



HIGH PRECISION BALL BEARINGS

Extra Thin Type Bearings
Flanged Bearings
Stainless Bearings
Bore Dia. 0.6mm To 95mm



Introduction

Sapporo Precision group has been fostering “EZO” brand for long years since its establishment. Fortunately, “EZO”, which was derived from the ancient name of Hokkaido Island, “EZO-CHI”, has achieved a remarkable growth and is enjoying profound trust from a number of domestic and foreign users in 35 different countries throughout the world.

This new catalogue includes the recent revisions of ISO standards for ball bearings as well as the new bearing series we have introduced during recent years.

It consists of two parts: TECHNICAL EXPLANATION and DIMENSION TABLES.

The basic dynamic load ratings listed in the Bearing Tables are in accordance with ISO 281.

The values reflect the effect of longer life due to improved manufacturing techniques and materials.

The basic static load ratings listed in the Bearing Tables are in accordance with ISO 76.

In line with the revisions of ISO standards, governing the principal dimensions and precision of bearings, the chamfer dimensions have been changed to the minimum.

SAPPORO PRECISION INC. has a policy of complying with trade laws such as the Foreign Exchange Control, the Trading Administration and others that could prohibit the exports of products of a strategic nature. In case of doubt, in particular concerning super high precision bearings over ISO 492: Tolerance class 2 quality, please check with us.

NOTE 1. All information, data and dimension tables in this catalogue have been compiled carefully and have been thoroughly checked. However, no responsibility for possible errors or omissions can be assumed.

NOTE 2. We reserve the right to change specifications and other information included in this catalogue without notice.

NOTE 3. Copyright reserved. If for certain reasons copying is required, prior approval by us should be obtained.



Technical Contents

● Bearing numbering system	3
● Design and characteristics of radial ball bearings	4
● Bearing material	4
● Type and characteristics of cages, shields and seals	5
● Tolerance, class, chamfer dimension of bearings	6
● Life and load rating	8
● Fitting of bearings	11
● Internal clearance	14
● Lubrication	16
● Maximum permissible bearing speed	19
● Frictional torque and temperature	19
● Basic rules for selecting and handling of bearings	20
● Problem, Cause, Remedy	21
● Damage, Cause, Remedy	22

Bearing numbering system

RETAINER

STEEL RIBBON TYPE(SPCC,SUS304): J
STEEL CROWN TYPE(SUS420J2,SUS304): W
RESIN CROWN TYPE(POLYAMIDE66): TW
STEEL RIVET TYPE(SPCC,SUS304): RJ
FULL COMPLEMENT: V
THRUST FM TYPE(SUS304): TP
THRUST F TYPE(C3604): TD

SEAL AND SHIELD

TEFLON SEAL WITH SNAP RING(PTFE): TTS
STEEL SHIELD WITH SNAP RING(SUS304): ZZS
PRESSED STEEL SHIELD(SPCC,SUS304): ZZ
CONTACT RUBBER SEAL(NBR): 2RS
CONTACT RUBBER SEAL(FKM): 2RS-V
NON-CONTACT RUBBER SEAL(NBR): 2RU
NON-CONTACT RUBBER SEAL(FKM): 2RU-V

RADIAL CLEARANCE

STANDARD: C2, C0(CN), C3, C4, C5
MINIATURE: MC1 0~5 μm
MC2 3~8 μm
MC3 5~10 μm
MC4 8~13 μm
MC5 13~20 μm
MC6 20~28 μm

STANDARD METRIC H
MR, MF, MT AND INCH SERIES --S

Ex.1		686	J	ZZ	MC3		SRL
Ex.2	F	608	TW	2RS	MC4	P6	SRL
Ex.3	MR	52	W	ZZ	MC2	P5	AF2
Ex.4	S	MF	128	W	TTS	PC5-B	P6
Ex.5	S	ER	1458	W	ZZS	C0	A3
Ex.6		6205	H	RJ	2RS	C3	SRL
Ex.7	F	6706	H	W	2RU	C0	SRL
Ex.8	S	R	144	J	ZZS	MC4	A5P
Ex.9	R		10	RJ	ZZ	C2	AV2
Ex.10	F	3-8M	H	TP			AF2

BEARING TYPE

INCH: R
INCH WITH FLANGE: FR
INCH WITH EXTENDED INNER RING: RW
INCH WITH EXTENDED INNER RING AND FLANGE: FRW
METRIC STANDARD: NO SYMBOL
METRIC WITH FLANGE: F
SPECIAL METRIC: MR
SPECIAL METRIC WITH FLANGE: MF
SPECIAL METRIC THIN TYPE: ET
SPECIAL INCH THIN TYPE: ER
THRUST WITH RACEWAY: FM
THRUST WITHOUT RACEWAY: F

TOLERANCE CLASS

• RADIAL & THRUST BALL BEARING
ISO & JIS CLASS 0: NO SYMBOL
ISO & JIS CLASS 6: P6
ISO & JIS CLASS 5: P5
ISO & JIS CLASS 4: P4
ANSI/ABMA ABEC1: NO SYMBOL
ANSI/ABMA ABEC3: A3
ANSI/ABMA ABEC5: A5
ANSI/ABMA ABEC7: A7

EX. GREASE CODE
MULTEMP SRL (MINIATURE STD): SRL
ALVANIA NO.2 (STANDARD): AV2

ISOFLEX SUPER LDS18 (SEMI STD): SL8
BEACON 325 (SEMI STD): B32
SHELL CASSIDA RLS2 (FOOD): RL2
MOLYKOTE 44M (HIGH TEMP): M4M
KRYTOX 240AC (ULTRA HIGH TEMP): K24

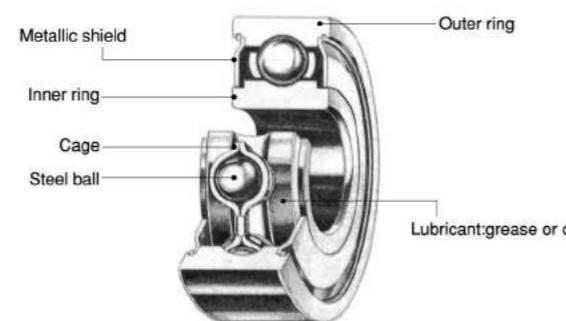
• INSTRUMENT BALL BEARING
ANSI/ABMA CLASS3P: A3P
ANSI/ABMA CLASS5P: A5P
ANSI/ABMA CLASS7P: A7P

EX. OIL CODE
AERO SHELL FLUID 12 (STANDARD): AF2
WINDSOR LUBE L-245X (SEMI STD): WL2
ISOFLEX PDP38: PD8

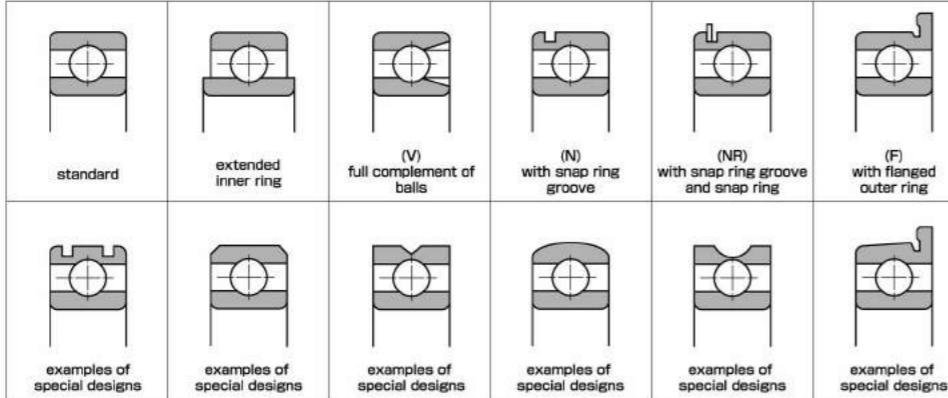
BEARING PART NO.

Design and characteristics of radial ball bearings

STRUCTURE OF BEARING



DESIGN OF BEARING



CHARACTERISTICS OF BEARINGS

LOAD	Single row radial ball bearings with balls separated by a cage can support radial loads, axial loads and tilting moments. A full complement V-type ball bearing can support only radial loads and some low axial loads.
SPEED	Maximum permissible speeds for ball bearings are mainly related to the bearing design and size, cage type, bearing internal clearance, method and type of lubrication, manufacturing accuracy, sealing methods and loads.
TORQUE AND NOISE LEVEL	Single row radial ball bearings are precision components and have low torque and noise levels.
INCLINATION OF INNER/OUTER RINGS	Shaft and housing seats with poor accuracy, fitting errors and shaft bending might cause inclination between the inner and outer rings although the internal clearance of the bearing will permit this to a certain extent. Generally, the maximum permissible inclination between the inner and outer rings is approximately 1 in 300.
TOUGHNESS	Bearings under load deform elastically at the contact point between the rolling element and bearing ring. This is influenced by the bearing type, size, form and load.
INSTALLATION AND REMOVAL	The single row radial ball bearing is a non-separable bearing. Therefore, shafts and housings should be so designed to enable bearing inspection and replacement when necessary.
AXIAL LOCATION	Improved axial location is obtained with NR and F type bearings.

Bearing material

Standard material for rings and balls is a vacuum degassed high carbon chromium steel allowing for high efficiency, low torque, low noise level and long bearing life. For bearings requiring anti-corrosion or heat-resistance properties, martensitic stainless steel is used.

