	19.8	1.75	FMA208	FM208	UA208
	80	172	102	143.8	54.2	37.0	14	15	M12	32.6	19.8	1.60	FMC208	FM208	UC208
When using bearings - type UE into housings FM designation of unit is FME															
When using bearings - type UD into housings FM designation of unit is FMD															
When using bearings - type US into housings FM designation of unit is FMS															

Triangle Pressed Flanged Units with Insert Ball Bearing
d = 25 to 35 mm

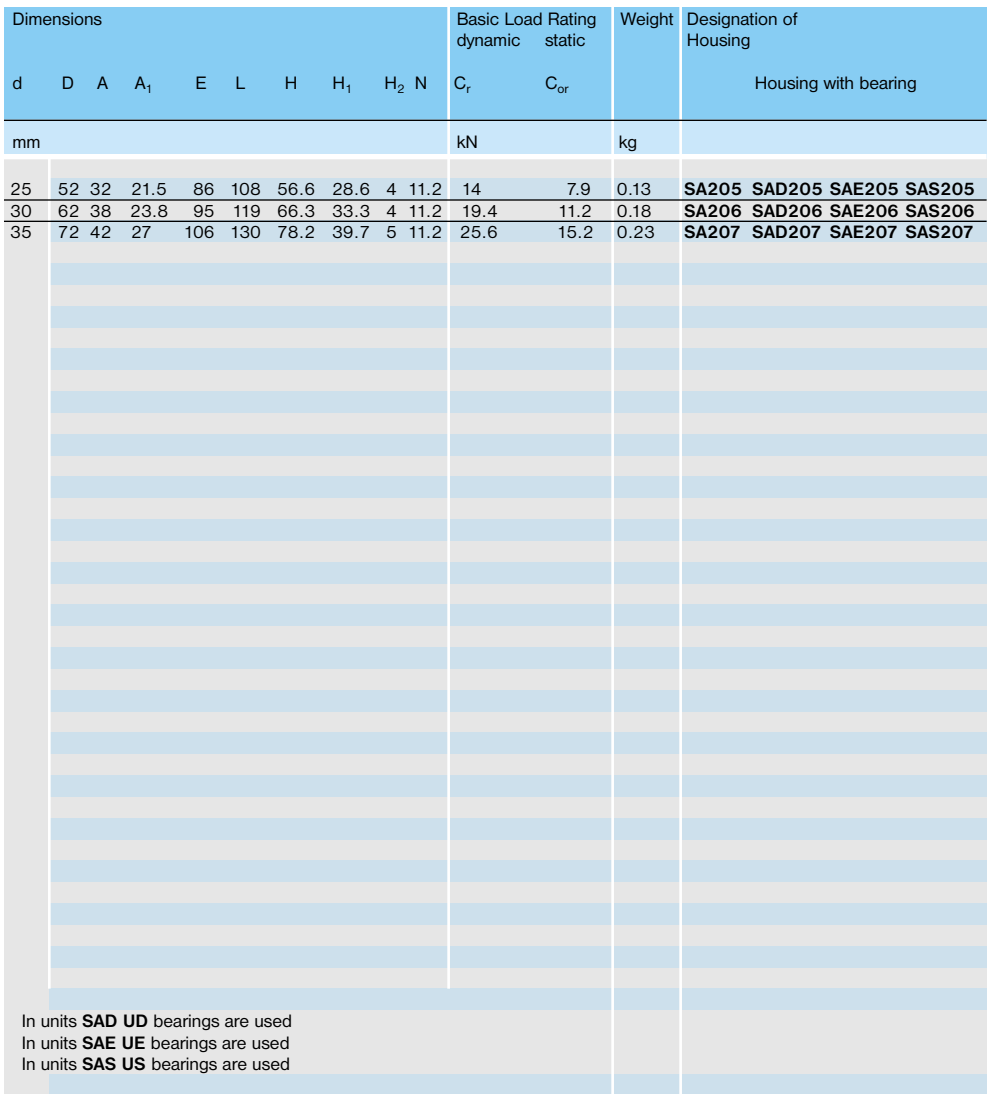


Dimensions											Basic Load Rating		Weight	Designation of		
d	D	H	E	H ₁	H ₂	A	A ₁	A ₂	N	m	dynamic	static		Unit	Housing	Bearing
mm											C _r	C _{or}	kg			
25	52	99.5	76.0	34.5	60	26.9	9.0	2.0	8.8	M8	14.0	7.9	0.36	FBA205	FB205	UA205
	52	99.5	76.0	34.5	60	19.8	9.0	2.0	8.8	M8	14.0	7.9	0.30	FBC205	FB205	UC205
30	62	112.5	90.5	38.5	71	30.1	9.5	2.5	10.5	M10	19.4	11.2	0.58	FBA206	FB206	UA206
	62	112.5	90.5	38.5	71	22.2	9.5	2.5	10.5	M10	19.4	11.2	0.50	FBC206	FB206	UC206
35	72	122.0	100.0	45.0	81	32.3	10.0	2.5	10.5	M10	25.6	15.2	0.81	FBA207	FB207	UA207
	72	122.0	100.0	45.0	81	24.1	10.0	2.5	10.5	M10	25.6	15.2	0.67	FBC207	FB207	UC207
When using bearings - type UE into housings FB designation of unit is FBE																
When using bearings - type UD into housings FB designation of unit is FBD																
When using bearings - type US into housings FB designation of unit is FBS																

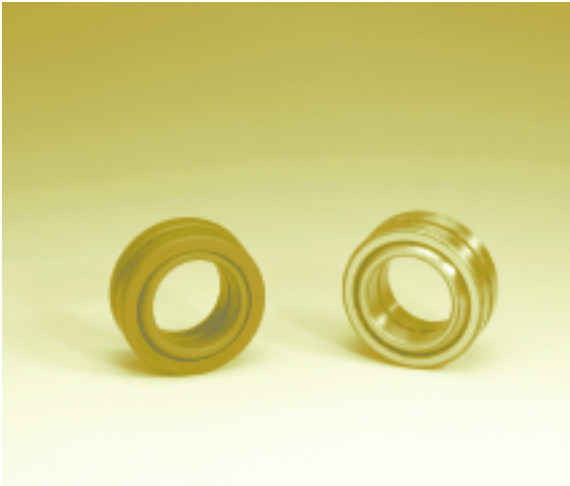
d = 20 to 35 mm



d = 25 to 35 mm



Spherical Plain Bearings



Spherical plain bearings are radial sliding bearings consisting of one inner and one outer ring which have spherical functional surfaces. Bearings are determined for arrangements where great radial forces at slow tilting or oscillating are acting and for arrangements where space adjustability of both components is secured. Besides radial load, bearings can also accommodate an axial load of certain magnitude in both directions.

Spherical plain bearings are produced of bearing steel. Rings are hardened, ground or phosphatized. Spherical plain bearings require minimum service. At first mounting the bearings are filled with grease and are relubricated in certain time periods according to operating conditions. For spherical plain bearings lubrication mainly greases with EP or MoS₂ additives are suitable.

Boundary Dimensions

Boundary dimensions of spherical plain bearings - Type GE comply with the international standard ISO 6124/1 (STN 02 3515) and bearings - type GEW with enlarged inner ring the international standard ISO 6124/2 (STN 02 3516).

Designation

Spherical plain bearings designation in standard design is shown in the dimension table and consists of type designation (GE or GEW) and size (digit indicates bore diameter in mm), e.g. GE30. Deviations from standard design (radial clearance, sealing, dimension change) are indicated by additional symbols according to STN 02 4608 (except for symbol E), placed after the basic designation. Symbol E - phosphatized bearing surface, e.g. GE30E.

Tolerance

Spherical plain bearings are produced in normal tolerance class which is not indicated. Deviation values correspond to the international standard ISO 6125.

