

FAG Angular Contact Ball Bearings

single row



FAG Angular Contact Ball Bearings

single row · Standards · Basic design · Tolerances · Cages · Speed suitability · Heat treatment

Single row angular contact ball bearings can accommodate radial and thrust loads. They accommodate thrust loads in only one direction; they are adjusted against another bearing which accommodates the opposite thrust load. Angular contact ball bearings are non-separable. They are suitable for high speeds. Their self-aligning capability is very limited.

Standards

Single row angular contact ball bearings DIN 628, part 1

Basic design of angular contact ball bearings

FAG single row angular contact ball bearings of series 72B and 73B have a contact angle of 40°. They can therefore accommodate high axial loads.



Tolerances

Angular contact ball bearings of series 72B and 73B are machined to normal tolerances (tolerance class PN, no suffix).

For the tolerances of angular contact ball bearings see radial bearings, page 56.

Cages

Most angular contact ball bearings are fitted with a cage of glass-fibre reinforced polyamide 66 (suffix TVP). These cages can be used at steady-state temperatures of up to 120 °C. If the bearings are

lubricated with oil, any additives contained in the oil may reduce the cage service life. Also, aged oil may reduce the cage life at higher temperatures; therefore, the oil change intervals have to be strictly observed (see also page 85).

Angular contact ball bearings with machined window-type brass cages are suffixed MP.

▼ Standard cages of angular contact ball bearings

Series	Solid polyamide cage (TVP) Bore reference number	Machined brass cage (MP)
72B	up to 20, 22 up to 26	21, from 28 on
73B	up to 20, 22 up to 26	21, from 28 on

Other cage designs on request. The suitability for high speeds and high temperatures as well as the load ratings for such cages may deviate from the values indicated for bearings with standard cages.

Speed suitability

General data on the suitability for high speeds are shown on page 87 et seq.

Under appropriate operating conditions, the reference speed may be exceeded up to the value for the limiting speed. Special operating conditions are taken into consideration by determining the thermally permissible operating speed.

If the reference speed in the tables exceeds the limiting speed, the higher value must not be used.

If angular contact ball bearings are mounted directly side by side, special measures are required to reach the high speeds of the single bearings (see Section "Attainable speeds of bearing pairs", page 181).

Heat treatment

FAG angular contact ball bearings are heat-treated in such a way that they can be used at operating temperatures of up to 150 °C. Bearings with an outside diameter of more than 240 mm are dimensionally stable up to 200 °C. If bearings with polyamide cage are used, the temperature limits of application of the cage material have to be observed.

Angular Contact Ball Bearings

single row · Universal designs

Universal designs

Single row angular contact ball bearings of universal design are intended for mounting in pairs, either in X arrangement (face to face), O arrangement (back to back) or T arrangement (tandem) or for group mounting. The following adjustments can be selected:

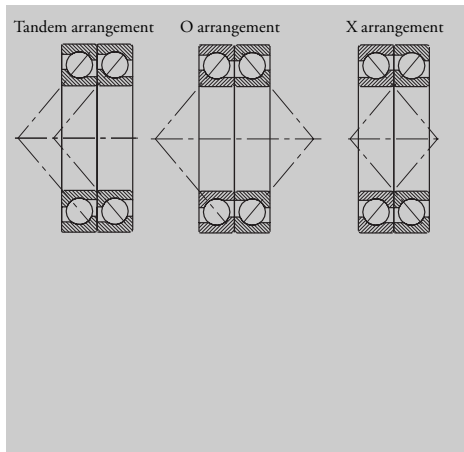
UA small axial clearance at X or O arrangement

UO zero clearance at X or O arrangement

The axial clearance (see table below) or zero clearance does not apply to mounted bearing pairs.

With tight fits (see pages 105 and 114) the axial clearance is reduced or the preload of the bearing pair increased.

When ordering, please state the number of individual bearings, not the number of bearing pairs or bearing sets.



