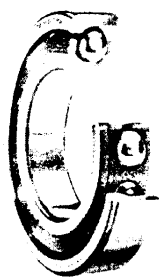
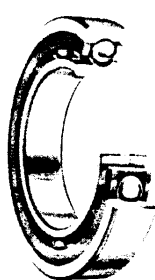




Angular contact ball bearing



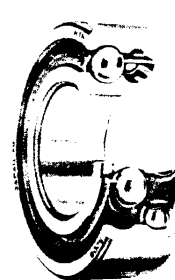
High speed use angular contact ball bearing



Ultra high speed use angular contact ball bearing



Four-point contact ball bearing



Double row angular contact ball bearing

1. Design features and special characteristics

1.1 Angular contact ball bearing

Angular contact ball bearings are non-separable type bearings. The line connecting the contact points of the ball and inner ring and the ball and outer ring creates an angle with the line drawn in the radial direction called the contact angle.

In addition to radial loads, single direction axial loads can also be accommodated by angular contact ball bearings.

Furthermore, since an axial load is generated from a radial force, these bearings are generally used in pairs facing each other. Standard type, high speed use type and ultra high speed varieties of angular contact ball bearings are available through NTN, and there are also many duplex varieties. A bearing accuracy of JIS Class 5 or higher is applied to duplex type angular contact ball bearings, and in many cases they are given a preload, in compliance with standard preload levels, before being used in an application. Table 2 shows information concerning angular contact ball bearings, and Table 3 shows similar information for duplex angular contact ball bearings.

Contact angle

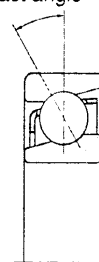


Diagram 1.

Table 1 Contact angle and contact angle codes

Contact angle	15°	30°	40°
Code	C	A ^①	B

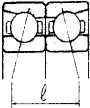
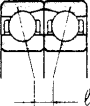
① A 30° contact angle is standard, and therefore the code "A" will usually be omitted.

Table 2 Angular contact ball bearing types and characteristics

Type	Design	Characteristics
Standard type		- Available in bearing series 79, 70, 72, 72B, 73, and 73B. - Contact angles: 30° and 40° (with B) available. - Standard bearing cage type differs depending on bearing no. (Refer to Table 4)
High speed use		- Available in bearing series 78C, 79C, 70C, 72C, and 73C. - Contact angles: 15° - All bearing accuracies JIS Class 5 or higher. - Standard bearing cage type differs depending on bearing no. (Refer to Table 4)
Ultra high speed use	 BNT type HSB type	- Available in bearing series HSB9C, HSB0C, BNT0, and BNT2; all boundary dimensions agree with JIS series dimensions. - Contact angles: 15°; HSB type HSB9 and HSB0: 15° and 30°. - All bearing accuracies JIS Class 5 or higher. - BNT type internal design can be altered; suitable for higher speed applications than high speed use bearings. - HSB series bearings have smaller diameter of balls than high speed use type bearings, so benefit by less torque for high precision, high speed applications. - The inner ring bore diameter and outer ring inner diameter of the HSB series have a ground undercut on one side enabling easy oil flow. - For even higher speed applications, there is a bearing in this series equipped with ceramic ball bearings. - For standard cage types refer to Table 4; molded resin cages are also available for some varieties.

●Angular Contact Ball Bearings

Table 3 Duplex angular contact ball bearings — types and characteristics

Duplex type		Characteristics
Back-to-back duplex (DB)		• Can accommodate radial loads and axial loads in either direction. • Has a large distance l between the acting load center of the bearing, and therefore a large momentary force load capacity. • Allowable misalignment angle is small.
Face-to-face duplex (DF)		• Can accommodate radial loads and axial loads in either direction. • Has a smaller distance l between the acting load center of the bearing, and therefore a smaller momentary force load capacity. • Has a larger allowable misalignment angle than back-to-back duplex type.
Tandem duplex (DT)		• Can accommodate radial loads and single direction axial loads. • Axial loads are received by both bearings as a set, and therefore heavy axial loads can be accommodated.