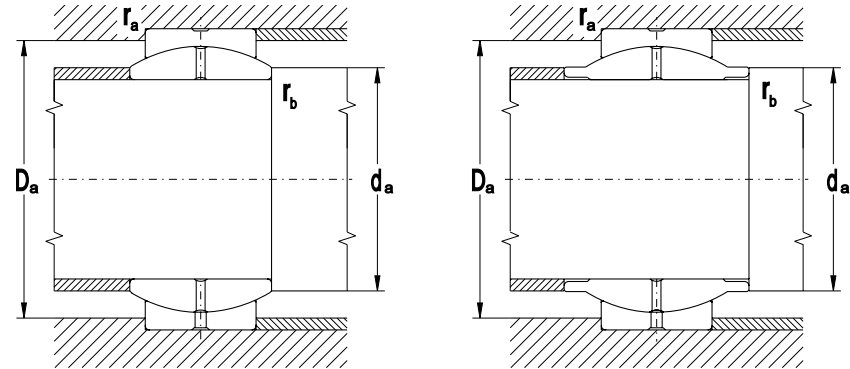
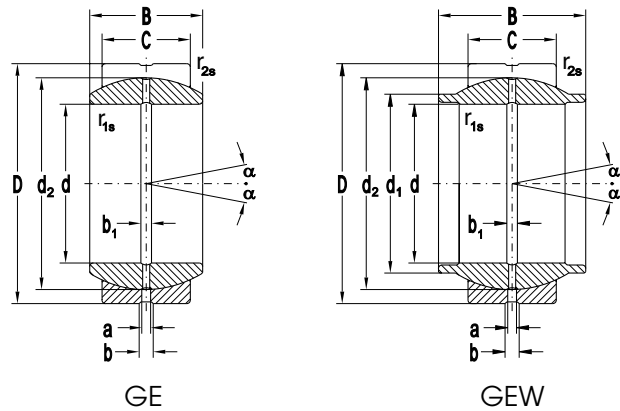
Radial Clearance

Spherical plain bearings are commonly produced with normal radial clearance which is not indicated. Radial clearance values are shown in the following table.

Bore Diameter		Radial Clearance					
over	to	C2		normal		C3	
		min	max	min	max	min	max
mm		µm					
12	20	10	40	40	82	82	124
20	35	12	50	50	100	100	150
35	60	15	60	60	120	120	180

Calculation of radial equivalent load, permissible static load, calculation of basic bearing life without relubrication and with relubrication is shown in the professional publication -No 324-82/94-S.

d = 14 to 60 mm

[illegible]

Accessories of Rolling Bearing



Machine components serving for fixing rolling bearings on the shaft or in the housing bore are involved in this category of accessories.

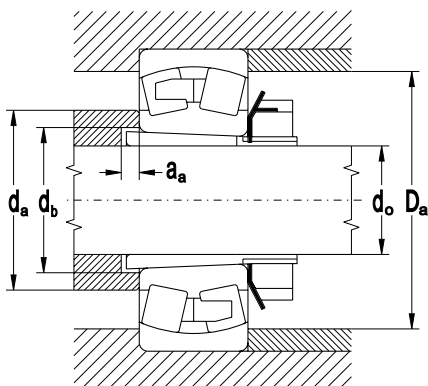
Adapter Sleeves

Adapter sleeves are used for fixing double row self-aligning ball bearings and double row spherical roller bearings with tapered bore (K) on cylindrical shafts. Material for adapter sleeves is steel with tensile strength 400 to 600 MPa.

Boundary dimensions of adapter sleeves are in the dimension tables and correspond to the standard ISO 113/1.

Adapter sleeve designation including nuts and locking devices is in the dimension tables. Adapter sleeve utilization for individual bearings with tapered bore is indicated in the corresponding part devoted to double row self - aligning and double row spherical roller bearings.

Abutment and fillet dimensions for bearings with adapter sleeves are shown in the following table.



Nominal Diameter		Adapter Sleeve Type																	
		H2			H3			H23			H30		H31			H32			
		Bearing Dimension Series																	
d	d ₀	d _b min	a _a min	d _b min	a _a min	03	d _b min	a _a min	32	23	d _b min	a _a min	d _b min	a _a min	31	22	d _b min	a _a min	32
mm																			
20	17	23	5	23	5	8	24	-	5		-	-	-	-	-	-	-	-	-
25	20	28	5	28	5	6	30	-	5		-	-	-	-	-	-	-	-	-
30	25	33	5	33	5	6	35	-	5		-	-	-	-	-	-	-	-	-
35	30	38	5	39	5	8	40	-	5		-	-	-	-	-	-	-	-	-
40	35	43	5	44	5	5	45	-	5		-	-	-	-	-	-	-	-	-
45	40	48	5	50	8	5	50	-	5		-	-	-	-	-	-	-	-	-
50	45	53	5	55	10	5	56	-	5		-	-	-	-	-	-	-	-	-
55	50	60	6	60	19	6	61	-	6		-	-	-	-	-	-	-	-	-
60	55	64	5	65	8	5	66	-	5		-	-	-	-	-	-	-	-	-
65	60	70	5	70	8	5	72	-	5		-	-	-	-	-	-	-	-	-
70	60	75	5	75	10	5	76	-	5		-	-	-	-	-	-	-	-	-
75	65	80	5	80	12	5	82	-	5		-	-	-	-	-	-	-	-	-
80	70	85	5	85	12	5	88	-	5		-	-	-	-	-	-	-	-	-
85	75	90	6	91	12	6	94	-	6		-	-	-	-	-	-	-	-	-
90	80	95	6	96	10	6	100	18	6		-	-	-	-	-	-	-	-	-
100	90	106	7	108	8	7	110	19	7		-	-	-	-	-	-	-	-	-
110	100	116	7	118	6	9	121	17	7		-	-	117	7	7	-	-	-	-
120	110	-	-	-	-	-	131	17	7		127	7	128	7	11	-	-	-	-
130	115	-	-	-	-	-	142	21	8		137	8	138	8	8	-	-	-	-
140	125	-	-	-	-	-	152	22	8		147	8	149	8	8	-	-	-	-
150	135	-	-	-	-	-	163	20	8		158	8	160	8	15	-	-	-	-
160	140	-	-	-	-	-	174	18	8		168	8	170	8	14	-	-	-	-
170	150	-	-	-	-	-	185	18	8		179	8	180	8	10	-	-	-	-
180	160	-	-	-	-	-	195	22	8		189	8	191	8	18	-	-	-	-
190	170	-	-	-	-	-	206	21	9		199	9	202	9	21	-	-	-	-
200	180	-	-	-	-	-	216	20	10		210	10	212	10	24	-	-	-	-
220	200	-	-	-	-	-	236	11	10		231	12	233	10	22	-	-	-	-
240	220						257	6	11		251	11	254	11	19				
260	240						278	2	11		171	13	276	11	25				
280	260						299	11	12		292	12	296	12	28				
300	280										313	12	318	12	32			321	12
320	300										334	13	338	13	39			343	13
340	320										355	14	360	14	-			-	-
360	340										375	14	380	14	-			-	-

Abutment and fillet dimensions $d_{a \min}$, $D_{a \max}$ a $r_{a \max}$ are shown in dimension tables of double row self-aligning and double row spherical roller bearings.

Withdrawal Sleeves

Withdrawal sleeves are used for fixing double row spherical roller bearings with tapered bore (K) on cylindrical shafts. Withdrawal sleeve material is steel with tensile strength 400 to 600 MPa. Boundary dimensions of withdrawal sleeves and corresponding withdrawal nuts, which must be ordered separately, correspond to the standard ISO 2982. Withdrawal sleeve and corresponding withdrawal nut designation to individual double row spherical roller bearings with tapered bore is shown in dimension tables devoted to these bearings. Abutment and fillet dimensions for bearings with withdrawal sleeves ($d_{a\min}$, $D_{a\max}$, $r_{a\max}$) are the same as for bearings without withdrawal sleeves and are indicated in corresponding dimension tables.

Locknuts and Withdrawal Nuts

Locknuts and withdrawal nuts are used for fixing inner bearing rings on adapter sleeves or directly on the shaft. Withdrawal nuts serve for dismounting of double row spherical roller bearings with tapered bore fixed by means of a withdrawal sleeve. Material for nuts is steel with minimum tensile strength 410 MPa. Boundary dimensions of locknuts and withdrawal nuts shown in the dimension tables correspond to the standard ISO 2982. Locknuts are produced in normal design (type KM) and in precision design (type KMA) and are shown in the dimension tables of this publication. When determining the axial runout parameter, following table is valid:

Nut Size Designation		Limiting Axial Runout Values of Abutment Face	
over	to	KM	KMA
		mm	
	10	0.04	0.025
10	20	0.05	0.03
20	25	0.05	0.03
25	30	0.06	0.04
30	40	0.06	0.05

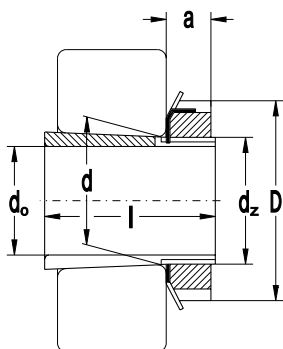
Locking Washers

Locking washers serve for locating of locknuts and are produced of steel with minimum tensile strength 274 MPa. Locking washer boundary dimensions are in the dimension tables of this publication and correspond to the standard ISO 2982.