▼ Axial clearance of angular contact ball bearing series 72B and 73B of universal design UA, paired in X or O arrangement

Bore reference number	Axial clearance of the bearing pair		Tolerance [µm]		Series 73B	
	Nominal dimension [µm] Series 72B, 73B Tolerance classes PN and P5		Series 72B PN	P5	PN	P5
03	24		+8	+6		
04	28		+8	+6	+8	+6
05	34		+8	+6	+8	+6
06	34		+8	+6	+8	+6
07	40		+8	+6	+8	+6
08	40		+8	+6	+8	+6
09	44		+8	+6	+8	+6
10	44		+8	+6	+12	+10
11	46		+8	+6	+12	+10
12	46		+12	+10	+12	+10
13	46		+12	+10	+12	+10
14	50		+12	+10	+12	+10
15	50		+12	+10	+12	+10
16	50		+12	+10	+12	+10
17	54		+12	+10	+12	+10
18	54		+12	+10	+12	+10
19	54		+12	+10	+12	+10
20	54		+12	+10	+12	+10
21	58		+12	+10	+12	+10
22	58		+12	+10	+12	+10
24	58		+12	+10	+12	+10
26	60		+12	+10	+12	+10
28	60		+12	+10	+12	+10
30	60		+12	+10	+12	+10
32	60		+12	+10	+12	+10
34	70		+12	+10	+12	+10

FAG Angular Contact Ball Bearings

single row · Universal design · Attainable speed of bearing pairs · Dynamic load rating ·

Equivalent loads

Tolerances of the universal designs

Angular contact ball bearings of universal design UO or UA are supplied with normal tolerances (no suffix for the tolerance) and, upon request, with tolerance class P5 (suffix P5.UO or P5.UA).

For tolerances of angular contact ball bearings of universal design, see radial bearings on page 56.

Exceptions: Bore tolerances for bearings of all tolerance classes uniformly to P5 (without suffix). Width tolerances are given in the table below:

▼ Width tolerances of the universal design						
Dimensions in mm						
Nominal bore diameter	over to	50	50	80	120	180
		80	80	120	180	315
Width deviation Δ _{Bs} [µm]						
Tolerance class	PN	0	0	0	0	0
		-250	-380	-380	-500	-500
	P5	0	0	0	0	0
		-250	-250	-380	-380	-500

Attainable speed of bearing pairs

Bearing pairs of universal designs UA and UO in X, O or tandem arrangement can reach an operating speed which is about 20 % lower than the calculated permissible operating speed of the single bearing. The limiting speed can be reached also with bearing pairs if their less favourable heat balance is considered in the operating conditions.

Dynamic load rating C for matched angular contact ball bearings

With several angular contact ball bearings of identical size and design mounted side by side, the load rating for the bearing group amounts to

$$C = i^{0.7} \cdot C_{\text{single bearing}} \text{ [kN]}$$

where

C dynamic load rating of the bearing group [kN]

i number of bearings

Consequently, for bearing pairs

$$C = 1.625 \cdot C_{\text{single bearing}} \text{ [kN]}$$

Equivalent dynamic load

Angular contact ball bearings, series 72B and 73B with a contact angle of α = 40°

Single bearings:

$$P = F_r \text{ [kN] for } \frac{F_a}{F_r} \leq 1.14$$

$$P = 0.35 \cdot F_r + 0.57 \cdot F_a \text{ [kN] for } \frac{F_a}{F_r} > 1.14$$

O or X arranged bearing pairs:

$$P = F_r + 0.55 \cdot F_a \text{ [kN] for } \frac{F_a}{F_r} \leq 1.14$$

$$P = 0.57 \cdot F_r + 0.93 \cdot F_a \text{ [kN] for } \frac{F_a}{F_r} > 1.14$$

Determining the axial load accommodated by a single bearing

Since the raceways of angular contact ball bearings are inclined, radial loads induce axial reaction forces which must be taken into account for the assessment of the equivalent load. The thrust force is calculated by means of the formulas listed in the table on the next page. The bearing which accommodates the external thrust K_a – independent of the axial reaction forces – is called bearing "A", the other one bearing "B".

