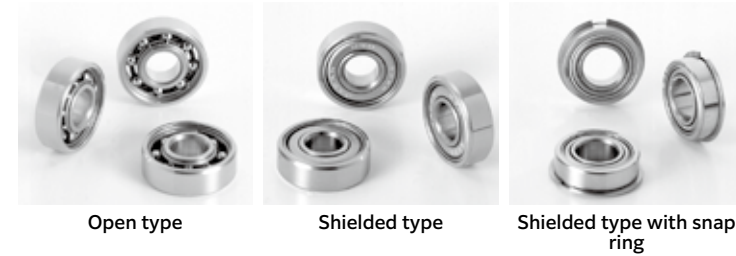
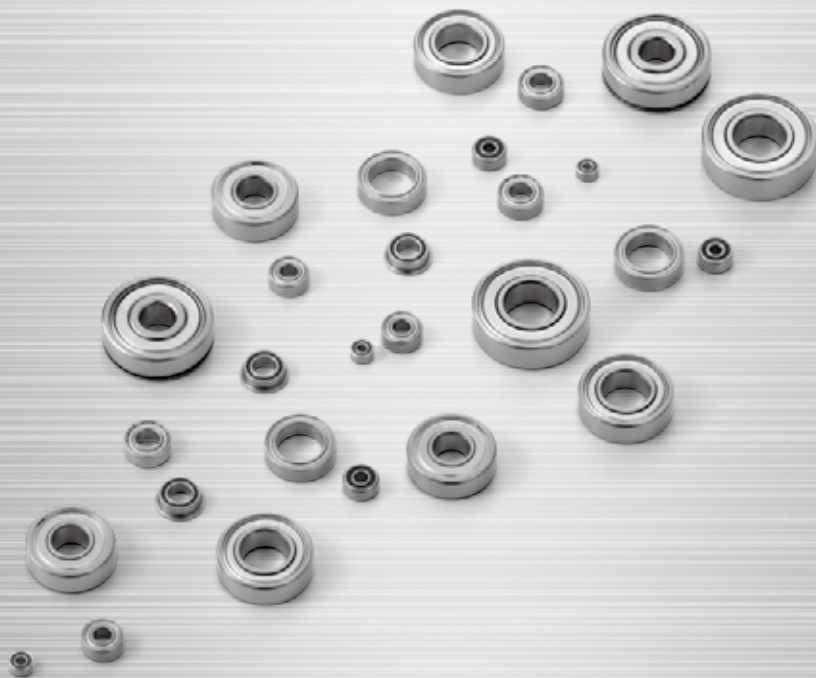


Miniature and Small Size Ball Bearings



1. Design features and characteristics

The dimensional range of miniature and extra small 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 - 2 mm wider width dimension than open type bearings.

The main variations of these bearings are shown in **Table 2**. Miniature and extra 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 outer diameter $D < 9\text{mm}$
Extra small ball bearings	Nominal bore diameter $d < 10\text{mm}$ Nominal outer diameter $D \geq 9\text{mm}$

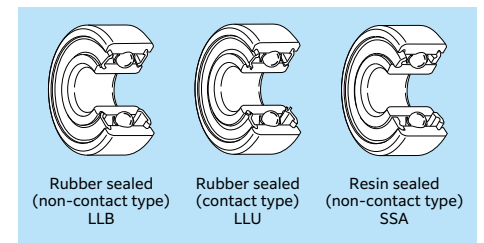


Fig. 1

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 extra small 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		Outer diameter dimensional tolerance Δ_{D1S} or Δ_{D2S}		Outer ring surface runout for rear surface S_{D1} Max.	Back face axial runout S_{ea1} Max.	Width deviation Δ_{c15} or Δ_{c25}		Width unevenness V_{c15} or V_{c25}	
		Upper	Lower			Upper	Lower	Max.	
ISO standard	Class 0	*	(see table below)	—	—	Identical to same bearing's inner ring Δ_{BS} .	—	Identical to same bearing's inner ring V_{BS} .	
	Class 6			—	—			5	
	Class 5			8	11			2.5	
	Class 4			4	7			1.5	
	Class 2			1.5	3 ¹⁾ 4			1.5	

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

* Unit: μm

Flange nominal outer diameter D_1 or D_2 mm		Outer diameter dimensional tolerance Δ_{D1S} or Δ_{D2S}	
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 extra small bearings can be found in Table 4.

