WBW BEARINGS

Self-Aligning Ball Bearing

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The outer ring raceway of self-aligning ball bearings forms a spherical surface whose center is common to the bearing center. The inner ring of the bearing has two raceways. The balls, cage, and inner ring of these bearings are capable of shifting in order to compensate for a certain degree of misalignment with the outer rings. As a result, the bearing is able to align itself and compensate for shaft / housing finishing unevenness, bearing fitting error, and other sources of misalignment as shown in Fig. 1. Since axial load capacity is limited, self-aligning ball bearing are not suitable for applications with heavy axial loads. It is recommended to use an adapter on a self-aligning ball bearing with a tapered bore inner diameter for ease of installation and disassembly. These bearings and adapters are often used on drive shaft applications.

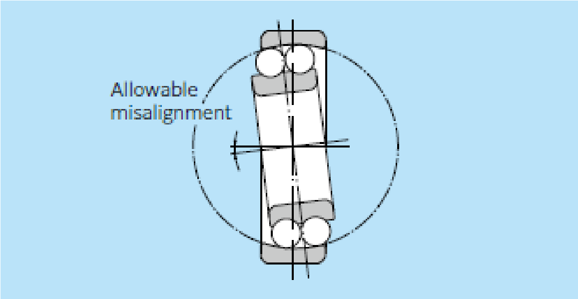

Fig. 1

Bearings with part numbers listed in Table 2 below have balls which protrude slightly from the bearing face as illustrated in Fig. 2. The total width dimensions are shown in Table 2. The allowable misalignment angle can be determined by the following function. This degree of allowable misalignment may be limited by the design of mating components around the bearing.

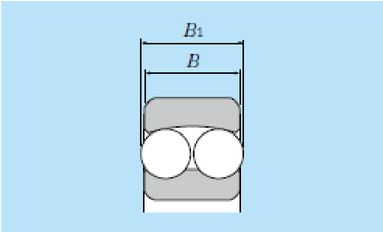

Fig. 2

Table 2

Unit: mm

Bearing numbers	Width dimension B	Total width dimension B_1
2222S (K)	53	54
2316S (K)	58	59
2319S (K)	67	68
2320S (K)	73	74
2321S	77	78
2322S (K)	80	81
1318S (K)	43	46
1319S (K)	45	49
1320S (K)	47	53
1321S	49	55
1322S (K)	50	56

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Tolerance suitable for self-aligning ball bearing:

Table 6.1 Bearing types and applicable tolerance

Bearing type		Applicable standard	Accuracy class					Tolerance table
Deep groove ball bearings		JIS B 1514-1 (ISO492)	Class 0	Class 6	Class 5	Class 4	Class 2	Table 6.4
Angular contact ball bearings			Class 0	Class 6	Class 5	Class 4	Class 2	
Self-aligning ball bearings			Class 0	—	—	—	—	
Cylindrical roller bearings			Class 0	Class 6	Class 5	Class 4	Class 2	
Needle roller bearings			Class 0	Class 6	Class 5	Class 4	—	
Self-aligning roller bearings			Class 0	—	—	—	—	
Tapered roller bearings	Metric series (single-row)	JIS B 1514	Class 0, 6X	Class 6[1)]	Class 5	Class 4	—	Table 6.5
	Metric series (double-row/four-row)	BAS1002	Class 0	—	—	—	—	Table 6.6
	Inch series	ANSI/ABMA Std.19	Class 4	Class 2	Class 3	Class 0	Class 00	Table 6.7
	J series	ANSI/ABMA Std.19.1	Class K	Class N	Class C	Class B	Class A	Table 6.8
Thrust ball bearings		JIS B 1514-2 (ISO199)	Class 0	Class 6	Class 5	Class 4	—	Table 6.9
Spherical roller thrust bearings			Class 0	—	—	—	—	Table 6.10

Table 8.9 Radial internal clearance of self-aligning ball bearings

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

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Parameters you often see on a bearing or bearing spare part drawings:

