

Single-row angular-contact ball bearings

Definition and capabilities

Always mounted in opposition to another bearing of same type, they offer high mounting stiffness, especially when preloaded.

→ Definition

■ Cage

Standard dimension bearings are equipped with either a metal cage or a synthetic material cage. In the latter case the maximum continuous operating temperature is 120°C or 248°F (150°C peak or 302°F peak).

Large-sized bearings are equipped with a machined brass cage.

■ Contact angle

Angular-contact ball bearings of normal precision have a contact angle of 40° (suffix B). Some bearings have a contact angle of 30°, in which case the bearing reference does not have the B suffix.

→ Capabilities

■ Load and speed

These bearings are designed to:

- withstand combined loads with a predominant axial component

$$F_a / F_r \geq 1$$

- withstand loads in one direction only (they must be mounted in opposition with bearings of the same type)
- accept relatively high speeds of rotation

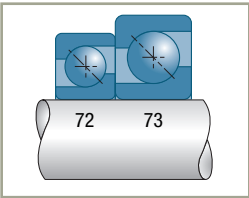
■ Misalignment

Assembly made up of a single bearing

Slight misalignment between the shaft and housing is acceptable. The value depends on the assembly clearance: from 0.10° to 0.15° if the assembly clearance is 0.06° in the case of a preloaded assembly.

Assembly made up of two bearings

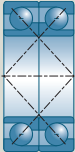
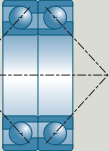
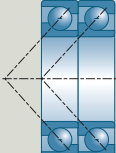
In this case, the assembly is similar to a double-row ball bearing and the acceptable misalignment values are very low, in the range of 0.06°.



Variants

■ Bearings for universal matching (suffix BG)

The bearings in the 72 ... BG, 73 ... BG series can be assembled in pairs to form a single pillow block. They are supplied individually and can be matched in either an X, O or Tandem arrangement.

Arrangement	Characteristics
Face-to-face or X arrangement (type DF)	 This arrangement constitutes a single assembly. Another bearing is needed to form the second pillow block of the shaft.
Back-to-back or O arrangement (type DB)	 Good rigidity under tilting torque. This assembly can in some cases ensure shaft retention on its own thanks to the distance between the load application point.
Tandem (type DT)	 For very high axial loads but in one direction only. This arrangement constitutes a single assembly; another bearing must be mounted in the opposite direction to form the second assembly of the shaft.

Other variants can give assemblies with a greater or lesser amount of preload (suffix BGL or BGO); they requires usually a prior technical study.

On request these bearings are supplied with a maximum runout mark on the inner ring. When the two bearings are assembled, their respective markings must be aligned.

Single-row angular-contact ball bearings *(continued)*

Tolerances and clearances

■ Tolerances

Usually manufactured in the normal tolerance class.

Single-row ball bearings can be supplied on request with all or specified characteristics in tolerance classes 6 and 5 (e.g. bore or axial run-out in tolerance class 6).

■ Axial clearance on assembly with two separate bearings

These bearings are always assembled in opposition, and their internal clearance is determined by adjusting the axial clearance of the shaft at the time of assembly.

For information, the relationship between the axial clearance and the radial clearance is given by the formula:

$$J_r = 0.83 J_a$$

These bearings can be installed preloaded if needed to increase the axial rigidity of an assembly. The maximum speed of rotation is then reduced, and depends on the value of the preload. Consult SNR.

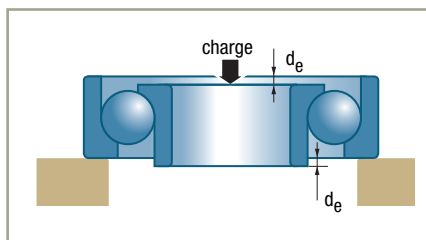
The aim of adjusting an assembly comprising two angular-contact ball bearings is to adjust the axial clearance, that is to say the initial relative position of the inner rings with respect to the outer rings, so that the bearings are positioned in the best possible operating conditions, while at the same time satisfying the specific assembly requirements (precision of rotation, rigidity, vibration, heating, etc.). The adjustment is defined either by an axial clearance or a preload.

The optimum preload of an assembly is determined according to the application specifications (rigidity, precision, temperature, vibration, etc.). Whatever the case, consult SNR.

The assembly and adjustment conditions affect the clearance of the assembly. Type BG bearings usually have reduced residual clearance after assembly.

■ Axial clearance of a BG assembly

The clearance of an assembly (X or O arrangement) is defined by the protrusion d_e of one ring with respect to the other.