CHEMICAL COMPOSITION OF BEARING MATERIALS

MATERIAL	SYMBOL	CHEMICAL COMPOSITION (Wt%)							EQUIVALENT	HARDNESS (HRC)
		C	Si	Mn	P	S	Cr	Mo		
HIGH CARBON CHROMIUM STEEL	SUJ2	0.95~1.10	0.15~0.35	≤0.50	≤0.025	≤0.025	1.30~1.60	≤0.08	SAE52100,100Cr6, ASTM52100, BS535A99,1.3505	60~64
STAINLESS STEEL	SUS440C	0.95~1.20	≤1.00	≤1.00	≤0.040	≤0.030	16.0~18.0	≤0.75	AISI440C, X102CrMo17, X105CrMo17, 1.4125, 1.3543	58~62
	KS440 (ACD34)	0.60~0.75	≤1.00	≤1.00	≤0.030	≤0.020	11.5~13.0	≤0.30	X65Cr13, 1.4037	58~62

Type and characteristics of cages, shields and seals

CAGES

W : ONE-PIECE STEEL CROWN TYPE	J : TWO-PIECES STEEL RIBBON TYPE	RJ : TWO-PIECES STEEL RIVET TYPE	TW : ONE-PIECE NYLON CROWN TYPE	V : FULL COMPLEMENT OF BALLS

The stainless steel pressed cage is inner ring guided. It shows excellent performance in low torque, low speed applications.

Consists of two mating steel pressings, the cover side and the finger side. Usually guided by the rolling elements and designed to reduce frictional torque.

The RJ type cage is suitable for larger bearings with a high load carrying capacity. The two pieces are riveted together and are strong enough to withstand higher levels of vibration and acceleration. The cage is guided by the balls and reduces frictional torque.

Moulded nylon cage. Reduces the fluctuation in running torque. Suitable for high speeds. Guided by the rolling elements. NYLON CAGE operating temperature range: from -30 to +120°C

This type of bearing has no cage but maximum possible number of balls. Due to the fact that the inner and outer ring have a filling slot, the axial load carrying capacity of this bearing type is low. This type of bearing is suitable for high radial load, low speed applications.

SHIELD , SEAL

ZZ : Pressed Steel Shield	ZZS : Steel Shield With Snap Ring	TTS : Teflon Seal With Snap Ring	2RS : Contact Rubber Seal	2RU : Non-Contact Rubber Seal

Non-contact shield pressed into outer ring. Very little grease leakage and low ingress of contaminants. Mainly used for smaller or narrower bearings.

Non-contact shield retained in outer ring. Low ingress of contaminants. Mainly used for smaller or narrower bearings. Seal can flex to accommodate internal pressure changes.

Teflon seal reinforced with glass fibre is retained in outer ring by snap ring. Low ingress of contaminants. Mainly used for smaller or narrower bearings. Seal can flex to accommodate internal pressure changes.

Rubber seal fitted into outer ring. Light contact with inner ring, retains grease and prevents ingress of external contaminants. NBR SEAL operating temperature range: from -40 to +120°C

Non-contact rubber seal fitted into outer ring, still provides effective sealing. NBR SEAL operating temperature range: from -40 to +120°C

Tolerance, class, chamfer dimension of bearings

TOLERANCES OF INNER RING AND OUTER RING WIDTH (ISO)

d (mm)		Δ_{dmp}				Δ_{ds}	V_{dp}						V_{dmp}									
		P0		P6	P5	P4	P4		P0		P6		P5		P4		P0	P6	P5	P4		
		Diameter series	0,2,3	7,8,9	0	2,3	7,8,9	0	2,3	7,8,9	0,2,3	7,8,9	0,2,3									
Over	Incl.	Upper	Lower	Lower	Lower	Lower	Upper	Lower	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	
0.6(1)	2.5	0	-8	-7	-5	-4	0	-4	10	8	6	9	7	5	5	4	4	3	6	5	3	2
2.5	10	0	-8	-7	-5	-4	0	-4	10	8	6	9	7	5	5	4	4	3	6	5	3	2
10	18	0	-8	-7	-5	-4	0	-4	10	8	6	9	7	5	5	4	4	3	6	5	3	2
18	30	0	-10	-8	-6	-5	0	-5	13	10	8	10	8	6	6	5	5	4	8	6	3	2.5
30	50	0	-12	-10	-8	-6	0	-6	15	12	9	13	10	8	8	6	6	5	9	8	4	3

Remarks1: The upper value of the bore diameter in this table is not applicable when the distance from the bearing ring face is less than 1.2 times the chamfer dimension r_{smax}

Remarks2: According to the revision of ANSI/ABMA Std.20-1996, the classes ABEC1 • ABEC3 • ABEC5 • ABEC7 are equivalent to CLASS0•CLASS6•CLASS5•CLASS4.

TOLERANCES OF OUTER RING (ISO)

D (mm)		Δ_{Dmp}				Δ_{Ds}	$V_{Dp}^{(2)}$						$V_{Dmp}^{(2)}$				P0		P6	P5	P4										
		P0		P6	P5	P4	P4		P0		P6		P5		P4																
		Diameter series	Diameter series	Open	Seal	Shield	Open	Seal	Shield	Open	Open	Open	Open	Open	Open	Open	0,2,3	7,8,9	0	2,3	2,3	7,8,9	0	2,3	2,3	7,8,9	0,2,3	7,8,9	0,2,3		
Over	Incl.	Upper	Lower	Lower	Lower	Lower	Upper	Lower	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.					
2.5(1)	6	0	-8	-7	-5	-4	0	-4	10	8	6	10	9	7	5	9	5	4	4	3	6	5	3	2	6	18	0	-8	-7	-5	-4
6	18	0	-8	-7	-5	-4	0	-4	10	8	6	10	9	7	5	9	5	4	4	3	6	5	3	2	18	30	0	-9	-8	-6	-5
18	30	0	-9	-8	-6	-5	0	-5	12	9	7	12	10	8	6	10	6	5	5	4	7	6	3	2.5	30	50	0	-11	-9	-7	-6
30	50	0	-11	-9	-7	-6	0	-6	14	11	8	16	11	9	7	13	7	5	5	6	8	7	4	3	50	80	0	-13	-11	-9	-7
50	80	0	-13	-11	-9	-7	0	-7	16	13	10	20	14	11	8	16	9	7	7	5	10	8	5	3.5	8	13	0	-13	-11	-9	-7

Remarks1: The lower value of the outside diameter in this table is not applicable when the distance from the bearing ring face is less than 1.2 times the chamfer dimension r_{smax}

Remarks2: According to the revision of ANSI/ABMA Std.20-1996, the classes ABEC1•ABEC3•ABEC5•ABEC7 are equivalent to CLASS0•CLASS6•CLASS5•CLASS4.

TOLERANCES OF INNER RING AND OUTER RING WIDTH(ABMA)

d (mm)		Δ_{dmp}				Δ_{ds}	V_{dp}		V_{dmp}		$\Delta_{Bs}(\Delta_{Cs})^{(2)}$		V_{Bs}		K_{ia}		S_{ia}		S_d		
		ABEC 5P		ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	Single bearing		ABEC 5P	ABEC 7P	ABEC 5P,7P	ABEC 5P,7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P
Over	Incl.	Upper	Lower	Upper	Lower	Max.	Max.	Upper	Lower	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.
-	10	0	-5	0	-5	2.5	2.5	0	-25	5	2.5	3.5	2.5	7	3	7	3	7	3	7	3
10	18	0	-5	0	-5	2.5	2.5	0	-25	5	2.5	3.5	2.5	7	3	7	3	7	3	7	3
18	30	0	-5	0	-5	2.5	2.5	0	-25	5	2.5	3.5	2.5	7	3	7	3	7	3	7	3

Remarks1: ABEC5P and ABEC7P are the tolerance classes for high precision bearings.

LIMIT TOLERANCE VALUES (METRIC) OF CHAMFER DIMENSIONS OF RADIAL BEARINGS

r_{smin}	Unit:mm			
	d(mm)	r_{smax}		
Over	Incl.	Radial	Axial	r_{amax}
0				

Life and load rating

BEARING LIFE

When bearings rotate, the inner and outer rings and rolling elements are constantly loaded. This produces material fatigue and eventually bearing failure. The total number of revolutions before a failure occurs is called the basic rating life.

Life of individual bearings varies considerably, even if they are of the same size, same material, same heat treatment and are under the same operating conditions.

Statistically, the total number of revolutions reached or exceeded by 90% of a sufficiently large group of apparently identical bearings before the first evidence of material fatigue occurs is called the basic rating life.

BASIC DYNAMIC LOAD RATING "Cr"

The basic dynamic load rating of a bearing with rotating inner ring and stationary outer ring is that load of constant magnitude and size which a sufficiently large group of apparently identical bearings can endure for a basic rating life of one million revolutions.

Radial bearings take central load. Values given for Cr in the dimension tables of this catalogue are for standard high chromium steel. 85% of the chromium steel values should be used for stainless steel.