Note: 1. Duplex bearings are manufactured in a set to specified clearance and preload values, therefore they must be assembled together with identically numbered bearings and not mixed with other arrangements.

2. Triplex arrangements of angular contact bearings are also available. Consult NTN Engineering for details.

1.2 Four-point angular contact ball bearings

Four-point angular contact ball bearings have a contact angle of 30° and inner rings which are separated in half. As shown in **Diagram 2**, when the inner and outer rings receive a radial load the ball bearings contact the inner and outer rings at four points. This construction enables a single bearing to accommodate axial loads from either direction, and when generally under a simple axial load or heavy axial load, the bearing functions in reliance on two contact points like ordinary bearings.

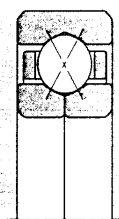


Diagram 2.

1.3 Double row angular contact ball bearings

The structure of double row angular contact ball bearings is designed by arranging two single row angular contact bearings back-to-back in duplex (DB) to form one united bearing with a contact angle of 30° .

These bearings are capable of accommodating radial

loads, axial loads in either direction, and have a high capacity for momentary loads as well.

As shown in **Diagram 3**, sealed and shielded type double row angular contact ball bearings are also available. Standard loads vary from those of open type bearings.

■ Flush ground

"Flush ground" is the name given to the finishing method shown in **Diagram 4** where the offset of the front and back faces of the bearing are ground to the same value. By doing this, a stated clearance or preload value can be achieved by using bearings with identical codes for these values, in other words by combining either DB or DF series bearings. DT series bearings can also be used in various arrangements to achieve uniform load distribution.

All BNT type bearings are flush ground, but other angular contact ball bearing series are not. If it is necessary to flush grind any of these other bearings, please consult NTN Engineering.

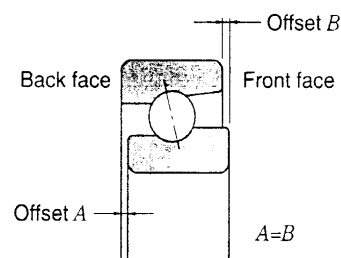
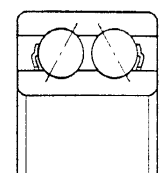
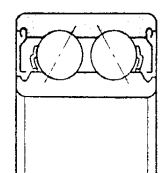


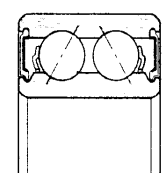
Diagram 4.



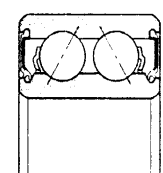
Open type



Shielded type (ZZ)



Non-contact sealed type (LLB)



Contact sealed type (LLU)

2. Standard cage types

Table 4 lists the standard cage types for angular contact ball bearings. For high speed use angular contact ball bearings, molded resin cages and machined cages are widely used.

Table 4 Standard cages for angular contact ball bearings

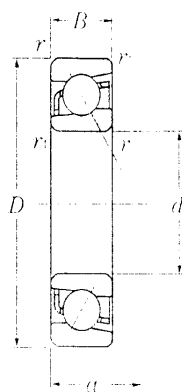
Bearing series	Molded resin cage	Pressed cage	Machined cage
79	7904~7913	—	7914 ~7960
70	7000~7024	—	7026 ~7040
72	—	7200 ~7222	7224 ~7240
73	—	7300 ~7322	7324 ~7340
72B	—	7200B~7222B	7224B ~7240B
73B	—	7300B~7322B	7324B ~7340B
78C	—	—	7805C ~7834C
79C	7904C~7913C	—	7914C ~7934C
70C	7000C~7024C	—	7026C ~7040C
72C	7200C~7220C	—	7221C ~7240C
73C	7303C~7312C	—	7300C ~7302C 7313C ~7340C
BNT0	—	—	BNT000 ~BNT009
BNT2	—	—	BNT200 ~BNT209
HSB9C	—	—	HSB910C~HSB934C
HSB0C	HSB010C~HSB032C	—	HSB034C
QJ2	—	—	QJ208 ~QJ224
QJ3	—	—	QJ306 ~QJ324
52	—	5200 ~5218	5219, 5220
53	—	5302 ~5315	—

1. Standard cages for 5S-BNT and 5S-HSB type bearings are the same as cages for BNT and HSB type bearings.

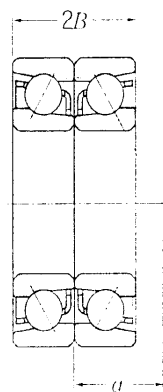
2. Due to the material characteristics of molded resin cages, use at application temperatures in excess of 120°C is not possible.