Bearing bore		Protusion value
from	to	in μm
10	30	8 - 19
35	50	8 - 20
55	80	11 - 23
85	110	17 - 29
115	180	20 - 32

The axial clearance of the assembly is calculated as follows:

- mean theoretical axial clearance:

$$2 d_e$$

- radial reduction of clearance due to interference fits:

$$\Delta J_r$$

- mean axial clearance of the assembly:

$$J_a = 2 d_e - (\Delta J_r / 0.83)$$

By applying this formula to the calculation of probable tolerances, one obtains a minimum clearance value close to zero with a conventional assembly (interference fit on shaft with a $j6/k6$ tolerance and clearance fit in the housing with an $H7/J7$ tolerance).

Single-row angular-contact ball bearings (continued)

Design criteria

■ Bearing life

■ Shaft mounted on two single bearings

Equivalent dynamic load

The axial equilibrium of the shaft depends not only on the external forces applied to it, but also on the forces induced by the radial loads applied to each bearing.

Equivalent static load

Its value P_0 is the greater of the two values obtained using the following formula:

$$P_0 = F_r$$

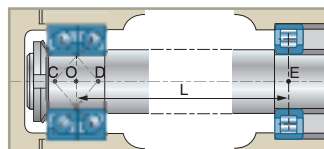
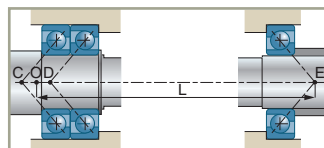
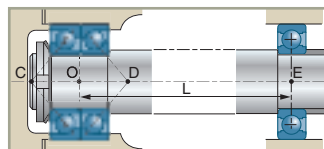
$$P_0 = 0.5 F_r + 0.26 F_a$$

■ Shaft with one of its two assemblies made up of two matched bearings in the 72...BG or 73...BG series

This assembly is considered as being made up of a single double-row ball bearing whose centre O is the midpoint of the distance CD between the load application points.

The arrangement of this type of assembly is hyperstatic. (3 seating points: E, C, D) and can only be likened approximately to an arrangement on two assemblies (seating points E and O) if the distance CD is less than $L/5$ and the rigidity of the assembly is satisfactory (misalignment $< 0.06^\circ$).

In all other cases, consult SNR.





■ Equivalent dynamic load of the double assembly (ISO 281 Standard)

Arrangements assembled in an O or X	$P = F_r + 0.55 F_a$	if	$F_a / F_r \leq 1.14$
	$P = 0.57 F_r + 0.93 F_a$	if	$F_a / F_r > 1.14$
Tandem assemblies	$P = F_r$	if	$F_a / F_r \leq 1.14$
	$P = 0.35 F_r + 0.57 F_a$	if	$F_a / F_r > 1.14$

■ Basic dynamic capacity of the double assembly

Basic dynamic capacity of an assembly of two identical matched bearings:

$$C_e = 1.625 C$$

■ Equivalent static load of a double assembly

For an O or X assembly:

$$P_0 = F_r + 0.52 F_a$$

For a tandem assembly, the value of P_0 is the greater of the two values obtained using the following formula:

$$\begin{aligned} P_0 &= F_r \\ P_0 &= 0.5 F_r + 0.26 F_a \end{aligned}$$

■ Basic static capacity of the assemblies

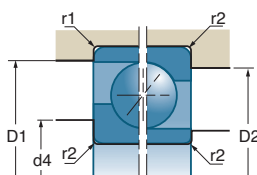
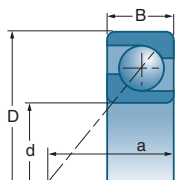
The static capacity of the assembly of two identical bearings is twice that of a single bearing.

$$C_{0e} = 2 C_0$$

Suffixes

A	Optimised internal design with polyamide cage
B	Contact angle of 40°
BG	Contact angle of 40° and non-preloaded universal pairing
M	Machined brass cage centred on the balls

Single-row angular-contact ball bearings (continued)