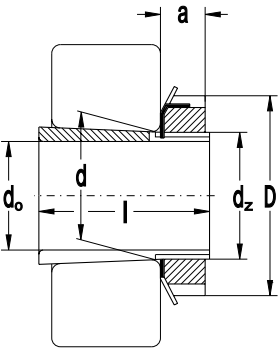
Snap Rings for Bearings with Snap Ring Groove on Outer Ring

Snap rings are used for simple axial fixing of bearings with a groove on outer ring (N) in housings. Material for snap rings is spring steel. Boundary dimensions for snap rings correspond to the standard ISO 464. Snap rings are designated by a number indicating the outer bearing diameter D and a number indicating minimum snap ring width f, e.g. 52/1.02. In practice also a commercial designation which indicates the ring type R and outer bearing diameter in mm, e.g. R52, is used. In the dimension tables snap rings for single row ball bearings - type 60, 62, 63 and 64 in N design are shown. Snap rings can also be used also for bearings in different design, their delivery should be discussed with supplier in advance. Snap rings are delivered separately.

$d_0 = 20$ to 75 mm

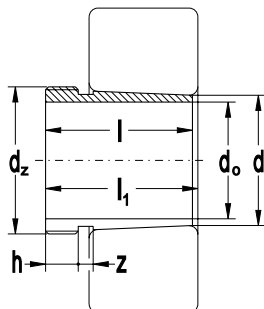
205

Adapter Sleeves
d₀ = 80 to 180 mm



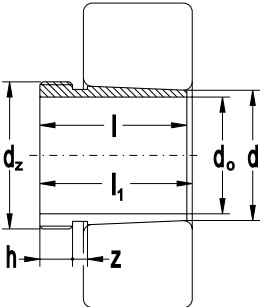
Dimensions						Sleeve Designation incl. Nut and Locking	Appropriate Components		Weight ~ kg
d ₀	d	d _z	D	L	a ~		Nut	Locking	
mm									
80	90	M90x2	120	62	18	H218	KM18	MB18	1.190
	90	M90x2	120	65	18	H318	KM18	MB18	1.370
	90	M90x2	120	86	18	H2318	KM18	MB18	1.690
85	95	M95x2	125	55	19	H219	KM19	MB19	1.370
	95	M95x2	125	68	19	H319	KM19	MB19	1.560
	95	M95x2	125	90	19	H2319	KM19	MB19	1.920
90	100	M100x2	130	58	20	H220	KM20	MB20	1.490
	100	M100x2	130	71	20	H320	KM20	MB20	1.690
	100	M100x2	130	97	20	H2320	KM20	MB20	2.150
100	110	M110x2	145	81	21	H3122	KM22	MB22	2.250
	110	M110x2	145	63	21	H222	KM22	MB22	1.930
	110	M110x2	145	77	21	H322	KM22	MB22	2.180
	110	M110x2	145	105	21	H2322	KM22	MB22	2.740
110	120	M120x2	145	72	22	H3024	KML24	MBL24	1.930
	120	M120x2	155	88	22	H3124	KM24	MB24	2.640
	120	M120x2	155	112	22	H2324	KM24	MB24	3.190
115	130	M130x2	155	80	23	H3026	KML26	MBL26	2.850
	130	M130x2	165	92	23	H3126	KM26	MB26	3.660
	130	M130x2	165	121	23	H2326	KM26	MB26	4.600
125	140	M140x2	165	82	24	H3028	KML28	MBL28	3.160
	140	M140x2	180	97	24	H3128	KM28	MB28	4.340
	140	M140x2	180	131	24	H2328	KM28	MB28	5.550
135	150	M150x2	180	87	26	H3030	KML30	MBL30	3.890
	150	M150x2	195	111	26	H3130	KM30	MB30	5.520
	150	M150x2	195	139	26	H2330	KM30	MB30	6.630
140	160	M160x3	190	93	28	H3032	KML32	MBL32	5.210
	160	M160x3	210	119	28	H3132	KM32	MB32	7.670
	160	M160x3	210	147	28	H2332	KM32	MB32	9.140
150	170	M170x3	200	101	29	H3034	KML34	MBL34	5.990
	170	M170x3	220	122	29	H3134	KM34	MB34	8.360
	170	M170x3	220	154	29	H2334	KM34	MB34	10.200
160	180	M180x3	210	109	30	H3036	KML36	MBL36	6.830
	180	M180x3	230	131	30	H3136	KM36	MB36	9.500
	180	M180x3	230	161	30	H2336	KM36	MB36	11.300
170	190	M190x3	220	112	31	H3038	KML38	MBL38	7.450
	190	M190x3	240	141	31	H3138	KM38	MB38	10.800
	190	M190x3	240	169	31	H2338	KM38	MB38	12.600
180	200	M200x3	240	120	32	H3040	KML40	MBL40	9.190
	200	M200x3	250	150	32	H3140	KM40	MB40	12.100
	200	M200x3	250	176	32	H2340	KM40	MB40	13.900

$d_0 = 35$ to 95 mm

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Withdrawal Sleeves

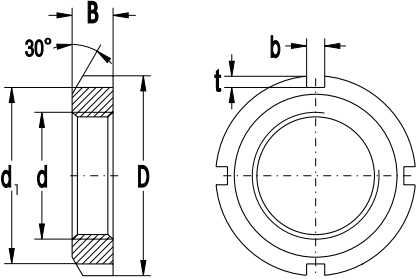
d₀ = 100 to 180 mm



Dimensions							Sleeve Designation	Corresp. Withdrawal Nut	Weight ~
d ₀	d	d _z	l	l ₁	h	z			
mm									kg
100	110	M125x2	68	72	11	8	AH3122	KM25	1.280
105	110	M120x2	68	72	11	8	AH3122X	KM24	0.786
	110	M125x2	82	86	12	8	AH3222X	KM25	1.060
	110	M125x2	98	102	16	8	AH2322X	KM25	1.350
110	120	M140x2	75	79	12	8	AH3124	KM28	1.670
	120	M140x2	105	109	17	8	AH2324	KM28	2.470
115	120	M130x2	60	64	13	8	AH3024X	KM26	0.737
	120	M130x2	75	79	12	8	AH3124X	KM26	0.948
	120	M135x2	90	94	14	8	AH3224X	KM27	1.310
	120	M135x2	105	109	17	8	AH2324X	KM27	1.610
125	130	M140x2	67	71	14	8	AH3026X	KM28	0.907
	130	M140x2	78	82	12	8	AH3126X	KM28	1.080
	130	M145x2	98	102	15	8	AH3226X	KM29	1.580
	130	M145x2	115	119	19	8	AH2326X	KM29	1.970
135	140	M150x2	68	73	14	10	AH3028X	KM30	0.996
	140	M150x2	83	88	14	10	AH3128X	KM30	1.260
	140	M155x3	104	109	15	10	AH3228X	KM31	1.810
	140	M155x3	125	130	20	10	AH2328X	KM31	2.340
145	150	M160x3	72	77	15	10	AH3030X	KM32	1.120
	150	M165x3	96	101	15	10	AH3130X	KM33	1.750
	150	M165x3	114	119	18	10	AH3230X	KM33	2.210
	150	M165x3	135	140	24	10	AH2330X	KM33	0.000
150	160	M170x3	77	82	16	10	AH3032	KM34	2.010
	160	M180x3	103	108	16	10	AH3132	KM36	3.180
	160	M180x3	124	130	20	12	AH3232	KM36	4.020
	160	M180x3	140	146	24	12	AH2332	KM36	4.690
160	170	M180x3	85	90	17	10	AH3034	KM36	2.400
	170	M190x3	104	109	16	10	AH3134	KM38	3.410
	170	M190x3	134	140	24	12	AH3234	KM38	3.410
	170	M190x3	146	152	24	12	AH2334	KM38	5.230
170	180	M190x3	92	98	17	12	AH3036	KM38	2.800
	180	M200x3	116	122	19	12	AH3136	KM40	4.160
	180	M200x3	105	110	17	10	AH2236	KM40	3.670
	180	M200x3	140	146	24	12	AH3236	KM40	5.290
	180	M200x3	154	160	26	12	AH2336	KM40	5.940
180	190	Tr205x4	96	102	17	12	AH3038	HML41T	3.280
	190	Tr210x4	125	131	19	12	AH3138	HM42T	4.730
	190	Tr210x4	112	117	18	10	AH2238	HM42T	4.150
	190	Tr210x4	160	167	26	14	AH2338	HM42T	6.530
	190	Tr210x4	145	152	25	14	AH3238	HM42T	5.800