●Single and Duplex Arrangements

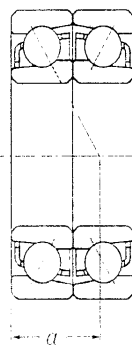
NTN



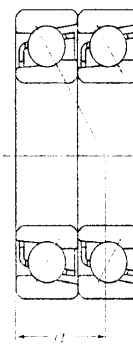
Single



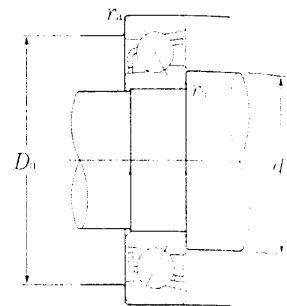
Back-to-back
arrangement
(DB)



Face-to-face
arrangement
(DF)

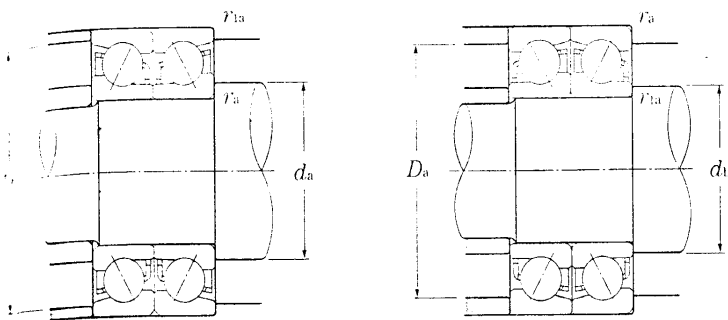


Tandem
arrangement
(DT)