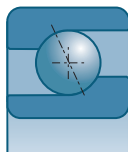


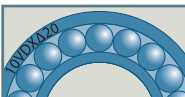
d		D	B	a				
mm	References	mm	mm	mm	10°N	10°N	rpm*	rpm*
15	7202 BA	35	11	16.0	8.0	4.4	16000	22000
17	7203 B 7203 BGA	40 40	12 12	18.0 18.0	9.9 16.1	5.5 11.0	14000 14000	20000 19000
20	7204 BA 7204 BGA 7304 B 7304 BGA	47 47 52 52	14 14 15 15	21.0 21.0 22.5 22.6	13.3 21.6 17.3 30.5	7.6 15.3 9.7 20.9	12000 11000 11000 11000	17000 16000 16000 15000
25	7205 BGA 7305 BGA	52 62	15 17	24.0 26.8	15.8 42.5	9.4 30.0	10000 9100	14000 12000
30	7206 BGA 7306 BGA	62 72	16 19	27.0 31.0	20.5 32.5	13.5 20.1	8700 7800	12000 10900
35	7207 BGA 7307 BA 7307 BGA	72 80 80	17 21 21	31.0 35.0 35.0	27.0 39.5 39.5	18.4 25.0 25.0	7400 6900 6900	10400 9700 9700
40	7208 BA 7208 BGA 7208 BGM 7308 BA 7308 BGA 7308 BGM	80 80 80 90 90 90	18 18 18 23 23 23	34.0 34.0 34.0 39.0 39.0 39.0	32.0 32.0 32.0 49.5 49.5 46.5	23.0 23.0 23.0 32.5 32.5 29.5	6600 6600 6600 6100 6100 6100	9300 9300 9300 8600 8600 8600
45	7209 BA 7209 BGA 7209 BGM 7309 BA 7309 BGA 7309 BGM	85 85 85 100 100 100	19 19 19 25 25 25	37.0 37.0 37.0 43.0 43.0 43.0	36.0 36.0 34.5 69.0 69.0 56.0	26.5 26.5 24.4 47.0 47.0 36.0	6100 6100 6100 5500 5500 5500	8600 8600 8600 7700 7700 7700
50	7210 BGA 7210 BGM 7310 BA 7310 BGA 7310 BGM	90 90 110 110 110	20 20 27 27 27	39.0 39.0 47.0 47.0 47.0	37.5 35.5 69.0 69.0 69.0	28.5 26.5 47.0 47.0 47.0	5700 5700 5000 5000 5000	8000 8000 7000 7000 7000

* These are the speed limits according to the SNR concept (see pages 85 to 87).

Characteristics

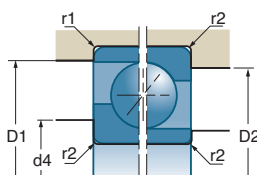
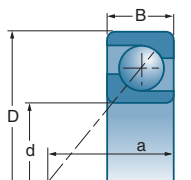
■ Single-row angular-contact ball bearings



	d4 min	D2 max	D1 max	r2 max	r1 max	
References	mm	mm	mm	mm	mm	kg
7202 BA	19	31	32.0	0.6	0.3	0.045
7203 B 7203 BGA	20.5 20.5	36.5 36.5	36.5 36.5	0.6 0.6	0.6 0.3	0.064 0.065
7204 BA 7204 BGA 7304 B 7304 BGA	26 26 26 26	41 41 46 46	43.0 43.0 48.5 48.5	1.0 1.0 1.0 1.1	0.6 0.6 0.6 0.6	0.107 0.104 0.150 0.143
7205 BGA 7305 BGA	31 32	46 55	48.0 58.0	1.0 1.1	0.6 0.6	0.131 0.223
7206 BGA 7306 BGA	36 37	56 65	58.0 68.0	1.0 1.0	0.6 0.6	0.210 0.349
7207 BGA 7307 BA 7307 BGA	42 44 44	65 71 71	68.0 75.0 75.0	1.0 1.5 1.5	0.6 1.0 1.0	0.287 0.457 0.475
7208 BA 7208 BGA 7208 BGM 7308 BA 7308 BGA 7308 BGM	47 47 47 49 49 49	73 73 73 81 81 81	76.0 76.0 76.0 85.0 85.0 85.0	1.0 1.0 1.0 1.5 1.5 1.5	0.6 0.6 0.6 1.0 1.0 1.0	0.373 0.373 0.373 0.626 0.626 0.626
7209 BA 7209 BGA 7209 BGM 7309 BA 7309 BGA 7309 BGM	52 52 52 54 54 54	78 78 78 91 91 91	81.0 81.0 81.0 95.0 95.0 95.0	1.0 1.0 1.0 1.5 1.5 1.5	0.6 0.6 0.6 1.0 1.0 1.0	0.414 0.414 0.414 0.835 0.835 0.835
7210 BGA 7210 BGM 7310 BA 7310 BGA 7310 BGM	57 57 61 61 61	83 83 99 99 99	86.0 86.0 104.0 104.0 104.0	1.0 1.0 2.0 2.0 2.0	0.6 0.6 1.0 1.0 1.0	0.466 0.466 1.080 1.080 1.080