LIFE FORMULA

The equation for the basic rating life for dynamically loaded ball bearings is as follows:

$$L_{10} = (Cr/P)^3 \times 10^6 \text{ Revolutions}, L_{10h} = 16667/n \cdot (Cr/P)^3 \text{ (Hours)}$$

whereby:
 L₁₀=BASIC RATING LIFE
 Cr=BASIC DYNAMIC LOAD RATING(N)
 P=EQUIVALENT LOAD(N)

L_{10h}=BASIC RATING LIFE IN OPERATING HOURS
 n=R.P.M.(REVOLUTIONS PER MINUTE)

EXAMPLES OF RATING LIFE L_{10h} VALUES USED:

OPERATING CONDITIONS	BASIC RATING LIFE L _{10h}
Infrequent operation.	500
Short or intermittent operation. Failure has little effect on function.	4,000~8,000
Intermittent operation. Failure has significant effect on function.	8,000~12,000
8 hours of non-continuous operation.	12,000~20,000
8 hours of continuous operation.	20,000~30,000
24 hours continuous operation.	40,000~60,000
24 hours of guaranteed trouble-free operation.	100,000~200,000

ADJUSTED LIFE FORMULA

The above life formula is for general use. In cases where a reliability of over 90% is required and where influences apart from load and speed or operating frequency should be taken into account for the rating life, ISO 281, 1990 gives an extended life formula:

$$L_{n0} = a_1 \times a_2 \times a_3 \times (Cr/P)^3 \times 10^6 \text{ (Revolutions)}$$

whereby:
 L_{n0}=Adjusted rating life in millions with a reliability of (100-n)% (n=the reliability rate)
 Cr=BASIC DYNAMIC LOAD RATING(N)
 P=EQUIVALENT DYNAMIC LOAD(N)
 a₁=Factor for a reliability other than 90%
 a₂=Factor for non-conventional materials
 a₃=Factor for non-conventional operating conditions, in particular lubrication

(1) RELIABILITY FACTOR a₁

When a reliability of over 90% is required, the corresponding factor should be selected from the following table.

●RELIABILITY FACTOR a₁

Reliability	90	91	92	93	94	95	96	97	98	99	(99.6)	(99.9)
a ₁	1.00	0.92	0.84	0.77	0.70	0.64	0.62	0.53	0.44	0.33	0.21	(0.10) (0.037)

(2) MATERIAL FACTOR a₂

Improvement in manufacturing techniques for raw material and for heat treatment of components have led to an extended fatigue life for bearings.

Our standard bearing material is a superior quality of vacuum degassed steel leading to an extended life for bearings.

The basic load ratings given in this catalogue have been established by taking this longer life into consideration. This gives an increase in the operating life in hours of a factor of 2.2 and a factor of 1.3 for the load carrying capacity. The material factor a₂=1.

(3) OPERATING CONDITIONS FACTOR a₃

This is an adjustment factor to meet non-conventional operating conditions for lubrication, temperature and load.

Under good lubrication conditions with a permanent oil film between rolling elements and rings, the factor a₃=1.

In unfavourable conditions ($dm \cdot n \leq 10,000$), a factor a₃ < 1 must be selected. d_m = mean bearing diameter = (D+d)/2 , n = operating speed.

At temperatures above 120°C, greater dimensional changes occur and the material hardness deteriorates which affects the bearing life.

The operating factor f_t for temperature can be taken from the following table:

●OPERATING TEMPERATURE AND LIFE COMPENSATION FACTOR f_t

BEARING TEMPERATURE (°C)	120	150	175	200	225	250	275	300
TEMPERATURE FACTOR (f _t)	1.00	0.90	0.85	0.75	0.65	0.60	0.52	0.45

Heat stabilized bearings, where the dimensions are stable above 120°C, are available on request.

BASIC STATIC LOAD RATING "Cor"

The Basic Static Load Rating applies to bearings where rotating motion does not occur or occurs only infrequently. The Basic Load Ratings and calculation methods in this catalogue are based on methods described in ISO 281 and on ISO Recommendations NR.76, taking into account the current level of bearing technology.

Excessive static load causes brinelling at the contact point between the rolling element and raceway.

As a standard of permissible static load, the basic load rating Cor for radial bearings is specified as follows:

Maximum contact pressure at the contact point between rolling element and bearing ring to be 4200 MPa and total permanent deformation of the bearing of appr. 1/10000th of the rolling element's diameter.

Basic Static Load Rating for stainless steel is 80% of that for standard bearing steel.

EQUIVALENT DYNAMIC BEARING LOAD "P"

Load conditions on bearings are usually a combination of radial and axial loads. In order to establish the equivalent radial load with definite force and direction we use the following formula:

● RADIAL LOAD FACTOR AND AXIAL LOAD FACTOR

Fa/(ZD ²)	e	Fa/Fr ≤ e		Fa/Fr > e	
		X	Y	X	Y
0.172	0.19	1	0	0.56	2.30
0.345	0.22	1	0	0.56	1.99
0.689	0.26	1	0	0.56	1.71
1.03	0.28	1	0	0.56	1.55
1.38	0.30	1	0	0.56	1.45
2.07	0.34	1	0	0.56	1.31
3.45	0.38	1	0	0.56	1.15
5.17	0.42	1	0	0.56	1.04
6.89	0.44	1	0	0.56	1.00

$$P = XFr + YFa(N)$$

X=RADIAL LOAD FACTOR
 Fr=RADIAL LOAD(N)
 Y=AXIAL LOAD FACTOR
 Fa=AXIAL LOAD(N)
 D=BALL DIAMETER(mm)

EQUIVALENT STATIC RADIAL LOAD "Po"

For ball bearings subject to both radial and axial loads, the static radial load with definite force and direction is called the Equivalent Static Radial Load.

The higher value from the two formula shown below should be used.

$$Po = 0.6 \times Fr + 0.5 \times Fa(N), Po = Fr(N)$$

SAFETY MODULUS "fs"

Permissible equivalent static load depends on basic static load rating.

But using limit of bearing charge by using condition. Accordingly we use safety modulus which is experimental value.

$$fs = Cor/Po$$

fs=SAFETY MODULUS
 Cor=BASIC STATIC LOAD RATING(N)
 Po=EQUIVALENT STATIC RADIAL LOAD(N)

USING CONDITION	fs
NORMAL OPERATION	1.0
SHOCK LOAD	1.5
SILENT AND HIGH ACCURATE ROTATION	2.0



Fitting of bearings

THE IMPORTANCE OF CORRECT FITTING

A bearing can only perform to its full capacity when it is correctly fitted on the shaft and in the housing. Insufficient interference on fitting surfaces could cause bearing rings to creep in a circumferential direction. Once this happens, considerable wear occurs on the fitting surface and both shaft and housing are damaged. Furthermore, abrasive particles may enter the bearing causing vibration, excessive heat and damage to raceways. It is therefore necessary to provide bearing rings under rotating load with an adequate interference fit to prevent creep. When using thin-type bearings under low load, the bearings should be fastened by a nut. Statically loaded bearings generally do not need to be fitted with an interference fit. Only when subject to a high degree of vibration do both inner and outer rings require fitting with an interference fit.

● FITTING OF BEARING AND SHAFT

CONDITION (STEEL SHAFT)	SHAFT BORE DIAMETER	SHAFT TOLERANCE CLASS	
		THIN TYPE	OTHERS
INNER RING ROTATING LOAD OR INDETERMINATE LOAD DIRECTION	LIGHT LOAD <= 0.06Cr OR FLUCTUATING LOAD	10 ≤ d ≤ 18 18 ≤ d ≤ 30 30 ≤ d ≤ 50	h5 h5 h5 js5
	STANDARD LOAD = 0.06 ~ 0.12Cr	10 ≤ d ≤ 18 18 ≤ d ≤ 30 30 ≤ d ≤ 50	js5 js5 js5 k5
OUTER RING ROTATING LOAD	NECESSARY FOR INNER RING TURNING EASILY AROUND SHAFT	ALL BORE DIAMETERS	g5 g6
	UNNECESSARY FOR INNER RING TURNING EASILY AROUND SHAFT	ALL BORE DIAMETERS	h5 h6

● FITTING OF BEARING AND HOUSING

CONDITION (ONE-PIECE HOUSING)	AXIAL DIRECTIONAL MOVEMENT OF OUTER RING	TOLERANCE CLASS OF SHAFT HOUSING SEATS	
		THIN TYPE	OTHERS
INNER RING ROTATING LOAD	VARYING LOADS	EASY TO MOVE	H6 H7
	LIGHT OR STANDARD LOAD	EASY TO MOVE	H7 H8
	HIGH TEMPERATURE OF INNER RING AND SHAFT	EASY TO MOVE	G6 G7
	LIGHT OR STANDARD LOAD PRECISE ROTATION	AS A RULE, IMPOSSIBLE TO MOVE	K5 K6
		POSSIBLE TO MOVE	JS6 J6
	QUIET OPERATION	EASY TO MOVE	H6 H6
INDETERMINATE LOAD DIRECTION	LIGHT OR STANDARD LOAD	IN GENERAL, POSSIBLE TO MOVE	JS6 J7
	STANDARD OR HEAVY LOAD	AS A RULE, IMPOSSIBLE TO MOVE	K5 K7
	LARGE SHOCK LOAD	IMPOSSIBLE TO MOVE	M5 M7
	LIGHT OR FLUCTUATING LOAD	IMPOSSIBLE TO MOVE	M5 M7
	OUTER RING ROTATING LOAD	STANDARD OR HEAVY LOAD	IMPOSSIBLE TO MOVE
	THIN-TYPE HOUSING SEATS HEAVY LOAD OR LARGE SHOCK LOAD	IMPOSSIBLE TO MOVE	P6 P7

● CHARACTERISTICS OF LOAD AND FITTING

ROTATING RING	LOAD	LOAD CONDITION	FITTING
INNER RING	STATIC	INNER RING ROTATING LOAD	INTERFERENCE FIT FOR INNER RING
OUTER RING	ROTATING	OUTER RING STATIC LOAD	CLEARANCE FIT FOR OUTER RING
OUTER RING	STATIC	OUTER RING ROTATING LOAD	CLEARANCE FIT FOR INNER RING
INNER RING	ROTATING	INNER RING STATIC LOAD	INTERFERENCE FIT FOR OUTER RING
IN THE CASE OF FLUCTUATING LOAD DIRECTION OR UNBALANCED LOAD	ROTATING OR STATIC	INDETERMINATE LOAD DIRECTION	INTERFERENCE FIT FOR INNER AND OUTER RING

CALCULATIONS OF FITS

(1) FITTING PRESSURE AND DIMENSIONAL CHANGES OF INNER AND OUTER RING

The right fit for each application is established taking various conditions into consideration such as load, speed, temperature, mounting dismounting of the bearing. The interference fit should be greater than normal in thin housings, housings of soft material or on hollow shafts.