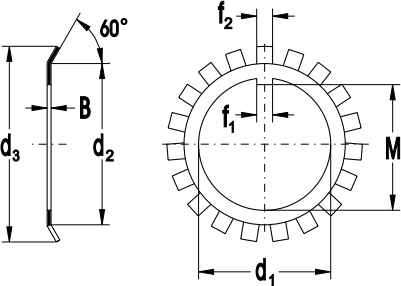
Locknuts

d = M10 x 0.75 to M200 x 3



Dimensions						Nut		Corresp.-	Weight
d	D	d ₁	B	b	t	Designation KM	KMA	Locking Washer	~
mm									kg
M10x0.75	18	13.5	4	3	2.0	KM0		MB0	0.004
M12x1	22	17	4	3	2.0	KM1		MB1	0.007
M15x1	25	21	5	4	2.0	KM2		MB2	0.010
M17x1	28	24	5	4	2.0	KM3		MB3	0.013
M20x1	32	26	6	4	2.0	KM4		MB4	0.019
M25x1.5	38	32	7	5	2.0	KM5	KMA5	MB5	0.025
M30x1.5	45	38	7	5	2.0	KM6	KMA6	MB6	0.043
M35x1.5	52	44	8	5	2.0	KM7	KMA7	MB7	0.053
M40x1.5	58	50	9	6	2.5	KM8	KMA8	MB8	0.085
M45x1.5	65	56	10	6	2.5	KM9	KMA9	MB9	0.120
M50x1.5	70	61	11	6	2.5	KM10	KMA10	MB10	0.150
M55x2	75	67	11	7	3.0	KM11	KMA11	MB11	0.160
M60x2	80	73	11	7	3.0	KM12	KMA12	MB12	0.170
M65x2	85	79	12	7	3.0	KM13	KMA13	MB13	0.200
M70x2	92	85	12	8	3.5	KM14	KMA14	MB14	0.240
M75x2	98	90	13	8	3.5	KM15	KMA15	MB15	0.290
M80x2	105	95	15	8	3.5	KM16	KMA16	MB16	0.400
M85x2	110	102	16	8	3.5	KM17	KMA17	MB17	0.450
M90x2	120	108	16	10	4.0	KM18	KMA18	MB18	0.560
M95x2	125	113	17	10	4.0	KM19		MB19	0.660
M100x2	130	120	18	10	4.0	KM20	KMA20	MB20	0.700
M105x2	140	126	18	12	5.0	KM21	KMA21	MB21	0.840
M110x2	145	133	19	12	5.0	KM22	KMA22	MB22	0.970
M115x2	150	137	19	12	5.0	KM23		MB23	1.010
M120x2	155	138	20	12	5.0	KM24	KMA24	MB24	1.080
M125x2	160	148	21	12	5.0	KM25	KMA25	MB25	1.190
M130x2	165	149	21	12	6.0	KM26	KMA26	MB26	1.250
M135x2	175	160	22	14	6.0	KM27		MB27	1.550
M140x2	180	160	22	14	6.0	KM28		MB28	1.600
M150x2	195	171	24	14	6.0	KM30		MB30	2.030
M160x3	210	182	25	16	7.0	KM32		MB32	2.590
M170x3	220	193	26	16	7.0	KM34		MB34	2.800
M180x3	230	203	27	18	8.0	KM36		MB36	3.070
M190x3	240	214	28	18	8.0	KM38		MB38	3.390
M200x3	250	226	29	18	8.0	KM40		MB40	3.690

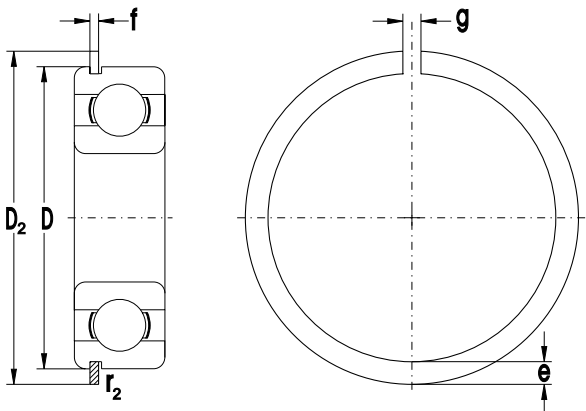
Locking Washers
d₁ = 10 to 200 mm



Dimensions							Locking Washer Designation	Weight 100 pcs ~
d ₁	d ₂	d ₃ ~	B ~	f ₁	f ₂	M		
mm								kg
10	13.5	21	1.00	3	3	8.5	MB0	0.130
12	17.0	25	1.00	3	3	10.5	MB1	0.200
15	21.0	28	1.00	4	4	13.5	MB2	0.260
17	24.0	32	1.00	4	4	15.5	MB3	0.320
20	26.0	36	1.00	4	4	18.5	MB4	0.350
25	32.0	42	1.25	5	5	23.0	MB5	0.640
30	38.0	49	1.25	5	5	27.5	MB6	0.780
35	44.0	57	1.25	6	5	32.5	MB7	1.040
40	50.0	62	1.25	6	6	37.5	MB8	1.230
45	56.0	69	1.25	6	6	42.5	MB9	1.520
50	61.0	74	1.25	6	6	47.5	MB10	1.600
55	67.0	81	1.50	8	7	52.5	MB11	1.960
60	73.0	86	1.50	8	7	57.5	MB12	2.530
65	79.0	92	1.50	8	7	62.2	MB13	2.900
70	85.0	98	1.50	8	8	66.5	MB14	3.340
75	90.0	104	1.50	8	8	71.5	MB15	3.560
80	95.0	112	1.80	10	8	76.5	MB16	4.640
85	102.0	119	1.80	10	8	81.5	MB17	5.240
90	108.0	126	1.80	10	10	86.5	MB18	6.230
95	113.0	133	1.80	10	10	91.5	MB19	6.700
100	120.0	140	1.80	12	10	96.5	MB20	7.650
105	126.0	145	1.80	12	12	100.5	MB21	8.260
110	133.0	154	1.80	12	12	105.5	MB22	9.400
115	137.0	159	2.00	12	12	110.5	MB23	10.800
120	135.0	148	2.00	14	12	115.0	MBL24	7.000
	138.0	164	2.00	14	12	115.0	MB24	10.500
125	148.0	170	2.00	14	12	120.0	MB25	11.800
130	149.0	175	2.00	14	12	125.0	MB26	11.300
135	160.0	185	2.00	14	14	130.0	MB27	14.400
140	160.0	192	2.00	16	14	135.0	MB28	14.200
150	171.0	205	2.00	16	14	145.0	MB30	15.500
160	182.0	217	2.50	18	16	154.0	MB32	22.200
170	193.0	232	2.50	18	16	164.0	MB34	24.700
180	203.0	242	2.50	20	18	174.0	MB36	16.800
190	214.0	252	2.50	20	18	184.0	MB38	27.800
200	226.0	262	2.50	20	18	194.0	MB40	29.300

Snap Rings for Bearings with Snap Ring Groove on Outer Ring

D = 32 to 200 mm

[illegible]

Rolling Elements



Balls

Balls as a rolling bearing component are made of the same material as bearing rings. The material hardness after processing (hardening) is 61 to 65 HRC.

Balls with diameter $D_w = 3.175$ to 17.462 mm are supplied within the tolerance classes 10, 16, 20, 28, 40, and 100. Balls with diameter $D_w = 18.256$ to 33.338 mm are supplied within the tolerance classes 16, 20, 28, 40 and 100 according to the international standard ISO 3290.

The delivery of balls in different tolerance class or made of a different material should be discussed in advance.

Within each tolerance class, balls of the same nominal diameter D_w are graded into grades according to mean grading deviation of the nominal ball diameter in the lot ΔD_{wm} .

Each grade is packed separately and is marked in documentation and package by the value of the nominal diameter mean deviation in the lot in μm , e.g.

Balls 6-40+4

This means that the ball has the nominal diameter 6 mm, tolerance class 40 and has the actual diameter within 6.003 to 6.005 mm.