FAG Angular Contact Ball Bearings

single row · Equivalent loads · Static load rating

Load conditions	Axial load F_a which has to be used in the equivalent dynamic load calculation Bearing A	Bearing B
$\frac{F_{rA}}{Y_A} \leq \frac{F_{rB}}{Y_B}$	$F_a = K_a + 0.5 \cdot \frac{F_{rB}}{Y_B}$	–
$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$	$F_a = K_a + 0.5 \cdot \frac{F_{rB}}{Y_B}$	–
$K_a > 0.5 \cdot \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B} \right)$	–	$F_a = 0.5 \cdot \frac{F_{rA}}{Y_A} - K_a$
$\frac{F_{rA}}{Y_A} > \frac{F_{rB}}{Y_B}$	–	$F_a = 0.5 \cdot \frac{F_{rA}}{Y_A} - K_a$
$K_a \leq 0.5 \cdot \left(\frac{F_{rA}}{Y_A} - \frac{F_{rB}}{Y_B} \right)$	–	$F_a = 0.5 \cdot \frac{F_{rA}}{Y_A} - K_a$

The factor of the axial load component F_a , $Y = 0.57$, is used in the formulas for bearings of series 72B and 73B.

The thrust load F_a is not considered in the empty blocks of the above table since $F_a/F_r < 1.14$ in these cases.

Static load rating C_0 for paired angular contact ball bearings

$$C_0 = 2 \cdot C_{0 \text{ single bearing}} \text{ [kN]}$$

Equivalent static load

Angular contact ball bearings, series 72B and 73B with a contact angle of $\alpha = 40^\circ$

Single bearings:

$$P_0 = F_r \quad \text{[kN] for } \frac{F_a}{F_r} \leq 1.9$$

$$P_0 = 0.5 \cdot F_r + 0.26 \cdot F_a \quad \text{[kN] for } \frac{F_a}{F_r} > 1.9$$

O or X arranged bearing pairs:

$$P_0 = F_r + 0.52 \cdot F_a \quad \text{[kN]}$$

FAG Angular Contact Ball Bearings

single row · Abutment dimensions · Suffixes

Abutment dimensions

See page 123 for general information on the abutment dimensions.

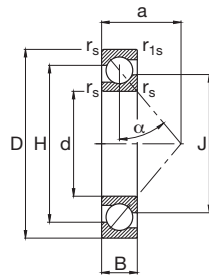
The tables list the maximum fillet radius r_g and the diameters of the abutment shoulders.

Suffixes

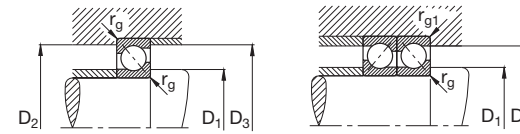
- B** changed internal design
- MP** machined window-type brass cage
- TVP** solid window-type cage of glass-fibre reinforced polyamide
- UA** universal design for mounting in pairs, O and X arranged bearing pairs have a small axial clearance
- UO** universal design for mounting in pairs, O and X arranged bearing pairs have zero clearance

FAG Angular Contact Ball Bearings

single row



B
Contact angle $\alpha = 40^\circ$

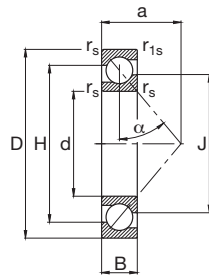


Rolling bearings can be fail-safe if $C_0/P_0 \geq 8$, see page 41.