(2) LOAD OF INTERFERENCE

The interference fit of shaft and inner ring decreases under radial load. The decrease in fit of shaft and inner ring is calculated by the following formula:

The higher value from the two formula shown below should be used.

$$\Delta dF = 0.08 \times \sqrt{d/B} \cdot Fr \times 10^{-3} \text{ (mm)}$$

$$\Delta dF = 0.02 \times Fr/B \times 10^{-3} \text{ (mm)}$$

(3) INFLUENCE OF TEMPERATURE ON BEARINGS, SHAFTS AND HOUSINGS

Each inner ring, outer ring or rolling element of a bearing rotating under load generates heat which will affect the interference fits of the shaft and the housing. Assuming a temperature difference within the bearing and the housing of $\Delta T(^{\circ}\text{C})$, that of the mating surface of the shaft and of the bearing is $(0.10 \sim 0.15)\Delta T$. Consequently, ΔdT , the decrease of the inner ring interference fit due to temperature change, is calculated from the following formula:

$$\Delta dT = (0.10 \sim 0.15) \times \Delta T \cdot a \cdot d \approx 0.0015 \times \Delta T \cdot d \times 10^{-3} \text{ (mm)}$$

ΔdT : DECREASE OF INTERFERENCE DUE TO TEMPERATURE DIFFERENCE(mm)
 ΔT : TEMPERATURE DIFFERENCE BETWEEN BEARING AND SURROUNDING HOUSING($^{\circ}\text{C}$)
 a : COEFFICIENT OF THERMAL EXPANSION FOR BEARING STEEL $\approx 12.5 \times 10^{-6}$ (l/C)
COEFFICIENT OF THERMAL EXPANSION FOR STAINLESS STEEL $\approx 10.3 \times 10^{-6}$ (l/C)
 d : NOMINAL BORE DIAMETER OF BEARING(mm)

It should also be noted that fit can increase due to temperature changes.

(4) EFFECTIVE INTERFERENCE, SURFACE ROUGHNESS AND ACCURACY

The surface roughness is smoothed during fitting and the effective interference becomes smaller than the theoretical interference. The surface roughness quality of a mating surface has an influence on how much this theoretical interference decreases. Effective interference can usually be calculated as follows:

Ground Shaft : $\Delta d = d/(d+2) \cdot \Delta da \text{ (mm)}$
Turned Shaft : $\Delta d = d/(d+3) \cdot \Delta da \text{ (mm)}$
Δd : EFFECTIVE INTERFERENCE(mm)
Δda : THEORETICAL INTERFERENCE(mm)
d : NOMINAL BORE DIAMETER OF BEARING(mm)

By combining these factors, the theoretical interference fit required for inner ring and shaft where the inner ring is subjected to rotating load is calculated as follows:

$\Delta da \geq (\Delta dF + \Delta dT) ((d+3)/d \text{ or } (d+2)/d) \text{ (mm)}$

Normally, shaft and housing seats have to meet the accuracy and roughness requirements as given below.

● ACCURACY AND ROUGHNESS OF SHAFT AND HOUSING SEATS

	SHAFT	HOUSING
ROUNDNESS	BELOW 50% OF SHAFT DIAMETER TOLERANCE	BELOW 50% OF HOUSING BORE DIAMETER TOLERANCE
CYLINDRICITY	BELOW 50% OF SHAFT DIAMETER TOLERANCE WITHIN BEARING WIDTH	BELOW 50% OF HOUSING BORE DIAMETER TOLERANCE WITHIN BEARING WIDTH
SQUARENESS		$\leq 3/1000 (0.17')$
ROUGHNESS OF MATING SURFACE	Rmax 3.2	Rmax 6.3

Mounting bearings with extra tight or light interference fits can lead to early bearing failure. In order to ensure safe operating conditions the tolerance variations of shaft seats, housing bores and bearing bore and outside diameter need to be reduced.

We recommend the tolerance zones are divided into two bands and selective assembly is applied. Bearings sorted into two tolerance bands for inner and outer rings are available on request. These bearings are marked as follows:

● SELECTIVE CLASSIFICATION OF OUTER AND BORE DIAMETER TOLERANCES AND INDICATION MARK

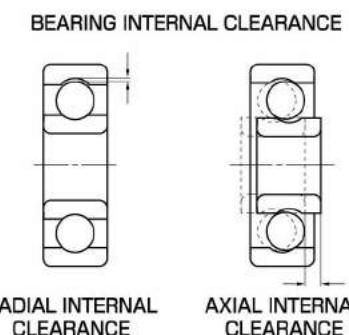
TOLERANCES OF OUTER DIAMETER	TOLERANCE OF BORE DIAMETER	TOLERANCE OF BORE DIAMETER		
		0~-D/2	-D/2~-D	0~-D
0~-d/2	1	C11	C12	C10 ZC1
-d/2~-d	2	C21	C22	C20
0~-d	0	C01	ZC2	C02

NOTE: 1. THIS IS APPLIED TO BOTH BEARINGS OF ABEC 5P AND P5.
2. UPON YOUR REQUEST, PLEASE SPECIFY THE MARK LISTED BELOW.
ZC1.... 2 SELECTIVE CLASSIFICATIONS FOR BORE DIAMETER
TOLERANCE (0~-d/2, -d/2~-d)
1 SELECTIVE CLASSIFICATION FOR OUTER DIAMETER TOLERANCE (0~-D)
ZC2.... 1 SELECTIVE CLASSIFICATION FOR BORE DIAMETER
TOLERANCE (0~-d)
2 SELECTIVE CLASSIFICATIONS FOR OUTER DIAMETER
TOLERANCE (0~-D/2, -D/2~-D)
ZC3.... 4 SELECTIVE CLASSIFICATIONS FOR BOTH BORE AND OUTER DIAMETER
TOLERANCE (0~-d/2~, -d/2~-d, 0~-D/2~, -D/2~-D)
D.... MINIMUM VALUE OF OUTER DIAMETER TOLERANCE
d.... MINIMUM VALUE OF BORE DIAMETER TOLERANCE

Internal clearance

INTERNAL CLEARANCE AND STANDARD VALUES

Internal clearance is the play between outer ring, inner ring and rolling element. Generally, the amount of up and down movement of the outer ring with respect to the fixed inner ring is called the radial internal clearance and its right and left movement the axial internal clearance. Bearing internal clearance in operation is an important factor that has a significant influence on other factors such as noise, vibration, heat and fatigue life. Radial ball bearings are usually classified by their internal radial clearance. When measuring the internal clearance, the bearing is subjected to a standard load in order to ensure full contact between all bearing components. Under such a load, the measured value is larger than the actual value stated for radial clearance; this is due to elastic deformation. The difference is compensated by the factors given in the tables below.



● RADIAL INTERNAL CLEARANCE OF SMALL AND MINIATURE BEARINGS

CLEARANCE SYMBOL		MC1	MC2	MC3	MC4	MC5	MC6	Unit μm	
CLEARANCE		min	0	3	5	8	13	20	
		max	5	8	10	13	20	28	

NOTE: 1. STANDARD CLEARANCE IS MC3.
2. FOR MEASURING CLEARANCE, OFFSET BY COMPENSATION FACTOR LISTED BELOW.

CLEARANCE SYMBOL		MC1	MC2	MC3	MC4	MC5	MC6	Unit μm
COMPENSATION FACTOR		1	1	1	1	2	2	

MEASURING LOAD IS AS FOLLOWS.
MINIATURE BEARINGS 2.5N (0.25kgf)
SMALL BEARINGS 4.4N (0.45kgf)

● RADIAL INTERNAL CLEARANCE OF STANDARD RADIAL BALL BEARINGS

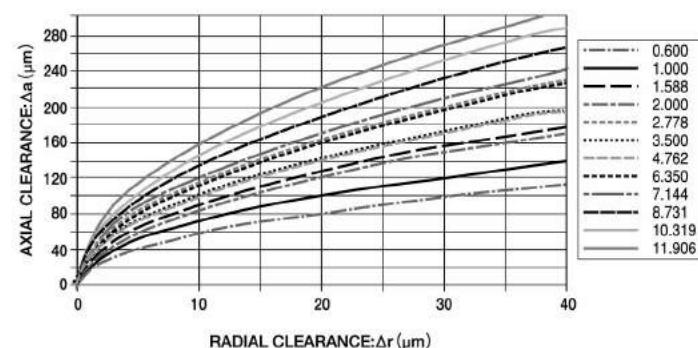
NOMINAL BORE DIAMETER d(mm)		CLEARANCE										Unit μm
OVER	INCL.	C2		CN(C0)		C3		C4		C5		Unit μm
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
10(ONLY)		0	7	2	13	8	23	14	29	20	37	
10	18	0	9	3	18	11	25	18	33	25	45	
18	24	0	10	5	20	13	28	20	36	28	48	
24	30	1	11	5	20	13	28	23	41	30	53	
30	40	1	11	6	20	15	33	28	46	40	64	
40	50	1	11	6	23	18	36	30	51	45	73	

NOTE: 1. FOR MEASURING CLEARANCE, OFFSET BY COMPENSATION FACTOR LISTED BELOW.

