

Deep Groove Ball Bearings



Deep Groove Ball Bearings

NTN



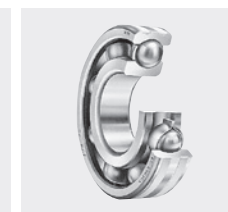
Open type



Shielded type



Sealed type
(non-contact)



Expansion
compensating bearing

1. Design features and characteristics

Deep groove ball bearings are very widely used. A deep groove is formed on the inner and outer ring of the bearing enabling the bearing to sustain radial and axial loads in either direction as well as the complex loads which result from the combination of these forces. Deep groove ball bearings are suitable for high speed applications.

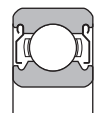
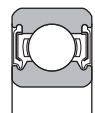
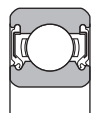
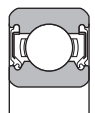
When two or more deep groove ball bearings are used in combination and mounted adjacent to each other a duplex set (D2) should be used. Duplex bearings (D2) utilize controlled tolerances to more evenly

distribute the loading between the individual bearing rows which improves the overall performance of the assembly.

In addition to unsealed and unlubricated "open" bearings, NTN provides deep groove ball bearings that are pre-lubricated with grease and enclosed by seals or shields. See section "11. Lubrication" for a list of some of the greases which can be used.

Table 1 shows the construction and special characteristics of various sealed deep groove ball bearings.

Table 1 Sealed ball bearings: construction and characteristics

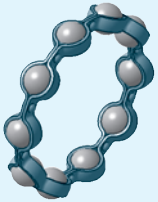
Types and codes		Shielded type	Sealed type		
		Non-contact type ZZ	Non-contact type LLB	Contact type LLU	Low torque type LLH
Construction					
		● Metal shield plate is affixed to the outside ring; the inner ring incorporates a V-groove and labyrinth clearance.	● The outer ring incorporates synthetic rubber molded to a steel plate; seal edge is aligned with V-groove along inner ring surface with labyrinth clearance.	● The outer ring incorporates synthetic rubber molded to a steel plate; seal edge contacts V-groove along inner ring surface.	● Basic construction is the same as LLU type, but a specially designed lip on the edge of the seal prevents foreign matter penetration; low torque construction.
Performance comparison	Torque	Small	Small	Higher	Medium
	Dust proofing	Good	Better than ZZ-type	Excellent	Much better than LLB-type
	Water proofing	Poor	Poor	Very good	Good
	High speed capacity	Same as open type	Same as open type	Limited by contact seals	Much better than LLU-type
	Allowable temp. range ¹⁾	Depends on lubricant	-20 to 120 °C	-20 to 110 °C	-20 to 120 °C

1) Please consult NTN Engineering about applications which exceed the allowable temperature range of products listed on this table.
Note: This chart lists double shielded and double sealed bearings, but single shielded (Z) and single sealed (LB, LU, LH) are also available. Grease lubrication should be used with single shielded and single sealed bearings.

2. Standard cage type

As shown in **Table 2**, pressed cages are generally used for most deep groove ball bearings. Larger size deep groove ball bearings, and bearings operating at high rotational speeds often utilize a machined cage.

Table 2 Standard cage for deep groove ball bearings

Cage type	Pressed cage	Machined cage
Bearing series		
67	6700 to 6706	—
68	6800 to 6834	6836 to 68 / 600
69	6900 to 6934	6936 to 69 / 500
160	16001 to 16052	16056 to 16072
60	6000 to 6052	6056 to 6084
62	6200 to 6244	—
63	6300 to 6344	—
64	6403 to 6416	—

3. Other deep groove ball bearing enhancements

3.1 Bearings with snap rings

A snap ring groove or snap ring groove with snap ring combination are optional enhancements for the outside diameter of most deep groove ball bearings. Snap rings allow for simpler axial positioning and installation in the housing. Snap rings can be utilized with both open type and sealed or shielded deep groove ball bearings. Consult **NTN Engineering**.

3.2 Expansion compensating bearings (creep prevention bearings)

NTN offers the innovative Expansion Compensating (EC) feature to help with bearing retention when mounted in light alloy housings which is often a problem at elevated temperatures due to property differences between the bearing steel and the housing. This functionality is achieved by machining circumferential grooves into the outside diameter of an otherwise standard outer ring. These grooves are filled with an optimized polymer which has an expansion rate higher than that of the typical light alloy housing. The net result is a more consistent interference fit across a wide operating temperature range. This more consistent fit condition helps prevent the bearing from rotating within the housing (known as bearing creep) which helps ensure good performance and long life.

(1) Allowable load

As a result of having grooves machined in the outside diameter, the ring strength is lower compared with a standard bearing. Thus, in order to prevent outer ring fracture, it is necessary to limit the maximum load applied to the bearing to be equal to or less than the allowable load C_P (see dimension table).

(2) Fit with housing

Table 3 shows the recommended fits for bearings with light metal alloy housings. In cases where the bearing is going to be interference fit with the housing, it is very important not to damage the polymer material. Therefore, it is essential that the lip of the housing diameter be given a 10 to 15° chamfer as shown in **Fig. 2**. Furthermore, as shown in **Fig. 2**, it is also advisable to apply the interference fit using a press in order not to force the bearing into the housing in a misaligned position.

Table 3 Recommended fits for outer ring and housing bore

Condition		Suitable bearing	Housing bore tolerance class
Load type, etc.	Housing material		
Rotating outer ring load Rotating inner ring load Indeterminate load	Light load Normal load	Deep groove ball bearings Cylindrical roller bearings	H6
Rotating outer ring load Indeterminate load	Heavy load Impact load	Thick-walled type deep groove ball bearings	N6

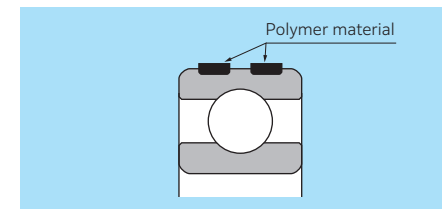


Fig. 1 Expansion compensating bearings

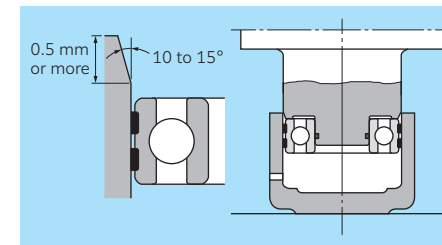


Fig. 2 Fitting method and housing bore diameter chamfer

(3) Radial internal clearance

Radial internal clearance are the same as those for standard deep groove ball bearings. With standard fit and application conditions, a C3 clearance is used. For more detailed information concerning this bearing, and the also manufactured of roller bearings contact **NTN Engineering**.

(4) Allowable temperature range

−20 to 120 °C

3.3 AC bearings (creep prevention bearings)

NTN Offers the AC type bearing which performs a similar function to the EC bearing. AC bearings have the same outside diameter dimensions as standard bearings with the addition of two O-rings located in circumferential grooves on the outside diameter of the outer ring (see **Fig. 3**). While the EC bearing is more beneficial when using a light alloy housing at elevated temperatures, AC bearings are suitable for applications where a “tight fit” is not possible but outer ring creeping exists under rotating load on the outer ring. AC bearing can also be installed as a floating side bearing to accommodate expansion of shaft by heat as it is more axial. Before installing the bearing into the housing, a high viscosity oil (base oil viscosity, 100 mm²/s or more) or grease must be applied to the space between two O-rings. This lubricant forms a thin oil layer on the bearing outer ring which prevents contact between the outer ring and housing, lowers the friction, and can minimize the occurrence of creeping by utilizing the friction force of the O-rings.

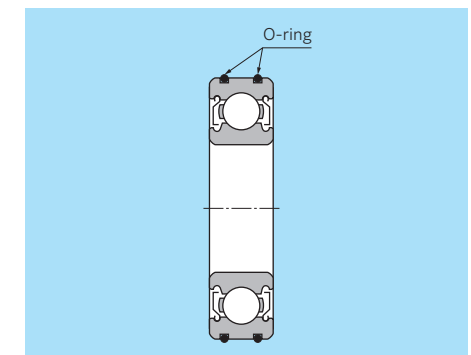


Fig. 3 AC bearing



(1) Allowable load

As is the case with the EC bearing, the load applied to an AC bearing shall be limited to C_p (see dimension table) in order to ensure the strength limit of the modified outer ring is not exceeded.

(2) Housing dimensions and shape

Fig. 4 shows the recommended shape of steel housings, and Table 4 shows the dimensions.

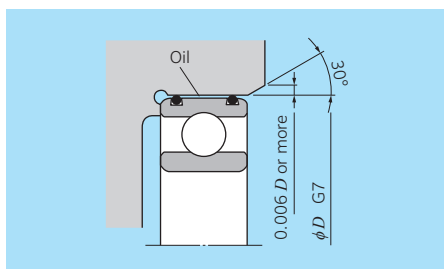


Fig. 4 Design of housing

Table 4 Dimensions and design

Housing bore tolerance	G7
Housing bore entrance chamfer	Max. 30°
Housing bore chamfer undercut	0.006D or more
Housing bore surface roughness Ra	2.5
Housing bore roundness	1/2 of bearing housing dimension tolerance

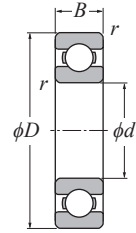
(3) Allowable temperature range

-20 to 120 °C



Deep Groove Ball Bearings

NTN



Open type



Shielded type
(ZZ)



Non-contact
sealed type
(LLB, LLF)



Low torque
sealed type
(LLH)



Contact
sealed type
(LLU)

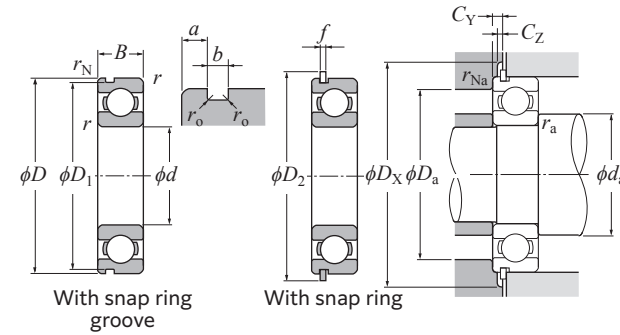
d 10–20 mm

Boundary dimensions				Basic load rating		Fatigue load limit kN	Factor	Allowable speed					Bearing number				
mm				dynamic kN	static kN			min ⁻¹					Open type		Shielded or sealed type ²⁾ (See drawings)		
d	D	B	r _s min ¹⁾	r _{Ns} Min.	C _r	C _{0r}	C _u	f ₀	Grease Open type ZZ, LLB, LLF Z, LB, LF	Oil Open type Z, LB, LF	LLH LH	LLU LU					
10	15	3	0.1	—	0.950	0.435	0.018	15.7	10 000	12 000	—	—	6700	—	—	—	—
	19	5	0.3	—	2.03	0.925	0.072	14.8	32 000	38 000	—	24 000	6800	ZZ	LLB	—	LLU
	22	6	0.3	0.3	2.99	1.27	0.099	14.0	30 000	36 000	25 000	21 000	6900	ZZ	LLB	LLH	LLU
	26	8	0.3	—	5.05	1.96	0.138	12.4	29 000	34 000	25 000	21 000	6000	ZZ	LLB	LLH	LLU
	30	9	0.6	0.5	5.65	2.39	0.182	13.2	25 000	30 000	21 000	18 000	6200	ZZ	LLB	LLH	LLU
	35	11	0.6	0.5	9.10	3.50	0.273	11.4	23 000	27 000	20 000	16 000	6300	ZZ	LLB	LLH	LLU
12	18	4	0.2	—	1.03	0.530	0.021	16.2	8 300	9 500	—	—	6701	—	LLF	—	—
	21	5	0.3	—	2.12	1.04	0.080	15.3	29 000	35 000	—	20 000	6801	ZZ	LLB	—	LLU
	24	6	0.3	0.3	3.20	1.46	0.115	14.5	27 000	32 000	22 000	19 000	6901	ZZ	LLB	LLH	LLU
	28	7	0.3	—	5.65	2.39	0.187	13.2	26 000	30 000	—	—	16001JR	—	—	—	—
	28	8	0.3	—	5.65	2.39	0.182	13.2	26 000	30 000	21 000	18 000	6001JR	ZZ	LLB	LLH	LLU
	32	10	0.6	0.5	6.75	2.75	0.214	12.7	22 000	26 000	20 000	16 000	6201	ZZ	LLB	LLH	LLU
15	37	12	1	0.5	10.8	4.20	0.325	11.1	20 000	24 000	19 000	15 000	6301	ZZ	LLB	LLH	LLU
	21	4	0.2	—	1.04	0.585	0.024	16.5	6 600	7 600	—	—	6702	—	LLF	—	—
	24	5	0.3	—	2.30	1.26	0.091	15.8	26 000	31 000	—	17 000	6802	ZZ	LLB	—	LLU
	28	7	0.3	0.3	4.05	2.00	0.157	14.8	24 000	28 000	—	16 000	6902	ZZ	LLB	—	LLU
	32	8	0.3	—	6.20	2.84	0.222	13.9	22 000	26 000	—	—	16002	—	—	—	—
	32	9	0.3	0.3	6.20	2.84	0.199	13.9	22 000	26 000	18 000	15 000	6002	ZZ	LLB	LLH	LLU
17	35	11	0.6	0.5	8.60	3.60	0.279	12.7	19 000	23 000	18 000	15 000	6202	ZZ	LLB	LLH	LLU
	42	13	1	0.5	12.7	5.45	0.425	12.3	17 000	21 000	15 000	12 000	6302	ZZ	LLB	LLH	LLU
	23	4	0.2	—	1.11	0.660	0.027	16.3	5 000	6 700	—	—	6703	—	LLF	—	—
	26	5	0.3	—	2.47	1.46	0.102	16.1	24 000	28 000	—	15 000	6803	ZZ	LLB	—	LLU
	30	7	0.3	0.3	5.15	2.58	0.202	14.7	22 000	26 000	—	14 000	6903JR	ZZ	LLB	—	LLU
	35	8	0.3	—	7.55	3.35	0.263	13.6	20 000	24 000	—	—	16003	—	—	—	—
20	35	10	0.3	0.3	7.55	3.35	0.243	13.6	20 000	24 000	16 000	14 000	6003	ZZ	LLB	LLH	LLU
	40	12	0.6	0.5	10.6	4.60	0.355	12.8	18 000	21 000	15 000	12 000	6203	ZZ	LLB	LLH	LLU
	47	14	1	0.5	15.0	6.55	0.510	12.2	16 000	19 000	14 000	11 000	6303	ZZ	LLB	LLH	LLU
	62	17	1.1	—	25.2	10.8	0.840	11.1	14 000	16 000	—	—	6403	ZZ	—	—	—
	27	4	0.2	—	1.15	0.730	0.031	16.1	5 000	5 700	—	—	6704	—	LLF	—	—
	32	7	0.3	0.3	4.45	2.47	0.185	15.5	21 000	25 000	—	13 000	6804JR	ZZ	LLB	—	LLU
20	37	9	0.3	0.3	7.05	3.70	0.288	14.7	19 000	23 000	—	12 000	6904	ZZ	LLB	—	LLU
	42	8	0.3	—	8.75	4.50	0.350	14.5	18 000	21 000	—	—	16004	—	—	—	—
	42	12	0.6	0.5	10.4	5.05	0.355	13.9	18 000	21 000	13 000	11 000	6004	ZZ	LLB	LLH	LLU
	47	14	1	0.5	14.2	6.65	0.505	13.2	16 000	18 000	12 000	10 000	6204	ZZ	LLB	LLH	LLU
	52	15	1.1	0.5	17.6	7.90	0.615	12.4	14 000	17 000	12 000	10 000	6304	ZZ	LLB	LLH	LLU