Limiting Deviation Diameter and Form. Limiting Surface Roughness.							
Tolerance Class	D _w over	to	ΔD _{wm}	V _{DwL} max	V _{Dws} max	Δ max	R _a max
	mm		μm				
3	0.25	12	±5	0.13	0.08	0.08	0.012
5	0.25	12	±5	0.25	0.13	0.13	0.020
10	0.25	25	±9	0.5	0.25	0.25	0.025
16	0.25	25	±10	0.8	0.4	0.4	0.032
20	0.25	38	±10	1	0.5	0.5	0.040
28	0.25	38	±12	1.4	0.7	0.7	0.050
40	0.25	50	±16	2	1	1	0.080
100	0.25	120	±40	5	2.5	2.5	0.125
200	0.25	150	±60	10	5	5	0.200

D_w

- nominal ball diameter

ΔD_{wm}

- limiting deviation of mean ball diameter as individual component

V_{DwL}

- ball diameter variation in a lot

V_{Dws}

- individual ball diameter variation

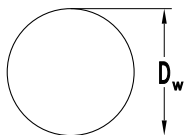
Δ

- deviation from roundness /out-of-roundness/

R_a

- surface roughness

$D_W = 1.000$ to 33.338 mm

[illegible]

Cylindrical Rollers

Cylindricals rollers are produced with convex contour of the rolling surface or in design with straight line contour and end crowned towards both faces (ZB).

After being made of rolling bearing steel the cylindrical rollers have hardness 60 to 65 HRC. Cylindrical rollers are usually delivered in the tolerance class III (DIN 5402). Delivery of rollers made of different dimensions or materials in than dimension tables of the catalogue should be discussed in advance.

Within each tolerance class, the cylindrical rollers of the same nominal diameter D_w and nominal length L_w are graded according to the mean grading deviation of the nominal cylindrical roller diameter and length.

Example of cylindrical roller designation is shown in documentation and packing.

Short cylindrical roller 8 x 12 ZB III + 2/-3

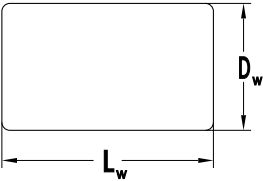
this means that the cylindrical roller has nominal diameter 8 mm and nominal length 12mm in ZB design, tolerance class III and has actual diameter 8.001 to 8.003 mm and actual length 11.994 to 12.000.

Limiting Coordinates of Cylindrical Roller Rounding		
Nominal Diameter r	Limiting Dimensions of Rounding Coordinates	
	$r_{s \min}$	$r_{s \max}$
mm	mm	
0.3	0.2	0.5
0.5	0.3	0.8
0.8	0.5	1.2
1	0.7	1.5
1.5	1.1	2.1
2	1.5	2.7

Limiting Deviations of Dimensions, Form and Position. Limiting Surface Roughness.									
Tolerance Class	D_w over	to	Δ_{Dwmp}	V_{DWL} max	V_{Dwp}	Δ max	V_{Dwmp} max	Face Convexity max	R_a max
	mm		μm						
I.	-	18	+10.25/-16.25	0.5	0.25	0.3	0.3	2	0.08
	18	26	+10.25/-16.25	0.5	0.25	0.4	0.5	2	0.08
II.	-	18	+10.25/-16.25	1	0.5	0.5	0.5	2	0.16
	18	26	+10.25/-16.25	1	0.5	0.8	1	2	0.16
III.	-	18	+11/-17	2	1	1	1	2	0.16
	18	26	+11/-17	2	1	1.5	1	2	0.16
IV.	-	18	0/-45	3	2	2	2	3	0.32
	18	26	0/-45	3	2	3	2	3	0.32
D_w - short cylindrical roller nominal diameter Δ_{Dwmp} - limiting deviation of cylindrical roller diameter as individual component V_{DWL} - variations of cylindrical roller diameter in a lot V_{Dwp} - variation of individual cylindrical roller diameter Δ - roundness deviation V_{Dwmp} - conicity R_a - cylindrical surface roughness									

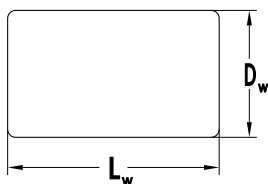
Dimension and shape Deviations, except Conicity and Convexity Are Valid in Central Section of Cylindrical Rollers.							
Tolerance Class	L _w over to		ΔL _{WS}	V _{LWL} max	S _w max	Face Convexity max	R _a max
	mm		μm				
I.	-	15	+2/-7	3	3	2	0.08
-	15	26	+2/-7	3	3	2	0.08
	26	40	+2.5/-7.5	5	5	3	0.08
II.	-	15	+3/-15	6	6	3	0.16
	15	40	+3/-15	6	6	5	0.16
III.	-	26	+10/-20	6	6	3	0.16
	26	40	+10/-20	6	6	5	0.32
IV.	-	10	0/-32	10	16	3	0.63
	10	18	0/-32	10	20	3	0.63
	18	30	0/-32	15	25	5	0.63
	30	40	0/-50	20	30	5	0.63
L _w - Short cylindrical roller nominal length ΔL _{WS} - limiting length deviations of rollers as individual components V _{LWL} - roller length variation in a lot S _w - lateral run-out R _a - face surface roughness							

Cylindrical Rollers
Dw = 3 to 22 mm



Dimension			Weight 100pcs	Dimension			Weight 100pcs	Dimension			Weight 100pcs
D _w × L _w		r	~	D _w × L _w		r	~	D _w × L _w		r	~
mm			kg	mm			kg	mm			kg
3x5 3.175x4.400 3.5x5	0.3	0.027	8x8	0.5	0.308	15x17	0.8	2.340			
	0.3	0.027	8x10	0.5	0.391	15x22	0.8	3.000			
	0.3	0.037	8x12	0.5	0.465	15x24	0.8	3.300			
			8x16	0.5	0.627	15x25	0.8	3.440			
4x6	0.3	0.058				15x30	0.8	4.130			
4x8	0.3	0.078	9x9	0.5	0.440	15x32	0.8	4.390			
4.5x4.5	0.3	0.068	9x10	0.5	0.496						
			9x13	0.5	0.450	16x16	0.8	2.480			
			9x14	0.5	0.680	16x17	0.8	2.660			
5x6	0.3	0.091				16x24	0.8	3.730			
5x8	0.3	0.121				16x27	0.8	4.230			
5x10	0.3	1.52	10x10	0.5	0.600	16x35	0.8	5.500			
5.349x9.520	0.3	0.166	10x11	0.5	0.670	16x47	0.8	7.370			
5.350x9.5	0.3	0.150	10x14	0.5	0.850	16.200x50	0.8	7.490			
5.5x5.5	0.3	0.100	10x15	0.5	9.200						
5.5x8	0.3	0.146	10x16	0.5	0.980						
			10x20	0.5	1.225	17x17	1.0	2.970			
6x6	0.3	0.130	10x30	0.5	1.830	17x24	1.0	4.200			
6x8	0.3	1.78				17x34	1.0	5.900			
6x10	0.3	0.219	11x11	0.8	0.810						
6x12	0.3	0.261	11x12	0.8	0.890	18x18	1.0	3.570			
6.350x6.350	0.4	0.158	11x15	0.8	1.100	18x19	1.0	3.770			
	0.5	0.296	11x16	0.8	1.180	18x26	0.8	5.100			
	0.5	0.166	11x18	0.8	1.330	18x30	1.0	5.960			
6.5x9	0.5	0.230	11x22	0.8	1.620	18x36	1.0	7.150			
6.5x11	0.5	0.258									
			12x12	0.8	1.040	19x19	1.0	4.160			
7x7	0.5	0.206				19x20	1.0	4.440			
7x10	0.5	0.296	13x13	0.8	1.330	19x28	1.0	6.100			
7x14	0.5	0.417	13x20	0.8	2.040	19x32	1.0	7.030			
7.350x14	0.5	0.463									
7.5x7.5	0.5	0.254	14x13.800	0.8	1.650	20x20	1.0	4.850			
7.5x9	0.5	0.310	14x14	0.8	1.650	20x30	1.0	7.300			
7.5x11	0.5	0.374	14x15	0.8	1.800	20x40	1.0	9.770			
7.5x17	0.4	0.583	14x20	0.8	2.380						
7.5x19	0.4	0.652	14x22	0.8	2.640	21x21	1.0	5.600			
7.5x22	0.4	0.757	14x26	0.8	3.100	21x22	1.0	9.940			
7.5x25.5	0.5	0.884	14x28	0.8	3.340	21x42	1.0	11.200			
7.937x6.350	0.5	0.241									
7.937x7.937	0.4	0.302	15x15	0.8	2.040	22x22	1.0	6.400			
7.950x6.350	0.3	0.240	15x16	0.8	2.200	22x24	1.0	7.110			

