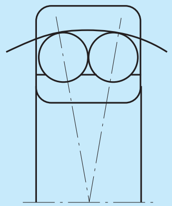
SELF-ALIGNING BALL BEARINGS

DESIGN, TYPES, AND FEATURES

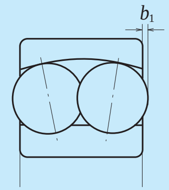
The outer ring has a spherical raceway and its center of curvature coincides with that of the bearing; therefore, the axis of the inner ring, balls and cage can deflect to some extent around the bearing center. This type is recommended when the alignment of the shaft and housing is difficult and when the shaft may bend. Since the contact angle is small, the axial load capacity is low.

Pressed steel cages are usually used.



PROTRUSION AMOUNT OF BALLS

Among self-aligning ball bearings, there are some in which the balls protrude from the side face as shown below. This protrusion amount b_1 is listed in the following table.



Bearing No.	b_1 (mm)
2222(K), 2316(K)	0.5
2319(K), 2320(K) 2321 , 2322(K)	0.5
1318(K)	1.5
1319(K)	2
1320(K), 1321 1322(K)	3

TOLERANCES AND RUNNING ACCURACY

TOLERANCES AND RUNNING ACCURACY ······ Table 8.2 (Pages A60 to A63)

RECOMMENDED FITS

RECOMMENDED FITS ······ Table 9.2 (Page A84)
Table 9.4 (Page A85)

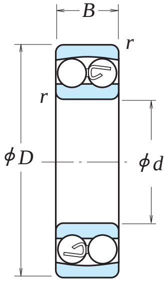
INTERNAL CLEARANCE

INTERNAL CLEARANCE ······ Table 9.12 (Page A90)

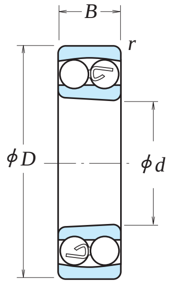
PERMISSIBLE MISALIGNMENT

The permissible misalignment of self-aligning ball bearings is approximately 0.07 to 0.12 radian (4° to 7°) under normal loads. However, depending on the surrounding structure, such an angle may not be possible. Use care in the structural design.

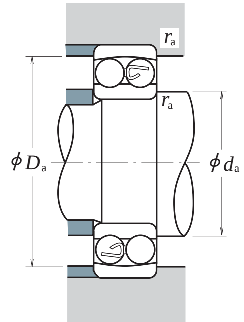
Bore Diameter 5 – 30 mm



Cylindrical Bore



Tapered Bore



Dynamic Equivalent Load

$P = XF_r + YF_a$

$F_a/F_r \leqq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.65	Y_2

Static Equivalent Load

$P_0 = F_r + Y_0 F_a$

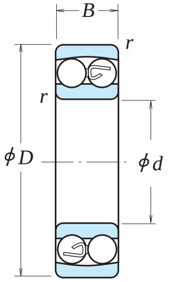
The values of e, Y_2, Y_3, and Y_0 are listed in the table below.