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

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Dynamic equivalent radial load
 $P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$	$\frac{F_a}{F_r} > e$
0.172	0.19	X	Y
0.345	0.22	1	0
0.689	0.26	0.56	Y
1.03	0.28	—	—
1.38	0.30	—	—
2.07	0.34	—	—
3.45	0.38	—	—
5.17	0.42	—	—
6.89	0.44	—	—

Static equivalent radial load

$$P_{0r} = 0.6F_r + 0.5F_a$$

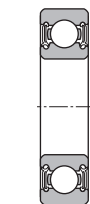
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number	Snap ring groove dimensions mm	Snap ring dimensions mm	Installation-related dimensions												Mass ⁵⁾	
			mm												kg	
			<i>D</i> ₁ Max.	<i>a</i> Max.	<i>b</i> Min.	<i>r</i> _o Max.	<i>D</i> ₂ Max.	<i>f</i> Max.	<i>d</i> _a Min.	<i>D</i> _a Max. ⁴⁾	<i>D</i> _X (approx.)	<i>C</i> _Y Max.	<i>C</i> _Z Min.	<i>r</i> _{as} Max.	<i>r</i> _{Nas} Max. (approx.)	
—	—	—	—	—	—	—	10.8	—	14.2	—	—	—	0.1	—	0.0015	
—	—	—	—	—	—	—	12	12.5	17	—	—	—	0.3	—	0.005	
N	NR	20.8	1.05	0.8	0.2	24.8	0.7	12	13	20	25.5	1.5	0.7	0.3	0.3	0.009
— ⁶⁾	— ⁶⁾	—	—	—	—	—	—	12	13.5	24	—	—	—	0.3	—	0.019
N	NR	28.17	2.06	1.35	0.4	34.7	1.12	14	16	26	35.5	2.9	1.2	0.6	0.5	0.032
N	NR	33.17	2.06	1.35	0.4	39.7	1.12	14	17	31	40.5	2.9	1.2	0.6	0.5	0.053
—	—	—	—	—	—	—	—	13.6	13.8	16.4	—	—	—	0.2	—	0.002
—	—	—	—	—	—	—	—	14	14.5	19	—	—	—	0.3	—	0.006
N	NR	22.8	1.05	0.8	0.2	26.8	0.7	14	15	22	27.5	1.5	0.7	0.3	0.3	0.011
—	—	—	—	—	—	—	—	14	—	26	—	—	—	0.3	—	0.019
NX2	NX2RX3	26.44	2.20	0.90	0.3	32.7	0.85	14	16	26	33.4	2.8	0.9	0.3	0.3	0.021
N	NR	30.15	2.06	1.35	0.4	36.7	1.12	16	17	28	37.5	2.9	1.2	0.6	0.5	0.037
N	NR	34.77	2.06	1.35	0.4	41.3	1.12	17	18.5	32	42	2.9	1.2	1	0.5	0.06
—	—	—	—	—	—	—	—	16.6	16.8	19.4	—	—	—	0.2	—	0.0025
—	—	—	—	—	—	—	—	17	17.5	22	—	—	—	0.3	—	0.007
N	NR	26.7	1.3	0.95	0.25	30.8	0.85	17	17.5	26	31.5	1.9	0.9	0.3	0.3	0.016
—	—	—	—	—	—	—	—	17	—	30	—	—	—	0.3	—	0.025
N	NR	30.15	2.06	1.35	0.4	36.7	1.12	17	19	30	37.5	2.9	1.2	0.3	0.3	0.03
N	NR	33.17	2.06	1.35	0.4	39.7	1.12	19	20	31	40.5	2.9	1.2	0.6	0.5	0.045
N	NR	39.75	2.06	1.35	0.4	46.3	1.12	20	23	37	47	2.9	1.2	1	0.5	0.082
—	—	—	—	—	—	—	—	18.6	18.8	21.4	—	—	—	0.2	—	0.0025
—	—	—	—	—	—	—	—	19	19.5	24	—	—	—	0.3	—	0.008
N	NR	28.7	1.3	0.95	0.25	32.8	0.85	19	20	28	33.5	1.9	0.9	0.3	0.3	0.018
—	—	—	—	—	—	—	—	19	—	33	—	—	—	0.3	—	0.032
N	NR	33.17	2.06	1.35	0.4	39.7	1.12	19	21	33	40.5	2.9	1.2	0.3	0.3	0.039
N	NR	38.1	2.06	1.35	0.4	44.6	1.12	21	23	36	45.5	2.9	1.2	0.6	0.5	0.066
N	NR	44.6	2.46	1.35	0.4	52.7	1.12	22	25	42	53.5	3.3	1.2	1	0.5	0.115
—	—	—	—	—	—	—	—	23.5	30	55.5	—	—	—	1	—	0.27
—	—	—	—	—	—	—	—	21.6	22.3	25.4	—	—	—	0.2	—	0.0045
N	NR	30.7	1.3	0.95	0.25	34.8	0.85	22	22.5	30	35.5	1.9	0.9	0.3	0.3	0.019
N	NR	35.7	1.7	0.95	0.25	39.8	0.85	22	24	35	40.5	2.3	0.9	0.3	0.3	0.036
—	—	—	—	—	—	—	—	22	—	40	—	—	—	0.3	—	0.051
N	NR	39.75	2.06	1.35	0.4	46.3	1.12	24	26	38	47	2.9	1.2	0.6	0.5	0.069
N	NR	44.6	2.46	1.35	0.4	52.7	1.12	25	28	42	53.5	3.3	1.2	1	0.5	0.106
N	NR	49.73	2.46	1.35	0.4	57.9	1.12	26.5	28.5	45.5	58.5	3.3	1.2	1	0.5	0.144

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.

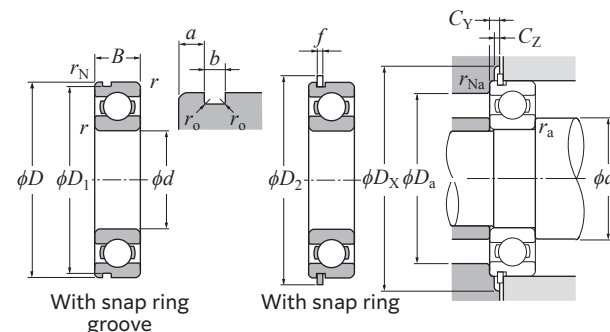
5) Does not include bearings with snap rings. 6) Refer to page B-54.

NTN



Contact
sealed type
(LLU)

1) Smallest allowable dimension for chamfer dimension r . 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.



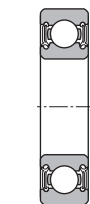
With snap ring

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19				2.30
0.345	0.22				1.90
0.689	0.26				1.70
1.03	0.28				1.50
1.38	0.30	1	0	0.56	1.40
2.07	0.34				1.30
3.45	0.38				1.10
5.17	0.42				1.00
6.89	0.44				1.00

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings.

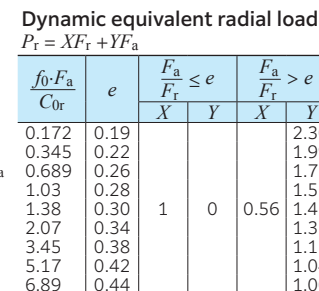
NTN



Contact
sealed type
(LLU)

1) Smallest allowable dimension for chamfer dimension r . 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

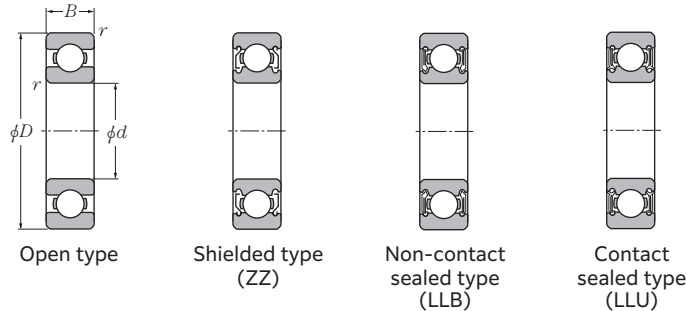
- NTN



3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.
5) Does not include bearings with snap rings.

Deep Groove Ball Bearings

NTN



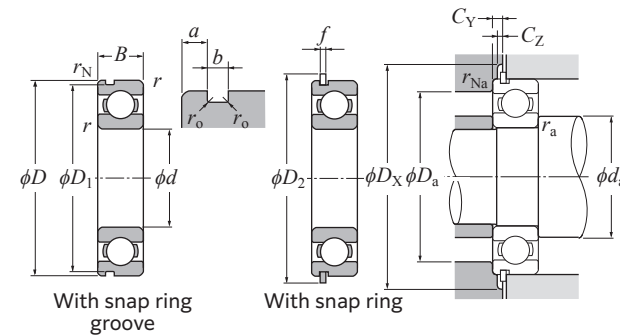
d 65–85 mm

Boundary dimensions	mm				Basic load rating		Fatigue load limit kN	Factor f_0	Allowable speed ¹⁾				Bearing number		
	d	D	B	$r_{s\min}^{1)}$	r_{Ns} Min.	C_r	C_{0r}		Grease Open type ZZ, LLB Z, LB	Oil Open type Z, LB	Open type LLU LU	Open type	Shielded or sealed type ²⁾ (See drawings)	Shielded or sealed type ²⁾ (See drawings)	Shielded or sealed type ²⁾ (See drawings)
65	85	10	0.6	0.5	12.8	11.0	0.730	16.2	7 400	8 700	4 100	6813	ZZ	LLB	LLU
	90	13	1	0.5	19.3	16.1	1.07	16.6	7 000	8 200	4 000	6913	ZZ	LLB	LLU
	100	11	0.6	—	22.7	18.7	1.26	16.5	6 500	7 700	—	16013	—	—	—
	100	18	1.1	0.5	34.0	25.2	1.83	15.8	6 500	7 700	3 900	6013	ZZ	LLB	LLU
	120	23	1.5	0.5	63.5	40.0	3.15	14.4	5 500	6 500	3 600	6213	ZZ	LLB	LLU
	140	33	2.1	0.5	103	60.0	4.60	13.2	4 900	5 800	3 300	6313	ZZ	LLB	LLU
	160	37	2.1	—	123	72.5	5.35	12.7	4 400	5 200	—	6413	—	—	—
70	90	10	0.6	0.5	13.4	11.9	0.795	16.1	6 900	8 100	3 800	6814	ZZ	LLB	LLU
	100	16	1	0.5	26.3	21.2	1.45	16.3	6 500	7 700	3 700	6914	ZZ	LLB	LLU
	110	13	0.6	—	27.0	22.6	1.52	16.5	6 100	7 100	—	16014	—	—	—
	110	20	1.1	0.5	42.0	31.0	2.30	15.6	6 100	7 100	3 600	6014	ZZ	LLB	LLU
	125	24	1.5	0.5	69.0	44.0	3.45	14.5	5 100	6 000	3 400	6214	ZZ	LLB	LLU
	150	35	2.1	0.5	115	68.0	5.10	13.2	4 600	5 400	3 100	6314	ZZ	LLB	LLU
	180	42	3	—	142	89.5	6.25	12.7	4 100	4 800	—	6414	—	—	—
75	95	10	0.6	0.5	13.9	12.9	0.855	16.0	6 400	7 600	3 600	6815	ZZ	LLB	LLU
	105	16	1	0.5	27.0	22.6	1.52	16.5	6 100	7 200	3 500	6915	ZZ	LLB	LLU
	115	13	0.6	—	27.6	24.0	1.60	16.6	5 700	6 700	—	16015	—	—	—
	115	20	1.1	0.5	44.0	33.5	2.44	15.8	5 700	6 700	3 300	6015	ZZ	LLB	LLU
	130	25	1.5	0.5	73.5	49.5	3.80	14.7	4 800	5 600	3 200	6215	ZZ	LLB	LLU
	160	37	2.1	0.5	126	77.0	5.55	13.2	4 300	5 000	2 900	6315	ZZ	LLB	LLU
	190	45	3	—	152	99.0	6.70	12.7	3 800	4 500	—	6415	—	—	—
80	100	10	0.6	0.5	14.0	13.3	0.885	16.0	6 000	7 100	3 400	6816	ZZ	LLB	LLU
	110	16	1	0.5	27.6	24.0	1.59	16.6	5 700	6 700	3 200	6916	ZZ	LLB	LLU
	125	14	0.6	—	28.1	25.1	1.64	16.4	5 300	6 200	—	16016	—	—	—
	125	22	1.1	0.5	53.0	40.0	2.91	15.6	5 300	6 200	3 100	6016	ZZ	LLB	LLU
	140	26	2	0.5	80.5	53.0	3.95	14.6	4 500	5 300	3 000	6216	ZZ	LLB	LLU
	170	39	2.1	0.5	136	86.5	6.05	13.3	4 000	4 700	2 700	6316	ZZ	LLB	LLU
	200	48	3	—	181	125	8.20	12.3	3 600	4 200	—	6416	—	—	—
85	110	13	1	0.5	20.7	19.0	1.26	16.2	5 700	6 700	3 100	6817	ZZ	LLB	LLU
	120	18	1.1	0.5	35.5	29.6	1.99	16.4	5 400	6 300	3 000	6917	ZZ	LLB	LLU
	130	14	0.6	—	28.7	26.2	1.68	16.4	5 000	5 900	—	16017	—	—	—
	130	22	1.1	0.5	55.0	43.0	3.00	15.8	5 000	5 900	2 900	6017	ZZ	LLB	LLU
	150	28	2	0.5	92.0	64.0	4.60	14.7	4 200	5 000	2 800	6217	ZZ	LLB	LLU
	180	41	3	0.5	147	97.0	6.55	13.3	3 800	4 500	2 600	6317	ZZ	LLB	LLU

1) Smallest allowable dimension for chamfer dimension r . 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

Deep Groove Ball Bearings

NTN



Dynamic equivalent radial load
 $P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