BORE DIAMETER OF NOMINAL BEARING d(mm)		MEASURING LOAD		COMPENSATION FACTOR					Unit μm
OVER	INCL.	N (kgf)	C2	CN (C0)	C3	C4	C5		Unit μm
10(INCLUDED)	18	24.5(2.5)	3~4	4	4	4	4		
18	50	49(5)	4~5	6	6	6	6		

RELATIONSHIP BETWEEN RADIAL INTERNAL CLEARANCE AND AXIAL INTERNAL CLEARANCE

The axial internal clearance is established from the ball diameter, outer and inner ring raceway radius and the radial internal clearance. Usually it is about 10 times the value of the internal radial clearance. Selection of a small internal radial clearance or an extra large interference fit in order to reduce the internal axial clearance after mounting is not recommended.



$$\Delta a = 2\sqrt{\Delta r(r_o + r - D_a)} \text{ (mm)}$$

Δa: AXIAL INTERNAL CLEARANCE(mm)
r_o: OUTER RING RACEWAY RADIUS(mm)
D_a: BALL DIAMETER(mm)
Δr: RADIAL INTERNAL CLEARANCE(mm)
r: INNER RING RACEWAY RADIUS(mm)

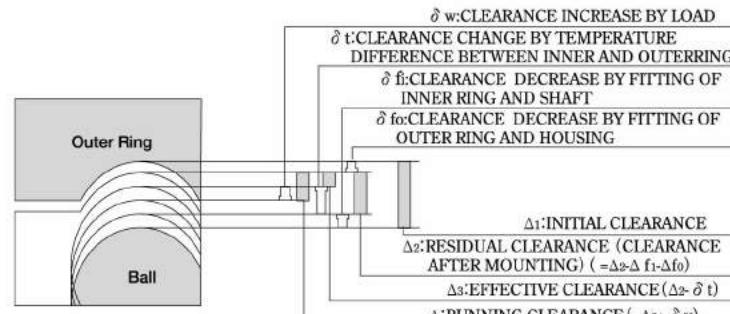
SELECTION OF BEARING CLEARANCE

Theoretically, maximum bearing life is with very slight preload. However, even a slight increase in this theoretical preload can have a considerably detrimental effect on the bearing life. Positive clearance should therefore be selected. MC3 is usually used for miniature or small bearings, standard clearance for general bearings and the clearance for thin section bearings should never be greater than "standard".

● SELECTION OF RADIAL INTERNAL CLEARANCE

Operating Condition	Clearance
Clearance fit for inner and outer ring. Low axial load. No axial load carrying requirement. Select bearing with reduced radial clearance. Lower vibration and noise. Low speeds.	MC1, MC2, C2
Lower frictional torque. Standard axial load. Average axial load carrying requirements. Slight interference fit for inner ring. Clearance fit for outer ring. Average/low speeds.	MC3, MC4, CN(C0)
Extremely low frictional torque. High axial load. High axial load carrying requirements. Heavy interference fit to support high loads or shock loads. Large temperature gradient from inner ring to outer ring. High degree of shaft deflection.	MC5, MC6, C3, C4, C5

CALCULATION OF CLEARANCE



(1) RUNNING CLEARANCE

Running clearance is the resultant clearance after load, temperature difference and fitting are taken into consideration.

$$\Delta = \Delta_1 - (\Delta t + \Delta f) + \Delta w \text{ (mm)}$$

(2) CLEARANCE REDUCTION BY TEMPERATURE DIFFERENCE BETWEEN INNER AND OUTER RING

In a bearing, the highest temperature is generated in the rolling element followed by the inner ring, with the outer ring having the lowest temperature. Since it is impossible to measure the temperature of a rolling element, in practice, the temperature of the inner ring is used.

$$\Delta t = a \times \Delta T \times D_o \text{ (mm)}$$

(3) CLEARANCE REDUCTION BY FITTING

When a bearing is fitted onto a shaft or into a housing with an interference fit, the internal clearance of the bearing reduces.

$$\begin{aligned}\delta f &= \delta fi + \delta fo = \\ \Delta db \times d / db \times ((1 - (do/d)^2)) / (1 - (do/db)^2) + \\ \Delta Da \times Da / D \times ((1 - (D/Dh)^2) / (1 - (Da/Dh)^2)) \quad (\text{mm})\end{aligned}$$

(4) CLEARANCE INCREASE BY LOAD

Load on a bearing deforms it elastically and increases the internal clearance.

$$\begin{aligned}\delta w &= C \times ((5 \times Fr) / (Z \times \cos \alpha))^{(2/3)} \times (1/dw)^{(1/3)} \quad (\text{mm}) \\ \text{The initial contact angle } \alpha_0 \text{ is calculated from the following two formulae:} \\ \cos \alpha_0 / \cos \alpha &= 1 + C / (2 \times m - 1) \times (Fa / (9.8 \times Z \times Dw^2 \times \sin \alpha))^{(2/3)} \\ 1 - \cos \alpha_0 &= \Delta r / (2 \times Dw \times (2 \times m - 1))\end{aligned}$$

SYMBOLS

ΔT	TEMPERATURE DIFFERENCE BETWEEN INNER AND OUTER RING	m	OSCULATION
D_o	OUTER RING RACEWAY DIAMETER	Z	NUMBER OF BALLS
Δdb	CLEARANCE OF INNER RING ON SHAFT	D_w	BALL DIAMETER
d_o	BORE DIAMETER OF HOLLOW SHAFT	α	CONTACT ANGLE
D_n	OUTSIDE DIAMETER OF HOUSING SEAT	α_0	INITIAL CONTACT ANGLE
ΔDa	CLEARANCE OF OUTER RING IN HOUSING	F_a	AXIAL LOAD
db	AVERAGE OUTSIDE DIAMETER OF INNER RING	Δr	RADIAL INTERNAL CLEARANCE
D_a	AVERAGE OUTSIDE DIAMETER OF OUTER RING	C	MATERIAL ELASTICITY FACTOR
a	COEFFICIENT OF THERMAL EXPANSION FOR BEARING STEEL		
		General Bearing	$C=0.00218$
		Instrument Bearing	$C=0.00287$
			$m=0.525$
			$m=0.560$

REQUIRED CHARACTERISTICS OF THE LUBRICANT

- (1) LOW FRICTION AND ABRASION
- (2) HIGH STABILITY AGAINST HEAT, GOOD THERMAL CONDUCTIVITY
- (3) STRONG OIL FILM
- (4) NON-CORROSIVE
- (5) PROVIDE A GOOD BARRIER AGAINST DUST AND MOISTURE
- (6) MAINTAIN A STABLE VISCOSITY

STANDARD LUBRICANT

Lubricant	Brand	EZO CODE	Manufacturer	MIL STANDARD	Operating Temperature(°C)	specific gravity
STD.GREASE	MULTEMP SRL	SRL	Kyodo Yushi		-40~+150	0.93
	ALVANIA 2S	AV2	Shell Oil Co.		-25~+120	0.92
STD. OIL	AERO SHELL FLUID 12	AF2	Shell Oil Co.	MIL-PRF-6085D	-50~+205	0.93

LUBRICATION METHOD

There are two types of lubricant: oil or grease. It is important to select the correct lubricant and lubrication method for each application and its conditions.

●LUBRICATING OIL AND GREASE

	LUBRICATING OIL	LUBRICATING GREASE
ROTATING SPEED	LOW • MEDIUM • HIGH SPEED	LOW • MEDIUM SPEED
LUBRICANT EFFICIENCY	EXCELLENT	GOOD
COOLING EFFECT	GOOD	NONE
TORQUE	COMPARATIVELY LOW	COMPARATIVELY HIGH
LUBRICANT LIFE	LONG	COMPARATIVELY SHORT
LUBRICANT REPLACEMENT	EASY	DIFFICULT
LUBRICANT LEAKAGE	SHOULD NOT BE USED WHERE OIL LEAKAGE IS UNACCEPTABLE	LITTLE GREASE LEAKAGE
IMPURITIES FILTRATION	EASY	DIFFICULT
SEALING EQUIPMENT	COMPLEX	SIMPLE

Lubrication

OBJECT OF LUBRICATION

The lubrication method and the lubricant have a direct effect on the bearing life; the most suitable lubrication must therefore be selected for each application. Effects of lubrication are described as follows:

(1) DECREASE OF FRICTION AND ABRASION

It decreases rolling friction between the raceway and the rolling elements, sliding friction between rolling element and cage and sliding friction of guide surface between the cage and the bearing ring.

(2) REDUCTION OF HEAT GENERATION

It dissipates heat generated inside the bearing as well as heat conducted from the outside thus preventing overheating of the bearing and deterioration of the lubricant.

(3) PROTECTION FROM CORROSION AND CONTAMINANTS

It prevents corrosion of rolling elements, bearing rings and cages and also prevents the ingress of contaminants and moisture into the bearing.