D_W = 22 to 53 mm



Dimension		Weight 100pcs	Dimension		Weight 100pcs			
D _w x L _w	r	~	D _w x L _w	r	~			
mm		kg	mm		kg			
22x34	1.0	10.000	38x38	2.0	33.300			
22x44	1.0	12.900	38x62	2.0	55.000			
22x48	1.0	14.200	40x40	2.0	38.900			
23x23	1.0	7.400						
23x34	1.0	11.200	42x42	2.0	45.400			
24x24	1.0	8.400	45x45	2.0	55.800			
24x26	1.0	9.100	48x48	2.0	67.700			
24x36	1.0	12.600						
24x40	1.0	14.100	48x52	2.0	73.700			
24x52	1.0	18.100	53x53	2.0	91.000			
25x25	1.5	9.500						
25x36	1.5	13.700						
26x26	1.5	10.700						
26x40	1.5	16.400						
26x48	1.5	19.800						
26x55	1.5	22.600						
27x48	1.5	21.400						
28x28	1.5	13.300						
28x30	1.5	14.300						
28x32	1.5	15.300						
28x44	1.5	21.000						
28x56	1.5	26.900						
30x30	1.5	16.300						
30x33	1.5	18.000						
30x48	1.5	26.200						
30x63	1.5	34.600						
32x32	1.5	19.900						
32x52	1.5	32.400						
32x64	1.5	40.000						
34x34	2.0	23.900						
34x55	2.0	38.700						

Special Rolling Bearings

In addition to standard and modified bearings shown in this catalogue, special rolling bearings are also made. As a rule, they have non-standard dimensions and cannot be involved in the standard types, they are made of different materials and are determined for usage in machines or equipment arrangements whose design does not allow standard bearings.

1. Single Row Cylindrical Roller Bearings - Type VL

Cylindrical roller bearings - type VL are predominantly used for textile spindle arrangements. Boundary dimensions of bearing do not correspond to the international dimension plan ISO 15. Bearings have sheet brass cages (designation Y is not indicated). A gradual transition to plastic cages (TNG) as a standard design is presumed because some qualities of plastic, as great elasticity, low weight and good sliding qualities predetermine these materials for modern rolling bearing cages. Cages made of these materials are suitable for temperatures from -30°C to $+110^{\circ}\text{C}$. Bearings VL 10 to VL 25 can be delivered also with a solid brass cage (M).

Static and dynamic load rating is stated for shaft raceway with nominal diameter corresponding to mean diameter d with deviation 0 to -0.015 mm , ovality and conicity max. $2\text{ }\mu\text{m}$, surface roughness max. $R_a = 0.08$ and hardness HRC = 61 to 65.

Designation

Bearing designation is indicated in the dimension table.

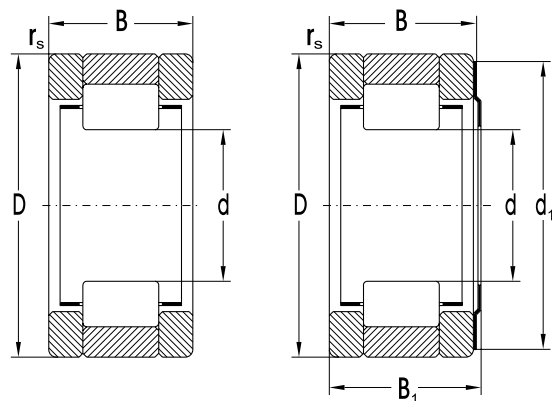
Radial equivalent dynamic load

$$P_r = F_r \quad [\text{kN}]$$

Radial equivalent static load

$$P_{or} = F_r \quad [\text{kN}]$$

d = 7.8 to 25



Dimension						Basic Load Rating		Limiting Speed		Weight	Cage	Dimensions	Bearing Designation	Dimension Deviation					
d	d _i	D	B	B ₁	r _s min	dynamic C _r	static C _{0a}	for Lubrication with Grease Oil		~		d		Δdmp ¹⁾ max min	ΔDmp ²⁾ max min	ΔB _s max min			
mm						kN		min ⁻¹		kg		mm		μm					
7.8		18	9		0.6	4.22	3.10	28000	33000	0.011	J	7.8	VL 7.8	+28	+20	+10 0	+70 -30		
8.1		18	9		0.6	4.3	2.87	34000	39000	0.012	TNG	8.1	VL 8.1	+10	0		+100 0		
8.8		20	10		0.6	5.31	3.48	24000	28000	0.014	J	8.8	VL 8.8	+28	+20	+10 0	+70 -30		
10		22	12		0.6	6.81	4.55	21000	25000	0.021	J, M	10	VL 10	+28	+20	+10 0	+70 -30		
		22	12		0.6	7.50	5.21	30000	35000	0.020	TNG		VL 10E	+28	+20	+10 0	+70 -30		
	21.7	22	10.2	11.4	0.6	7.50	5.21	30000	35000	0.021	TNG		VL 10ZETNG	+28	+20	+10 0	+70 -30		
12		26	14		0.6	11.00	7.79	18000	21000	0.032	J, M	12	VL 12	+28	+20	+10 0	+70 -30		
		26	14		0.6	12.10	8.91	25000	30000	0.031	TNG		VL 12E	+28	+20	+10 0	+70 -30		
14		30	14		0.6	12.30	8.47	15000	18000	0.043	J, M	14	VL 14	+28	+20	+10 0	+70 -30		
		30	14		0.6	13.60	10.00	22000	27000	0.042	TNG		VL 14E	+28	+20	+10 0	+70 -30		
16		35	17		0.6	16.50	12.30	13000	16000	0.073	J, M	16	VL 16	+28	+20	+10 0	+70 -30		
18		36	17		0.6	17.10	14.40	12600	15000	0.076	M	18	VL 18	+28	+20	+10 0	+70 -30		
20		40	19		0.6	20.30	17.40	12000	14000	0.107	M	20	VL 20	+28	+20	+10 0	+70 -30		
25		48	19		0.6	24.60	22.80	9400	11000	0.155	M	25	VL 25	+28	+20	+10 0	+70 -30		
													1) Circle tolerance inscribed to rolling elements 2) Loose rings have ΔD _{mp} -150/ - 50 μm						

2.Single Row Ball Bearings with Flexible Rings - Type LGVZ

Single row ball bearings with flexible rings - type LGVZ fulfil in the arrangement a different role than bearings in common arrangements and that is why they must have specific qualities in comparison with bearings of standard design. They are mainly flexible bearing rings enabling operating ovality and a corresponding cage, small cross section and high dimension and operating accuracy especially of the outer ring. Bearings are determined especially for arrangements of wave speed reducers in harmonic gearboxes for robots and manipulators.

Boundary Dimensions

Boundary dimensions of single row ball bearings with flexible rings do not correspond to the international dimension plan ISO 15.

Designation

Bearing designation in basic design is shown in the dimension table. Additional designation represents designation of ovality range (K1, K2) and of some symbol according to STN 024608, especially the radial clearance. Designation example -LGVZ 160120K1 C3.

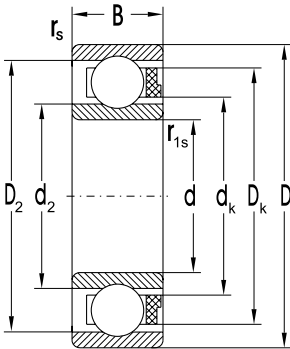
Operational Ovality

Bearings with flexible rings have inner and outer rings substantially smaller in comparison with bearings of common design of the same size and this enables the operational ovality O . Values of the inner ring operational ovality $O = (d_{\max} - d_{\min})/2$ are shown in the dimension table. Bearings in basic design are determined for a normal ovality range. Ovality range size in the basic design is not indicated. A different ovality range is indicated by symbols K1 and K2.

Operating Temperature

Bearings are determined for operating temperature to 95°C, 110°C for short time periods. Operating temperature is limited by cage material and lubricant used.

d = 37 to 120 mm

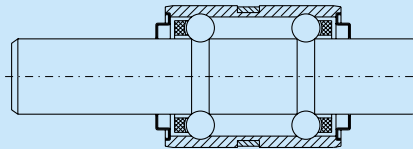


- 1) Durably
- 2) Short term

3. Bearing Units

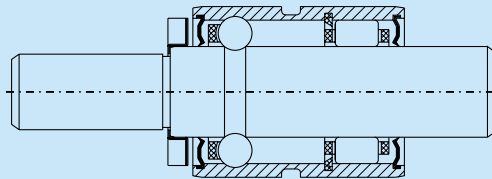
3.1 Double Row Ball Bearings for Textile Machines and Instrument Technics

Bearings for textile machines are designed for high speed and relatively low load, i.e. they have high dimension and operation accuracy, which secures their high utilization value and operating reliability. Bearings create a nonseparable unit consisting of a shaft and a cylindrical bush arranged in a rotary way on two rows of balls. Light one - side cages made of plastic are centered on rolling elements. Raceways on the shaft and in the bush are made in the high tolerance class. Against impurity penetration there are effective contact or non-contact sealing on both sides. Bearings are filled with grease which secures effective lubrication usually during the whole bearing life. In some cases the bearings are adapted for re-lubrication. The bearing creates a complex arrangement unit enabling simple mounting and service. Bearings for instrument technics have also high dimension and operation accuracy and work as a rule at lower speed than bearings in textile machines.