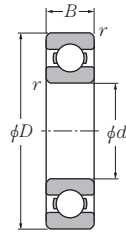
$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number		Snap ring groove dimensions				Snap ring dimensions		Installation-related dimensions										Mass ⁵⁾
		mm				mm		mm										kg
		Groove / Snap ring ³⁾ (See drawings)	D_1 Max.	a Max.	b Min.	r_o Max.	D_2 Max.	f Max.	Min.	d_a Max. ⁴⁾	D_a Max.	D_X (approx.)	C_Y Max.	C_Z Min.	r_{as} Max.	r_{Nas} Max.	(approx.)	
N	NR	82.9	1.7	1.3	0.4	89.4	1.12	69	70	81	91	2.5	1.2	0.6	0.5	0.128		
N	NR	87.9	2.1	1.3	0.4	94.4	1.12	70	71.5	85	96	2.9	1.2	1	0.5	0.206		
—	—	—	—	—	—	—	—	69	—	96	—	—	—	0.6	—	0.307		
N	NR	96.8	2.87	2.7	0.6	106.5	2.46	71.5	74	93.5	108	5	2.5	1	0.5	0.421		
N	NR	115.21	4.06	3.1	0.6	129.7	2.82	73	80.5	112	131.5	6.5	2.9	1.5	0.5	0.99		
N	NR	135.23	4.9	3.1	0.6	149.7	2.82	76	86	129	152	7.3	2.9	2	0.5	2.08		
—	—	—	—	—	—	—	—	76	—	149	—	—	—	2	—	3.3		
N	NR	87.9	1.7	1.3	0.4	94.4	1.12	74	75.5	86	96	2.5	1.2	0.6	0.5	0.137		
N	NR	97.9	2.5	1.3	0.4	104.4	1.12	75	77.5	95	106	3.3	1.2	1	0.5	0.334		
—	—	—	—	—	—	—	—	74	—	106	—	—	—	0.6	—	0.441		
N	NR	106.81	2.87	2.7	0.6	116.6	2.46	76.5	80.5	103.5	118	5	2.5	1	0.5	0.604		
N	NR	120.22	4.06	3.1	0.6	134.7	2.82	78	85	117	136.5	6.5	2.9	1.5	0.5	1.07		
N	NR	145.24	4.9	3.1	0.6	159.7	2.82	81	92.5	139	162	7.3	2.9	2	0.5	2.52		
—	—	—	—	—	—	—	—	83	—	167	—	—	—	2.5	—	4.83		
N	NR	92.9	1.7	1.3	0.4	99.4	1.12	79	80	91	101	2.5	1.2	0.6	0.5	0.145		
N	NR	102.6	2.5	1.3	0.4	110.7	1.12	80	82.5	100	112	3.3	1.2	1	0.5	0.353		
—	—	—	—	—	—	—	—	79	—	111	—	—	—	0.6	—	0.464		
N	NR	111.81	2.87	2.7	0.6	121.6	2.46	81.5	85.5	108.5	123	5	2.5	1	0.5	0.649		
N	NR	125.22	4.06	3.1	0.6	139.7	2.82	83	90.5	122	141.5	6.5	2.9	1.5	0.5	1.18		
N	NR	155.22	4.9	3.1	0.6	169.7	2.82	86	99	149	172	7.3	2.9	2	0.5	3.02		
—	—	—	—	—	—	—	—	88	—	177	—	—	—	2.5	—	5.72		
N	NR	97.9	1.7	1.3	0.4	104.4	1.12	84	85	96	106	2.5	1.2	0.6	0.5	0.154		
N	NR	107.6	2.5	1.3	0.4	115.7	1.12	85	88	105	117	3.3	1.2	1	0.5	0.373		
—	—	—	—	—	—	—	—	84	—	121	—	—	—	0.6	—	0.597		
N	NR	120.22	2.87	3.1	0.6	134.7	2.82	86.5	91.5	118.5	136.5	5.3	2.9	1	0.5	0.854		
N	NR	135.23	4.9	3.1	0.6	149.7	2.82	89	95.5	131	152	7.3	2.9	2	0.5	1.4		
N	NR	163.65	5.69	3.5	0.6	182.9	3.1	91	105	159	185	8.4	3.1	2	0.5	3.59		
—	—	—	—	—	—	—	—	93	—	187	—	—	—	2.5	—	6.76		
N	NR	107.6	2.1	1.3	0.4	115.7	1.12	90	91	105	117	2.9	1.2	1	0.5	0.27		
N	NR	117.6	3.3	1.3	0.4	125.7	1.12	91.5	94	113.5	127	4.1	1.2	1	0.5	0.536		
—	—	—	—	—	—	—	—	89	—	126	—	—	—	0.6	—	0.626		
N	NR	125.22	2.87	3.1	0.6	139.7	2.82	91.5	97	123.5	141.5	5.3	2.9	1	0.5	0.89		
N	NR	145.24	4.9	3.1	0.6	159.7	2.82	94	103	141	162	7.3	2.9	2	0.5	1.79		
N	NR	173.66	5.69	3.5	0.6	192.9	3.1	98	112	167	195	8.4	3.1	2.5	0.5	4.23		

Deep Groove Ball Bearings

NTN



Open type



Shielded type
(ZZ)



Non-contact
sealed type
(LLB)



Contact
sealed type
(LLU)

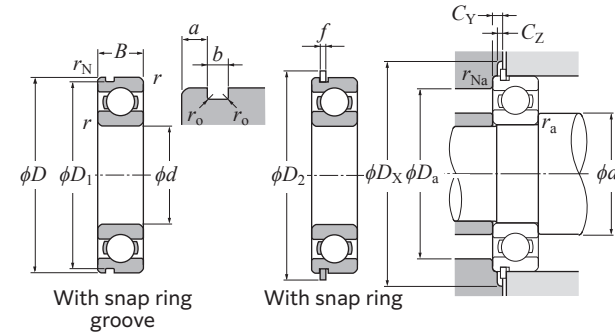
d 90–120 mm

Boundary dimensions				Basic load rating		Fatigue load limit kN	Factor	Allowable speed			Bearing number				
mm				dynamic kN	static kN			Grease Open type ZZ, LLB Z, LB	$\min^{-1}$ Oil Open type Z, LB	LLU LU	Open type	Shielded or sealed type ²⁾ (See drawings)			
d	D	B	$r_{s \min}^{1)}$	C_r	C_{0r}										
90	115	13	1	0.5	21.1	19.7	1.30	16.1	5 400	6 300	3 000	6818	ZZ	LLB	LLU
	125	18	1.1	0.5	36.5	31.5	2.05	16.5	5 100	6 000	2 900	6918	ZZ	LLB	LLU
	140	16	1	—	37.0	33.5	2.07	16.5	4 700	5 600	—	16018	—	—	—
	140	24	1.5	0.5	64.5	49.5	3.45	15.6	4 700	5 600	2 800	6018	ZZ	LLB	LLU
	160	30	2	0.5	106	71.5	5.00	14.5	4 000	4 700	2 600	6218	ZZ	LLB	LLU
	190	43	3	0.5	158	107	7.10	13.3	3 600	4 200	2 400	6318	ZZ	LLB	LLU
95	120	13	1	0.5	21.4	20.5	1.31	16.1	5 000	5 900	2 800	6819	ZZ	LLB	LLU
	130	18	1.1	0.5	37.5	33.5	2.10	16.6	4 800	5 700	2 800	6919	ZZ	LLB	LLU
	145	16	1	—	38.0	35.0	2.13	16.5	4 500	5 300	—	16019	—	—	—
	145	24	1.5	0.5	67.0	54.0	3.55	15.8	4 500	5 300	2 600	6019	ZZ	LLB	LLU
	170	32	2.1	0.5	121	82.0	5.55	14.4	3 700	4 400	2 500	6219	ZZ	LLB	LLU
	200	45	3	0.5	169	119	7.65	13.3	3 300	3 900	2 300	6319	ZZ	LLB	LLU
100	125	13	1	0.5	21.7	21.2	1.33	16.0	4 800	5 600	2 700	6820	ZZ	LLB	LLU
	140	20	1.1	0.5	45.5	39.5	2.44	16.4	4 500	5 300	2 600	6920	ZZ	LLB	LLU
	150	16	1	—	39.0	36.5	2.18	16.4	4 200	5 000	—	16020	—	—	—
	150	24	1.5	0.5	66.5	54.0	3.50	15.9	4 200	5 000	2 600	6020	ZZ	LLB	LLU
	180	34	2.1	0.5	135	93.0	6.15	14.4	3 500	4 200	2 300	6220	ZZ	LLB	LLU
	215	47	3	—	192	141	8.75	13.2	3 200	3 700	2 200	6320	ZZ	LLB	LLU
105	130	13	1	0.5	22.0	22.0	1.35	15.9	4 600	5 400	2 500	6821	ZZ	—	LLU
	145	20	1.1	0.5	47.0	42.0	2.52	16.5	4 300	5 100	2 500	6921	ZZ	LLB	LLU
	160	18	1	—	57.5	50.5	3.00	16.3	4 000	4 700	—	16021	—	—	—
	160	26	2	0.5	80.5	65.5	4.15	15.8	4 000	4 700	2 400	6021	ZZ	LLB	LLU
	190	36	2.1	0.5	147	105	6.75	14.4	3 400	4 000	2 300	6221	ZZ	LLB	LLU
	225	49	3	—	204	153	9.35	13.2	3 000	3 600	2 100	6321	ZZ	—	LLU
110	140	16	1	0.5	27.5	28.2	1.68	16.0	4 300	5 100	2 400	6822	ZZ	LLB	LLU
	150	20	1.1	0.5	48.5	44.5	2.60	16.6	4 100	4 800	2 400	6922	ZZ	LLB	LLU
	170	19	1	—	63.5	56.5	3.25	16.3	3 800	4 500	—	16022	—	—	—
	170	28	2	0.5	91.0	73.0	4.55	15.6	3 800	4 500	2 300	6022	ZZ	LLB	LLU
	200	38	2.1	0.5	160	117	7.35	14.3	3 200	3 800	2 200	6222	ZZ	LLB	LLU
	240	50	3	—	227	179	10.5	13.1	2 900	3 400	1 900	6322	ZZ	LLB	LLU
120	150	16	1	0.5	32.0	33.0	1.89	16.0	4 000	4 700	2 200	6824	ZZ	LLB	LLU
	165	22	1.1	0.5	59.0	54.0	3.05	16.5	3 800	4 400	2 100	6924	ZZ	—	LLU
	180	19	1	—	70.0	63.5	3.50	16.4	3 500	4 100	—	16024	—	—	—
	180	28	2	0.5	94.0	79.5	4.65	15.9	3 500	4 100	2 100	6024	ZZ	LLB	LLU

1) Smallest allowable dimension for chamfer dimension r . 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

Deep Groove Ball Bearings

NTN



With snap ring
groove

With snap ring

Dynamic equivalent radial load
 $P_r = XF_r + YF_a$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

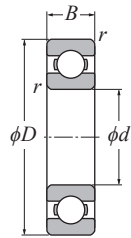
$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number	Snap ring groove dimensions	mm				Snap ring dimensions	Installation-related dimensions										Mass ⁵⁾	
		mm					mm											kg
		<i>D</i> ₁ Max.	<i>a</i> Max.	<i>b</i> Min.	<i>r</i> _o Max.		<i>D</i> ₂ Max.	<i>f</i> Max.	Min.	<i>d</i> _a Max. ⁴⁾	<i>D</i> _a Max.	<i>D</i> _X (approx.)	<i>C</i> _Y Max.	<i>C</i> _Z Min.	<i>r</i> _{as} Max.	<i>r</i> _{Nas} Max.		
Groove / Snap ring ³⁾ (See drawings)																		
N	NR	112.6	2.1	1.3	0.4	120.7	1.12	95	96	110	122	2.9	1.2	1	0.5	0.285	0.554	
N	NR	122.6	3.3	1.3	0.4	130.7	1.12	96.5	99	118.5	132	4.1	1.2	1	0.5	0.554		
—	—	—	—	—	—	—	—	95	—	135	—	—	—	1	—	0.848		
N	NR	135.23	3.71	3.1	0.6	149.7	2.82	98	102	132	152	6.1	2.9	1.5	0.5	1.02	2.15	
N	NR	155.22	4.9	3.1	0.6	169.7	2.82	99	109	151	172	7.3	2.9	2	0.5	2.15		
N	NR	183.64	5.69	3.5	0.6	202.9	3.1	103	118	177	205	8.4	3.1	2.5	0.5	4.91		
N	NR	117.6	2.1	1.3	0.4	125.7	1.12	100	101	115	127	2.9	1.2	1	0.5	0.3	0.579	
N	NR	127.6	3.3	1.3	0.4	135.7	1.12	101.5	104	123.5	137	4.1	1.2	1	0.5	0.579		
—	—	—	—	—	—	—	—	100	—	140	—	—	—	1	—	0.885		
N	NR	140.23	3.71	3.1	0.6	154.7	2.82	103	109	137	157	6.1	2.9	1.5	0.5	1.08	2.62	
N	NR	163.65	5.69	3.5	0.6	182.9	3.1	106	116	159	185	8.4	3.1	2	0.5	2.62		
N	NR	193.65	5.69	3.5	0.6	212.9	3.1	108	125	187	215	8.4	3.1	2.5	0.5	5.67		
N	NR	122.6	2.1	1.3	0.4	130.7	1.12	105	106	120	132	2.9	1.2	1	0.5	0.313	0.785	
N	NR	137.6	3.3	1.9	0.6	145.7	1.7	106.5	110	133.5	147	4.7	1.7	1	0.5	0.785		
—	—	—	—	—	—	—	—	105	—	145	—	—	—	1	—	0.91		
N	NR	145.24	3.71	3.1	0.6	159.7	2.82	108	110	142	162	6.1	2.9	1.5	0.5	1.15	3.14	
N	NR	173.66	5.69	3.5	0.6	192.9	3.1	111	122	169	195	8.4	3.1	2	0.5	3.14		
N	NR	208.6	5.69	3.5	1	227.8	3.1	113	133	202	230	8.4	3.1	2.5	0.5	7		
N	NR	127.6	2.1	1.3	0.4	135.7	1.12	110	111	125	137	2.9	1.2	1	0.5	0.33	0.816	
N	NR	142.6	3.3	1.9	0.6	150.7	1.7	111.5	115	138.5	152	4.7	1.7	1	0.5	0.816		
—	—	—	—	—	—	—	—	110	—	155	—	—	—	1	—	1.2		
N	NR	155.22	3.71	3.1	0.6	169.7	2.82	114	119	151	172	6.1	2.9	2	0.5	1.59	3.7	
N	NR	183.64	5.69	3.5	0.6	202.9	3.1	116	125	179	205	8.4	3.1	2	0.5	3.7		
N	NR	217.0	6.5	4.5	1	237	3.5	118	134	212	239	9.6	3.5	2.5	0.5	8.05		
N	NR	137.6	2.5	1.9	0.6	145.7	1.7	115	118	135	147	3.9	1.7	1	0.5	0.515	0.849	
N	NR	147.6	3.3	1.9	0.6	155.7	1.7	116.5	120	143.5	157	4.7	1.7	1	0.5	0.849		
—	—	—	—	—	—	—	—	115	—	165	—	—	—	1	—	1.46		
N	NR	163.65	3.71	3.5	0.6	182.9	3.1	119	126	161	185	6.4	3.1	2	0.5	1.96	4.36	
N	NR	193.65	5.69	3.5	0.6	212.9	3.1	121	132	189	215	8.4	3.1	2	0.5	4.36		
N	NR	232.0	6.5	4.5	1	252	3.5	123	149	227	254	9.6	3.5	2.5	0.5	9.54		
N	NR	147.6	2.5	1.9	0.6	155.7	1.7	125	128	145	157	3.9	1.7	1	0.5	0.555	1.15	
N	NR	161.8	3.7	1.9	0.6	171.5	1.7	126.5	132	158.5	173	5.1	1.7	1	0.5	1.15		
—	—	—	—	—	—	—	—	125	—	175	—	—	—	1	—	1.56		
N	NR	173.66	3.71	3.5	0.6	192.9	3.1	129	136	171	195	6.4	3.1	2	0.5	2.07		

Deep Groove Ball Bearings

NTN



Open type



Shielded type
(ZZ)



Contact
sealed type
(LLU)