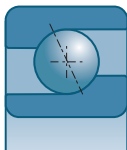
Single-row angular-contact ball bearings (continued)

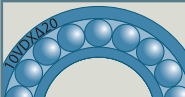


d		D	B	a				
mm	References	mm	mm	mm	10°N	10°N	rpm*	rpm*
55	7211 BA	100	21	43.0	46.5	36.0	5100	7200
	7211 BGA	100	21	43.0	46.5	36.0	5100	7200
	7211 BGM	100	21	43.0	44.0	33.5	5100	7200
	7311 BA	120	29	51.0	79.0	56.0	4500	6400
	7311 BGA	120	29	51.0	79.0	56.0	4500	6400
	7311 BGM	120	29	51.0	79.0	56.0	4500	6400
60	7212 BA	110	22	47.0	56.0	44.5	4700	6500
	7212 BGA	110	22	47.0	56.0	44.5	4700	6600
	7212 BGM	110	22	47.0	54.0	41.5	4700	6600
	7312 BA	130	31	55.0	90.0	65.0	4200	5900
	7312 BGA	130	31	55.0	90.0	65.0	4200	5800
	7312 BGM	130	31	55.0	85.0	60.0	4200	5800
65	7213 BA	120	23	50.5	64.0	53.0	4300	6000
	7213 BGA	120	23	50.5	64.0	53.0	4300	6000
	7213 BGM	120	23	50.5	61.0	49.5	4300	6000
	7213 BM	120	23	50.5	61.0	49.5	4300	6000
	7313 BGA	140	33	60.0	102.0	75.0	3900	5400
	7313 BGM	140	33	60.0	102.0	75.0	3900	5400
70	7214 BA	125	24	53.0	69.0	58.0	4100	5700
	7214 BGA	125	24	53.0	69.0	58.0	4100	5700
	7214 BGM	125	24	53.0	66.0	54.0	4100	5700
	7314 BGA	150	35	64.0	114.0	86.0	3600	5000
	7314 BGM	150	35	64.0	114.0	86.0	3600	5000
75	7215 BA	130	25	56.0	69.0	58.0	3900	5400
	7215 BGA	130	25	56.0	69.0	58.0	3900	5500
	7215 BGM	130	25	56.0	69.0	58.0	3900	5400
	7315 BGM	160	37	68.0	128.0	100.0	3400	4700
80	7216 BGM	140	26	59.0	80.0	69.0	3600	5000
	7316 BGM	170	39	72.0	140.0	114.0	3200	4400
85	7217 BGM	150	28	63.0	90.0	80.0	3400	4700
	7317 BGM	180	41	76.0	151.0	127.0	3000	4200
90	7218 BGM	160	30	67.0	107.0	94.0	3200	4400
	7318 BGM	190	43	80.0	162.0	140.0	2800	4000

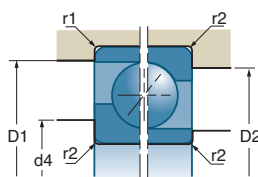
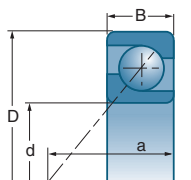
* These are the speed limits according to the SNR concept (see pages 85 to 87).

■ Single-row angular-contact ball bearings (continued)