●GREASE FILLING VOLUME

SYMBOL	FILLING VOLUME(%)	OPERATING CONDITION	
		SPEED	LOAD
M	70±10	LOW	HEAVY
S	50±10	LOW	MEDIUM
G	40±10	MEDIUM	MEDIUM
L	30±10	MEDIUM	MEDIUM
Q	25±5	MEDIUM	MEDIUM
K	20±5	HIGH	LIGHT
X	10±5	HIGH	LIGHT

NOTE: LIGHT LOAD ($\leq 0.06Cr$)
STANDARD LOAD ($\leq 0.12Cr$)

●CRITERIA FOR LUBRICATING OIL SELECTION

OPERATING TEMPERATURE OF BEARING (°C)	dn	ISO VISCOSITY GRADE OF LUBRICATING OIL(VG)	
		MEDIUM LOAD	HEAVY LOAD/SHOCK LOAD
-30~0	UP TO PERMISSIBLE ROTATING SPEED	15,22,32	32,46
0~+60	UP TO 15000	32,46,68	100
	15000~80000	32,46	68
	80000~150000	22,32	32
	150000~500000	10	22,32
+60~+100	UP TO 15000	150	220
	15000~80000	100	150
	80000~150000	68	100,150
	150000~500000	32	68
+100~+150	UP TO PERMISSIBLE ROTATING SPEED	320	

NOTE: 1.IF HEAVY LOADS OCCUR AT LOW SPEEDS, A HIGHER VISCOSITY LUBRICATING OIL SHOULD BE USED.
2.THIS TABLE IS FOR OIL BATH LUBRICATION SYSTEM AND RECIRCULATING OIL SYSTEMS.
3.bn = BEARING BORE DIAMETER d(mm) X ROTATING SPEED n(r.p.m)

●COMMON OIL BRANDS AND EFFICIENCY

Manufacturer	Brand	Code	Lubricant Base	Flash Point (°C)	Viscosity (m ² /s)	Operating Temperature (°C)	Approved Standard
Shell Oil Co.	Aero Shell Fluid 31	AF1	Dester	237	14.33 (40°C)	-40~+204	MIL-PRF-83282D
	Aero Shell Fluid 12	AF2	Dester	220	8.9 (54.4°C)	-54~+135	MIL-PRF-6085D
	Aero Shell Fluid 3	AF3	Mineral	155	10.0 (38°C)	-47~+115	MIL-PRF-7870C
Anderson Oil Co.	Windsor Lube L-245X	WL2	Dester	215	14.0 (38°C)	-55~+175	MIL-PRF-6085D
Dupont,E.I.	Krytox 143AZ	KAZ	Fluorinated	-	12.4 (40°C)	-54~+149	-
Kluber Lub.	Isoflex PDB38	PD8	Dester	210	12.0 (40°C)	-55~+100	-
Anderol Co.	Anderol 402	A42	Dester	227	12.4 (40°C)	-54~+177	MIL-PRF-6085D
Nippon Oil Corp.	Antirust P2100	002	Mineral	166	13.0 (40°C)	-20~+115	VV-L-800c

●COMMON GREASE BRANDS AND EFFICIENCY

Manufacturer	Brand	Code	Thickening Agent	Lubricant Base	Drop Point (°C)	Cone Penetration: Worked (60 strokes)	Operating Temperature (°C)	Approved Standard
Shell Oil Co.	Alvania 1S	AV1	Lithium	Mineral	182	323	-35~+120	-
	Alvania 2S	AV2	Lithium	Mineral	185	275	-25~+120	-
	Alvania 3S	AV3	Lithium	Mineral	185	242	-20~+135	-
	Alvania RLQ	RLQ	Lithium	Mineral	195	275	-30~+120	-
	Aero Shell NO.7	AG7	Microgel	Dester	260	296	-73~+149	MIL-PRF-83282D
	Aero Shell NO.14	AG4	Calium	Dester	148	273	-54~+93	MIL-G-25537C
	Aero Shell NO.15	AG5	Fluorotelomer	Silicone	260	290	-73~+232	MIL-G-25013E
	Aero Shell NO.16	AG6	Microgel	Polyester,Mineral	260	308	-54~+204	MIL-G-25760A
	Aero Shell NO.17	AG8	Microgel	Dester	260	295	-73~+149	MIL-G-21164D
	Aero Shell NO.22	AG2	Microgel	Synthetic Hydrocarbon	260	275	-65~+204	MIL-PRF-81322F
	Alvania EP2	AE2	Lithium	Mineral	184	284	-20~+110	-
	Retinax CL2	RXA	Lithium	Mineral	181	284	-15~+130	-
	Shell Cassida HDS2	HS2	Aluminum Complex	PAO	240	280	-30~+120	NSF(USDA)H1
	Shell Cassida RLS2	RL2	Aluminum Complex	PAO	240	275	-35~+120	NSF(USDA)H1
Kyodo Yushi	Multemp PS NO.2	PS2	Lithium	Dester,Mineral	190	275	-55~+130	-
Kyodo Yushi	Multemp SRL	SRL	Lithium	Dester,Mineral	191	245	-50~+150	-
Kluber Lub.	Staburags NBU12	NB2	Barium	Mineral	220	270	-35~+150	NSF(USDA)H2
	Staburags NBU12/300KP	NB3	Barium	Mineral	220	300	-35~+150	-
	Staburags NBU8 EP	NB8	Barium	Mineral	220	280	-35~+150	NSF(USDA)H2
	Isoflex NBU15	NB5	Barium	Dester,Mineral	200	280	-40~+130	MIL-G-25760A
	Isoflex TOPAS NB52	B52	Barium	Synthetic Hydrocarbon	220	280	-60~+160	-
	Isoflex Altitime SL2	AS2	Lithium	Dester	180	280	-70~+150	-
	Isoflex LDS18 Special A	L8A	Lithium	Dester	190	280	-60~+130	MIL-G-23827B
	Isoflex Super LDS18	SL8	Lithium	Dester	190	280	-60~+130	MIL-G-7118A
	Isoflex PDB38 CX2000	PDC	Lithium	Synthetic	-	-	-70~+120	-
	Barielta IEL	IEL	PTFE	Fluorinated	-	280	-35~+220	-
	Barielta IELV	IEV	PTFE	Fluorinated	-	280	-65~+200	-
	Barielta IMI	IMI	PTFE	Fluorinated	-	280	-50~+220	-
Dow Corning Co.	Barielta IMI/V	IMV	PTFE	Fluorinated	-	280	-50~+220	-
	Barielta L55/2	L55	PTFE	Fluorinated	-	280	-35~+260	NSF(USDA)H2
	Barielta IS	BS1	PTFE	Fluorinated	-	280	-35~+260	-
	Klubersynth UH1 64-62	UH6	Silicate	Synthetic Hydrocarbon	-	280	-40~+150	NSF(USDA)H1
	Molykote 33M	M3M	Lithium	Silicone	200	260	-70~+180	-
	Molykote 33L	M3L	Lithium	Silicone	200	300	-70~+180	-
	Molykote 44M	M4M	Lithium	Silicone	210	260	-40~+200	-
	Molykote BR2 Plus	BR2	Lithium	Mineral	180	280	-30~+150	-
	Molykote FS3451	F35	PTFE	Fluorinated	232	310	-40~+200	-
Dupont,E.I.	Krytox 240AC	K24	PFPE	Fluorinated	-	282	-35~+288	MIL-G-27617
	Krytox 240AZ	K2Z	PFPE	Fluorinated	-	285	-54~+149	MIL-G-27617
Esso Standard	Beacon325J	B32	Lithium	Dester	190	274	-60~+120	-
	Templex N3	TX3	Lithium Complex	Mineral	260	230	-30~+160	-
Mobil Oil Co.	Mobil NO.28	MG2	Bentrite	Synthetic Hydrocarbon	262	280	-62~+204	MIL-G-81322E
	Mobilux EP2	MGE	Lithium	Mineral	202	280	-30~+130	-
Nippon Grease Co.	Nig Ace W	NAW	Diurea	Synthetic	268	256	-30~+150	-
Shinetsu Chemical Co.	Silicolube G40M	G40	Lithium	Silicone	210	260	-30~+200	MIL-L-15719A



Maximum permissible bearing speed

Each bearing type has its own limiting speed. The theoretical speed that bearings can run at safely, even if heat generation by internal friction occurs, is called the maximum permissible speed. The permissible speed is related to bearing type, type of cage, lubricant type, load and cooling conditions to which the bearing is subjected. For contact rubber seals(2RS type), the permissible speeds are limited by the peripheral velocity of the seal lip. Normally, this is approximately 50 - 60% of that of non-contact rubber seals. If light contact rubber seals are required, this must be stipulated with the order. If high loads occur, the permissible speed values must be reduced and the following supplementary factors applied, except under standard operating conditions(Cr/P<12, Fa/Fr>0.2)

●COMPENSATION FOR MAXIMUM PERMISSIBLE SPEED DEPENDENT ON LOAD RATIO

Cr/P	5	6	7	8	9	10	11	12
COMPENSATION FACTOR	0.72	0.79	0.85	0.90	0.93	0.96	0.98	1.00

●COMPENSATION FOR MAXIMUM PERMISSIBLE SPEED UNDER COMBINED AXIAL AND RADIAL LOAD

Fa/Fr	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
COMPENSATION FACTOR	1.00	0.95	0.93	0.91	0.89	0.88	0.87	0.86



Frictional torque and temperature

<p

$$M = \mu \cdot F \cdot d/2 \text{ (N} \cdot \text{mm)}$$

M:FRictional torque(N·mm)
F:Bearing load (N)
d:Shaft diameter(mm)
 $\mu=0.0015$ COEFFICIENT OF FRICTION

TEMPERATURE INCREASE

Friction and grease resistance can increase the bearing temperature. In the initial stages of operation, the internal bearing temperature rises rapidly: as the heat dissipates to the shaft and housing and the cooling effect of the lubricant begins to take effect, the temperature stabilizes. Constant high temperatures lead to a reduction in bearing clearance, a deterioration of the running accuracy and of the lubricant and thereby a reduction in bearing life. It is important to consider the effect of temperature increases when selecting the bearing.