d 10~30mm

Boundary dimensions						Basic load ratings				Limiting speeds ¹⁾		Bearing numbers ²⁾	Load center	Mass ³⁾
d	D	B	mm		C _r	C _{0r}	C _r	C _{0r}	rpm					
			r _{s min} ⁴⁾	r _{is min} ⁵⁾					grease	oil	mm			
														kg single (approx.)
10	26	8	16	0.3	0.15	4.65	2.07	470	212	29,000	39,000	7000	9	0.023
	30	9	18	0.6	0.3	5.45	2.74	555	279	28,000	37,000	7200	10.5	0.029
	30	9	18	0.6	0.3	5.00	2.52	510	257	24,000	32,000	7200B	13	0.029
	35	11	22	0.6	0.3	10.1	4.95	1,030	500	26,000	34,000	7300	12	0.041
	35	11	22	0.6	0.3	9.50	4.60	970	470	22,000	29,000	7300B	15	0.041
12	28	8	16	0.3	0.15	5.05	2.46	515	251	26,000	35,000	7001	10	0.025
	32	10	20	0.6	0.3	7.60	3.95	775	405	25,000	33,000	7201	11.5	0.035
	32	10	20	0.6	0.3	7.00	3.65	715	375	21,000	28,000	7201B	14	0.036
	37	12	24	1	0.6	11.2	5.25	1,140	535	23,000	30,000	7301	13	0.044
	37	12	24	1	0.6	10.5	4.95	1,080	505	19,000	26,000	7301B	16.5	0.045
15	32	9	18	0.3	0.15	5.80	3.15	590	320	23,000	31,000	7002	11.5	0.035
	35	11	22	0.6	0.3	9.05	4.70	925	480	22,000	29,000	7202	12.5	0.046
	35	11	22	0.6	0.3	8.35	4.35	855	445	18,000	25,000	7202B	16	0.046
	42	13	26	1	0.6	13.5	7.20	1,370	735	19,000	26,000	7302	15	0.055
	42	13	26	1	0.6	12.5	6.65	1,270	680	17,000	22,000	7302B	19	0.057
17	35	10	20	0.3	0.15	7.15	3.85	730	390	21,000	28,000	7003	12.5	0.046
	40	12	24	0.6	0.3	12.0	6.60	1,220	675	19,000	26,000	7203	14.5	0.064
	40	12	24	0.6	0.3	11.0	6.10	1,120	625	17,000	22,000	7203B	18	0.066
	47	14	28	1	0.6	15.9	8.65	1,630	880	18,000	24,000	7303	16	0.107
	47	14	28	1	0.6	14.8	8.00	1,510	820	15,000	20,000	7303B	20.5	0.109
20	42	12	24	0.6	0.3	9.70	5.60	990	570	19,000	25,000	7004	15	0.08
	47	14	28	1	0.6	14.5	8.40	1,480	855	17,000	23,000	7204	17	0.1
	47	14	28	1	0.6	13.3	7.70	1,360	785	15,000	20,000	7204B	21.5	0.102
	52	15	30	1.1	0.6	18.7	10.4	1,910	1,060	16,000	21,000	7304	18	0.138
	52	15	30	1.1	0.6	17.3	9.65	1,770	985	13,000	18,000	7304B	22.5	0.141
25	42	9	18	0.3	0.15	7.15	4.95	730	505	17,000	22,000	7905	14	0.05
	47	12	24	0.6	0.3	10.7	6.85	1,100	700	16,000	21,000	7005	16.5	0.093
	52	15	30	1	0.6	16.2	10.3	1,650	1,050	14,000	19,000	7205	19	0.125
	52	15	30	1	0.6	14.8	9.40	1,510	960	12,000	16,000	7205B	24	0.129
	62	17	34	1.1	0.6	26.4	15.8	2,690	1,610	13,000	17,000	7305	21	0.23
	62	17	34	1.1	0.6	24.4	14.6	2,490	1,490	11,000	15,000	7305B	27	0.234
30	47	9	18	0.3	0.15	7.55	5.75	770	585	14,000	19,000	7906	15.5	0.056
	55	13	26	1	0.6	12.0	9.45	1,410	935	13,000	18,000	7006	19	0.135



Equivalent bearing load

dynamic

$$P_r = XF_r + YF_a$$

Contact angle	e	Single, DT				DB, DF			
		$F_a/F_r \leq e$		$F_a/F_r > e$		$F_a/F_r \leq e$		$F_a/F_r > e$	
		X	Y	X	Y	X	Y	X	Y
30°	0.80	1	0	0.39	0.76	1	0.78	0.63	1.24
40°	1.14	1	0	0.35	0.57	1	0.55	0.57	0.93

static

$$P_{or} = X_o F_r + Y_o F_a$$

Contact angle	Single, DT		DB, DF	
	X_o	Y_o	X_o	Y_o
30°	0.5	0.33	1	0.66
40°	0.5	0.26	1	0.52