Boundary Dimensions (mm)				Basic Load Ratings (N)		{kgf}		Limiting Speeds (min⁻¹)		Bearing Numbers		Abutment and Fillet Dimensions (mm)			Constant	Axial Load Factors			Mass (kg)
d	D	B	r min.	C_r	C_{0r}	C_r	C_{0r}	Grease	Oil	Cylindrical Bore	Tapered Bore([1])	d_a min.	D_a max.	r_a max.	e	Y_2	Y_3	Y_0	approx.
5	19	6	0.3	2 530	475	258	49	30 000	36 000	**135**	—	7	17	0.3	0.34	2.9	1.9	1.9	0.009
6	19	6	0.3	2 530	475	258	49	30 000	36 000	**126**	—	8	17	0.3	0.34	2.9	1.9	1.9	0.008
7	22	7	0.3	2 750	600	280	61	26 000	32 000	**127**	—	9	20	0.3	0.31	3.1	2.0	2.1	0.013
8	22	7	0.3	2 750	600	280	61	26 000	32 000	**108**	—	10	20	0.3	0.31	3.1	2.0	2.1	0.016
9	26	8	0.6	4 150	895	425	91	26 000	30 000	**129**	—	13	22	0.6	0.32	3.1	2.0	2.1	0.021
10	30	9	0.6	5 550	1 190	570	121	22 000	28 000	**1200**	—	14	26	0.6	0.32	3.1	2.0	2.1	0.033
	30	14	0.6	7 450	1 590	760	162	24 000	28 000	**2200**	—	14	26	0.6	0.64	1.5	0.98	1.0	0.042
	35	11	0.6	7 350	1 620	750	165	20 000	24 000	**1300**	—	14	31	0.6	0.35	2.8	1.8	1.9	0.057
	35	17	0.6	9 200	2 010	935	205	18 000	22 000	**2300**	—	14	31	0.6	0.71	1.4	0.89	0.93	0.077
12	32	10	0.6	5 700	1 270	580	130	22 000	26 000	**1201**	—	16	28	0.6	0.36	2.7	1.8	1.8	0.039
	32	14	0.6	7 750	1 730	790	177	22 000	26 000	**2201**	—	16	28	0.6	0.58	1.7	1.1	1.1	0.048
	37	12	1	9 650	2 160	985	221	18 000	22 000	**1301**	—	17	32	1	0.33	2.9	1.9	2.0	0.066
	37	17	1	12 100	2 730	1 240	278	17 000	22 000	**2301**	—	17	32	1	0.60	1.6	1.1	1.1	0.082
15	35	11	0.6	7 600	1 750	775	179	18 000	22 000	**1202**	—	19	31	0.6	0.32	3.1	2.0	2.1	0.051
	35	14	0.6	7 800	1 850	795	188	18 000	22 000	**2202**	—	19	31	0.6	0.50	1.9	1.3	1.3	0.055
	42	13	1	9 700	2 290	990	234	16 000	20 000	**1302**	—	20	37	1	0.33	2.9	1.9	2.0	0.093
	42	17	1	12 300	2 910	1 250	296	14 000	18 000	**2302**	—	20	37	1	0.51	1.9	1.2	1.3	0.108
17	40	12	0.6	8 000	2 010	815	205	16 000	20 000	**1203**	—	21	36	0.6	0.31	3.1	2.0	2.1	0.072
	40	16	0.6	9 950	2 420	1 010	247	16 000	20 000	**2203**	—	21	36	0.6	0.50	1.9	1.3	1.3	0.085
	47	14	1	12 700	3 200	1 300	325	14 000	17 000	**1303**	—	22	42	1	0.32	3.1	2.0	2.1	0.13
	47	19	1	14 700	3 550	1 500	365	13 000	16 000	**2303**	—	22	42	1	0.51	1.9	1.2	1.3	0.15
20	47	14	1	10 000	2 610	1 020	266	14 000	17 000	**1204**	**1204 K**	25	42	1	0.29	3.4	2.2	2.3	0.12
	47	18	1	12 800	3 300	1 310	340	14 000	17 000	**2204**	**2204 K**	25	42	1	0.47	2.1	1.3	1.4	0.133
	52	15	1.1	12 600	3 350	1 280	340	12 000	15 000	**1304**	**1304 K**	26.5	45.5	1	0.29	3.4	2.2	2.3	0.165
	52	21	1.1	18 500	4 700	1 880	480	11 000	14 000	**2304**	**2304 K**	26.5	45.5	1	0.50	1.9	1.2	1.3	0.193
25	52	15	1	12 200	3 300	1 250	335	12 000	14 000	**1205**	**1205 K**	30	47	1	0.28	3.5	2.3	2.4	0.14
	52	18	1	12 400	3 450	1 270	350	12 000	14 000	**2205**	**2205 K**	30	47	1	0.41	2.4	1.5	1.6	0.15
	62	17	1.1	18 200	5 000	1 850	510	10 000	13 000	**1305**	**1305 K**	31.5	55.5	1	0.28	3.5	2.3	2.4	0.255
	62	24	1.1	24 900	6 600	2 530	675	9 500	12 000	**2305**	**2305 K**	31.5	55.5	1	0.47	2.1	1.4	1.4	0.319
30	62	16	1	15 800	4 650	1 610	475	10 000	12 000	**1206**	**1206 K**	35	57	1	0.25	3.9	2.5	2.6	0.22
	62	20	1	15 300	4 550	1 560	460	10 000	12 000	**2206**	**2206 K**	35	57	1	0.38	2.5	1.6	1.7	0.249
	72	19	1.1	21 400	6 300	2 190	645	8 500	11 000	**1306**	**1306 K**	36.5	65.5	1	0.26	3.7	2.4	2.5	0.385
	72	27	1.1	32 000	8 750	3 250	895	8 000	10 000	**2306**	**2306 K**	36.5	65.5	1	0.44	2.2	1.4	1.5	0.48