Terms	Quantifiers	Description
Nominal bore diameter	*d*	Reference dimension representing the bore diameter size, and reference value with respect to the dimensional difference of the actual bore diameter surface.
Single bore diameter	*d*s	Distance between two parallel straight lines that are in contact with the intersection line of the actual bearing bore diameter surface and the radial plane.
Deviation of a single bore diameter	Δ *d*s	Difference between *d*s and *d* (difference of nominal diameter serving as the measured bore and standard).
Mean bore diameter in a single plane	*d*mp	Arithmetic mean of the maximum and minimum measured bore diameters within one radial plane. In the model figure, in arbitrary radial plane A*i*, when the maximum bore diameter is *dsi*1 and the minimum bore diameter is *dsi*3, the value is obtained by (*dsi*1 + *dsi*3)/2. There is one value for each plane.
Mean bore diameter	*d*m	Arithmetic mean of the maximum and minimum measured bore diameters obtained from all the cylindrical surfaces. In the model figure, when the maximum measured bore diameter is *d*s11 and the minimum measured bore diameter is *d*s23, which are obtained from the all the planes A1, A2,…Ai, the mean bore diameter is obtained by (*d*s11 + *d*s23)/2. There is one value for one cylindrical surface.
Deviation of mean bore diameter	Δ *d*m	Difference between the mean bore diameter and the nominal bore diameter.
Deviation of mean bore diameter in a single plane	Δ *d*mp	Difference between the arithmetic mean and the nominal bore diameter of the maximum and minimum measured bore diameters within one radial plane. The value is specified in JIS.
Variation of bore diameter in a single plane	*Vd*sp	Difference between the maximum and minimum measured bore diameters within one radial plane. In the model figure, in radial plane A1, when the maximum measured bore diameter is *d*s11 and the minimum measured bore diameter is *d*s13, the difference is *Vd*sp and one value can be obtained for one plane. This characteristic is an index that indicates the roundness. The value is specified in JIS.

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Variation of mean bore diameter	*Vd*mp	Difference between the maximum and minimum values of the mean bore diameter within a plane that are obtained from all the planes. A unique value is obtained for each product, and it is near to cylindricity (that is different from geometric cylindricity). The value is specified in JIS.
Nominal inner ring width	*B*	Distance between both theoretical side surfaces of a raceway. This value is a reference dimension that represents the raceway surface (distance between both side surfaces).
Single inner ring width	*B*s	Distance between two intersections. The straight is perpendicular to the plane that is in contact with the inner ring reference side and both actual side surfaces. This value represents the actual width dimension of an inner ring.
Deviation of a single inner ring width	Δ *B*s	Difference between the measured inner ring width and the nominal inner ring width. This value is also the difference between the measured inner ring width dimension and the reference dimension that represents the inner ring width. The value is specified in JIS.
Variation of inner ring width	*VB*s	Difference between the maximum and minimum measured inner ring widths, which are specified in JIS.
Radial runout of inner ring of assembled bearing	*K*ia	Difference between the maximum and minimum values of the radial distance between the inner ring bore diameter at each angle position and one fixed point of the outer ring outer diameter surface with respect to radial runout.
Axial runout of inner ring of assembled bearing	*S*ia	Difference between the maximum and minimum values of the axial distance between the inner ring reference side surface at each angle position and one fixed point of the outer ring outer diameter surface with respect to half the radial distance of the raceway contact diameter from the inner ring central axis and the inner ring of a deep groove ball bearing.

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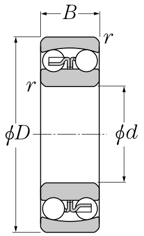
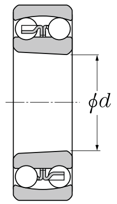
Bearing Damage and Cause

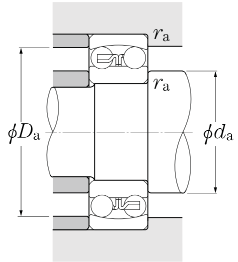
Bearing damage	Damaged parts	Causes														
		Handling		Bearing periphery			Lubrication		Load			Speed			Bearing selection	
		Poor storage condition/ vibration during transportation	Improper handling/ installation	Insufficient accuracy of shaft/housing	Infiltration of bearing by foreign matter (insufficient sealing performance)	Temperature (heat effect)	Lubricant (insufficient/ improper quality)	Lubrication method (insufficient)	Excessively large impact load/preload	Excessively large moment	Excessively small load	High speed/ rapid acceleration and deceleration	Large vibration	Swinging/vibration/ standstill	Excessively large/ small clearance	Excessively large/ small interference
Flaking (separation)	Raceway surface/ rolling element surface		○	○	○	○	○	○	○	○					○	
Seizure	Raceway/ rolling element/cage		○			○	○	○	○	○		○			○	
Cracks/chips	Raceway/rolling element		○	○			○		○	○						○
Cage damage	Rivets break or become loose		○		○		○	○	○	○		○	○			
Rolling path skewing	Raceway surface		○	○											○	
Smearing/ scuffing	Raceway surface/ rolling element surface/ rib surface/ roller end surface		○		○		○	○	○		○					
Rust/ corrosion	Rust on a part of or the entire surface of the rolling element pitch	○	○		○		○	○								
Fretting	Red rust on fitting surface		○						○				○			
	Brinelling indentations form on the raceway of the rolling element pitch	○					○	○						○		○
Wear	Raceway surface/ rolling element surface/ rib surface/ roller end surface		○		○		○	○								
Electrolytic corrosion	Pits form on the raceway. The pits gradually grow into ripples.		○													
Dents and scratches	Raceway surface/ rolling element surface		○		○				○	○						
Creeping	Fitting surface		○	○		○			○							○
Speckles and discoloration	Raceway surface/ rolling element surface				○		○	○								
Peeling	Raceway surface/ rolling element surface				○		○	○								