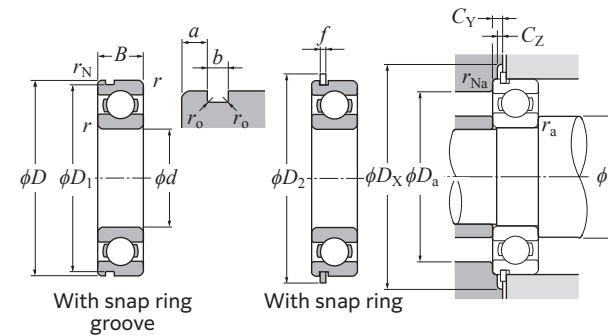
d 120–170 mm

Boundary dimensions				Basic load rating		Fatigue load limit	Factor	Allowable speed			Bearing number		
mm				dynamic	static	C_u	f_0	min^{-1}			Open type or sealed type ²⁾		
d	D	B	$r_{s \min}^{1)}$	C_r	C_{0r}			Grease Open type ZZ, Z	Oil Open type Z	LLU LU			
120	215	40	2.1	—	172	131	7.95	14.4	2 900	3 400	2 000	6224	ZZ LLU
	260	55	3	—	229	185	10.5	13.5	2 600	3 100	1 700	6324	ZZ LLU
130	165	18	1.1	0.5	41.0	41.0	2.25	16.1	3 700	4 300	2 000	6826	ZZ LLU
	180	24	1.5	0.5	72.0	67.5	3.65	16.5	3 500	4 100	1 900	6926	ZZ LLU
	200	22	1.1	—	88.5	79.5	4.25	16.2	3 200	3 800	—	16026	— —
	200	33	2	0.5	118	101	5.70	15.8	3 200	3 800	1 900	6026	ZZ LLU
	230	40	3	—	185	146	8.55	14.5	2 700	3 100	1 800	6226	ZZ LLU
	280	58	4	—	254	214	11.7	13.6	2 400	2 800	—	6326	— —
140	175	18	1.1	0.5	42.5	44.5	2.35	16.0	3 400	4 000	1 900	6828	ZZ LLU
	190	24	1.5	0.5	74.0	71.5	3.70	16.6	3 200	3 800	1 800	6928	ZZ LLU
	210	22	1.1	—	91.0	85.0	4.35	16.4	3 000	3 500	—	16028	— —
	210	33	2	—	122	109	5.85	15.9	3 000	3 500	1 800	6028	ZZ LLU
	250	42	3	—	184	150	8.40	14.8	2 500	2 900	1 600	6228	ZZ LLU
	300	62	4	—	280	246	13.0	13.6	2 200	2 600	—	6328	— —
150	190	20	1.1	0.5	53.0	55.0	2.80	16.1	3 100	3 700	1 700	6830	ZZ LLU
	210	28	2	—	94.0	90.5	4.55	16.5	3 000	3 500	1 700	6930	ZZ LLU
	225	24	1.1	—	107	101	5.00	16.4	2 800	3 200	—	16030	— —
	225	35	2.1	—	139	126	6.55	15.9	2 800	3 200	1 700	6030	ZZ LLU
	270	45	3	—	195	168	9.05	15.1	2 300	2 700	1 500	6230	ZZ LLU
	320	65	4	—	305	284	14.5	13.9	2 100	2 400	—	6330	— —
160	200	20	1.1	0.5	53.5	57.0	2.82	16.1	2 900	3 400	1 600	6832	ZZ LLU
	220	28	2	—	96.5	96.0	4.65	16.6	2 800	3 300	1 600	6932	ZZ LLU
	240	25	1.5	—	109	108	5.10	16.5	2 600	3 000	—	16032	— —
	240	38	2.1	—	158	144	7.30	15.9	2 600	3 000	1 600	6032	ZZ LLU
	290	48	3	—	205	186	9.45	15.4	2 100	2 500	—	6232	— —
	340	68	4	—	310	286	14.2	13.9	1 900	2 300	—	6332	— —
170	215	22	1.1	—	66.5	70.5	3.35	16.1	2 700	3 200	—	6834	ZZ —
	230	28	2	—	95.0	95.5	4.50	16.5	2 600	3 100	—	6934	ZZ —
	260	28	1.5	—	131	128	5.90	16.4	2 400	2 800	—	16034	— —
	260	42	2.1	—	187	172	8.55	15.8	2 400	2 800	—	6034	ZZ —
	310	52	4	—	235	223	11.1	15.3	2 000	2 400	—	6234	— —
	360	72	4	—	360	355	17.0	13.6	1 800	2 100	—	6334	— —

1) Smallest allowable dimension for chamfer dimension r . 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

Deep Groove Ball Bearings

NTN



With snap ring
groove

With snap ring

Dynamic equivalent radial load
 $P_r = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

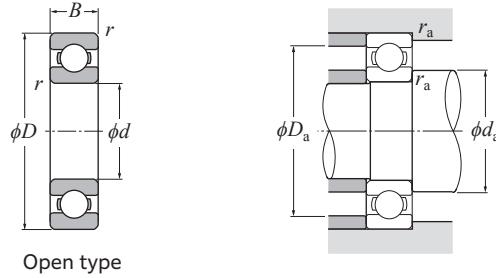
Static equivalent radial load

$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Bearing number (Groove / Snap ring ³⁾ (See drawings)		Snap ring groove dimensions mm				Snap ring dimensions mm		Installation-related dimensions										Mass ⁵⁾
		<i>D</i> ₁ Max.	<i>a</i> Max.	<i>b</i> Min.	<i>r</i> _o Max.	<i>D</i> ₂ Max.	<i>f</i> Max.	Min.	<i>d</i> _a Max. ⁴⁾	<i>D</i> _a Max.	mm						kg	
											<i>D</i> _X (approx.)	<i>C</i> _Y Max.	<i>C</i> _Z Min.	<i>r</i> _{as} Max.	<i>r</i> _{Nas} Max. (approx.)			
N	NR	217.0	6.5	4.5	1	227.8	3.1	131	143	204	230	9.2	3.1	2	0.5	5.15		
—	—	—	—	—	—	—	—	133	162	247	—	—	—	2.5	—	12.4		
N	NR	161.8	3.3	1.9	0.6	171.5	1.7	136.5	139.5	158.5	173	4.7	1.7	1	0.5	0.8		
N	NR	176.8	3.7	1.9	0.6	186.5	1.7	138	144	172	188	5.1	1.7	1.5	0.5	1.52		
—	—	—	—	—	—	—	—	136.5	—	193.5	—	—	—	1	—	2.31		
N	NR	193.65	5.69	3.5	0.6	212.9	3.1	139	148	191	215	8.4	3.1	2	0.5	3.16		
N	NR	222.0	6.5	4.5	1	242	3.5	143	158	217	244	9.6	3.5	2.5	0.5	5.82		
—	—	—	—	—	—	—	—	146	—	264	—	—	—	3	—	15.3		
N	NR	171.8	3.3	1.9	0.6	181.5	1.7	146.5	150	168.5	183	4.7	1.7	1	0.5	0.85		
N	NR	186.8	3.7	1.9	0.6	196.5	1.7	148	154	182	198	5.1	1.7	1.5	0.5	1.62		
—	—	—	—	—	—	—	—	146.5	—	203.5	—	—	—	1	—	2.45		
—	—	—	—	—	—	—	—	149	158	201	—	—	—	2	—	3.35		
N	NR	242.0	6.5	4.5	1	262	3.5	153	173	237	264	9.6	3.5	2.5	0.5	7.57		
—	—	—	—	—	—	—	—	156	—	284	—	—	—	3	—	18.5		
N	NR	186.8	3.3	1.9	0.6	196.5	1.7	156.5	161	183.5	198	4.7	1.7	1	0.5	1.16		
—	—	—	—	—	—	—	—	159	167	201	—	—	—	2	—	2.47		
—	—	—	—	—	—	—	—	156.5	—	218.5	—	—	—	1	—	3.07		
—	—	—	—	—	—	—	—	161	169	214	—	—	—	2	—	4.08		
—	—	—	—	—	—	—	—	163	188	257	—	—	—	2.5	—	9.41		
—	—	—	—	—	—	—	—	166	—	304	—	—	—	3	—	22		
N	NR	196.8	3.3	1.9	0.6	206.5	1.7	166.5	171	193.5	208	4.7	1.7	1	0.5	1.23		
—	—	—	—	—	—	—	—	169	178	211	—	—	—	2	—	2.61		
—	—	—	—	—	—	—	—	168	—	232	—	—	—	1.5	—	3.64		
—	—	—	—	—	—	—	—	171	183	229	—	—	—	2	—	5.05		
—	—	—	—	—	—	—	—	173	—	277	—	—	—	2.5	—	11.7		
—	—	—	—	—	—	—	—	176	—	324	—	—	—	3	—	26		
—	—	—	—	—	—	—	—	176.5	182	208.5	—	—	—	1	—	1.63		
—	—	—	—	—	—	—	—	179	188	221	—	—	—	2	—	2.74		
—	—	—	—	—	—	—	—	178	—	252	—	—	—	1.5	—	4.93		
—	—	—	—	—	—	—	—	181	196	249	—	—	—	2	—	6.76		
—	—	—	—	—	—	—	—	186	—	294	—	—	—	3	—	14.5		
—	—	—	—	—	—	—	—	186	—	344	—	—	—	3	—	30.7		

3) Sealed and shielded bearings are also available. 4) This dimension applies to sealed and shielded bearings.



Open type

d 180–260 mm

Boundary dimensions				Basic load rating		Fatigue load limit kN	Factor	Allowable speed		Bearing number
mm				dynamic kN	static kN			min ⁻¹		
d	D	B	r _s min ¹⁾	C _r	C _{0r}	C _u	f ₀	Grease lubrication	Oil lubrication	Open type
180	225	22	1.1	67.0	73.0	3.40	16.1	2 600	3 000	6836
	250	33	2	122	119	5.45	16.5	2 400	2 900	6936
	280	31	2	129	134	5.85	16.5	2 300	2 700	16036
	280	46	2.1	210	199	9.70	15.6	2 300	2 700	6036
	320	52	4	252	241	11.9	15.1	1 900	2 200	6236
	380	75	4	390	405	19.0	13.9	1 700	2 000	6336
190	240	24	1.5	81.0	88.0	4.00	16.1	2 400	2 900	6838
	260	33	2	125	127	5.65	16.6	2 300	2 700	6938
	290	31	2	149	156	6.70	16.6	2 100	2 500	16038
	290	46	2.1	218	215	10.1	15.8	2 100	2 500	6038
	340	55	4	282	281	13.5	15.0	1 800	2 100	6238
	400	78	5	395	415	18.9	14.1	1 600	1 900	6338
200	250	24	1.5	82.0	91.5	4.05	16.1	2 300	2 700	6840
	280	38	2.1	174	168	7.45	16.2	2 200	2 600	6940
	310	34	2	157	160	6.65	16.6	2 000	2 400	16040
	310	51	2.1	241	243	11.2	15.6	2 000	2 400	6040
	360	58	4	298	310	14.4	15.2	1 700	2 000	6240
	420	80	5	455	500	22.3	13.8	1 500	1 800	6340
220	270	24	1.5	84.5	98.0	4.15	16.0	2 100	2 400	6844
	300	38	2.1	178	180	7.55	16.4	2 000	2 300	6944
	340	37	2.1	200	216	8.65	16.5	1 800	2 200	16044
	340	56	3	267	289	12.5	15.8	1 800	2 200	6044
	400	65	4	330	365	15.8	15.3	1 500	1 800	6244
	460	88	5	455	520	22.0	14.3	1 400	1 600	6344
240	300	28	2	94.0	112	4.55	15.9	1 900	2 200	6848
	320	38	2.1	188	203	8.05	16.5	1 800	2 100	6948
	360	37	2.1	197	217	8.30	16.5	1 700	2 000	16048
	360	56	3	276	310	12.8	16.0	1 700	2 000	6048
260	320	28	2	96.5	120	4.65	15.8	1 700	2 000	6852
	360	46	2.1	245	280	10.9	16.3	1 600	1 900	6952
	400	44	3	252	299	11.1	16.5	1 500	1 800	16052
	400	65	4	325	375	15.1	15.8	1 500	1 800	6052

1) Smallest allowable dimension for chamfer dimension r.

Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

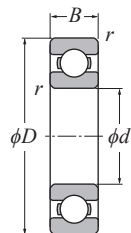
$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

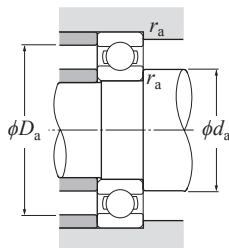
$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Installation-related dimensions			Mass kg (approx.)
d_a Min.	mm D_a Max.	r_{as} Max.	
186.5	218.5	1	2.03
189	241	2	4.76
189	271	2	6.49
191	269	2	8.8
196	304	3	15.1
196	364	3	35.6
198	232	1.5	2.62
199	251	2	4.98
199	281	2	6.77
201	279	2	9.18
206	324	3	18.2
210	380	4	41
208	242	1.5	2.73
211	269	2	7.1
209	301	2	8.68
211	299	2	11.9
216	344	3	21.6
220	400	4	46.3
228	262	1.5	3
231	289	2	7.69
231	329	2	11.3
233	327	2.5	15.7
236	384	3	30.2
240	440	4	60.8
249	291	2	4.6
251	309	2	8.28
251	349	2	12.1
253	347	2.5	16.8
269	311	2	5
271	349	2	13.9
273	387	2.5	18.5
276	384	3	25



Open type



d 280–440 mm

Boundary dimensions				Basic load rating		Fatigue load limit kN	Factor	Allowable speed		Bearing number
mm				dynamic kN	static kN			min ⁻¹		
d	D	B	r _{s min} ¹⁾	C _r	C _{0r}	C _u	f ₀	Grease lubrication	Oil lubrication	Open type
280	350	33	2	151	177	6.65	16.1	1 600	1 900	6856
	380	46	2.1	252	299	11.1	16.5	1 500	1 800	6956
	420	44	3	257	315	11.3	16.5	1 400	1 600	16056
	420	65	4	360	420	16.9	15.5	1 400	1 600	6056
300	380	38	2.1	179	210	7.60	16.1	1 500	1 700	6860
	420	56	3	305	375	13.7	16.2	1 400	1 600	6960
	460	50	4	325	410	14.5	16.3	1 300	1 500	16060
	460	74	4	395	480	18.4	15.6	1 300	1 500	6060
320	400	38	2.1	186	228	7.95	16.1	1 400	1 600	6864
	440	56	3	315	405	14.1	16.4	1 300	1 500	6964
	480	50	4	335	440	14.9	16.4	1 200	1 400	16064
	480	74	4	410	530	19.3	15.7	1 200	1 400	6064
340	420	38	2.1	189	236	8.05	16.0	1 300	1 500	6868
	460	56	3	325	430	14.4	16.5	1 200	1 400	6968
	520	57	4	380	515	17.0	16.3	1 100	1 300	16068
	520	82	5	465	610	21.9	15.6	1 100	1 300	6068
360	440	38	2.1	207	258	8.55	16.0	1 200	1 400	6872
	480	56	3	330	455	14.8	16.5	1 100	1 300	6972
	540	57	4	390	550	17.6	16.4	1 100	1 200	16072
	540	82	5	485	670	23.0	15.7	1 100	1 200	6072
380	480	46	2.1	256	340	10.8	16.1	1 100	1 300	6876
	520	65	4	360	510	15.9	16.6	1 100	1 200	6976
	560	82	5	505	725	24.1	15.9	990	1 200	6076
400	500	46	2.1	251	340	10.6	16.0	1 100	1 200	6880
	540	65	4	370	535	16.4	16.5	990	1 200	6980
	600	90	5	565	825	26.9	15.7	930	1 100	6080
420	520	46	2.1	288	405	12.4	16.1	1 000	1 200	6884
	560	65	4	380	560	16.8	16.4	940	1 100	6984
	620	90	5	590	895	28.3	15.8	880	1 000	6084
440	540	46	2.1	292	420	12.6	16.0	950	1 100	6888
	600	74	4	405	615	18.0	16.4	890	1 000	6988

1) Smallest allowable dimension for chamfer dimension r.

Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

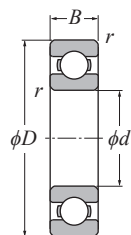
$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

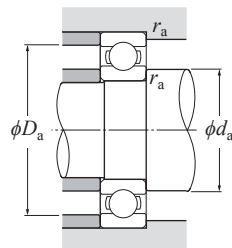
$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Installation-related dimensions			Mass kg (approx.)
d _a Min.	mm D _a Max.	r _{as} Max.	
289	341	2	7.4
291	369	2	14.8
293	407	2.5	23
296	404	3	31
311	369	2	10.5
313	407	2.5	23.5
316	444	3	32.5
316	444	3	43.8
331	389	2	10.9
333	427	2.5	24.8
336	464	3	34.2
336	464	3	46.1
351	409	2	11.5
353	447	2.5	26.2
356	504	3	47.1
360	500	4	61.8
371	429	2	12.3
373	467	2.5	27.5
376	524	3	49.3
380	520	4	64.7
391	469	2	19.7
396	504	3	39.8
400	540	4	67.5
411	489	2	20.6
416	524	3	41.6
420	580	4	87.6
431	509	2	21.6
436	544	3	43.4
440	600	4	91.1
451	529	2	22.5
456	584	3	60



Open type



d 460–600 mm

Boundary dimensions				Basic load rating		Fatigue load limit kN	Factor	Allowable speed		Bearing number
mm				dynamic	static			min ⁻¹		
<i>d</i>	<i>D</i>	<i>B</i>	<i>r_s</i> min ¹⁾	<i>C_r</i>	<i>C_{0r}</i>				Grease lubrication	
460	580	56	3	350	515	15.1	16.2	900	1 100	6892
	620	74	4	415	645	18.5	16.4	850	1 000	6992
480	600	56	3	355	540	15.4	16.1	860	1 000	6896
	650	78	5	480	770	21.5	16.5	810	950	6996
500	620	56	3	360	560	15.7	16.1	820	970	68/500
	670	78	5	490	805	22.2	16.5	770	910	69/500
530	650	56	3	365	580	15.9	16.0	770	900	68/530
560	680	56	3	370	600	16.1	16.0	710	840	68/560
600	730	60	3	415	705	18.2	16.0	660	780	68/600

1) Smallest allowable dimension for chamfer dimension r.

Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

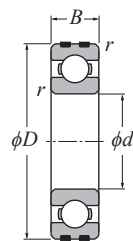
$$P_{0r} = 0.6 F_r + 0.5 F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Installation-related dimensions			Mass kg (approx.)
d _a Min.	mm D _a Max.	r _{as} Max.	
473	567	2.5	34.8
476	604	3	62.2
493	587	2.5	36.2
500	630	4	73
513	607	2.5	37.5
520	650	4	75.5
543	637	2.5	39.5
573	667	2.5	41.5
613	717	2.5	51.7

Expansion Compensating Bearings

NTN



Open type



Shielded type
(ZZ)



Non-contact
sealed type
(LLB)



Low torque
sealed type
(LLH)



Contact
sealed type
(LLU)

d 10–50 mm

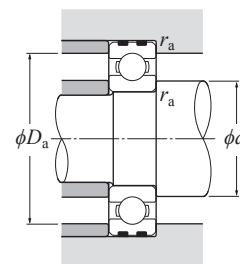
Boundary dimensions	Basic load rating		Fatigue load limit	Allowable load	Factor	Allowable speed				Bearing number			
	mm	dynamic kN	static kN										
	d D B r _{s min} ¹⁾	C _r	C _{0r}	C _u	C _p	f ₀	Grease Open type ZZ, LLB	Oil Open type Z, LLB	LLH LH	LLU LU	Open type	Shielded or sealed type ²⁾ (See drawings)	
10	26 8 0.3	5.05	1.96	0.138	1.65	12.4	29 000	34 000	25 000	21 000	EC-6000	ZZ LLB LLH LLU	
	30 9 0.6	5.65	2.39	0.182	2.39	13.2	25 000	30 000	21 000	18 000	EC-6200	ZZ LLB LLH LLU	
	35 11 0.6	9.10	3.50	0.273	3.45	11.4	23 000	27 000	20 000	16 000	EC-6300	ZZ LLB LLH LLU	
12	28 8 0.3	5.65	2.39	0.182	1.78	13.2	26 000	30 000	21 000	18 000	EC-6001JRX	ZZ LLB LLH LLU	
	32 10 0.6	6.75	2.75	0.214	2.29	12.7	22 000	26 000	20 000	16 000	EC-6201	ZZ LLB LLH LLU	
	37 12 1	10.8	4.20	0.325	3.65	11.1	20 000	24 000	19 000	15 000	EC-6301	ZZ LLB LLH LLU	
15	32 9 0.3	6.20	2.83	0.199	2.83	13.9	22 000	26 000	18 000	15 000	EC-6002	ZZ LLB LLH LLU	
	35 11 0.6	8.60	3.60	0.279	2.78	12.7	19 000	23 000	18 000	15 000	EC-6202	ZZ LLB LLH LLU	
	42 13 1	12.7	5.45	0.425	4.40	12.3	17 000	21 000	15 000	12 000	EC-6302	ZZ LLB LLH LLU	
17	35 10 0.3	7.55	3.35	0.263	2.88	13.6	20 000	24 000	16 000	14 000	EC-6003	ZZ LLB LLH LLU	
	40 12 0.6	10.6	4.60	0.243	3.45	12.8	18 000	21 000	15 000	12 000	EC-6203	ZZ LLB LLH LLU	
	47 14 1	15.0	6.55	0.355	6.55	12.2	16 000	19 000	14 000	11 000	EC-6303	ZZ LLB LLH LLU	
20	42 12 0.6	10.4	5.05	0.355	5.05	13.9	18 000	21 000	13 000	11 000	EC-6004	ZZ LLB LLH LLU	
	47 14 1	14.2	6.65	0.505	5.05	13.2	16 000	18 000	12 000	10 000	EC-6204	ZZ LLB LLH LLU	
	52 15 1.1	17.6	7.90	0.615	7.90	12.4	14 000	17 000	12 000	10 000	EC-6304	ZZ LLB LLH LLU	
25	47 12 0.6	11.2	5.85	0.380	5.85	14.5	15 000	18 000	11 000	9 400	EC-6005	ZZ LLB LLH LLU	
	52 15 1	15.5	7.85	0.550	6.55	13.9	13 000	15 000	11 000	8 900	EC-6205	ZZ LLB LLH LLU	
	62 17 1.1	23.5	10.9	0.855	10.9	12.6	12 000	14 000	9 700	8 100	EC-6305	ZZ LLB LLH LLU	
30	55 13 1	14.7	8.30	0.650	8.30	14.8	13 000	15 000	9 200	7 700	EC-6006	ZZ LLB LLH LLU	
	62 16 1	21.6	11.3	0.795	9.85	13.8	11 000	13 000	8 800	7 300	EC-6206	ZZ LLB LLH LLU	
	72 19 1.1	29.5	15.0	1.14	15.0	13.3	10 000	12 000	7 900	6 600	EC-6306	ZZ LLB LLH LLU	
35	62 14 1	17.7	10.3	0.805	10.3	14.8	12 000	14 000	8 200	6 800	EC-6007	ZZ LLB LLH LLU	
	72 17 1.1	28.4	15.3	1.09	14.5	13.8	9 800	11 000	7 600	6 300	EC-6207	ZZ LLB LLH LLU	
	80 21 1.5	37.0	19.1	1.47	18.5	13.1	8 800	10 000	7 300	6 000	EC-6307	ZZ LLB LLH LLU	
40	68 15 1	18.6	11.5	0.890	11.5	15.2	10 000	12 000	7 300	6 100	EC-6008	ZZ LLB LLH LLU	
	80 18 1.1	32.5	17.8	1.24	17.5	14.0	8 700	10 000	6 700	5 600	EC-6208	ZZ LLB LLH LLU	
	90 23 1.5	45.0	24.0	1.83	23.4	13.2	7 800	9 200	6 400	5 300	EC-6308	ZZ LLB LLH LLU	
45	75 16 1	23.2	15.1	1.16	15.1	15.3	9 200	11 000	6 500	5 400	EC-6009	ZZ LLB LLH LLU	
	85 19 1.1	36.0	20.4	1.60	20.3	14.1	7 800	9 200	6 200	5 200	EC-6209	ZZ LLB LLH LLU	
	100 25 1.5	58.5	32.0	2.50	27.4	13.1	7 000	8 200	5 600	4 700	EC-6309	ZZ LLB LLH LLU	
50	80 16 1	24.2	16.6	1.24	16.6	15.5	8 400	9 800	6 000	5 000	EC-6010	ZZ LLB LLH LLU	
	90 20 1.1	39.0	23.2	1.82	17.7	14.4	7 100	8 300	5 700	4 700	EC-6210	ZZ LLB LLH LLU	
	110 27 2	68.5	38.5	2.99	33.0	13.2	6 400	7 500	5 000	4 200	EC-6310	ZZ LLB LLH LLU	

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.

B-40

Expansion Compensating Bearings

NTN



Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34	1	0	0.56	1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

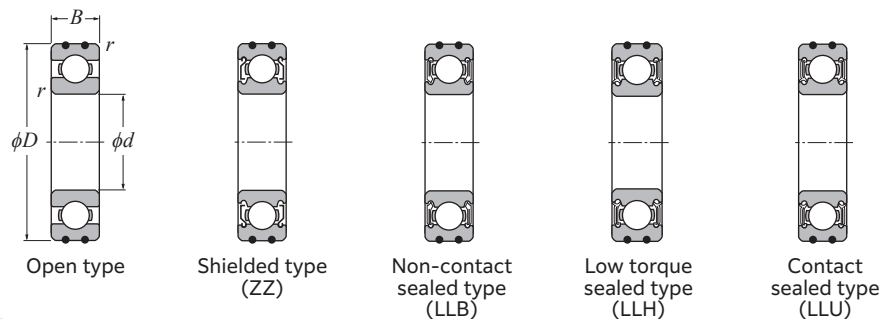
$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Installation-related dimensions				Mass	
mm				kg	
Min.	d _a Max. ³⁾	D _a Max.	r _{as} Max.	Open type (approx.)	
12	13.5	24	0.3	0.019	
14	16	26	0.6	0.031	
14	17	31	0.6	0.051	
14	16	26	0.3	0.021	
16	17.5	28	0.6	0.036	
17	18.5	32	1	0.058	
17	19	30	0.3	0.029	
19	20.5	31	0.6	0.043	
20	23	37	1	0.079	
19	21	33	0.3	0.037	
21	23	36	0.6	0.062	
22	25	42	1	0.11	
24	26	38	0.6	0.066	
25	28	42	1	0.101	
26.5	28.5	45.5	1	0.139	
29	30.5	43	0.6	0.075	
30	32	47	1	0.122	
31.5	35	55.5	1	0.223	
35	37	50	1	0.11	
35	39	57	1	0.191	
36.5	43	65.5	1	0.334	
40	42	57	1	0.148	
41.5	45	65.5	1	0.277	
43	47	72	1.5	0.44	
45	47	63	1	0.183	
46.5	51	73.5	1	0.352	
48	54	82	1.5	0.609	
50	52.5	70	1	0.233	
51.5	55.5	78.5	1	0.391	
53	61.5	92	1.5	0.80	
55	57.5	75	1	0.246	
56.5	60	83.5	1	0.444	
59	68.5	101	2	1.03	

3) This dimension applies to sealed and shielded bearings.

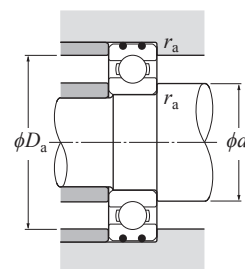
B-41



d 10–45 mm

Boundary dimensions				Basic load rating		Fatigue load limit kN	Allowable load kN	Factor <i>f</i> ₀	Allowable speed				Bearing number				
				dynamic kN	static kN				min ⁻¹	Grease Open type ZZ, LLB Z, LB	Oil Open type Z, LB	LLH LH	LLU LU	Open type	Shielded or sealed type ²⁾ (See drawings)		
<i>d</i>	<i>D</i>	<i>B</i>	<i>r</i> _{s min} ¹⁾	<i>C</i> _r	<i>C</i> _{0r}	<i>C</i> _u	<i>C</i> _p										
10	26	8	0.3	5.05	1.96	0.138	1.53	12.4	29 000	34 000	25 000	21 000	AC-6000	ZZ	LLB	LLH	LLU
	30	9	0.6	5.65	2.39	0.182	2.39	13.2	25 000	30 000	21 000	18 000	AC-6200	ZZ	LLB	LLH	LLU
	35	11	0.6	9.10	3.50	0.273	2.98	11.4	23 000	27 000	20 000	16 000	AC-6300	ZZ	LLB	LLH	LLU
12	28	8	0.3	5.65	2.39	0.182	1.73	13.2	26 000	30 000	21 000	18 000	AC-6001JRX	ZZ	LLB	LLH	LLU
	32	10	0.6	6.75	2.75	0.214	2.75	12.7	22 000	26 000	20 000	16 000	AC-6201	ZZ	LLB	LLH	LLU
	37	12	1	10.8	4.20	0.325	3.00	11.1	20 000	24 000	19 000	15 000	AC-6301	ZZ	LLB	LLH	LLU
15	32	9	0.3	6.20	2.83	0.199	2.43	13.9	22 000	26 000	18 000	15 000	AC-6002	ZZ	LLB	LLH	LLU
	35	11	0.6	8.60	3.60	0.279	2.71	12.7	19 000	23 000	18 000	15 000	AC-6202	ZZ	LLB	LLH	LLU
	42	13	1	12.7	5.45	0.425	3.90	12.3	17 000	21 000	15 000	12 000	AC-6302	ZZ	LLB	LLH	LLU
17	35	10	0.3	7.55	3.35	0.263	2.44	13.6	20 000	24 000	16 000	14 000	AC-6003	ZZ	LLB	LLH	LLU
	40	12	0.6	10.6	4.60	0.243	3.50	12.8	18 000	21 000	15 000	12 000	AC-6203	ZZ	LLB	LLH	LLU
	47	14	1	15.0	6.55	0.355	5.10	12.2	16 000	19 000	14 000	11 000	AC-6303	ZZ	LLB	LLH	LLU
20	42	12	0.6	10.4	5.05	0.355	3.80	13.9	18 000	21 000	13 000	11 000	AC-6004	ZZ	LLB	LLH	LLU
	47	14	1	14.2	6.65	0.505	4.20	13.2	16 000	18 000	12 000	10 000	AC-6204	ZZ	LLB	LLH	LLU
	52	15	1.1	17.6	7.90	0.615	5.40	12.4	14 000	17 000	12 000	10 000	AC-6304	ZZ	LLB	LLH	LLU
25	47	12	0.6	11.2	5.85	0.380	4.50	14.5	15 000	18 000	11 000	9 400	AC-6005	ZZ	LLB	LLH	LLU
	52	15	1	15.5	7.85	0.550	5.80	13.9	13 000	15 000	11 000	8 900	AC-6205	ZZ	LLB	LLH	LLU
	62	17	1.1	23.5	10.9	0.855	7.30	12.6	12 000	14 000	9 700	8 100	AC-6305	ZZ	LLB	LLH	LLU
30	55	13	1	14.7	8.30	0.650	6.85	14.8	13 000	15 000	9 200	7 700	AC-6006	ZZ	LLB	LLH	LLU
	62	16	1	21.6	11.3	0.795	7.55	13.8	11 000	13 000	8 800	7 300	AC-6206	ZZ	LLB	LLH	LLU
	72	19	1.1	29.5	15.0	1.14	11.0	13.3	10 000	12 000	7 900	6 600	AC-6306	ZZ	LLB	LLH	LLU
35	62	14	1	17.7	10.3	0.805	8.95	14.8	12 000	14 000	8 200	6 800	AC-6007	ZZ	LLB	LLH	LLU
	72	17	1.1	28.4	15.3	1.09	9.65	13.8	9 800	11 000	7 600	6 300	AC-6207	ZZ	LLB	LLH	LLU
	80	21	1.5	37.0	19.1	1.47	13.4	13.1	8 800	10 000	7 300	6 000	AC-6307	ZZ	LLB	LLH	LLU
40	80	18	1.1	32.5	17.8	1.24	11.6	14.0	8 700	10 000	6 700	5 600	AC-6208	ZZ	LLB	LLH	LLU
	90	23	1.5	45.0	24.0	1.83	16.6	13.2	7 800	9 200	6 400	5 300	AC-6308	ZZ	LLB	LLH	LLU
45	85	19	1.1	36.0	20.4	1.60	14.7	14.1	7 800	9 200	6 200	5 200	AC-6209	ZZ	LLB	LLH	LLU
	100	25	1.5	58.5	32.0	2.50	21.8	13.1	7 000	8 200	5 600	4 700	AC-6309	ZZ	LLB	LLH	LLU

1) Smallest allowable dimension for chamfer dimension r. 2) This bearing number is for double sealed and double shielded type bearings, but single sealed and single shielded type are also available.



Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

$\frac{f_0 \cdot F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

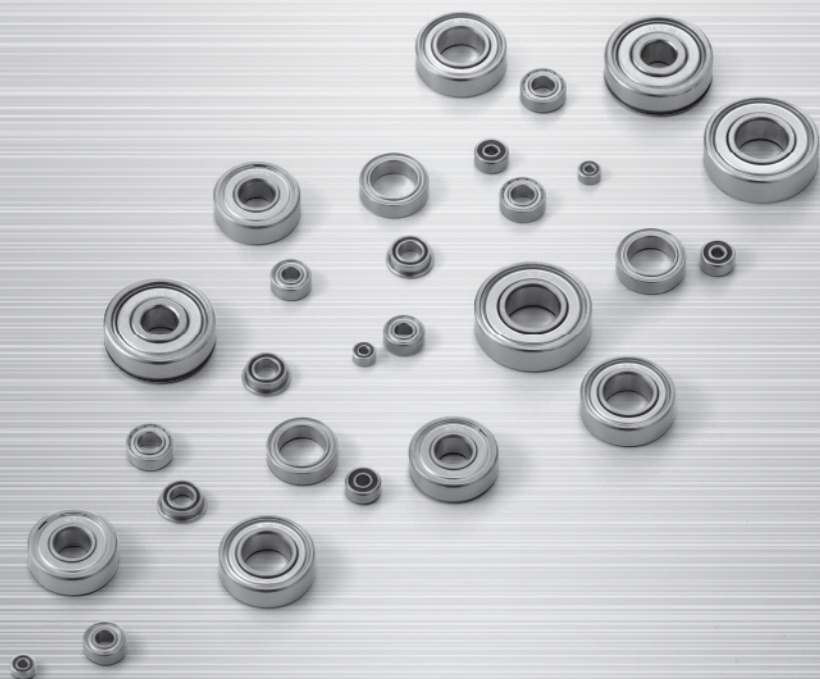
$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Installation-related dimensions				Mass	
mm				kg	
Min.	d _a Max. ³⁾	D _a Max.	r _a Max.	Open type (approx.)	
12	13.5	24	0.3	0.019	
14	16	26	0.6	0.031	
14	17	31	0.6	0.051	
14	16	26	0.3	0.021	
16	17.5	28	0.6	0.036	
17	18.5	32	1	0.058	
17	19	30	0.3	0.029	
19	20.5	31	0.6	0.043	
20	23	37	1	0.079	
19	21	33	0.3	0.037	
21	23	36	0.6	0.062	
22	25	42	1	0.11	
24	26	38	0.6	0.066	
25	28	42	1	0.101	
26.5	28.5	45.5	1	0.139	
29	30.5	43	0.6	0.075	
30	32	47	1	0.122	
31.5	35	55.5	1	0.223	
35	37	50	1	0.11	
35	39	57	1	0.191	
36.5	43	65.5	1	0.334	
40	42	57	1	0.148	
41.5	45	65.5	1	0.277	
43	47	72	1.5	0.44	
46.5	51	73.5	1	0.352	
48	54	82	1.5	0.609	
51.5	55.5	78.5	1	0.391	
53	61.5	92	1.5	0.8	

3) This dimension applies to sealed and shielded bearings.

Miniature and Small Size Ball Bearings



● Miniature and Small Size Ball Bearings

NTN



Open type



Shielded type



Shielded type with snap ring

1. Design features and characteristics

The dimensional range of miniature and small size ball bearings can be found in **Table 1**. Boundary dimensions for both metric and inch series are in accordance with the internationally specified ISO and ANSI/ABMA standards. The most widely used sealed and shielded type ball bearings generally have a 1 to 2 mm wider width dimension than open type bearings.

The main variations of these bearings are shown in **Table 2**. Miniature and small size ball bearings can also utilize snap rings, which simplify assembly within the housing. These bearings with snap rings can also be found in the dimensional tables in this catalog.

Among the most generally used sealed and shielded bearings are standard ZZ and ZZA type which incorporate non-contact steel shield plates. **Fig. 1** also shows non-contact type rubber sealed LLB and resin sealed SSA type bearings, as well as the contact-type rubber sealed LLU bearing.

Section "11. Lubrication" provides additional information on grease filled within the sealed and shielded bearings.

Table 1 Dimensional range

Bearing	Dimensional range
Miniature ball bearings	Nominal outside diameter $D < 9$ mm
Small size ball bearings	Nominal bore diameter $d < 10$ mm Nominal outside diameter $D \geq 9$ mm

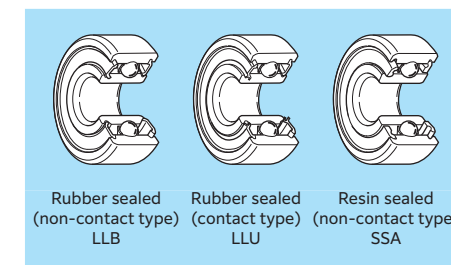


Fig. 1

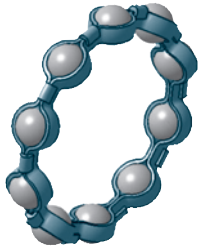
Table 2 Main types and construction

Type	Standard type code			Flange-attached type code		
	Construction	Metric series	Inch series	Construction	Metric series	Inch series
Open type		6 BC	R		FL6 FLBC	FLR
Shielded type		6 x x ZZ W6 x x ZZ WBC x x x ZZ	RA x x ZZ		FL6 x x x ZZ FLW6 x x x ZZ FLWBC x x x ZZ	FLRA x x ZZ

Note: 1. Representative codes are shown. For further details, please refer to dimension tables.
2. May change to ZA or SA for shielded type bearings, according to the bearing number.

2. Standard cage type

Pressed steel cages are standard for miniature and small size bearings.



3. Dimensional and rotational accuracy

The accuracy of miniature and small size ball bearings complies with JIS standards. Accuracy of these bearings is defined by Table A-54 in section "6. Bearing Accuracy." Flange accuracies are listed in Table 3.

Table 3 Tolerance and tolerance values for outer ring flange

Unit: μm

Accuracy class		Outside diameter dimensional tolerance ΔD_{1s} or ΔD_{2s} Upper Lower	Outer ring surface runout for rear surface S_{D1} Max.	Back face axial runout S_{ea1} Max.	Width deviation ΔC_{1s} or ΔC_{2s} Upper Lower	Width unevenness V_{C1s} or V_{C2s} Max.
ISO standard	Class 0	* (see table below)	—	—	Identical to same bearings inner ring ΔB_s .	Identical to same bearings inner ring V_{Bs} .
	Class 6		—	—		
	Class 5		8	11		5
	Class 4		4	7		2.5
	Class 2		1.5	3 ¹⁾ 4		1.5

1) Applies to nominal outside diameter D of 18 mm or less.

* Unit: μm

Flange nominal outside diameter D_1 or D_2 mm		Outside diameter dimensional tolerance ΔD_{1s} or ΔD_{2s}	
Over	Incl.	Upper	Lower
—	10	+220	-36
10	18	+270	-43
18	30	+330	-52
30	50	+390	-62

4. Radial internal clearance

Radial internal clearance is defined by Table A-88 in section "8. Internal Clearance and Preload."

The radial clearance values for high precision miniature and small size ball bearings can be found in Table 4.

Table 4 Radial internal clearance for high precision bearings

Unit: μm

MIL Standard	Tight				Standard						Loose		Extra Loose	
Code	C2S		CNS		CNM		CNL		C3S		C3M		C3L	
Internal clearance	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	0	5	3	8	5	10	8	13	10	15	13	20	20	28

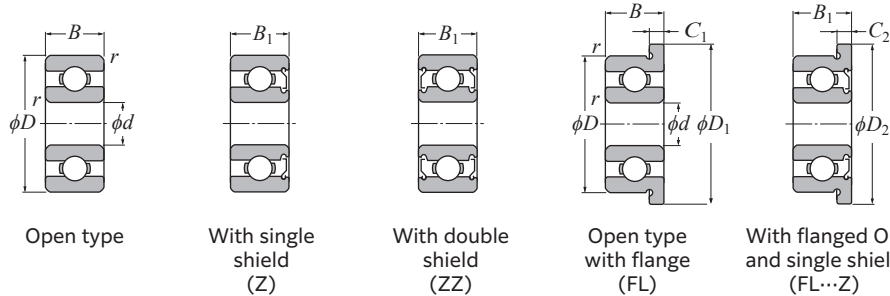
Note: 1. These standards are specified in accordance with MIL B-23063. However, **NTN** codes are shown.

2. Clearance values do not include compensation for measuring load.

Miniature and Small Size Ball Bearings

NTN

Metric series



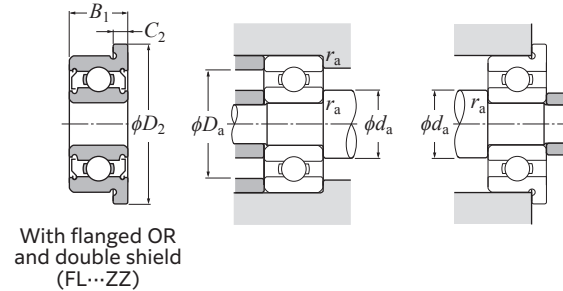
d 1.5–5 mm

d	Boundary dimensions								Basic load rating		Fatigue load limit N C _u	Factor f ₀	Allowable speed	
	mm								dynamic	static			min ⁻¹	
	D	B	B ₁	D ₁	D ₂	C ₁	C ₂	r _{s min} ¹⁾	C _r	C _{0r}			Grease lubrication	Oil lubrication
1.5	4	1.2	2	5	5	0.4	0.6	0.15	113	29.0	0.775	13.6	88 000	100 000
	5	2	2.6	6.5	6.5	0.6	0.8	0.15	189	51.0	1.35	13.3	79 000	93 000
	6	2.5	3	7.5	7.5	0.6	0.8	0.15	305	86.0	2.28	12.3	71 000	84 000
2	4	1.2	—	—	—	—	—	0.05	115	37.0	0.970	14.8	83 000	98 000
	5	1.5	2.3	6.1	6.1	0.5	0.6	0.08	189	51.0	1.35	13.3	74 000	87 000
	5	2	2.5	—	—	—	—	0.1	189	51.0	1.35	13.3	74 000	87 000
	6	2.3	3	7.5	7.5	0.6	0.8	0.15	310	89.0	2.37	12.8	67 000	79 000
	6	2.5	—	7.2	—	0.6	—	0.15	310	89.0	2.37	12.8	67 000	79 000
	7	2.5	—	—	—	—	—	0.15	430	120	3.20	11.9	59 000	70 000
	7	2.8	3.5	8.5	8.5	0.7	0.9	0.15	425	125	3.30	12.4	62 000	73 000
2.5	5	1.5	2.3	—	—	—	—	0.08	169	59.0	1.56	15.0	70 000	82 000
	6	1.8	2.6	7.1	7.1	0.5	0.8	0.08	231	73.0	1.92	14.2	65 000	76 000
	7	—	3	—	8.2	—	0.6	0.15	315	96.0	2.53	13.7	59 000	70 000
	7	2.5	3.5	8.5	8.5	0.7	0.9	0.15	315	96.0	2.53	13.7	59 000	70 000
	8	2.5	2.8	9.2	—	0.6	—	0.15	475	152	4.05	13.2	56 000	66 000
	8	2.8	4	9.5	9.5	0.7	0.9	0.15	610	174	7.05	11.5	56 000	66 000
3	6	2	2.5	7.2	7.2	0.6	0.6	0.08	268	94.0	2.47	14.7	60 000	71 000
	7	2	3	8.1	8.1	0.5	0.8	0.1	430	130	3.45	12.9	58 000	68 000
	8	2.5	—	9.2	—	0.6	—	0.15	620	180	7.25	11.9	54 000	63 000
	8	3	4	9.5	9.5	0.7	0.9	0.15	620	180	7.25	11.9	54 000	63 000
	9	2.5	4	10.2	10.6	0.6	0.8	0.15	700	219	8.85	12.4	50 000	59 000
	9	3	5	10.5	10.5	0.7	1	0.15	700	219	8.85	12.4	50 000	59 000
	10	4	4	11.5	11.5	1	1	0.15	710	224	9.05	12.7	50 000	58 000
	10	4	4	11.5	11.5	1	1	0.15	710	224	9.05	12.7	50 000	58 000
4	7	2	2.5	8.2	8.2	0.6	0.6	0.08	246	88.0	2.31	15.3	54 000	63 000
	8	2	3	9.2	9.2	0.6	0.6	0.08	440	140	5.65	13.9	52 000	61 000
	9	2.5	4	10.3	10.3	0.6	1	0.15	710	224	9.05	12.7	49 000	57 000
	10	3	4	11.2	11.6	0.6	0.8	0.15	720	235	9.50	13.3	46 000	55 000
	11	4	4	12.5	12.5	1	1	0.15	790	276	11.1	13.7	45 000	52 000
	12	4	4	13.5	13.5	1	1	0.2	1 080	360	14.4	12.8	43 000	51 000
	13	5	5	15	15	1	1	0.2	1 450	490	19.8	12.4	42 000	49 000
	16	5	5	—	—	—	—	0.3	1 940	680	23.1	12.4	37 000	44 000
5	8	2	2.5	9.2	9.2	0.6	0.6	0.08	241	91.0	2.39	15.8	49 000	57 000
	9	2.5	3	10.2	10.2	0.6	0.6	0.15	555	211	5.55	14.6	46 000	55 000
	10	3	4	11.2	11.6	0.6	0.8	0.15	790	276	11.1	13.7	45 000	52 000

1) Smallest allowable dimension for chamfer dimension r.