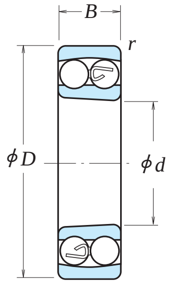
Note ([1]) The suffix K represents bearings with tapered bores (1 : 12)

Remarks For the dimensions related to adapters, refer to Page **B358**.

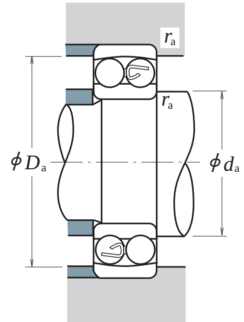
Bore Diameter 35 – 70 mm



Cylindrical Bore



Tapered Bore



Dynamic Equivalent Load

$P = XF_r + YF_a$

$F_a/F_r \leqq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.65	Y_2

Static Equivalent Load

$P_0 = F_r + Y_0 F_a$

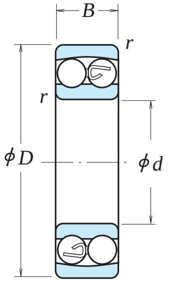
The values of e, Y_2, Y_3, and Y_0 are listed in the table below.

Boundary Dimensions (mm)				Basic Load Ratings (N)		{kgf}		Limiting Speeds (min⁻¹)		Bearing Numbers		Abutment and Fillet Dimensions (mm)			Constant	Axial Load Factors			Mass (kg)
d	D	B	r min.	C_r	C_{0r}	C_r	C_{0r}	Grease	Oil	Cylindrical Bore	Tapered Bore(1)	d_a min.	D_a max.	r_a max.	e	Y_2	Y_3	Y_0	approx.
35	72	17	1.1	15 900	5 100	1 620	520	8 500	10 000	**1207**	**1207 K**	41.5	65.5	1	0.23	4.2	2.7	2.8	0.32
	72	23	1.1	21 700	6 600	2 210	675	8 500	10 000	**2207**	**2207 K**	41.5	65.5	1	0.37	2.6	1.7	1.8	0.378
	80	21	1.5	25 300	7 850	2 580	800	7 500	9 500	**1307**	**1307 K**	43	72	1.5	0.26	3.8	2.5	2.6	0.51
	80	31	1.5	40 000	11 300	4 100	1 150	7 100	9 000	**2307**	**2307 K**	43	72	1.5	0.46	2.1	1.4	1.4	0.642
40	80	18	1.1	19 300	6 500	1 970	665	7 500	9 000	**1208**	**1208 K**	46.5	73.5	1	0.22	4.3	2.8	2.9	0.415
	80	23	1.1	22 400	7 350	2 290	750	7 500	9 000	**2208**	**2208 K**	46.5	73.5	1	0.33	3.0	1.9	2.0	0.477
	90	23	1.5	29 800	9 700	3 050	990	6 700	8 500	**1308**	**1308 K**	48	82	1.5	0.24	4.0	2.6	2.7	0.715
	90	33	1.5	45 500	13 500	4 650	1 380	6 300	8 000	**2308**	**2308 K**	48	82	1.5	0.43	2.3	1.5	1.5	0.889
45	85	19	1.1	22 000	7 350	2 240	750	7 100	8 500	**1209**	**1209 K**	51.5	78.5	1	0.21	4.7	3.0	3.1	0.465
	85	23	1.1	23 300	8 150	2 380	830	7 100	8 500	**2209**	**2209 K**	51.5	78.5	1	0.30	3.2	2.1	2.2	0.522
	100	25	1.5	38 500	12 700	3 900	1 300	6 000	7 500	**1309**	**1309 K**	53	92	1.5	0.25	4.0	2.6	2.7	0.955
	100	36	1.5	55 000	16 700	5 600	1 700	5 600	7 100	**2309**	**2309 K**	53	92	1.5	0.41	2.4	1.5	1.6	1.2