Table 4 Radial internal clearance for high precision bearings

Unit: μm

MIL Standard Code	Tight				Standard				Loose		Extra Loose			
	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

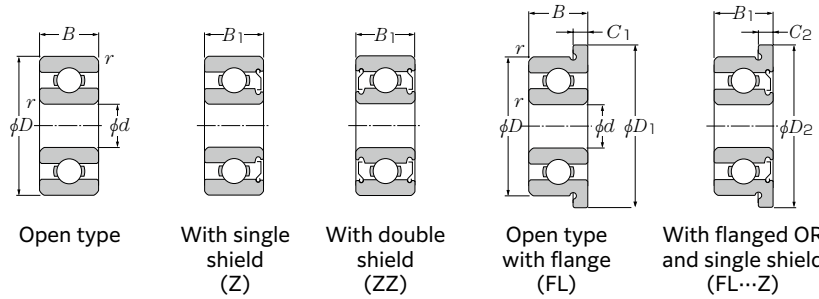
Note: 1. These standards are specified in accordance with MIL B23063. However, **NTN** codes are shown.

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

Miniature and Small Size Ball Bearings



Metric series

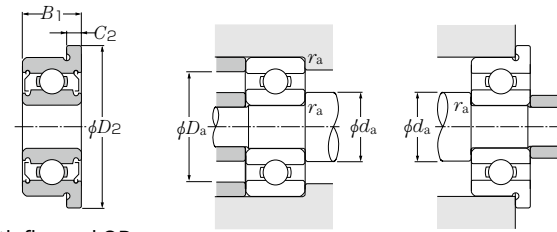


a 1.5 ~ 5mm

d	Boundary dimensions								Basic load rating		Fatigue Factor		Allowable speed		
	mm								dynamic N	static C _{0r}	load limit N	f ₀	Grease lubrication	Oil lubrication	
	D	B	B ₁	D ₁	D ₂	C ₁	C ₂	r _{s min} ¹⁾							
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	
	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



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

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				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	0	0.56	1.00

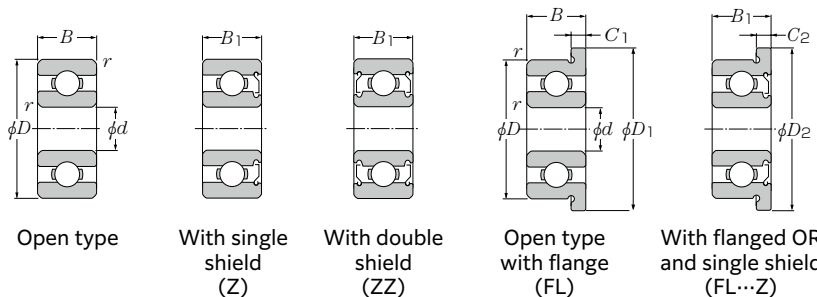
Static equivalent radial load $P_{0r} = 0.6 F_r + 0.5 F_a$