Miniature and Small Size Ball Bearings

NTN



With flanged OR and double shield (FL...ZZ)

Dynamic equivalent radial load
 $P_r = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

$P_{0r} = 0.6F_r + 0.5F_a$
When $P_{0r} < F_r$ use $P_{0r} = F_r$.

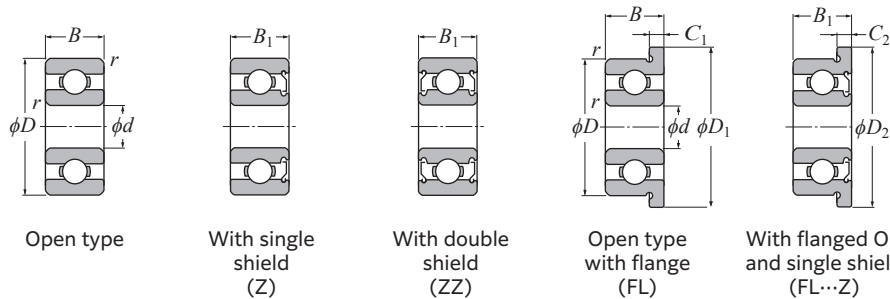
Open type	Bearing numbers					Installation-related dimensions				Mass (approx.)	
	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	mm		r_{as} Max.	Open type	g	
						Min.	Max. ²⁾			Open type	Open type with flange
68/1.5	W68/1.5SA	SSA	FL68/1.5	FLW68/1.5SA	SSA	2.3	2.4	3.2	0.05	0.07	0.09
69/1.5A	W69/1.5ASA	SSA	FL69/1.5A	FLW69/1.5ASA	SSA	2.7	2.9	3.8	0.15	0.18	0.24
60/1.5	W60/1.5ZA	ZZA	FL60/1.5	FLW60/1.5ZA	ZZA	2.7	3	4.8	0.15	0.35	0.42
672	—	—	—	—	—	2.5	2.6	3.5	0.05	0.06	—
682	W682SA	SSA	FL682	FLW682SA	SSA	2.8	2.9	4.2	0.08	0.13	0.17
BC2-5	WBC2-5SA	SSA	—	—	—	2.8	2.9	4.2	0.1	0.16	—
692	W692SA	SSA	FL692	FLW692SA	SSA	3.2	3.3	4.8	0.15	0.31	0.38
BC2-6	—	—	FLBC2-6	—	—	3.2	3.3	4.8	0.15	0.32	0.38
BC2-7A	—	—	—	—	—	3.2	3.6	5.8	0.15	0.44	—
602	W602ZA	ZZA	FL602	FLW602ZA	ZZA	3.2	3.7	5.8	0.15	0.54	0.64
67/2.5	W67/2.5ZA	ZZA	—	—	—	3.1	3.3	4.4	0.08	0.11	—
68/2.5	W68/2.5ZA	ZZA	FL68/2.5	FLW68/2.5ZA	ZZA	3.1	3.6	4.8	0.08	0.22	0.26
—	WBC2.5-7ZA	ZZA	—	FLWBC2.5-7ZA	ZZA	3.7	4	5.8	0.15	0.6 ³⁾	0.67 ³⁾
69/2.5	W69/2.5SA	SSA	FL69/2.5	FLW69/2.5SA	SSA	3.7	4	5.8	0.15	0.43	0.53
BC2.5-8	WBC2.5-8ZA	ZZA	FLBC2.5-8	—	—	3.7	4.3	6.8	0.15	0.57	0.65
60/2.5	W60/2.5ZA	ZZA	FL60/2.5	FLW60/2.5ZA	ZZA	3.7	4.1	6.8	0.15	0.72	0.83
673	WA673SA	SSA	FL673	FLWA673SA	SSA	3.6	4.1	5.4	0.08	0.2	0.26
683	W683Z	ZZ	FL683	FLW683Z	ZZ	3.9	4.1	5.8	0.1	0.33	0.38
BC3-8	—	—	FLBC3-8	—	—	4.2	4.4	6.8	0.15	0.52	0.6
693	W693Z	ZZ	FL693	FLW693Z	ZZ	4.2	4.4	6.8	0.15	0.61	0.72
BC3-9	WBC3-9ZA	ZZA	FLBC3-9	FLAWBC3-9ZA	ZZA	4.2	5	7.8	0.15	0.71	0.79
603	W603Z	ZZ	FL603	FLW603Z	ZZ	4.2	5	7.8	0.15	0.92	1
623	623Z	ZZ	FL623	FL623Z	ZZ	4.2	5.2	8.8	0.15	1.6	1.8
674A	WA674ASA	SSA	FL674A	FLWA674ASA	SSA	4.6	5	6.4	0.08	0.28	0.35
BC4-8	WBC4-8Z	ZZ	FLBC4-8	FLWBC4-8Z	ZZ	4.8	5	6.8	0.08	0.38	0.46
684AX50	FL684AX50Z	ZZ	FL684AX50	FLW684AX50Z	ZZ	5	5.2	7.8	0.1	0.67	0.76
BC4-10	WBC4-10Z	ZZ	FLBC4-10	FLAWBC4-10Z	ZZ	5.2	6	8.8	0.15	1	1.1
694	694Z	ZZ	FL694	FL694Z	ZZ	5.2	6.4	9.8	0.15	1.8	2
604	604Z	ZZ	FL604	FL604Z	ZZ	5.6	6.6	10.4	0.2	2.1	2.3
624	624Z	ZZ	FL624	FL624Z	ZZ	5.6	6.2	11.4	0.2	3.2	3.5
634	634Z	ZZ	—	—	—	6	7.6	14	0.3	5.1	—
675	WA675Z	ZZ	FL675	FLWA675Z	ZZ	5.6	6	7.4	0.08	0.32	0.4
BC5-9	WBC5-9Z	ZZ	FLBC5-9	FLWBC5-9Z	ZZ	5.2	6.1	7.8	0.15	0.55	0.63
BC5-10	WBC5-10Z	ZZ	FLBC5-10	FLAWBC5-10Z	ZZ	6.2	6.4	8.8	0.15	0.88	0.97

2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown.

● Miniature and Small Size Ball Bearings

NTN

Metric series



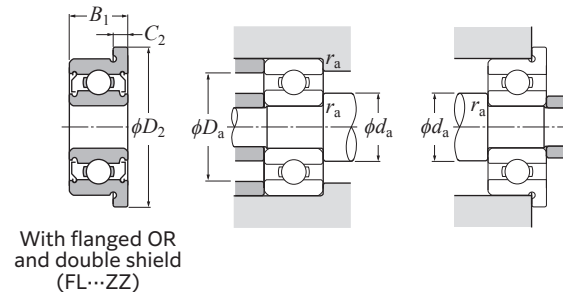
d 5–9 mm

Boundary dimensions										Basic load rating		Fatigue load limit	Factor	Allowable speed	
mm										dynamic	static	N	f_0	min ⁻¹	
d	D	B	B_1	D_1	D_2	C_1	C_2	$r_{s \min}^{1)}$	$r_{s \min}^{1)}$	C_r	C_{0r}	N	f_0	Grease lubrication	Oil lubrication
5	11	—	4	—	12.6	—	0.8	0.15	0.15	795	282	11.4	14.0	43 000	51 000
	11	3	5	12.5	12.5	0.8	1	0.15	0.15	795	282	11.4	14.0	43 000	51 000
	13	4	4	15	15	1	1	0.2	0.2	1 190	430	17.3	13.4	40 000	47 000
	13	—	5	—	15	—	1	0.2	0.2	1 190	430	17.3	13.4	40 000	47 000
	14	5	5	16	16	1	1	0.2	0.2	1 470	505	20.5	12.8	39 000	46 000
	16	5	5	18	18	1	1	0.3	0.3	1 940	680	23.1	12.4	37 000	44 000
	19	6	6	—	—	—	—	0.3	0.3	2 590	885	64.5	12.1	34 000	40 000
6	10	2.5	3	11.2	11.2	0.6	0.6	0.1	0.1	515	196	5.15	15.2	43 000	51 000
	12	3	4	13.2	13.6	0.6	0.8	0.15	0.15	920	365	14.8	14.5	40 000	47 000
	13	3.5	5	15	15	1.0	1.1	0.15	0.15	1 200	440	17.5	13.7	39 000	46 000
	15	5	5	17	17	1.2	1.2	0.2	0.2	1 490	530	21.3	13.3	37 000	44 000
	16	6	6	—	—	—	—	0.2	0.2	1 960	695	28.1	12.7	36 000	42 000
	17	6	6	19	19	1.2	1.2	0.3	0.3	2 430	865	35.0	12.3	35 000	42 000
	19	6	6	22	22	1.5	1.5	0.3	0.3	2 590	885	64.5	12.1	34 000	40 000
7	11	2.5	3	12.2	12.2	0.6	0.6	0.1	0.1	610	269	7.05	15.6	40 000	47 000
	13	3	4	14.2	14.6	0.6	0.8	0.15	0.15	915	375	15.2	14.9	38 000	45 000
	14	3.5	5	16	16	1	1.1	0.15	0.15	1 300	505	20.4	14.0	37 000	44 000
	17	5	5	19	19	1.2	1.2	0.3	0.3	1 780	715	28.8	14.0	35 000	41 000
	19	6	6	—	—	—	—	0.3	0.3	2 480	910	60.0	12.9	34 000	40 000
	22	7	7	—	—	—	—	0.3	0.3	3 700	1 400	97.0	12.5	32 000	37 000
	22	7	7	—	—	—	—	0.3	0.3	3 700	1 400	97.0	12.5	32 000	37 000
8	12	2.5	3.5	13.2	13.6	0.6	0.8	0.1	0.1	570	252	6.60	15.9	38 000	45 000
	14	3.5	4	15.6	15.6	0.8	0.8	0.15	0.15	910	385	15.5	15.2	36 000	43 000
	16	4	5	18	18	1	1.1	0.2	0.2	1 780	715	28.8	14.0	35 000	41 000
	19	6	6	22	22	1.5	1.5	0.3	0.3	2 200	865	35.0	13.8	33 000	39 000
	22	7	7	25	25	1.5	1.5	0.3	0.3	3 700	1 400	97.0	12.5	32 000	37 000
	24	8	8	—	—	—	—	0.3	0.3	4 450	1 590	122	11.7	31 000	36 000
	24	8	8	—	—	—	—	0.3	0.3	4 450	1 590	122	11.7	31 000	36 000
9	14	3	4.5	—	—	—	—	0.1	0.1	1 020	465	18.8	15.5	36 000	42 000
	17	4	5	19	19	1	1.1	0.2	0.2	1 910	820	33.0	14.4	33 000	39 000
	20	6	6	—	—	—	—	0.3	0.3	2 750	1 090	44.0	13.5	32 000	38 000
	24	7	7	—	—	—	—	0.3	0.3	3 750	1 450	94.5	12.9	31 000	36 000
	26	8	8	—	—	—	—	0.6	0.6	5 050	1 960	138	12.4	30 000	35 000
	26	8	8	—	—	—	—	0.6	0.6	5 050	1 960	138	12.4	30 000	35 000

1) Smallest allowable dimension for chamfer dimension r .

● Miniature and Small Size Ball Bearings

NTN



Dynamic equivalent radial load
 $P_r = X F_r + Y F_a$

$f_0 F_a / C_{0r}$	e	$F_a / F_r \leq e$		$F_a / F_r > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

$P_{0r} = 0.6 F_r + 0.5 F_a$
 When $P_{0r} < F_r$ use $P_{0r} = F_r$.

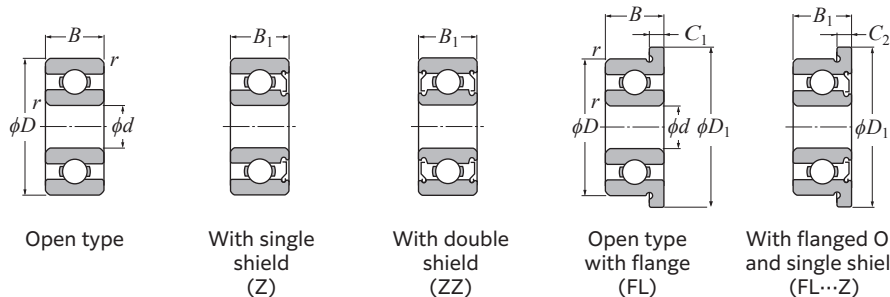
Bearing numbers						Installation-related dimensions				Mass (approx.)	
Open type	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	mm				g	
						d_a Min.	d_a Max. ²⁾	D_a Max.	r_{as} Max.	Open type	Open type with flange
—	WBC5-11Z	ZZ	—	FLWBC5-11Z	ZZ	6.2	6.8	9.8	0.2	1.8 ³⁾	2 ³⁾
685	W685Z	ZZ	FL685	FLW685Z	ZZ	6.2	6.8	9.8	0.15	1.1	1.3
695A	695AZ	ZZ	FL695A	FL695AZ	ZZ	6.6	6.9	11.4	0.2	2.4	2.7
—	WBC5-13Z	ZZ	—	FLWBC5-13Z	ZZ	6.6	6.9	11.4	0.2	3.4 ³⁾	3.7 ³⁾
605	605Z	ZZ	FL605	FL605Z	ZZ	6.6	7.4	12.4	0.2	3.5	3.9
625	625Z	ZZ	FL625	FL625Z	ZZ	7	7.6	14	0.3	4.8	5.2
635	635Z	ZZ	—	—	—	7	9.5	17	0.3	8	—
676A	WA676AZ	ZZ	FL676A	FLWA676AZ	ZZ	6.6	6.7	9.2	0.1	0.65	0.74
BC6-12	WBC6-12Z	ZZ	FLBC6-12	FLAWBC6-12Z	ZZ	7.2	7.9	10.8	0.15	1.3	1.4
686	W686Z	ZZ	FL686	FLW686Z	ZZ	7	7.2	11.8	0.15	1.9	2.2
696	696Z	ZZ	FL696	FL696Z	ZZ	7.6	7.8	13.4	0.2	3.8	4.3
BC6-16A	BC6-16AZ	ZZ	—	—	—	7.6	8	14.4	0.2	5.2	—
606	606Z	ZZ	FL606	FL606Z	ZZ	8	8.6	15	0.3	6	6.5
626	626Z	ZZ	FL626	FL626Z	ZZ	8	9.5	17	0.3	8.1	9.2
677	WA677Z	ZZ	FL677	FLWA677Z	ZZ	7.8	8.1	10.2	0.1	0.67	0.77
BC7-13	WBC7-13Z	ZZ	FLBC7-13	FLAWBC7-13Z	ZZ	8.2	8.9	11.8	0.15	1.4	1.5
687A	W687AZ	ZZ	FL687A	FLW687AZ	ZZ	8.2	8.7	12.8	0.15	2.1	2.4
697	697Z	ZZ	FL697	FL697Z	ZZ	9	10	15	0.3	5.2	5.7
607	607Z	ZZ	—	—	—	9	10.4	17	0.3	8	—
627	627Z	ZZ	—	—	—	9	12.2	20	0.3	13	—
678A	W678AZ	ZZ	FL678A	FLAW678AZ	ZZ	8.8	9.1	11.2	0.1	0.75	0.86
BC8-14	WBC8-14Z	ZZ	FLBC8-14	FLWBC8-14Z	ZZ	9.2	9.5	12.8	0.15	1.8	1.9
688A	W688AZ	ZZ	FL688A	FLW688AZ	ZZ	9.6	10	14.4	0.2	3.1	3.5
698	698Z	ZZ	FL698	FL698Z	ZZ	10	10.6	17	0.3	7.3	8.4
608	608Z	ZZ	FL608	FL608Z	ZZ	10	12.2	20	0.3	12	13
628	628Z	ZZ	—	—	—	10	12.1	22	0.3	17	—
679	W679Z	ZZ	—	—	—	9.8	10.4	13.2	0.1	1.4	—
689	W689Z	ZZ	FL689	FLW689Z	ZZ	10.6	10.7	15.4	0.2	3.2	3.6
699	699Z	ZZ	—	—	—	11	11.6	18	0.3	8.2	—
609JX2	609JX2Z	ZZ	—	—	—	11	13.1	22	0.3	14	—
629X50	629X50Z	ZZ	—	—	—	13	13.9	22	0.3	20	—

2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown.