- ◆ After assembly, the bearing should be rotated to check its correct operation. If the bearing does not appear to be functioning correctly, it should be re-examined to establish the cause of the malfunction.
- ◆ It is not advisable to mix oils and greases as this will affect the efficiency of the bearing.
- ◆ Bearings must be stored in a clean environment with stable temperature. They should be handled with care to avoid the possibility of corrosion and rusting.
- ◆ Lint-free cloth must be used to wipe shaft and housing seats to avoid the ingress of contaminants into the bearing.

Basic rules for selecting and handling of bearings

NOTES ON SELECTING

- ◆ The efficiency of thin type bearings can be greatly affected by the precision of shaft and housing seats. The accuracy of the surrounding structure must be such that it will not adversely affect the operation of the bearing. If you have any questions, in particular regarding series 670 and 680, please contact us.
- ◆ In applications with steel crown type cages (w type), where high acceleration, heavy loads, shock loads or vertical shafts occur or where oil is the only lubricant available, please contact us.
- ◆ Selection of fitting clearance and grease type requires a careful consideration of rotating speed, load conditions and temperature in order to prevent premature bearing failure.
- ◆ Full complement ball bearings are suitable for low speed and heavy radial load conditions. There is a danger of balls being pushed out of the bearing through the filling slot, even under light axial load. For this reason, full complement ball bearings are not suitable for supporting axial loads.

NOTES ON HANDLING

- ◆ The actual assembly area should be kept free from dust as any contamination has a detrimental effect on the operation and life of rolling bearings. If there is any doubt concerning the cleanliness of a bearing, it can be washed with a suitable agent and then relubricated.
- ◆ When fitting bearings, the fitting forces must not be transmitted via the rolling elements. If it is necessary to heat the bearing to facilitate fitting, the temperature should not exceed +120°C.



Problem, Cause, Remedy

	PROBLEM	CAUSE	REMEDY
Noise	High pitched metallic noise	Poor lubrication	Improve lubrication
		Clearance too small	Correct clearance
		Poor fitting	Investigate mounting method and seating
		Excessive load	Examine shaft and housing tolerances for closing effect
	Low pitched metallic noise	Brinelled raceway surface	Avoid shock loads
		Rust and damage	Check and replace seals and relubricate
	Regular noise	Flaking of raceway surface	Improve lubrication and check fitting, clearance and fixing method
		Ingress of foreign matter	Check and replace seals and relubricate
		Excessive clearance	Correct clearance
Heavy vibration	Irregular noise	Damege and flaking of rolling element	Reduce loads and/or clearance
		Variable clearance due to temperature changes	Check fits taking housing material and temperature into consideration
		Damage to raceways	Improve lubrication and check fitting, clearance and fixing method
		Flaking of raceway and rolling element	Improve lubrication and check fitting, clearance and fixing method
	Excessive heat generation	Ingress of foreign matter	Check and replace seals and relubricate
		Excessive clearance	Correct clearance
		Poor location	Ensure abutment face and fitting diameter are perpendicular
		Clearance too small	Correct clearance
Lubrication failure	Poor location	Poor location	Ensure abutment face and fitting diameter are perpendicular
		Excessive load	Examine shaft and housing tolerances for closing effect
		Poor lubrication	Improve lubrication
	Too much grease	Creep	Maintain recommended shaft and housing fits
		Too much grease	Use correct lubricant quantity
		Ingress of foreign matter	Check and replace seals and relubricate

Damage, Cause, Remedy

Incorrect handling of bearing can cause damage and shorten the life. The following list shows typical causes and suggested remedies.

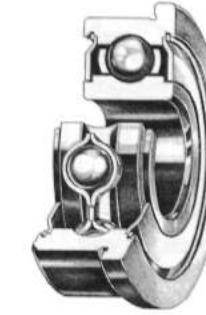
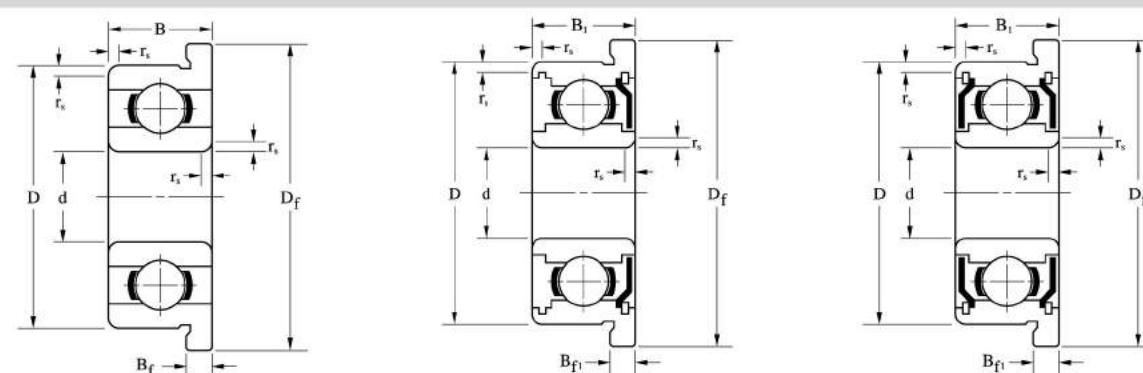
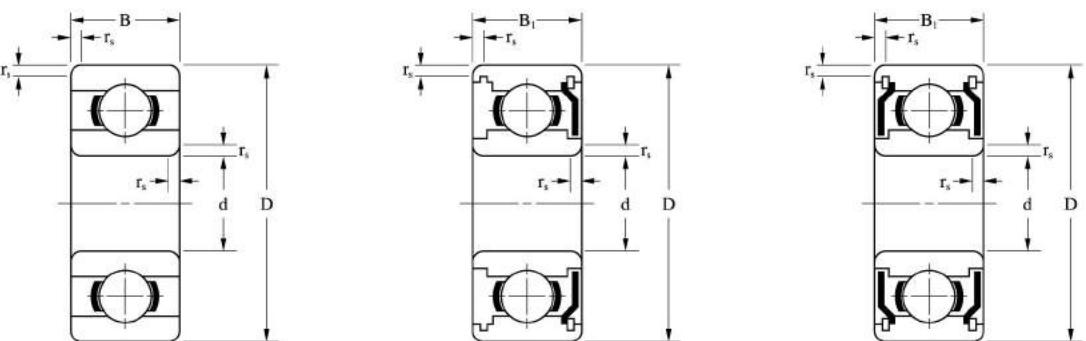
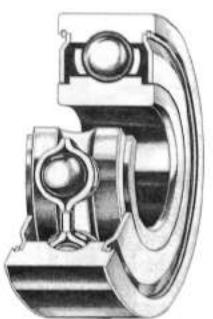
PROBLEM	DAMAGE	CAUSE	REMEDY
Flaking	Flaking on one side of entire raceway	Excessive axial load by poor fitting or linear expansion	Use clearance fit on non-rotating bearing outer ring
	Flaking at rolling element pitch on raceways	Raceways brinelled during fitting	Careful fitting
		Corrosion during down time	Apply corrosion protective
	Premature flaking of raceway and rolling element surfaces	Excessive load	
		Clearance too small	Check fitting
		Poor lubrication	Correct clearance
		Poor fitting	Use correct lubricant quantity
		Corrosion	
	Flaking across the raceway	Poor fitting and eccentricity	Fitting and centering with care
	Flaking around raceway	Shaft deflection	Use bearing with larger internal clearance
		Geometric inaccuracy of shaft and housing	Shaft and abutments to be square
		Poor housing accuracy	Check geometric accuracy of housing bore
Indentations	Indentations on raceway at rolling element pitch	Shock loads during fitting or poor handling	Handling with care
	Overrolling	Excessive static load	Check static load
Pick-up	Discolouration of raceway and rolling element surface	Ingress of foreign matter	Ensure cleanliness of components and integrity of seals
	Softening of surfaces	Excessive load	Check fitting
		Clearance too small	Correct clearance
		Poor lubrication	Use correct lubricant quantity
Electrical erosion	Raceway eroded at regular intervals	Poor fitting	Check fitting method
		Arcing due to bearing conducting electricity	Ground the bearing, Insulate the bearing
Fracture	Raceway surface fracture	Excessive shock loads	Correct loading
		High interference fit	Proper fitting
		Increase of flaking and softening/welding of inner ring to shaft	Ensure correct geometry of shaft and housing
		Corner fillet radii too large	Correct fillet radii
	Rolling element fracture	Excessive shock loads	Correct loading
		Excessive internal clearance	Check fitting and clearance
	Cage fracture	Tilting moments	Fit with care
		High speed impulse and high acceleration	Ensure uniform rotation
		Incorrect lubrication	Check lubricant and lubrication method
Skidding	Scoring of raceway and rolling element surfaces	Ingress of foreign matter in bearing	Improve sealing
		Hard grease	Use soft grease
Abrasion	Extreme abrasion of raceway, rolling element and cage	High start-up acceleration	Control acceleration
		Ingress of foreign matter	Improve sealing
		Corrosion	Improve lubrication
	Creep	Poor lubrication	
		Loose fit	Correct tolerances and fitting
	Incorrectly fixed		Correct fixing
	Fretting corrosion	Small movements between surfaces	Increase interference fit
	False brinelling	Vibration in non-rotating bearing	Insulate bearing from vibration
		Small oscillations in application	Use oil as lubricant
			Apply preload
Corrosion	Rust inside bearing	Poor storage	Careful storage and handling
		Condensation	
	Rust on fitting surface	Fretting	Increase interference fit
		Fluctuating load	Use oil as lubricant
Corrosion	Ingress of acid, alkali or gas	Ingress of acid, alkali or gas	Check sealing
		Chemical reaction with lubricant	Use correct lubricant