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

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	Open type with flange	g
							d _a Min.	D _a Max. ²⁾				
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	
	W69/1.5ASA	SSA	FL69/1.5A	FLW69/1.5ASA	SSA	2.7	2.9	3.8	0.15	0.18	0.24	
	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	—	
	W682SA	SSA	FL682	FLW682SA	SSA	2.8	2.9	4.2	0.08	0.13	0.17	
	WBC2-5SA	SSA	—	—	—	2.8	2.9	4.2	0.1	0.16	—	
	W692SA	SSA	FL692	FLW692SA	SSA	3.2	3.3	4.8	0.15	0.31	0.38	
	—	—	FLBC2-6	—	—	3.2	3.3	4.8	0.15	0.32	0.38	
	—	—	—	—	—	3.2	3.6	5.8	0.15	0.44	—	
	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	—	
	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⁾	
	W69/2.5SA	SSA	FL69/2.5	FLW69/2.5SA	SSA	3.7	4	5.8	0.15	0.43	0.53	
	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	
	W683Z	ZZ	FL683	FLW683Z	ZZ	3.9	4.1	5.8	0.1	0.33	0.38	
	—	—	FLBC3-8	—	—	4.2	4.4	6.8	0.15	0.52	0.6	
	W693Z	ZZ	FL693	FLW693Z	ZZ	4.2	4.4	6.8	0.15	0.61	0.72	
	WBC3-9ZA	ZZA	FLBC3-9	FLAWBC3-9ZA	ZZA	4.2	5	7.8	0.15	0.71	0.79	
	W603Z	ZZ	FL603	FLW603Z	ZZ	4.2	5	7.8	0.15	0.92	1	
	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
		WBC4-8Z	ZZ	FLBC4-8	FLWBC4-8Z	ZZ	4.8	5	6.8	0.08	0.38	0.46
W684AX50Z		ZZ	FL684AX50	FLW684AX50Z	ZZ	5	5.2	7.8	0.1	0.67	0.76	
WBC4-10Z		ZZ	FLBC4-10	FLAWBC4-10Z	ZZ	5.2	6	8.8	0.15	1	1.1	
694Z		ZZ	FL694	FL694Z	ZZ	5.2	6.4	9.8	0.15	1.8	2	
604Z		ZZ	FL604	FL604Z	ZZ	5.6	6.6	10.4	0.2	2.1	2.3	
624Z		ZZ	FL624	FL624Z	ZZ	5.6	6.2	11.4	0.2	3.2	3.5	
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	
	WBC5-9Z	ZZ	FLBC5-9	FLWBC5-9Z	ZZ	5.2	6.1	7.8	0.15	0.55	0.63	
	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

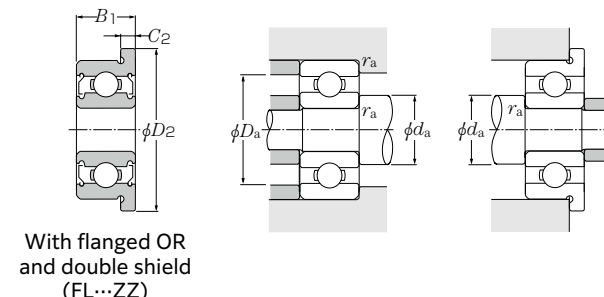


d 5 ~ 9mm

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



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

Dynamic equivalent radial load

$$P_r = X F_r + Y F_a$$

f ₀ ·F _a C _{0r}	e	F _a /F _r ≤ e		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				1.31
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.

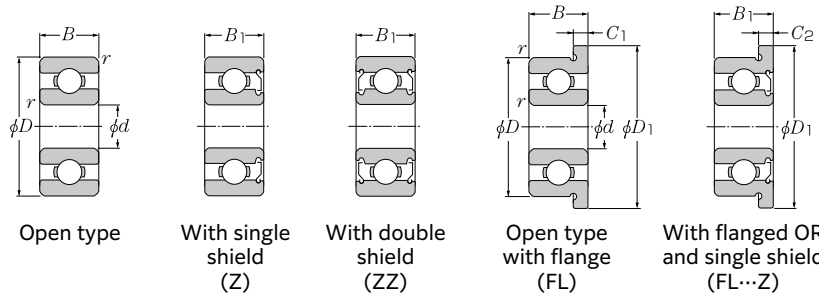
Open type	Bearing numbers					Installation-related dimensions mm				Mass (approx.) g	
	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	d _a Min.	D _a Max. ²⁾	r _{as} Max.	Open type	Open type with flange	
											Max.
—	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



Inch series

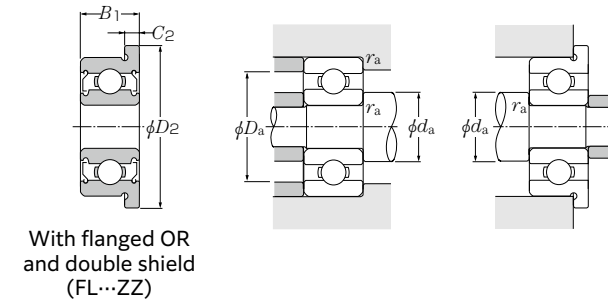


d 1.984 ~ 9.525mm

d	Boundary dimensions							Basic load rating		Factor f ₀	Allowable speed min ⁻¹	Oil lubrication	
	mm							dynamic	static			Grease lubrication	Oil lubrication
	D	B	B ₁	D ₁	C ₁	C ₂	r _{s min} ¹⁾	C _r	C _{0r}				
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
3.967	12.7	4.366	4.366	—	—	—	0.3	1 270	395	16.1	11.7	43 000	51 000
	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	3700	1 400	94.5	12.7	31 000	37 000

1) Smallest allowable dimension for chamfer dimension r.