Cylindrical bore



Tapered bore



d 10 ～ 35mm

Boundary dimensions (mm) d	D	B	$r_{s\,min}$ 1)	Basic load rating dynamic (kN) C_r	static (kN) C_{0r}	Fatigue load limit (kN) C_u	Allowable speed (min⁻¹) Grease lubrication	Oil lubrication	Bearing numbers Cylindrical bore	Tapered bore 2)	Installation-related dimensions (mm) d_a Min.	D_a Max.	r_{as} Max.
10	30	9	0.6	5.55	1.19	0.049	22 000	28 000	**1200S**	—	14.0	26.0	0.6
	30	14	0.6	7.45	1.59	0.067	24 000	28 000	**2200S**	—	14.0	26.0	0.6
	35	11	0.6	7.35	1.62	0.074	20 000	24 000	**1300S**	—	14.0	31.0	0.6
	35	17	0.6	9.20	2.01	0.096	18 000	22 000	**2300S**	—	14.0	31.0	0.6
12	32	10	0.6	5.70	1.27	0.053	22 000	26 000	**1201S**	—	16.0	28.0	0.6
	32	14	0.6	7.75	1.73	0.089	22 000	26 000	**2201S**	—	16.0	28.0	0.6
	37	12	1	9.65	2.16	0.078	18 000	22 000	**1301S**	—	17.0	32.0	1
	37	17	1	12.1	2.73	0.120	17 000	22 000	**2301S**	—	17.0	32.0	1
15	35	11	0.6	7.60	1.75	0.072	18 000	22 000	**1202S**	—	19.0	31.0	0.6
	35	14	0.6	7.80	1.85	0.095	18 000	22 000	**2202S**	—	19.0	31.0	0.6
	42	13	1	9.70	2.29	0.081	16 000	20 000	**1302S**	—	20.0	37.0	1
	42	17	1	12.3	2.91	0.130	14 000	18 000	**2302S**	—	20.0	37.0	1
17	40	12	0.6	8.00	2.01	0.083	16 000	20 000	**1203S**	—	21.0	36.0	0.6
	40	16	0.6	9.95	2.42	0.130	16 000	20 000	**2203S**	—	21.0	36.0	0.6
	47	14	1	12.7	3.20	0.110	14 000	17 000	**1303S**	—	22.0	42.0	1
	47	19	1	14.7	3.55	0.160	13 000	16 000	**2303S**	—	22.0	42.0	1
20	47	14	1	10.0	2.61	0.110	14 000	17 000	**1204S**	**1204SK**	25.0	42.0	1
	47	18	1	12.8	3.30	0.140	14 000	17 000	**2204S**	**2204SK**	25.0	42.0	1
	52	15	1.1	12.6	3.35	0.140	12 000	15 000	**1304S**	**1304SK**	26.5	45.5	1
	52	21	1.1	18.5	4.70	0.210	11 000	14 000	**2304S**	**2304SK**	26.5	45.5	1
25	52	15	1	12.2	3.30	0.130	12 000	14 000	**1205S**	**1205SK**	30.0	47.0	1
	52	18	1	12.4	3.45	0.200	12 000	14 000	**2205S**	**2205SK**	30.0	47.0	1
	62	17	1.1	18.2	5.00	0.150	10 000	13 000	**1305S**	**1305SK**	31.5	55.5	1
	62	24	1.1	24.9	6.60	0.290	9 500	12 000	**2305S**	**2305SK**	31.5	55.5	1
30	62	16	1	15.8	4.65	0.190	10 000	12 000	**1206S**	**1206SK**	35.0	57.0	1
	62	20	1	15.3	4.55	0.260	10 000	12 000	**2206S**	**2206SK**	35.0	57.0	1
	72	19	1.1	21.4	6.30	0.190	8 500	11 000	**1306S**	**1306SK**	36.5	65.5	1
	72	27	1.1	32.0	8.75	0.380	8 000	10 000	**2306S**	**2306SK**	36.5	65.5	1
35	72	17	1.1	15.9	5.10	0.210	8 500	10 000	**1207S**	**1207SK**	41.5	65.5	1
	72	23	1.1	21.7	6.60	0.320	8 500	10 000	**2207S**	**2207SK**	41.5	65.5	1
	80	21	1.5	25.3	7.85	0.280	7 500	9 500	**1307S**	**1307SK**	43.0	72.0	1.5
	80	31	1.5	40.0	11.3	0.480	7 100	9 000	**2307S**	**2307SK**	43.0	72.0	1.5

1) Smallest allowable dimension for chamfer dimension *r*. 2) "**K**" indicates bearings having a tapered bore with a taper ratio of 1:12

Dynamic equivalent radial load

$P_r = XF_r + YF_a$

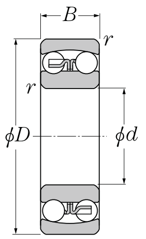
$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.65	Y_2