● Miniature and Small Size Ball Bearings

NTN

Inch series



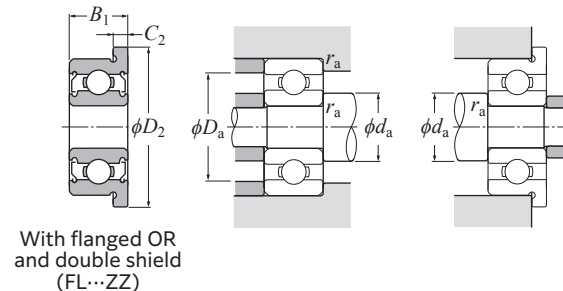
d 1.984–9.525 mm

d	Boundary dimensions							Basic load rating		Fatigue load limit	Factor	Allowable speed	
	mm							dynamic	static	N	f_0	min ⁻¹	Oil lubrication
	D	B	B ₁	D ₁	C ₁	C ₂	$r_{s \min}^{1)}$	C_r	C_{0r}	C_u			
1.984	6.35	2.38	3.571	7.52	0.58	0.79	0.08	310	89.0	2.37	12.8	67 000	79 000
2.380	4.762	1.588	2.38	5.94	0.46	0.79	0.08	137	42.0	1.12	14.8	73 000	85 000
	7.938	2.779	3.571	9.12	0.58	0.79	0.13	475	152	4.05	13.2	56 000	66 000
3.175	6.35	2.38	2.779	7.52	0.58	0.79	0.08	315	96.0	2.53	13.7	59 000	70 000
	7.938	2.779	3.571	9.12	0.58	0.79	0.08	620	180	7.25	11.9	54 000	63 000
	9.525	2.779	3.571	10.72	0.58	0.79	0.13	710	224	9.05	12.7	49 000	58 000
	9.525	3.967	3.967	11.18	0.76	0.76	0.3	710	224	9.05	12.7	49 000	58 000
	12.7	4.366	4.366	—	—	—	0.3	1 270	395	16.1	11.7	43 000	51 000
3.967	7.938	2.779	3.175	9.12	0.58	0.91	0.08	370	133	3.50	14.8	51 000	60 000
4.762	7.938	2.779	3.175	9.12	0.58	0.91	0.08	440	143	3.80	14.2	49 000	58 000
	9.525	3.175	3.175	10.72	0.58	0.79	0.08	785	268	10.8	13.3	46 000	55 000
	12.7	3.967	—	—	—	—	0.3	1 450	490	19.8	12.4	41 000	48 000
	12.7	4.978	4.978	14.35	1.07	1.07	0.3	1 450	490	19.8	12.4	41 000	48 000
6.350	9.525	3.175	3.175	10.72	0.58	0.91	0.08	232	94.0	2.47	16.4	43 000	51 000
	12.7	3.175	4.762	13.89	0.58	1.14	0.13	920	370	15.0	14.7	39 000	46 000
	15.875	4.978	4.978	17.53	1.07	1.07	0.3	1 640	615	24.9	13.6	36 000	43 000
	19.05	—	7.142	—	—	—	0.41	2 590	885	64.5	12.1	34 000	40 000
9.525	22.225	—	7.142	24.61	—	1.57	0.41	3 700	1 400	94.5	12.7	31 000	37 000

1) Smallest allowable dimension for chamfer dimension r .

● Miniature and Small Size Ball Bearings

NTN



Dynamic equivalent radial load
 $P_r = XF_r + YF_a$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

Static equivalent radial load

$P_{0r} = 0.6F_r + 0.5F_a$
 When $P_{0r} < F_r$ use $P_{0r} = F_r$.

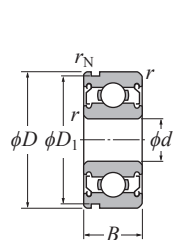
Open type	Bearing numbers					Installation-related dimensions			Mass (approx.)	
	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	mm	mm	mm	g	g
						Min.	Max. ²⁾	Max.	Open type	Open type with flange
R1-4	RA1-4ZA	ZZA	FLR1-4	FLRA1-4ZA	ZZA	2.8	3.3	5.5	0.08	0.35
R133	RA133ZA	ZZA	FLR133	FLRA133ZA	ZZA	2.9	3.1	4	0.08	0.12
R1-5	RA1-5ZA	ZZA	FLR1-5	FLRA1-5ZA	ZZA	3.2	4.3	7.1	0.1	0.69
R144	RA144ZA	ZZA	FLR144	FLRA144ZA	ZZA	3.9	4	5.5	0.08	0.27
R2-5	RA2-5Z	ZZ	FLR2-5	FLRA2-5Z	ZZ	4	4.4	7	0.08	0.61
RA2-6	RA2-6ZA	ZZA	FLR2-6	FLRA2-6ZA	ZZA	4	5.2	8.7	0.1	0.88
R2	RA2ZA	ZZA	FLR2	FLRA2ZA	ZZA	4.8	5.2	7.8	0.3	1.3
RA2	RA2Z	ZZ	—	—	—	4.8	5.4	11	0.3	2.5
RA155	RA155ZA	ZZA	FLR155	FLRA155ZA	ZZA	4.8	5.3	7	0.08	0.54
R156	RA156Z	ZZ	FLR156	FLRA156Z	ZZ	5.5	5.6	7	0.08	0.44
R166	R166Z	ZZ	FLR166	FLAR166Z	ZZ	5.6	5.9	8.7	0.08	0.8
R3	—	—	—	—	—	6.4	7.2	11	0.3	2.2
RA3	RA3Z	ZZ	FLRA3	FLRA3Z	ZZ	6	6.4	11	0.3	2.4
R168A	R168AZ	AZZ	—	FLAR168AZ	ZZ	7.1	7.3	8.7	0.08	0.6
R188	RA188ZA	ZZA	FLR188	FLRA188ZA	ZZA	7.2	8.2	11.8	0.1	1.6
R4	R4Z	ZZ	FLR4	FLR4Z	ZZ	8	8.6	14.2	0.3	4.4
—	RA4Z	ZZ	—	—	—	8.4	9.5	17	0.4	11 ³⁾
—	R6Z	ZZ	—	FLR6Z	ZZ	11.5	11.9	20.2	0.4	14 ³⁾

2) This dimension applies to sealed and shielded bearings. 3) Values for double shielded bearings are shown.

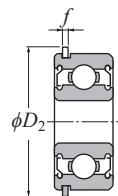
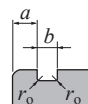
● Miniature and Small Size Ball Bearings

NTN

With snap ring groove
With snap ring



Shielded type
with snap ring groove
(ZZ)



Shielded type
with snap ring
(ZZ)

d 5–10 mm

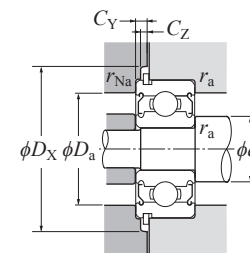
Boundary dimensions					Basic load rating		Fatigue load limit N C _u	Factor f ₀	Allowable speed		Bearing numbers ²⁾	
mm					dynamic	static			min ⁻¹		Shielded type with snap ring groove	Shielded type with snap ring
d	D	B	r _{s min} ¹⁾	r _{Ns} Min.	C _r	C _{0r}			Grease lubrication	Oil lubrication		
5	13	4	0.2	0.1	1 190	430	17.3	13.4	40 000	47 000	SC559ZZN	ZZNR
	14	5	0.2	0.2	1 470	505	20.5	12.8	39 000	46 000	SC571ZZN	ZZNR
6	12	4	0.15	0.1	640	365	—	14.5	40 000	47 000	*F-SC6A06ZZ1N	ZZ1NR
	13	5	0.15	0.1	1 200	440	17.5	13.7	39 000	46 000	SC6A04ZZN	ZZNR
	15	5	0.2	0.2	1 490	530	21.3	13.3	37 000	44 000	SC6A17ZZN	ZZNR
	19	6	0.3	0.3	2 590	885	64.5	12.1	34 000	40 000	SC669ZZN	ZZNR
8	16	5	0.2	0.1	1 390	585	23.6	14.6	35 000	41 000	SC890ZZN	ZZNR
	22	7	0.3	0.4	3 700	1 400	97.0	12.5	32 000	37 000	SC850ZZN	ZZNR
10	26	8	0.3	0.3	5 050	1 960	138	12.4	29 000	34 000	SC0039ZZN	ZZNR

1) Smallest allowable dimension for chamfer dimension *r*.

2) "*" mark indicates that stainless steel is used.

● Miniature and Small Size Ball Bearings

NTN



Dynamic equivalent radial load

$$P_r = XF_r + YF_a$$

$\frac{f_0 F_a}{C_{0r}}$	e	$\frac{F_a}{F_r} \leq e$		$\frac{F_a}{F_r} > e$	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28				1.55
1.38	0.30				1.45
2.07	0.34				1.31
3.45	0.38				1.15
5.17	0.42				1.04
6.89	0.44				1.00

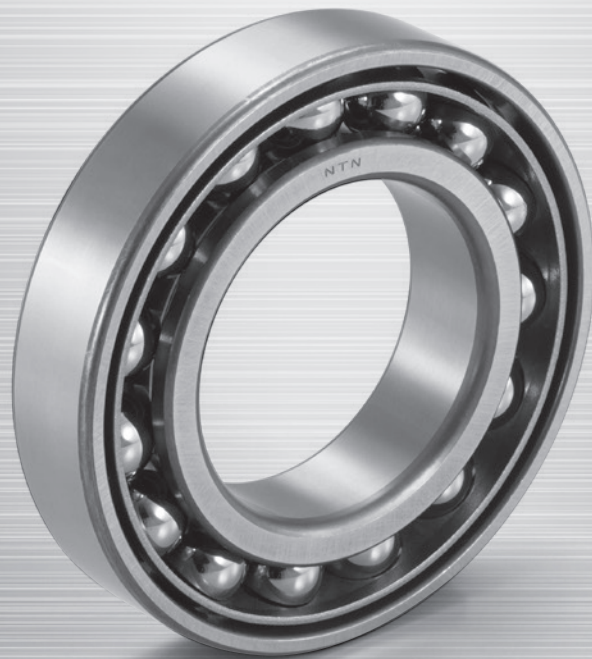
Static equivalent radial load

$$P_{0r} = 0.6F_r + 0.5F_a$$

When $P_{0r} < F_r$ use $P_{0r} = F_r$.

Snap ring groove dimensions				Snap ring dimensions		Installation-related dimensions								Mass	
mm				mm		mm									kg
D_1	a	b	r_o	D_2	f	d_a		D_a	D_X	C_Y	C_Z	r_{as}	r_{Nas}	With snap ring (approx.)	
Max.	Max.	Min.	Max.	Max.	Max.	Min.	Max.	Max.	(approx.)	Max.	Min.	Max.	Max.		
12.15	0.88	0.55	0.2	15.2	0.55	6.6	6.9	11.4	15.9	1.2	0.6	0.2	0.1	0.002	
13.03	1.28	0.65	0.06	16.13	0.54	6.6	7.4	12.4	16.9	1.6	0.6	0.2	0.2	0.004	
11.15	0.78	0.60	0.02	14.2	0.55	7.2	7.9	10.8	14.9	1.1	0.6	0.15	0.1	0.001	
12.15	1.08	0.55	0.2	15.2	0.55	7	7.2	11.8	15.9	1.4	0.6	0.15	0.1	0.002	
14.03	1.03	0.65	0.06	17.2	0.6	7.6	7.8	13.4	17.9	1.4	0.7	0.2	0.2	0.004	
17.9	0.93	0.80	0.2	22	0.7	8	9.5	17	22.8	1.4	0.7	0.3	0.3	0.008	
14.95	0.53	0.65	0.05	18.2	0.54	9.6	10	14.4	18.9	0.9	0.6	0.2	0.1	0.003	
20.8	2.35	0.80	0.2	24.8	0.7	10	12.7	20	25.5	2.8	0.7	0.3	0.4	0.013	
24.5	2.20	0.90	0.3	28.8	0.85	12	13.5	24	29.5	2.8	0.9	0.3	0.3	0.02	

Angular Contact Ball Bearings



Angular contact ball bearing



Four-point contact ball bearing



Double row angular contact ball bearing

1. Design features and characteristics

1.1 Angular contact ball bearing

Angular contact ball bearings are non-separable bearings with a defined contact angle in the radial direction relative to the straight line that runs through the point where each ball makes contact with the inner and outer rings (see Fig. 1). Table 1 provides information on contact angles and their designated codes.

In addition to radial loads, angular contact ball bearings can accommodate single direction axial loads. Since an axial load is generated from a radial force, these bearings are generally used in pairs. Table 2 shows general angular contact ball bearing characteristics, Table 3 shows information on using duplex (side by side) angular contact ball bearings, and Table 4 shows information on

multiple-row angular contact ball bearings.

For bearings with a contact angle of 15° and bearing tolerance JIS Class 5 or higher, see special catalog "Precision Rolling Bearings (CAT. No. 2260/E)."

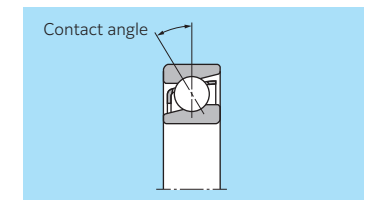


Fig. 1

Table 1 Contact angle and contact angle codes

Contact angle	15°	30°	40°
Contact angle code	C	A ¹⁾	B

¹⁾ Contact angle code A is omitted from part number.

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 number (see Table 5).

Table 3 Duplex angular contact ball bearings — types and characteristics

Duplex type	Design	Characteristics
Back-to-back arrangement (DB)		- Can accommodate radial loads and axial loads in either direction. - Has a large distance between the acting load centers of the bearings, and therefore a large momentary force load capacity. - Allowable misalignment angle is small.
Face-to-face arrangement (DF)		- Can accommodate radial loads and axial loads in either direction. - Has a smaller distance between the acting load centers of the bearings, and therefore a smaller momentary force load capacity. - Has a larger allowable misalignment angle than back-to-back duplex type.
Tandem arrangement (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 angular contact ball bearings are manufactured in a set to specified clearance and preload; therefore, they must be assembled side by side with identically numbered bearings and not be mixed with other arrangements.
2. To satisfy specified clearance and preload, tightening must be performed until the inner ring width surfaces or outer ring width surfaces come in contact with each other.