50	90	20	1.1	22 800	8 100	2 330	830	6 300	8 000	**1210**	**1210 K**	56.5	83.5	1	0.21	4.7	3.1	3.2	0.525
	90	23	1.1	23 300	8 450	2 380	865	6 300	8 000	**2210**	**2210 K**	56.5	83.5	1	0.28	3.4	2.2	2.3	0.564
	110	27	2	43 500	14 100	4 450	1 440	5 600	6 700	**1310**	**1310 K**	59	101	2	0.23	4.2	2.7	2.8	1.25
	110	40	2	65 000	20 200	6 650	2 060	5 000	6 300	**2310**	**2310 K**	59	101	2	0.42	2.3	1.5	1.6	1.58
55	100	21	1.5	26 900	10 000	2 750	1 020	6 000	7 100	**1211**	**1211 K**	63	92	1.5	0.20	4.9	3.2	3.3	0.705
	100	25	1.5	26 700	9 900	2 720	1 010	6 000	7 100	**2211**	**2211 K**	63	92	1.5	0.28	3.5	2.3	2.4	0.746
	120	29	2	51 500	17 900	5 250	1 820	5 000	6 300	**1311**	**1311 K**	64	111	2	0.23	4.2	2.7	2.8	1.6
	120	43	2	76 500	24 000	7 800	2 450	4 800	6 000	**2311**	**2311 K**	64	111	2	0.41	2.4	1.5	1.6	2.03
60	110	22	1.5	30 500	11 500	3 100	1 180	5 300	6 300	**1212**	**1212 K**	68	102	1.5	0.18	5.3	3.4	3.6	0.90
	110	28	1.5	34 000	12 600	3 500	1 290	5 300	6 300	**2212**	**2212 K**	68	102	1.5	0.28	3.5	2.3	2.4	1.03
	130	31	2.1	57 500	20 800	5 900	2 130	4 500	5 600	**1312**	**1312 K**	71	119	2	0.23	4.3	2.8	2.9	2.03
	130	46	2.1	88 500	28 300	9 000	2 880	4 300	5 300	**2312**	**2312 K**	71	119	2	0.40	2.4	1.6	1.6	2.57
65	120	23	1.5	31 000	12 500	3 150	1 280	4 800	6 000	**1213**	**1213 K**	73	112	1.5	0.17	5.7	3.7	3.8	1.15
	120	31	1.5	43 500	16 400	4 450	1 670	4 800	6 000	**2213**	**2213 K**	73	112	1.5	0.28	3.5	2.3	2.4	1.4
	140	33	2.1	62 500	22 900	6 350	2 330	4 300	5 300	**1313**	**1313 K**	76	129	2	0.23	4.2	2.7	2.9	2.54
	140	48	2.1	97 000	32 500	9 900	3 300	3 800	4 800	**2313**	**2313 K**	76	129	2	0.39	2.5	1.6	1.7	3.2
70	125	24	1.5	35 000	13 800	3 550	1 410	4 800	5 600	**1214**	—	78	117	1.5	0.18	5.3	3.4	3.6	1.3
	125	31	1.5	44 000	17 100	4 500	1 740	4 500	5 600	**2214**	—	78	117	1.5	0.26	3.7	2.4	2.5	1.52
	150	35	2.1	75 000	27 700	7 650	2 830	4 000	5 000	**1314**	—	81	139	2	0.22	4.4	2.8	3.0	3.19
	150	51	2.1	111 000	37 500	11 300	3 850	3 600	4 500	**2314**	—	81	139	2	0.38	2.6	1.7	1.8	3.9