Static equivalent radial load

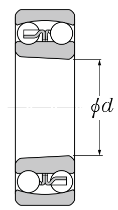
$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

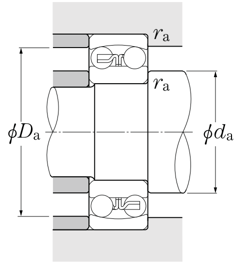
Constant e	Axial load factors Y_1	Y_2	Y_0	Mass (kg) (approx.)
0.32	2.00	3.10	2.10	0.034
0.64	0.98	1.50	1.00	0.046
0.35	1.80	2.80	1.90	0.059
0.71	0.89	1.40	0.93	0.078
0.36	1.80	2.70	1.80	0.041
0.58	1.10	1.70	1.10	0.051
0.33	1.90	2.90	2.00	0.068
0.60	1.10	1.60	1.10	0.087
0.32	2.00	3.10	2.10	0.050
0.50	1.30	1.90	1.30	0.058
0.33	1.90	2.90	2.00	0.101
0.51	1.20	1.90	1.30	0.113
0.31	2.00	3.10	2.10	0.074
0.50	1.30	1.90	1.30	0.089
0.32	2.00	3.10	2.10	0.130
0.51	1.20	1.90	1.30	0.160
0.29	2.20	3.40	2.30	0.120
0.47	1.30	2.10	1.40	0.142
0.29	2.20	3.40	2.30	0.164
0.50	1.20	1.90	1.30	0.207
0.28	2.30	3.50	2.40	0.140
0.41	1.50	2.40	1.60	0.160
0.28	2.30	3.50	2.40	0.261
0.47	1.40	2.10	1.40	0.332
0.25	2.50	3.90	2.60	0.220
0.38	1.60	2.50	1.70	0.262
0.26	2.40	3.70	2.50	0.391
0.44	1.40	2.20	1.50	0.500
0.23	2.70	4.20	2.80	0.330
0.37	1.70	2.60	1.80	0.403
0.26	2.50	3.80	2.60	0.520
0.46	1.40	2.10	1.40	0.671



Cylindrical bore



Tapered bore



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Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.65	Y_2

Static equivalent radial load

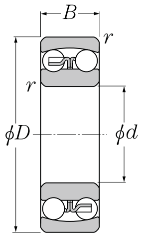
$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