3.2 Double Row Bearings for Water Pumps of Combustion Motors

Bearings for water pumps of combustion motors create an inseparable unit consisting of a shaft and a cylindrical bush arranged in two rows of balls or in one row of balls and one row of cylindrical rollers. Balls or cylindrical rollers are arranged in light one-side plastic cages. Raceways on the shaft and in the cylindrical bush are made in high tolerance class. Against impurity penetration there is an effective contact sealing on both sides. Bearings are filled with grease which secures effective lubrication during the whole bearing life. The bearing creates a complex arrangement unit enabling simple mounting and service.

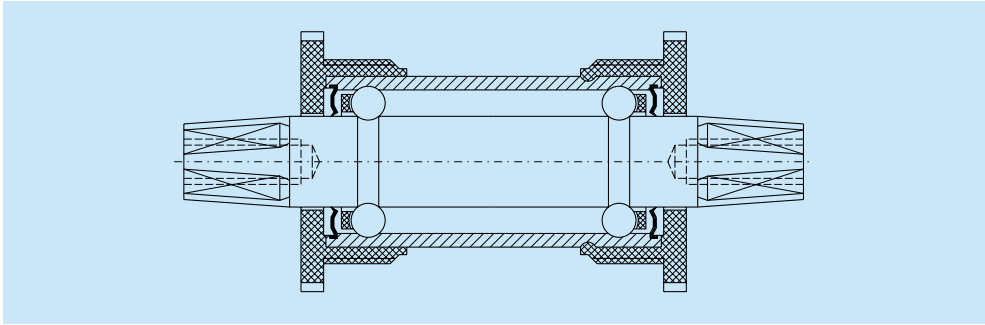


3.3 Bottom Bracket Bearings for Bicycles

Bottom bracket bearings for bicycles create an inseparable unit consisting of a steel case - hardened or hardened shaft and a cylindrical bush made of bearing steel or of AL- alloy or also of polyamide filled with glass fibre. Raceways for two rows of balls are created by grinding directly on the shaft and in the cylindrical bush. Balls are arranged in one - side light cages made of plastic. Against impurity penetration there is a rubber contact sealing on both sides. Bearings are filled with grease which secures effective lubrication during the whole bearing life.

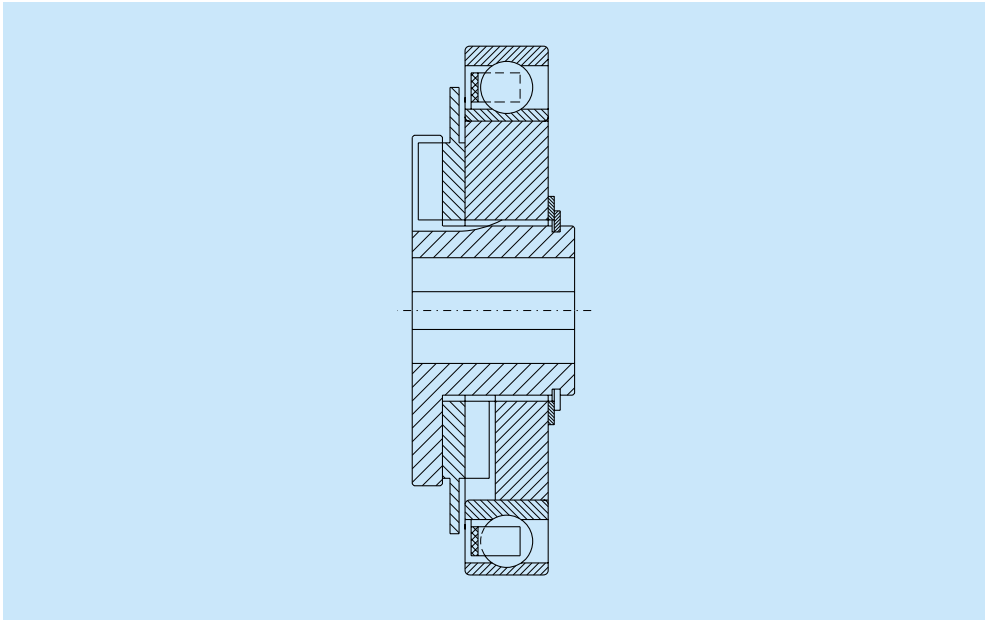
The advantage of these bearings is that they do not demand any maintenance and when mouting no clearance adjustment is necessary as for classical arrangements, because the optimum clearance is set directly by the bearing manufacturer.

For bearing clamping into the bicycle frame hub dishes made of galvanized steel or plastic are used. Ring dish creates one unit with the double row ball bearing, left dish is independent and supports the bearing only radially. By this design the bearing compact can be universally utilized for bicycles with various frame hub length in the range 66 to 71 mm.



3.4 Wave Generators

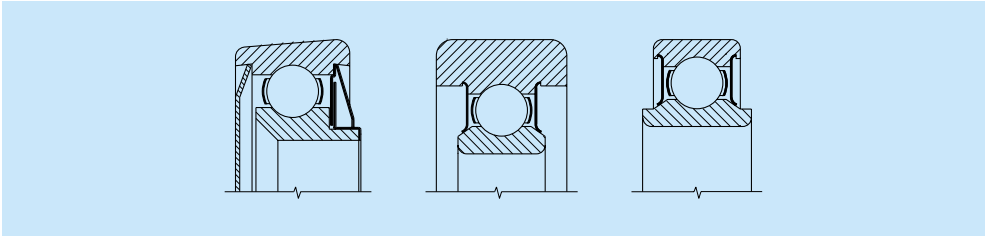
Wave generators together with flexible and rigid geared wheel create the main components of the harmonic gearbox. These components represent for the time being the top of design and technology of harmonic gearbox production. Besides utilization in robots and manipulators they can be used, where high kinematic accuracy and small backlash of the gear in corresponding equipment and compactness and design simplicity are required, e.g. at machine tool construction, in medicine technics, etc.



Survey of Further Special Rolling Bearings

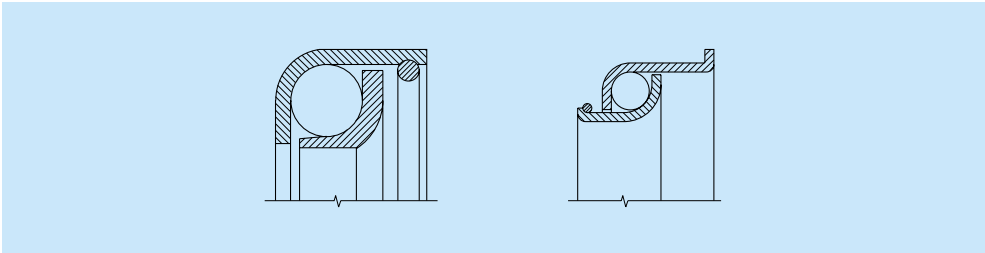
Single Row Ball Bearings

For industrial needs, especially for automobile, aircraft industries and industries dealing with production of transportation equipment the bearings shown in the picture below have been developed and are being manufactured.



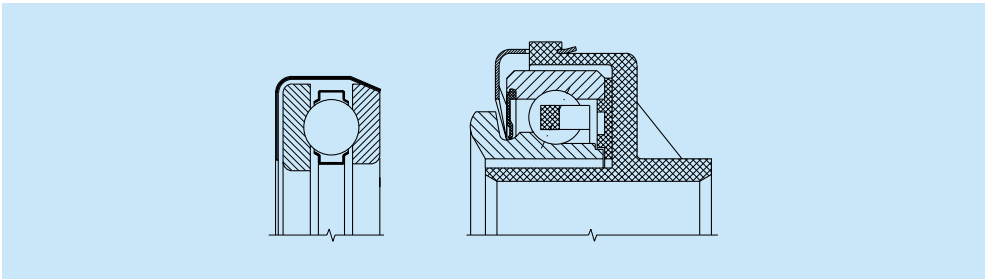
Single Row Ball Bearings with Pressed Steel Sheet Rings

Used for motor vehicle aggregates, especially for the steering column arrangement.