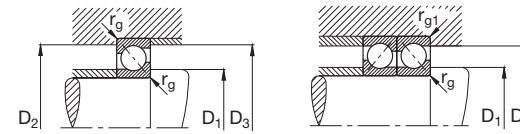
Shaft	Dimensions								Mass ≈ kg	Load rating		Limiting speed ≈ min ⁻¹	Reference speed	Code Bearing FAG	Abutment dimensions				
	d mm	D	B	r _s min	r _{fs} min	a ≈	H ≈	J ≈		dyn. C kN	stat. C ₀				D ₁ min mm	D ₂ max	D ₃ max	r _g max	r _{g1} max
10	10	30	9	0.6	0.3	13	22.1	18.2	0.032	5	2.5	32000	26000	7200B.TVP	14.2	25.8	27.6	0.6	0.3
	12	32	10	0.6	0.3	14	24.6	19.7	0.035	6.95	3.4	28000	26000	7201B.TVP	16.2	27.8	29.6	0.6	0.3
12	12	37	12	1	0.6	16	27.2	22.3	0.06	10.6	5	24000	19000	7301B.TVP	17.6	31.4	32.8	1	0.6
	15	35	11	0.6	0.3	16	27.6	22.7	0.044	8	4.3	24000	22000	7202B.TVP	19.2	30.8	32.6	0.6	0.3
15	15	42	13	1	0.6	18	31.8	25.7	0.082	12.9	6.55	20000	17000	7302B.TVP	20.6	36.4	37.8	1	0.6
	17	40	12	0.6	0.6	18	31.2	26.4	0.065	10	5.5	20000	20000	7203B.TVP	21.2	35.8	35.8	0.6	0.6
17	17	47	14	1	0.6	20	35.8	28.7	0.109	16	8.3	18000	15000	7303B.TVP	22.6	41.4	42.8	1	0.6
	20	47	14	1	0.6	21	36.6	30.6	0.104	13.4	7.65	18000	18000	7204B.TVP	25.6	41.4	42.8	1	0.6
20	20	52	15	1.1	0.6	23	39.9	32.6	0.143	19	10.4	17000	13000	7304B.TVP	27	45	47.8	1	0.6
	25	52	15	1	0.6	24	41.6	35.4	0.127	14.6	9.3	16000	16000	7205B.TVP	30.6	46.4	47.8	1	0.6
25	25	62	17	1.1	0.6	27	48.1	39.5	0.223	26	15	14000	11000	7305B.TVP	32	55	57.8	1	0.6
	30	62	16	1	0.6	27	49.8	43.1	0.196	20.4	13.4	13000	13000	7206B.TVP	35.6	56.4	57.8	1	0.6
30	30	72	19	1.1	0.6	31	56	46.8	0.341	32.5	20	11000	10000	7306B.TVP	37	65	67.8	1	0.6
	35	72	17	1.1	0.6	31	57.8	49.8	0.282	27	18.3	11000	12000	7207B.TVP	42	65	67.8	1	0.6
35	35	80	21	1.5	1	35	63.1	52.9	0.447	39	25	9500	9000	7307B.TVP	44	71	74.4	1.5	1
	40	80	18	1.1	0.6	34	64.6	56	0.367	32	23.2	9500	10000	7208B.TVP	47	73	75.8	1	0.6
40	40	90	23	1.5	1	39	71.3	59.5	0.609	50	32.5	8500	8500	7308B.TVP	49	81	84.4	1.5	1
	45	85	19	1.1	0.6	37	70	60.8	0.405	36	26.5	8500	9500	7209B.TVP	52	78	80.8	1	0.6
45	45	100	25	1.5	1	43	79.5	66.2	0.812	60	40	7500	7500	7309B.TVP	54	91	94.4	1.5	1
	50	90	20	1.1	0.6	39	74.4	66.5	0.458	37.5	28.5	8000	9000	7210B.TVP	57	83	85.8	1	0.6
50	50	110	27	2	1	47	87.6	73.1	1.05	69.5	47.5	7000	7000	7310B.TVP	61	99	104.4	2	1
	55	100	21	1.5	1	43	83	72.6	0.604	46.5	36	7000	8500	7211B.TVP	64	91	94.4	1.5	1
55	55	120	29	2	1	51	95.3	80.3	1.38	78	56	6300	6700	7311B.TVP	66	109	114.4	2	1
	60	110	22	1.5	1	47	91.1	79.5	0.78	56	44	6300	7500	7212B.TVP	69	101	104.4	1.5	1
60	60	130	31	2.1	1.1	55	103.4	87.3	1.72	90	65.5	5600	6300	7312B.TVP	72	118	123	2.1	1
	65	120	23	1.5	1	51	98.9	86.4	1	64	53	6000	7000	7213B.TVP	74	111	114.4	1.5	1
65	65	140	33	2.1	1.1	60	111.5	94.3	2.12	102	75	5300	6000	7313B.TVP	77	128	133	2.1	1

FAG Angular Contact Ball Bearings

single row



B
Contact angle $\alpha = 40^\circ$



Rolling bearings can be fail-safe if $C_0/P_0 \geq 8$, see page 41.