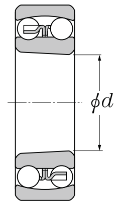
d 40 ～ 75mm

Boundary dimensions (mm)				Basic load rating (kN)		Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers		Installation-related dimensions (mm)			Constant	Axial load factors			Mass (kg)
d	D	B	$r_{s\,min}$ 1)	dynamic C_r	static C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore 2)	d_a Min.	D_a Max.	r_{as} Max.	e	Y_1	Y_2	Y_0	(approx.)
40	80	18	1.1	19.3	6.50	0.260	7 500	9 000	**1208S**	**1208SK**	46.5	73.5	1	0.22	2.8	4.3	2.9	0.420
	80	23	1.1	22.4	7.35	0.390	7 500	9 000	**2208S**	**2208SK**	46.5	73.5	1	0.33	1.9	3.0	2.0	0.506
	90	23	1.5	29.8	9.70	0.300	6 700	8 500	**1308S**	**1308SK**	48.0	82.0	1.5	0.24	2.6	4.0	2.7	0.727
	90	33	1.5	45.5	13.5	0.580	6 300	8 000	**2308S**	**2308SK**	48.0	82.0	1.5	0.43	1.5	2.3	1.5	0.918
45	85	19	1.1	22.0	7.35	0.290	7 100	8 500	**1209S**	**1209SK**	51.5	78.5	1	0.21	3.0	4.7	3.1	0.470
	85	23	1.1	23.3	8.15	0.510	7 100	8 500	**2209S**	**2209SK**	51.5	78.5	1	0.30	2.1	3.2	2.2	0.556
	100	25	1.5	38.5	12.7	0.330	6 000	7 500	**1309S**	**1309SK**	53.0	92.0	1.5	0.25	2.6	4.0	2.7	0.971
	100	36	1.5	55.0	16.7	0.710	5 600	7 100	**2309S**	**2309SK**	53.0	92.0	1.5	0.41	1.5	2.4	1.6	1.200
50	90	20	1.1	22.8	8.10	0.330	6 300	8 000	**1210S**	**1210SK**	56.5	83.5	1	0.21	3.1	4.7	3.2	0.535
	90	23	1.1	23.3	8.45	0.570	6 300	8 000	**2210S**	**2210SK**	56.5	83.5	1	0.28	2.2	3.4	2.3	0.598
	110	27	2	43.5	14.1	0.350	5 600	6 700	**1310S**	**1310SK**	59.0	101	2	0.23	2.7	4.2	2.8	1.230
	110	40	2	65.0	20.2	0.860	5 000	6 300	**2310S**	**2310SK**	59.0	101	2	0.42	1.5	2.3	1.6	1.630
55	100	21	1.5	26.9	10.0	0.400	6 000	7 100	**1211S**	**1211SK**	63.0	92.0	1.5	0.20	3.2	4.9	3.3	0.708
	100	25	1.5	26.7	9.90	0.720	6 000	7 100	**2211S**	**2211SK**	63.0	92.0	1.5	0.28	2.3	3.5	2.4	0.807
	120	29	2	51.5	17.9	0.400	5 000	6 300	**1311S**	**1311SK**	64.0	111	2	0.23	2.7	4.2	2.8	1.600
	120	43	2	76.5	24.0	1.00	4 800	6 000	**2311S**	**2311SK**	64.0	111	2	0.41	1.5	2.4	1.6	2.080
60	110	22	1.5	30.5	11.5	0.460	5 300	6 300	**1212S**	**1212SK**	68.0	102	1.5	0.18	3.4	5.3	3.6	0.910
	110	28	1.5	34.0	12.6	0.840	5 300	6 300	**2212S**	**2212SK**	68.0	102	1.5	0.28	2.3	3.5	2.4	1.100
	130	31	2.1	57.5	20.8	0.510	4 500	5 600	**1312S**	**1312SK**	71.0	119	2	0.23	2.8	4.3	2.9	2.000
	130	46	2.1	88.5	28.3	1.20	4 300	5 300	**2312S**	**2312SK**	71.0	119	2	0.40	1.6	2.4	1.6	2.580
65	120	23	1.5	31.0	12.5	0.500	4 800	6 000	**1213S**	**1213SK**	73.0	112	1.5	0.17	3.7	5.7	3.8	1.160
	120	31	1.5	43.5	16.4	0.920	4 800	6 000	**2213S**	**2213SK**	73.0	112	1.5	0.28	2.3	3.5	2.4	1.500
	140	33	2.1	62.5	22.9	0.670	4 300	5 300	**1313S**	**1313SK**	76.0	129	2	0.23	2.7	4.2	2.9	2.470
	140	48	2.1	97.0	32.5	1.40	3 800	4 800	**2313S**	**2313SK**	76.0	129	2	0.39	1.6	2.5	1.7	3.200
70	125	24	1.5	35.0	13.8	0.550	4 800	5 600	**1214S**	—	78.0	117	1.5	0.18	3.4	5.3	3.6	1.300
	125	31	1.5	44.0	17.1	1.10	4 500	5 600	**2214S**	—	78.0	117	1.5	0.26	2.4	3.7	2.5	1.550
	150	35	2.1	75.0	27.7	0.690	4 000	5 000	**1314S**	—	81.0	139	2	0.22	2.8	4.4	3.0	3.030
	150	51	2.1	111	37.5	1.60	3 600	4 500	**2314S**	—	81.0	139	2	0.38	1.7	2.6	1.8	3.900
75	130	25	1.5	39.0	15.7	0.630	4 300	5 300	**1215S**	**1215SK**	83.0	122	1.5	0.17	3.6	5.6	3.8	1.360
	130	31	1.5	44.5	17.8	1.20	4 300	5 300	**2215S**	**2215SK**	83.0	122	1.5	0.25	2.5	3.9	2.6	1.600
	160	37	2.1	80.0	30.0	0.720	3 800	4 500	**1315S**	**1315SK**	86.0	149	2	0.22	2.8	4.4	2.9	3.630
	160	55	2.1	125	43.0	1.80	3 400	4 300	**2315S**	**2315SK**	86.0	149	2	0.38	1.6	2.5	1.7	4.780

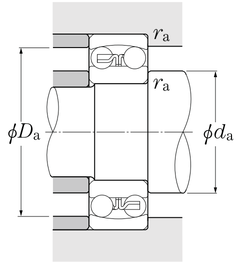
1) Smallest allowable dimension for chamfer dimension r. 2) "**K**" indicates bearings having a tapered bore with a taper ratio of 1:12



Cylindrical bore



Tapered bore



Dynamic equivalent radial load

$P_r = XF_r + YF_a$

$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
X	Y	X	Y
1	Y_1	0.65	Y_2

Static equivalent radial load

$P_{0r} = F_r + Y_0 F_a$

For values of e, Y_1, Y_2 and Y_0 see the table below.