Miniature and Small Size Ball Bearings



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 $P_{0r} = F_r$.

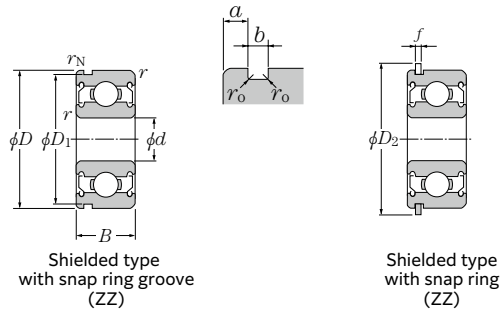
Open type	Bearing numbers					Installation-related dimensions				Mass (approx.)	
	With single shield	With double shield	Open type with flange	With flanged OR and single shield	With flanged OR and double shield	Min. d _a	Max. D _a ²⁾	r _{as} Max.	Open type	Open type with flange	
R1-4	RA1-4ZA	ZZA	FLR1-4	FLRA1-4ZA	ZZA	2.8	3.3	5.5	0.08	0.35	0.41
R133	RA133ZA	ZZA	FLR133	FLRA133ZA	ZZA	2.9	3.1	4	0.08	0.12	0.16
R1-5	RA1-5ZA	ZZA	FLR1-5	FLRA1-5ZA	ZZA	3.2	4.3	7.1	0.1	0.69	0.76
R144	RA144ZA	ZZA	FLR144	FLRA144ZA	ZZA	3.9	4	5.5	0.08	0.27	0.33
R2-5	RA2-5Z	ZZ	FLR2-5	FLRA2-5Z	ZZ	4	4.4	7	0.08	0.61	0.68
RA2-6	RA2-6ZA	ZZA	FLR2-6	FLRA2-6ZA	ZZA	4	5.2	8.7	0.1	0.88	0.96
R2	RA2ZA	ZZA	FLR2	FLRA2ZA	ZZA	4.8	5.2	7.8	0.3	1.3	1.5
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	0.61
R156	RA156Z	ZZ	FLR156	FLRA156Z	ZZ	5.5	5.6	7	0.08	0.44	0.51
R166	R166Z	ZZ	FLR166	FLAR166Z	ZZ	5.6	5.9	8.7	0.08	0.8	0.89
R3	—	—	—	—	—	6.4	7.2	11	0.3	2.2	—
RA3	RA3Z	ZZ	FLRA3	FLRA3Z	ZZ	6	6.4	11	0.3	2.4	2.7
R168A	R168AZ	AZZ	—	FLAR168AZ	ZZ	7.1	7.3	8.7	0.08	0.6	0.69
R188	RA188ZA	ZZA	FLR188	FLRA188ZA	ZZA	7.2	8.2	11.8	0.1	1.6	1.7
R4	R4Z	ZZ	FLR4	FLR4Z	ZZ	8	8.6	14.2	0.3	4.4	4.8
—	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⁾	15 ³⁾

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

Miniature and Small Size Ball Bearings



With snap ring groove
With snap ring

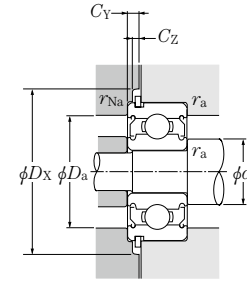


d 5 ~ 10mm

Boundary dimensions	Basic load rating		Fatigue load limit	Factor	Allowable speed		Bearing numbers ²⁾					
	dynamic	static			Grease lubrication	Oil lubrication	Shielded type with snap ring groove	Shielded type with snap ring				
mm	r_{Na}	C_r	C_{0r}	f_0	min^{-1}	min^{-1}						
d D B $r_{s \text{ min}^{-1}}$	Min.	C_r	C_{0r}									
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



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				2.30
0.345	0.22				1.99
0.689	0.26				1.71
1.03	0.28	1	0	0.56	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 $P_{0r} = F_r$.

Snap ring groove dimensions				Snap ring dimensions		Installation-related dimensions								Mass
mm				mm		mm								kg
D_1	a	b	r_0	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