	d4 min	D2 max	D1 max	r2 max	r1 max	
References	mm	mm	mm	mm	mm	kg
7211 BA	64	91	95.0	1.5	1.0	0.633
7211 BGA	64	91	95.0	1.5	1.0	0.633
7211 BGM	64	91	95.0	1.5	1.0	0.633
7311 BA	66	109	114.0	2.0	1.0	1.410
7311 BGA	66	109	114.0	2.0	1.0	1.410
7311 BGM	66	109	114.0	2.0	1.0	1.410
7212 BA	69	101	105.0	1.5	1.0	0.798
7212 BGA	69	101	105.0	1.5	1.0	0.798
7212 BGM	69	101	105.0	1.5	1.0	0.798
7312 BA	72	118	123.0	2.1	1.0	1.810
7312 BGA	72	118	123.0	2.1	1.0	1.810
7312 BGM	72	118	123.0	2.1	1.0	1.810
7213 BA	74	111	115.0	1.5	1.0	1.030
7213 BGA	74	111	115.0	1.5	1.0	1.030
7213 BGM	74	111	115.0	1.5	1.0	1.100
7213 BM	72	113	115.0	1.5	1.0	1.100
7313 BGA	77	128	133.0	2.1	1.0	2.160
7313 BGM	77	128	133.0	2.1	1.0	2.324
7214 BA	79	116	120.0	1.5	1.0	1.140
7214 BGA	79	116	120.0	1.5	1.0	1.140
7214 BGM	79	116	120.0	1.5	1.0	1.185
7314 BGA	82	138	143.0	2.1	1.0	2.650
7314 BGM	82	138	143.0	2.1	1.0	2.800
7215 BA	84	121	125.0	1.5	1.0	1.190
7215 BGA	84	121	125.0	1.5	1.0	1.190
7215 BGM	84	121	125.0	1.5	1.0	1.291
7315 BGM	87	148	153.0	2.1	1.0	3.170
7216 BGM	91	129	134.0	2.0	1.0	1.460
7316 BGM	92	158	163.0	2.1	1.0	4.280
7217 BGM	96	139	144.0	2.0	1.0	1.920
7317 BGM	99	166	173.0	2.5	1.0	4.580
7218 BGM	101	149	154.0	2.0	1.0	2.350
7318 BGM	104	176	183.0	2.5	1.0	5.320

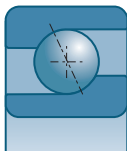
Single-row angular-contact ball bearings (continued)

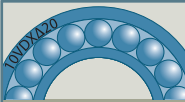


d		D	B	a				
mm	References	mm	mm	mm	10°N	10°N	rpm*	rpm*
95	7219 BGM 7319 BGM	170 200	32 45	72.0 84.0	116.0 172.0	101.0 154.0	3000 2700	4200 3800
100	7220 BGM 7320 BGM	180 215	34 47	76.0 90.0	130.0 194.0	114.0 181.0	2800 2500	4000 3500
105	7321 BGM	225	49	94.0	241.0	230.0	2400	3400
110	7222 BGM 7322 BGM	200 240	38 50	84.0 98.0	154.0 226.0	144.0 225.0	2500 2200	3600 3200
120	7224 BGM 7324 BGM	215 260	40 55	90.0 108.0	161.0 250.0	165.0 260.0	2400 2100	3300 2900
130	7226 BGM 7326 BGM	230 280	40 58	96.0 115.0	177.0 275.0	180.0 300.0	2200 1900	3100 2700
140	7228 BGM 7328 BGM	250 300	42 62	103.0 123.0	197.0 300.0	212.0 340.0	2100 1800	2900 2500
150	7230 BGM 7330 BGM	270 320	45 65	111.0 131.0	225.0 330.0	255.0 390.0	1900 1700	2600 2300
160	7232 BGM 7332 BGM	290 340	48 68	118.0 139.0	238.0 360.0	280.0 450.0	1700 1600	2400 2200
170	7234 BGM 7334 BGM	310 360	52 72	127.0 147.0	265.0 390.0	325.0 510.0	1600 1500	2300 2100

* These are the speed limits according to the SNR concept (see pages 85 to 87).

■ Single-row angular-contact ball bearings (continued)



	d4 min	D2 max	D1 max	r2 max	r1 max	
References	mm	mm	mm	mm	mm	kg
7219 BGM 7319 BGM	107 109	158 186	163.0 193.0	2.1 2.5	1.0 1.0	2.780 6.180
7220 BGM 7320 BGM	112 114	168 201	173.0 208.0	2.1 2.5	1.0 1.0	3.410 7.650
7321 BGM	119	211	218.0	2.5	1.0	9.460
7222 BGM 7322 BGM	122 124	188 226	193.0 233.0	2.1 2.5	1.0 1.0	4.720 10.400
7224 BGM 7324 BGM	132 134	203 246	208.0 253.0	2.1 2.5	1.0 1.0	6.210 14.400
7226 BGM 7326 BGM	144 147	216 263	223.0 271.0	2.5 3.0	1.0 1.5	6.920 17.500
7228 BGM 7328 BGM	154 157	236 283	243.0 291.0	2.5 3.0	1.0 1.5	8.910 21.600
7230 BGM 7330 BGM	164 167	256 303	263.0 311.0	2.5 3.0	1.0 1.5	11.600 26.000
7232 BGM 7332 BGM	174 177	276 323	283.0 331.0	2.5 3.0	1.0 1.5	28.000 30.500
7234 BGM 7334 BGM	187 187	293 343	301.0 351.0	3.0 3.0	1.5 1.5	35.000 34.342