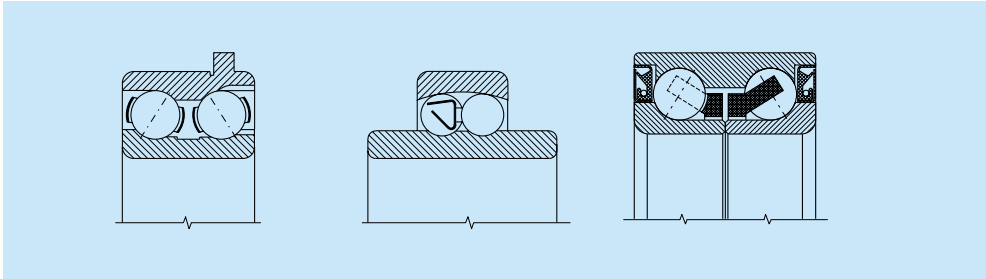
Clutch Bearings

Used in automobile industry for clutches of passenger cars and trucks.



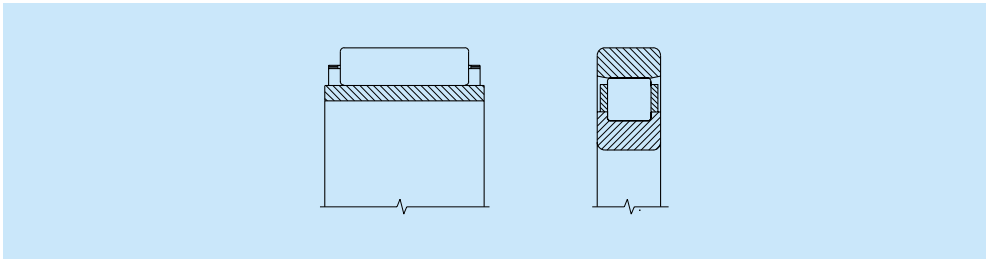
Double Row Ball Bearings

Used in aircraft and automobile industries.



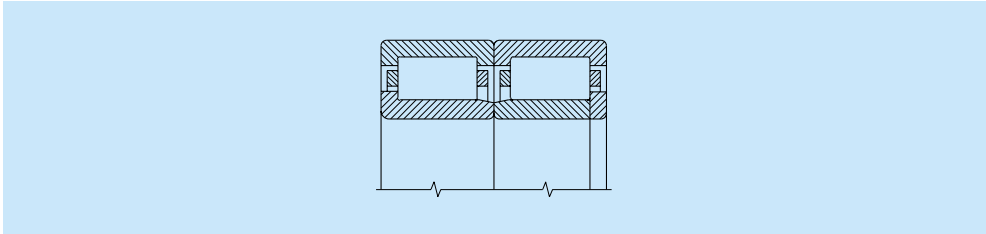
Single Row Cylindrical Roller Bearings

Used in automobile and aircraft industries.



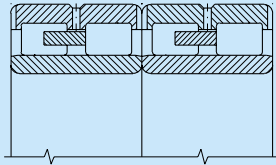
Single Row Cylindrical Roller Bearings for Railway Vehicle Axles

Used for axle arrangements of passenger cars and wagons, motor coaches and locomotives. Bearings have a solid brass cage centered on cylindrical rollers, or on the ribs of the outer ring (in this case the cage has lubrication grooves). Inner rings and semi - units are mutually interchangeable.



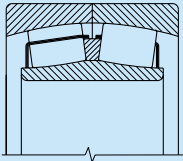
Multi-Row Cylindrical Roller Bearings

Used for accommodation of especially great radial forces with limited space, especially in metallurgy, for arrangement of rolling mill rollers. These bearings have rings with lubricating holes so that access of lubricant into all cylindrical roller rows can be secured.



Doble Row Spherical Roller Bearings

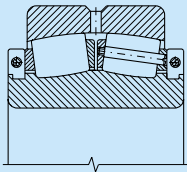
Used for special arrangements, e.g. output shaft arrangements of gearbox for concrete mixer drive and for arrangement of concrete mixer drive drum, where the bearing has wider outer ring being split.



Double Row Spherical Roller Bearings and Single Row Cylindrical Roller Bearings, Split Bearings

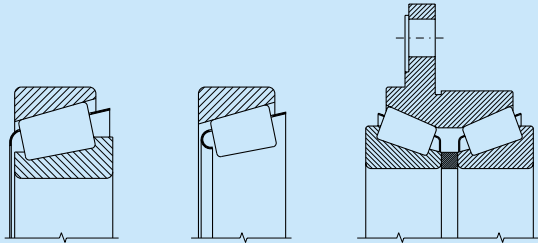
Double row spherical roller bearings are designed for convertor journal arrangements to enable replacement without dismounting other elements adjoining the bearing from both sides of the shaft.

Single row cylindrical roller bearings belong among the series of split cylindrical roller bearings utilized for arrangement of rolling mill rollers. The aim of splitting is to enable mounting and dismounting without dismantling other construction elements on the journal.



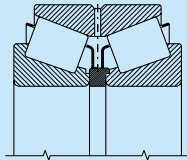
Single Row and Double Row Tapered Roller Bearings

Used prevalingly in automobile industry and in the area of heavy mechanical engineering.



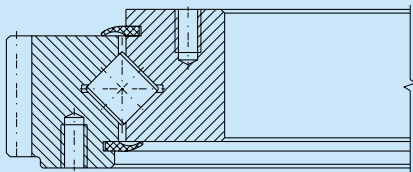
Double Row Tapered Roller Bearings

Used for arrangements of rolling mill rollers and other equipments in steel rolling mills.



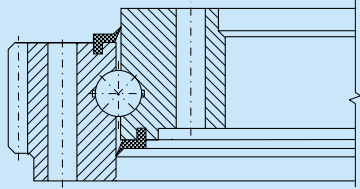
Slewing Rings with Crossed Rollers

Slewing rings with crossed rollers in standard design are compact double - ring bearings with cross arrangement of cylindrical rollers in the raceway between inner and outer ring. Cylindrical rollers are in most cases split by separators made of plastic, or by a compact or segment cage. Contact angle of the raceways is usually 45° . Bearings are delivered with clearance or preload, it depends on their utilization. Bearing rings have holes for fixing screws. Inner space is protected by seals against excessive grease leakage from bearing and penetration of macro - impurities into the bearing. They are produced with outer diameter from 300 to 2500 mm, with intenal or external gear, or without gear for arrangements of construction and earth machines, robots and manipulators, machine tools, cutter loaders, rotating shields, wind-power plants, and rotational furnaces.



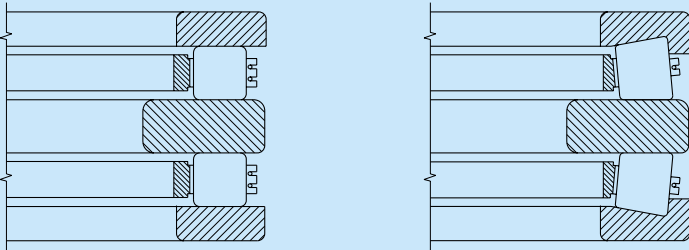
Slewing Ring with Balls

Bearings are suitable for both durably rotating equipments and for machines with a cyclical character of work having medium size e.g. excavators and cranes. For higher rotational speed bearings with compact or segment cage are produced. They have relatively low friction moment. Arrangement rigidity with the use of ball bearings is lower than by crossed roller bearings. Their contact angle is usually 45° . They are produced with outer diameter from 300 to 2650mm with internal or external gear, or without gear.



Double Direction Cylindrical Roller and Tapered Roller Thrust Bearings

Used for accommodation of great axial forces in rolling mill roller arrangements and also where great rigidity in axial direction is required, mainly in arrangement of vertical lathe tables.

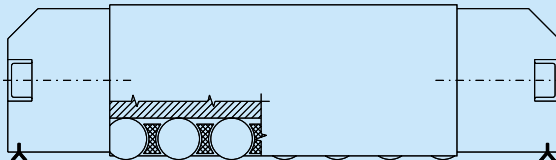


Linear Motion Roller Bearings (VVP)

These bearings are used where exact linear motion with small passive resistances and high rigidity of the system at relatively great loading forces is required. Linear motion roller bearings create a linear integrated arrangement unit with holes for fixing into the adjoining component and with wipers protecting functional surfaces against pollution.

The advantage of these linear motion roller bearings (except for small passive resistance) is their high rigidity, operation accuracy and load rating, continuous operation at low speeds (0.5mm min^{-1}).

These qualities enable the use of these rolling units in accurate machine tool and forming machines with numerical control.



More precise information concerning special bearings can be obtained in firms' publications.