d 80 ~ 110mm

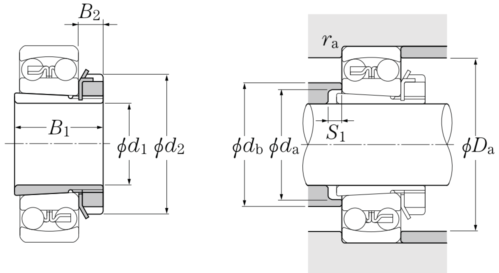
Boundary dimensions (mm)				Basic load rating (kN) dynamic	static	Fatigue load limit (kN)	Allowable speed (min⁻¹)		Bearing numbers		Installation-related dimensions (mm)			Constant	Axial load factors			Mass (kg)
d	D	B	$r_{s\,min}$ [1]	C_r	C_{0r}	C_u	Grease lubrication	Oil lubrication	Cylindrical bore	Tapered bore[2]	d_a Min.	D_a Max.	r_{as} Max.	e	Y_1	Y_2	Y_0	(approx.)
80	140	26	2	40.0	17.0	0.680	4 000	5 000	**1216S**	**1216SK**	89	131	2	0.16	3.9	6.0	4.1	1.68
	140	33	2	49.0	19.9	1.30	4 000	5 000	**2216S**	**2216SK**	89	131	2	0.25	2.5	3.9	2.7	2.02
	170	39	2.1	89.0	33.0	0.800	3 600	4 300	**1316S**	**1316SK**	91	159	2	0.22	2.9	4.5	3.1	4.24
	170	58	2.1	130	45.0	1.90	3 200	4 000	**2316S**	**2316SK**	91	159	2	0.39	1.6	2.5	1.7	5.63
85	150	28	2	49.5	20.8	0.830	3 800	4 500	**1217S**	**1217SK**	94	141	2	0.17	3.7	5.7	3.8	2.10
	150	36	2	58.5	23.6	1.50	3 800	4 800	**2217S**	**2217SK**	94	141	2	0.25	2.5	3.9	2.6	2.56
	180	41	3	98.5	38.0	0.950	3 400	4 000	**1317S**	**1317SK**	98	167	2.5	0.21	2.9	4.6	3.1	5.03
	180	60	3	142	51.5	2.10	3 000	3 800	**2317S**	**2317SK**	98	167	2.5	0.37	1.7	2.6	1.8	6.56
90	160	30	2	57.5	23.5	0.940	3 600	4 300	**1218S**	**1218SK**	99	151	2	0.17	3.8	5.8	3.9	2.56
	160	40	2	70.5	28.7	1.80	3 600	4 300	**2218S**	**2218SK**	99	151	2	0.27	2.4	3.7	2.5	3.22
	190	43	3	117	44.5	1.20	3 200	3 800	**1318S**	**1318SK**	103	177	2.5	0.22	2.8	4.3	2.9	5.83
	190	64	3	154	57.5	2.40	2 800	3 600	**2318S**	**2318SK**	103	177	2.5	0.38	1.7	2.6	1.7	7.75
95	170	32	2.1	64.0	27.1	1.10	3 400	4 000	**1219S**	**1219SK**	106	159	2	0.17	3.7	5.8	3.9	3.12
	170	43	2.1	84.0	34.5	2.00	3 400	4 000	**2219S**	**2219SK**	106	159	2	0.27	2.4	3.7	2.5	3.96
	200	45	3	129	51.0	1.40	3 000	3 600	**1319S**	**1319SK**	108	187	2.5	0.23	2.8	4.3	2.9	6.79
	200	67	3	161	64.5	2.70	2 800	3 400	**2319S**	**2319SK**	108	187	2.5	0.38	1.7	2.6	1.8	8.97
100	180	34	2.1	69.5	29.7	1.20	3 200	3 800	**1220S**	**1220SK**	111	169	2	0.17	3.6	5.6	3.8	3.74
	180	46	2.1	94.5	38.5	2.30	3 200	3 800	**2220S**	**2220SK**	111	169	2	0.27	2.4	3.7	2.5	4.71
	215	47	3	140	57.5	1.60	2 800	3 400	**1320S**	**1320SK**	113	202	2.5	0.24	2.7	4.1	2.8	8.40
	215	73	3	187	79.0	3.30	2 400	3 200	**2320S**	**2320SK**	113	202	2.5	0.38	1.7	2.6	1.8	11.5
105	190	36	2.1	75.0	32.5	1.30	3 000	3 600	**1221S**	—	116	179	2	0.18	3.6	5.5	3.7	4.43
	190	50	2.1	109	45.0	2.60	3 000	3 600	**2221S**	—	116	179	2	0.28	2.3	3.5	2.4	5.73
	225	49	3	154	64.5	1.80	2 600	3 200	**1321S**	—	118	212	2.5	0.23	2.7	4.2	2.9	9.58
	225	77	3	200	87.0	3.60	2 400	3 000	**2321S**[3]	—	118	212	2.5	0.38	1.7	2.6	1.7	14.5
110	200	38	2.1	87.0	38.5	1.50	2 800	3 400	**1222S**	**1222SK**	121	189	2	0.18	3.7	5.7	3.9	5.21
	200	53	2.1	122	51.5	2.90	2 800	3 400	**2222S**	**2222SK**	121	189	2	0.28	2.2	3.5	2.3	6.75
	240	50	3	161	72.5	2.10	2 400	3 000	**1322S**	**1322SK**	123	227	2.5	0.22	2.8	4.4	3.0	11.5
	240	80	3	211	94.5	3.90	2 200	2 800	**2322S**[3]	**2322SK**	123	227	2.5	0.37	1.7	2.6	1.8	17.5

1) Smallest allowable dimension for chamfer dimension r. 2) "K" indicates bearings having a tapered bore with a taper ratio of 1:12.
3) A machined cage is the standard for 2321S and 2322S(K).