For single and DT arrangement,

When $P_{or} < F_r$ use $P_{or} = F_r$

Basic load ratings				Limiting speeds ^①		Bearing numbers ^②			Abutment and fillet dimensions					
dynamic	static	dynamic	static	(duplex)		DB	DF	DT	mm					
(duplex)	(duplex)	(duplex)	(duplex)	grease	oil				d_a	d_b	D_a	D_b	r_{as}	r_{1as}
C_r	C_{or}	C_r	C_{or}	rpm					min	min	max	max	max	max
7.50	4.15	765	425	23,000	31,000	DB	DF	DT	12.5	12.5	23.5	24.8	0.3	0.15
8.80	5.45	900	560	22,000	30,000	DB	DF	DT	14.5	12.5	25.5	27.5	0.6	0.3
8.10	5.05	825	515	19,000	26,000	DB	DF	DT	14.5	12.5	25.5	27.5	0.6	0.3
16.5	9.85	1,680	1,000	20,000	27,000	DB	DF	DT	14.5	12.5	30.5	32.5	0.6	0.3
15.4	9.20	1,570	940	18,000	24,000	DB	DF	DT	14.5	12.5	30.5	32.5	0.6	0.3
8.20	4.90	840	500	21,000	28,000	DB	DF	DT	14.5	14.5	25.5	26.8	0.3	0.15
12.3	7.95	1,260	810	20,000	26,000	DB	DF	DT	16.5	14.5	27.5	29.5	0.6	0.3
11.4	7.35	1,160	750	17,000	23,000	DB	DF	DT	16.5	14.5	27.5	29.5	0.6	0.3
18.2	10.5	1,850	1,070	18,000	24,000	DB	DF	DT	17.5	16.5	31.5	32.5	1	0.6
17.1	9.90	1,750	1,010	16,000	21,000	DB	DF	DT	17.5	16.5	31.5	32.5	1	0.6
9.40	6.30	960	640	18,000	24,000	DB	DF	DT	17.5	17.5	29.5	30.8	0.3	0.15
14.7	9.40	1,500	960	17,000	23,000	DB	DF	DT	19.5	17.5	30.5	32.5	0.6	0.3
13.6	8.70	1,390	885	15,000	20,000	DB	DF	DT	19.5	17.5	30.5	32.5	0.6	0.3
21.9	14.4	2,230	1,470	15,000	21,000	DB	DF	DT	20.5	19.5	36.5	37.5	1	0.6
20.3	13.3	2,070	1,360	13,000	18,000	DB	DF	DT	20.5	19.5	36.5	37.5	1	0.6
11.6	7.65	1,190	780	17,000	22,000	DB	DF	DT	19.5	19.5	32.5	33.8	0.3	0.15
19.4	13.2	1,980	1,350	15,000	21,000	DB	DF	DT	21.5	19.5	35.5	37.5	0.6	0.3
17.9	12.2	1,830	1,250	13,000	18,000	DB	DF	DT	21.5	19.5	35.5	37.5	0.6	0.3
25.9	17.3	2,640	1,760	14,000	19,000	DB	DF	DT	22.5	21.5	41.5	42.5	1	0.6
24.0	16.0	2,450	1,640	12,000	16,000	DB	DF	DT	22.5	21.5	41.5	42.5	1	0.6
15.8	11.2	1,610	1,140	15,000	20,000	DB	DF	DT	24.5	24.5	37.5	39.5	0.6	0.3
23.6	16.8	2,400	1,710	14,000	18,000	DB	DF	DT	25.5	24.5	41.5	42.5	1	0.6
21.6	15.4	2,200	1,570	12,000	16,000	DB	DF	DT	25.5	24.5	41.5	42.5	1	0.6
30.5	20.8	3,100	2,130	12,000	17,000	DB	DF	DT	27	24.5	45	47.5	1	0.6
28.2	19.3	2,870	1,970	11,000	14,000	DB	DF	DT	27	24.5	45	47.5	1	0.6
11.6	9.95	1,180	1,010	13,000	18,000	DB	DF	DT	27.5	27.5	39.5	40.8	0.3	0.15
17.5	13.7	1,780	1,400	12,000	17,000	DB	DF	DT	29.5	29.5	42.5	44.5	0.6	0.3
26.3	20.6	2,690	2,100	11,000	15,000	DB	DF	DT	30.5	29.5	46.5	47.5	1	0.6
24.0	18.8	2,450	1,920	10,000	13,000	DB	DF	DT	30.5	29.5	46.5	47.5	1	0.6
43.0	31.5	4,400	3,250	10,000	14,000	DB	DF	DT	32	29.5	55	57.5	1	0.6
39.5	29.3	4,050	2,980	9,100	12,000	DB	DF	DT	32	29.5	55	57.5	1	0.6
12.3	11.5	1,250	1,170	12,000	15,000	DB	DF	DT	32.5	32.5	44.5	45.8	0.3	0.15
22.5	18.9	2,300	1,930	11,000	14,000	DB	DF	DT	35.5	35.5	49.5	50.5	1	0.6