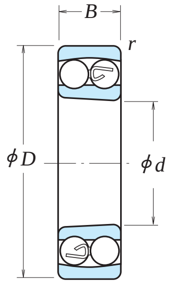
Note (1) The suffix K represents bearings with tapered bores (1 : 12)

Remarks For the dimensions related to adapters, refer to Page **B358** and **B359**.

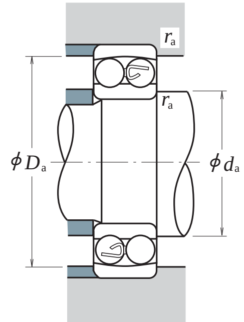
Bore Diameter 75 – 110 mm



Cylindrical Bore



Tapered Bore



Dynamic Equivalent Load

$P = XF_r + YF_a$

$F_a/F_r \leqq e$		$F_a/F_r > e$	
X	Y	X	Y
1	Y_3	0.65	Y_2

Static Equivalent Load

$P_0 = F_r + Y_0 F_a$

The values of e, Y_2, Y_3, and Y_0 are listed in the table below.

Boundary Dimensions (mm)				Basic Load Ratings (N)		Basic Load Ratings {kgf}		Limiting Speeds (min^{-1})		Bearing Numbers
d	D	B	r min.	C_r	C_{0r}	C_r	C_{0r}	Grease	Oil	Cylindrical Bore
75	130	25	1.5	39 000	15 700	4 000	1 600	4 300	5 300	**1215**
	130	31	1.5	44 500	17 800	4 550	1 820	4 300	5 300	**2215**
	160	37	2.1	80 000	30 000	8 150	3 050	3 800	4 500	**1315**
	160	55	2.1	125 000	43 000	12 700	4 400	3 400	4 300	**2315**
80	140	26	2	40 000	17 000	4 100	1 730	4 000	5 000	**1216**
	140	33	2	49 000	19 900	5 000	2 030	4 000	5 000	**2216**
	170	39	2.1	89 000	33 000	9 100	3 400	3 600	4 300	**1316**
	170	58	2.1	130 000	45 000	13 200	4 600	3 200	4 000	**∗ 2316**
85	150	28	2	49 500	20 800	5 050	2 120	3 800	4 500	**1217**
	150	36	2	58 500	23 600	5 950	2 400	3 800	4 800	**2217**
	180	41	3	98 500	38 000	10 000	3 850	3 400	4 000	**1317**
	180	60	3	142 000	51 500	14 500	5 250	3 000	3 800	**2317**
90	160	30	2	57 500	23 500	5 850	2 400	3 600	4 300	**1218**
	160	40	2	70 500	28 700	7 200	2 930	3 600	4 300	**2218**
	190	43	3	117 000	44 500	12 000	4 550	3 200	3 800	**∗ 1318**
	190	64	3	154 000	57 500	15 700	5 850	2 800	3 600	**2318**
95	170	32	2.1	64 000	27 100	6 550	2 770	3 400	4 000	**1219**
	170	43	2.1	84 000	34 500	8 550	3 500	3 400	4 000	**2219**
	200	45	3	129 000	51 000	13 200	5 200	3 000	3 600	**∗ 1319**
	200	67	3	161 000	64 500	16 400	6 550	2 800	3 400	**∗ 2319**
100	180	34	2.1	69 500	29 700	7 100	3 050	3 200	3 800	**1220**
	180	46	2.1	94 500	38 500	9 650	3 900	3 200	3 800	**2220**
	215	47	3	140 000	57 500	14 300	5 850	2 800	3 400	**∗ 1320**
	215	73	3	187 000	79 000	19 100	8 050	2 400	3 200	**∗ 2320**
105	190	36	2.1	75 000	32 500	7 650	3 300	3 000	3 600	**1221**
	190	50	2.1	109 000	45 000	11 100	4 550	3 000	3 600	**2221**
	225	49	3	154 000	64 500	15 700	6 600	2 600	3 200	**∗ 1321**
	225	77	3	200 000	87 000	20 400	8 850	2 400	3 000	**∗ 2321**
110	200	38	2.1	87 000	38 500	8 900	3 950	2 800	3 400	**1222**
	200	53	2.1	122 000	51 500	12 500	5 250	2 800	3 400	**∗ 2222**
	240	50	3	161 000	72 000	16 400	7 300	2 400	3 000	**∗ 1322**
	240	80	3	211 000	94 500	21 600	9 650	2 200	2 800	**∗ 2322**