Adapters

WBW

(For self-aligning ball bearings)



d 17 ～ 50mm

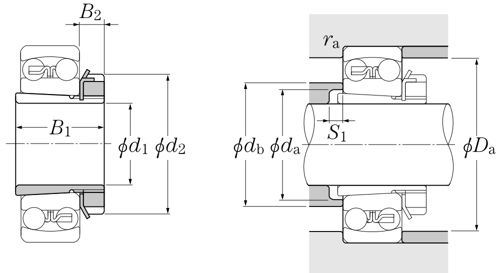
Boundary dimensions (mm)				Numbers		Installation-related dimensions (mm)					Mass[1] kg
d_1	B_1	d_2	B_2	Bearing	Adapter	d_a Min.	d_b Max.	S_1 Min.	D_a Max.	r_{as} Max.	(approx.)
17	24	32	7	1204SK;	**H 204**	23	27	5	41	1	0.041
	28	32	7	2204SK;	**H 304**	24	28	5	41	1	0.045
	28	32	7	1304SK;	**H 304**	24	31	8	45	1	0.045
	31	32	7	2304SK;	**H2304**	24	28	5	45	1	0.049
20	26	38	8	1205SK;	**H 205X**	28	33	5	46	1	0.07
	29	38	8	2205SK;	**H 305X**	29	33	5	46	1	0.075
	29	38	8	1305SK;	**H 305X**	29	37	6	55	1	0.075
	35	38	8	2305SK;	**H2305X**	29	34	5	55	1	0.087
25	27	45	8	1206SK;	**H 206X**	33	39	5	56	1	0.099
	31	45	8	2206SK;	**H 306X**	34	39	5	56	1	0.109
	31	45	8	1306SK;	**H 306X**	34	44	6	65	1	0.109
	38	45	8	2306SK;	**H2306X**	35	40	5	65	1	0.126
30	29	52	9	1207SK;	**H 207X**	38	46	5	65	1	0.125
	35	52	9	2207SK;	**H 307X**	39	45	5	65	1	0.142
	35	52	9	1307SK;	**H 307X**	39	50	7	71.5	1.5	0.142
	43	52	9	2307SK;	**H2307X**	40	46	5	71.5	1.5	0.165
35	31	58	10	1208SK;	**H 208X**	44	52	5	73	1	0.174
	36	58	10	2208SK;	**H 308X**	44	50	5	73	1	0.189
	36	58	10	1308SK;	**H 308X**	44	56	5	81.5	1.5	0.189
	46	58	10	2308SK;	**H2308X**	45	52	5	81.5	1.5	0.224
40	33	65	11	1209SK;	**H 209X**	49	57	5	78	1	0.227
	39	65	11	2209SK;	**H 309X**	49	57	8	78	1	0.248
	39	65	11	1309SK;	**H 309X**	49	61	5	91.5	1.5	0.248
	50	65	11	2309SK;	**H2309X**	50	58	5	91.5	1.5	0.28
45	35	70	12	1210SK;	**H 210X**	53	62	5	83	1	0.274
	42	70	12	2210SK;	**H 310X**	54	63	10	83	1	0.303
	42	70	12	1310SK;	**H 310X**	54	67	5	100	2	0.303
	55	70	12	2310SK;	**H2310X**	56	65	5	100	2	0.362
50	37	75	12	1211SK;	**H 211X**	60	70	6	91.5	1.5	0.308

1) Indicates adapter mass.
Note: 1. Refer to pages B-82 to B-85 for bearing dimensions, basic rated loads, and mass.
2. Adapters for series 12 bearings can also be used with H2 and H3 series bearings. Caution: the B_1 dimension of H3 series bearings is longer than that of H2 series bearings.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.
4. Refer to pages D-2 to D-7 and D-12 to D-14 for adapter locknut and washer dimensions.

Adapters

WBW

(For self-aligning ball bearings)