Shaft	Dimensions								Mass ≈ kg	Load rating		Limiting speed ≈ min ⁻¹	Reference speed	Code Bearing FAG	Abutment dimensions				
	d mm	D	B	r _s min	r _{fs} min	a ≈	H ≈	J ≈		dyn. C kN	stat. C ₀				D ₁ min mm	D ₂ max	D ₃ max	r _g max	r _{g1} max
70	70	125	24	1.5	1	53	104.2	91	1.08	69.5	58.5	5600	6700	7214B.TVP	79	116	119.4	1.5	1
	70	150	35	2.1	1.1	64	119.6	101.5	2.57	114	86.5	5000	5600	7314B.TVP	82	138	143	2.1	1
75	75	130	25	1.5	1	56	109.2	96.5	1.16	68	58.5	5300	6700	7215B.TVP	84	121	124.4	1.5	1
	75	160	37	2.1	1.1	68	127.9	108.2	3.08	127	100	4500	5300	7315B.TVP	87	148	153	2.1	1
80	80	140	26	2	1	59	117.2	102.9	1.42	80	69.5	5000	6000	7216B.TVP	91	129	134.4	2	1
	80	170	39	2.1	1.1	72	136.7	115.7	3.66	140	114	4300	4800	7316B.TVP	92	158	163	2.1	1
85	85	150	28	2	1	63	125	110.6	1.82	90	80	4500	6000	7217B.TVP	96	139	144.4	2	1
	85	180	41	3	1.1	76	144	122	4.26	150	127	4000	4500	7317B.TVP	99	166	173	2.5	1
90	90	160	30	2	1	67	133.4	117.5	2.21	106	93	4300	5600	7218B.TVP	101	149	154.4	2	1
	90	190	43	3	1.1	80	152.2	129	4.99	160	140	3800	4300	7318B.TVP	104	176	183	2.5	1
95	95	170	32	2.1	1.1	72	141.5	124.7	2.63	116	100	4000	5300	7219B.TVP	107	158	163	2.1	1
	95	200	45	3	1.1	84	159.5	137.1	5.77	173	153	3800	4000	7319B.TVP	109	186	193	2.5	1
100	100	180	34	2.1	1.1	76	149.6	131.5	3.16	129	114	3800	5000	7220B.TVP	112	168	173	2.1	1
	100	215	47	3	1.1	90	171.3	144.9	7.16	193	180	3600	3600	7320B.TVP	114	201	208	2.5	1
105	105	190	36	2.1	1.1	80	157.7	138.2	4.18	143	129	6000	4800	7221B.MP	117	178	183	2.1	1
	105	225	49	3	1.1	94	178.9	154	9	200	193	5300	3400	7321B.MP	119	211	218	2.5	1
110	110	200	38	2.1	1.1	84	165.7	144.9	4.44	153	143	3600	4500	7222B.TVP	122	188	193	2.1	1
	110	240	50	3	1.1	98	190.3	161	9.73	224	224	3400	3200	7322B.TVP	124	226	233	2.5	1
120	120	215	40	2.1	1.1	90	178.9	157.2	5.31	166	160	3400	4300	7224B.TVP	132	203	208	2.1	1
	120	260	55	3	1.1	107	206.5	175	12.4	250	260	3200	3000	7324B.TVP	134	246	253	2.5	1
130	130	230	40	3	1.1	96	191.8	169.7	6.12	186	190	3200	3800	7226B.TVP	144	216	223	2.5	1
	130	280	58	4	1.5	115	222.5	188.5	15.1	275	300	3000	2600	7326B.TVP	147	263	271	3	1.5
140	140	250	42	3	1.1	103	207.5	183.5	8.55	196	212	4800	3400	7228B.MP	154	236	243	2.5	1
	140	300	62	4	1.5	123	237	203	20.4	300	340	4300	2400	7328B.MP	157	283	291	3	1.5
150	150	270	45	3	1.1	111	223.5	197.5	10.9	224	255	4500	3000	7230B.MP	164	256	263	2.5	1
	150	320	65	4	1.5	131	253.9	217	24.8	325	390	3800	2200	7330B.MP	167	303	311	3	1.5
160	160	290	48	3	1.1	118	238	212	13.5	236	280	4300	2800	7232B.MP	174	276	283	2.5	1
	160	340	68	4	1.5	139	270	231	29	360	450	3600	2000	7332B.MP	177	323	331	3	1.5