Bearing Numbers	Abutment and Fillet Dimensions (mm)			Constant	Axial Load Factors			Mass (kg)
Tapered Bore([1])	d_a min.	D_a max.	r_a max.	e	Y_2	Y_3	Y_0	approx.
1215 K	83	122	1.5	0.17	5.6	3.6	3.8	1.41
2215 K	83	122	1.5	0.25	3.9	2.5	2.6	1.6
1315 K	86	149	2	0.22	4.4	2.8	2.9	3.65
2315 K	86	149	2	0.38	2.5	1.6	1.7	4.77
1216 K	89	131	2	0.16	6.0	3.9	4.1	1.73
2216 K	89	131	2	0.25	3.9	2.5	2.7	1.97
1316 K	91	159	2	0.22	4.5	2.9	3.1	4.31
∗ 2316 K	91	159	2	0.39	2.5	1.6	1.7	5.54
1217 K	94	141	2	0.17	5.7	3.7	3.8	2.09
2217 K	94	141	2	0.25	3.9	2.5	2.6	2.48
1317 K	98	167	2.5	0.21	4.6	2.9	3.1	5.13
2317 K	98	167	2.5	0.37	2.6	1.7	1.8	6.56
1218 K	99	151	2	0.17	5.8	3.8	3.9	2.55
2218 K	99	151	2	0.27	3.7	2.4	2.5	3.13
∗ 1318 K	103	177	2.5	0.22	4.3	2.8	2.9	5.94
2318 K	103	177	2.5	0.38	2.6	1.7	1.7	7.76
1219 K	106	159	2	0.17	5.8	3.7	3.9	3.21
2219 K	106	159	2	0.27	3.7	2.4	2.5	3.87
∗ 1319 K	108	187	2.5	0.23	4.3	2.8	2.9	6.84
∗ 2319 K	108	187	2.5	0.38	2.6	1.7	1.8	9.01
1220 K	111	169	2	0.17	5.6	3.6	3.8	3.82
2220 K	111	169	2	0.27	3.7	2.4	2.5	4.53
∗ 1320 K	113	202	2.5	0.24	4.1	2.7	2.8	8.46
∗ 2320 K	113	202	2.5	0.38	2.6	1.7	1.8	11.6
—	116	179	2	0.18	5.5	3.6	3.7	4.52
—	116	179	2	0.28	3.5	2.3	2.4	5.64
—	118	212	2.5	0.23	4.2	2.7	2.9	10
—	118	212	2.5	0.38	2.6	1.7	1.7	14.4
1222 K	121	189	2	0.17	5.7	3.7	3.9	5.33
∗ 2222 K	121	189	2	0.28	3.5	2.2	2.3	6.64
∗ 1322 K	123	227	2.5	0.22	4.4	2.8	3.0	12
∗ 2322 K	123	227	2.5	0.37	2.6	1.7	1.8	17.4

Notes ([1]) The suffix K represents bearings with tapered bores (1 : 12)

(∗) The balls of the bearings marked ∗ protrude slightly from the bearing face. The protrusion amounts are shown on Page **B77.**

Remarks For the dimensions related to adapters, refer to Pages **B360** and **B361**.