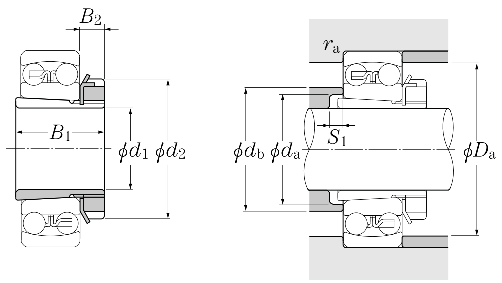
d 50 ～ 85mm

Boundary dimensions (mm)				Numbers		Installation-related dimensions (mm)					Mass[1] kg
d_1	B_1	d_2	B_2	Bearing	Adapter	d_a Min.	d_b Max.	S_1 Min.	D_a Max.	r_{as} Max.	(approx.)
50	45	75	12	2211SK;	**H 311X**	60	69	11	91.5	1.5	0.345
	45	75	12	1311SK;	**H 311X**	60	73	6	110	2	0.345
	59	75	12	2311SK;	**H2311X**	61	71	6	110	2	0.42
55	38	80	13	1212SK;	**H 212X**	64	76	5	101.5	1.5	0.346
	47	80	13	2212SK;	**H 312X**	65	75	9	101.5	1.5	0.394
	47	80	13	1312SK;	**H 312X**	65	79	5	118	2	0.394
	62	80	13	2312SK;	**H2312X**	66	77	5	118	2	0.481
60	40	85	14	1213SK;	**H 213X**	70	83	5	111.5	1.5	0.401
	50	85	14	2213SK;	**H 313X**	70	81	8	111.5	1.5	0.458
	50	85	14	1313SK;	**H313X**	70	85	5	128	2	0.458
	65	85	14	2313SK;	**H2313X**	72	84	5	128	2	0.557
65	43	98	15	1215SK;	**H 215X**	80	93	5	121.5	1.5	0.707
	55	98	15	2215SK;	**H 315X**	80	93	12	121.5	1.5	0.831
	55	98	15	1315SK;	**H 315X**	80	97	5	148	2	0.831
	73	98	15	2315SK;	**H2315X**	82	96	5	148	2	1.05
70	46	105	17	1216SK;	**H 216X**	85	100	5	130	2	0.882
	59	105	17	2216SK;	**H 316X**	86	98	12	130	2	1.03
	59	105	17	1316SK;	**H 316X**	86	103	5	158	2	1.03
	78	105	17	2316SK;	**H2316X**	87	103	5	158	2	1.28
75	50	110	18	1217SK;	**H 217X**	90	106	6	140	2	1.02
	63	110	18	2217SK;	**H 317X**	91	104	12	140	2	1.18
	63	110	18	1317SK;	**H 317X**	91	110	6	166	2.5	1.18
	82	110	18	2317SK;	**H2317X**	94	110	6	166	2.5	1.45
80	52	120	18	1218SK;	**H 218X**	95	111	6	150	2	1.19
	65	120	18	2218SK;	**H 318X**	96	112	10	150	2	1.37
	65	120	18	1318SK;	**H 318X**	96	116	6	176	2.5	1.37
	86	120	18	2318SK;	**H2318X**	99	117	6	176	2.5	1.69
85	55	125	19	1219SK;	**H 219X**	101	118	7	158	2	1.37
	68	125	19	2219SK;	**H 319X**	102	117	9	158	2	1.56

1) Indicates adapter mass.
Note: 1. Refer to pages B-84 to B-87 for bearing dimensions, basic rated loads, and mass.
2. Adapters for series 12 bearings can also be used with H2 and H3 series bearings. Caution: the B_1 dimension of H3 series bearings is longer than that of H2 series bearings.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.
4. Refer to pages D-2 to D-7 and D-12 to D-14 for adapter locknut and washer dimensions.

Adapters

(For self-aligning ball bearings)



d 85 ～ 100mm

Boundary dimensions (mm)				Numbers		Installation-related dimensions (mm)					Mass[1)] (kg)
d_1	B_1	d_2	B_2	Bearing	Adapter	d_a Min.	d_b Max.	S_1 Min.	D_a Max.	r_{as} Max.	(approx.)
85	68	125	19	1319SK;	**H 319X**	102	123	7	186	2.5	1.56
	90	125	19	2319SK;	**H2319X**	105	123	7	186	2.5	1.92
90	58	130	20	1220SK;	**H 220X**	106	125	7	168	2	1.49
	71	130	20	2220SK;	**H 320X**	107	123	8	168	2	1.69
	71	130	20	1320SK;	**H 320X**	107	130	7	201	2.5	1.69
	97	130	20	2320SK;	**H2320X**	110	129	7	201	2.5	2.15
100	63	145	21	1222SK;	**H 222X**	116	138	7	188	2	1.93
	77	145	21	2222SK;	**H 322X**	117	137	6	188	2	2.18
	77	145	21	1322SK;	**H 322X**	117	150	9	226	2.5	2.18
	105	145	21	2322SK;	**H2322X**	121	142	7	226	2.5	2.74

1) Indicates adapter mass.

Note: 1. Refer to pages **B-86** to **B-87** for bearing dimensions, basic rated loads, and mass.
2. Adapters for series **12** bearings can also be used with **H2** and **H3** series bearings. Caution: the B_1 dimension of **H3** series bearings is longer than that of **H2** series bearings.
3. Adapter numbers which are appended with the code "X" indicate narrow slit type adapters which use washers with straight inner tabs.
4. Refer to pages **D-2** to **D-9** and **D-12** to **D-14** for adapter locknut and washer dimensions.