Dimension Contents

- Metric series (0.6≤d≤4mm) 24
- Metric series (5≤d≤9mm) 26
- Inch series 28
- Extra thin metric series: 6700, 6800, 6900 (10≤d≤30mm) 30
- Extra thin metric series: 6700, 6800, 6900 (35≤d≤95mm) 32
- Large sized stainless series: 6000H, 6200H, 6300H 34
- Extra thin series: ET, ER 36
- Thrust series: FM, F 37
- Interchange 38

Metric series (0.6≤d≤4mm)



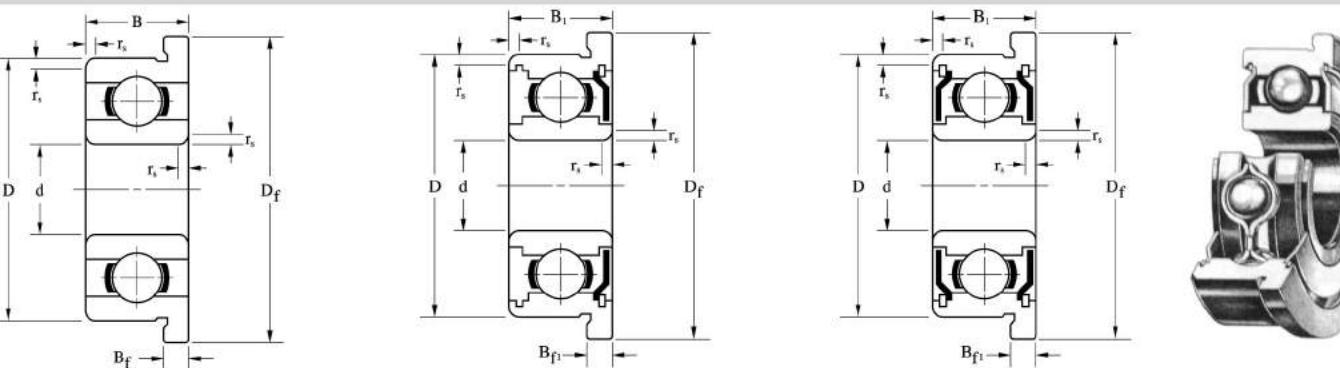
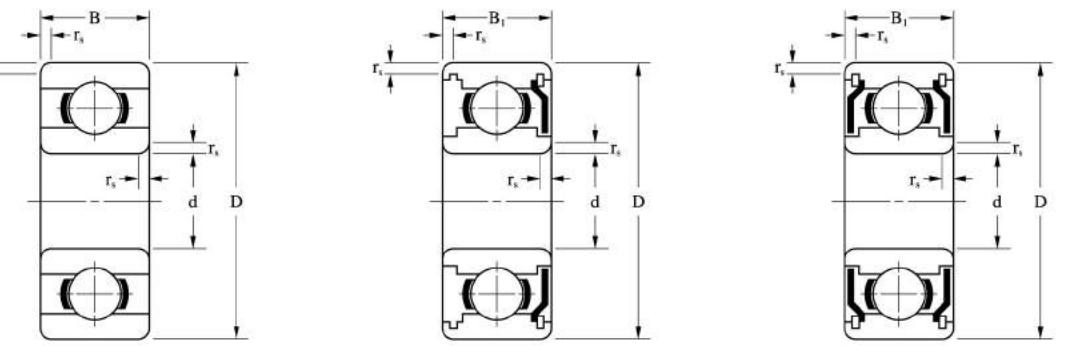
Bore Diameter: d	Outer Diameter: D	Flange Diameter: Df	Radius: r_s(min)	Open Bearings				Seal, Shield Bearings				
				Width: B		Flange Width: Bf		Bearing Reference				
				Open	Flange Open	Shield	Flange Shield	Seal	2RS	2RU	TTs	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	
0.6	0.0236	2.5	0.0984	—	—	0.05	0.0020	1.0	0.0394	—	—	68/0.6
1.0	0.0394	3.0	0.1181	3.8	0.1496	0.05	0.0020	1.0	0.0394	0.3	0.0118	681 F681
		3.0	0.1181	—	—	0.05	0.0020	1.5	0.0591	—	—	MR31 —
		4.0	0.1575	5.0	0.1969	0.10	0.0039	1.6	0.0630	0.5	0.0197	691 F691
1.2	0.0472	4.0	0.1575	4.8	0.1890	0.10	0.0039	1.8	0.0709	0.4	0.0157	MR41X MF41X MR41XZZ
1.5	0.0591	4.0	0.1575	5.0	0.1969	0.05	0.0020	1.2	0.0472	0.4	0.0157	681X F681X 681XZZ F681XZZ
		5.0	0.1969	6.5	0.2559	0.15	0.0059	2.0	0.0787	0.6	0.0236	691X F691X 691XZZ F691XZZ
		6.0	0.2362	7.5	0.2953	0.15	0.0059	2.5	0.0984	—	—	601X — 601XZZ F601XZZ
2.0	0.0787	4.0	0.1575	—	—	0.05	0.0020	1.2	0.0472	—	—	672 672ZZ
		5.0	0.1969	6.1	0.2402	0.08	0.0031	1.5	0.0591	0.5	0.0197	682 F682 682ZZ F682ZZ
		5.0	0.1969	6.2	0.2441	0.10	0.0039	2.0	0.0787	0.6	0.0236	MR52 MF52 MR52ZZ MF52ZZ
		6.0	0.2362	7.5	0.2953	0.15	0.0059	2.3	0.0906	0.6	0.0236	692 F692 692ZZ F692ZZ
		6.0	0.2362	7.2	0.2835	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR62 MF62 MR62ZZ MF62ZZ
		7.0	0.2756	8.2	0.3228	0.15	0.0059	2.5	0.0984	—	—	MR72 — MR72ZZS F72ZZS
		7.0	0.2756	8.5	0.3346	0.15	0.0059	2.8	0.1102	—	—	602 F602ZS 602ZZS F602ZZS — TTS
2.5	0.0984	6.0	0.2362	7.1	0.2795	0.08	0.0031	1.8	0.0709	0.5	0.0197	682X F682X 682XZZ F682XZZ
		7.0	0.2756	8.5	0.3346	0.15	0.0059	2.5	0.0984	—	—	692X — 692ZZS F692ZZS — TTS
		8.0	0.3150	—	—	0.20	0.0079	2.5	0.0984	—	—	MR82X — — —
		8.0	0.3150	9.5	0.3740	0.15	0.0059	2.8	0.1102	0.7	0.0276	602X F602X 602XZZ F602ZZ —
3.0	0.1181	6.0	0.2362	7.2	0.2835	0.10	0.0039	2.0	0.0787	0.6	0.0236	MR63 MF63 MR63ZZ MF63ZZ
		7.0	0.2756	8.1	0.3189	0.10	0.0039	2.0	0.0787	0.5	0.0197	683 F683 683ZZ F683ZZ 2RS 2RU —
		7.0	0.2756	8.1	0.3189	0.10	0.0039	3.0	0.1181	0.8	0.0315	— F683(TTS) — — — TTS
		8.0	0.3150	9.2	0.3622	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR83 MF83 MR83ZZ MF83ZZ
		8.0	0.3150	9.5	0.3740	0.15	0.0059	3.0	0.1181	0.7	0.0276	693 F693 693ZZ F693ZZ 2RS —
		9.0	0.3543	10.2	0.4016	0.20	0.0079	2.5	0.0984	0.6	0.0236	MR93 MF93 MF93 — — —
		9.0	0.3543	10.6	0.4173	0.15	0.0059	—	—	—	—	MR93ZZ MF93ZZ — — —
		9.0	0.3543	10.5	0.4134	0.15	0.0059	3.0	0.1181	0.7	0.0276	603 F603 603ZZ F603ZZ — — —
		10.0	0.3937	11.5	0.4528	0.15	0.0059	4.0	0.1575	1.0	0.0394	623 ⁽¹⁾ F623 ⁽¹⁾ 623ZZ F623ZZ 2RS 2RU TTS
		13.0	0.5118	—	—	0.20	0.0079	5.0	0.1969	—	—	633 ⁽¹⁾ — 633ZZ — 2RS 2RU —
4.0	0.1575	7.0	0.2756	8.2	0.3228	0.10	0.0039	2.0	0.0787	0.6	0.0236	MR74 MF74 — — —
		7.0	0.2756	8.2	0.3228	0.10	0.0039	—	—	—	—	MR74ZZ MF74ZZ — — —
		8.0	0.3150	9.2	0.3622	0.15	0.0059	2.0	0.0787	0.6	0.0236	MR84 MF84 — — —
		8.0	0.3150	9.2	0.3622	0.10	0.0039	—	—	—	—	MR84ZZ MF84ZZ — — — TTS
		9.0	0.3543	10.3	0.4055	0.10	0.0039	2.5	0.0984	0.6	0.0236	684 F684 684ZZ F684ZZ 2RS 2RU TTS
		10.0	0.3937	11.2	0.4409	0.20	0.0079	3.0	0.1181	0.6	0.0236	MR104 MF104 MF104 — — —
		10.0	0.3937	11.6	0.4567	0.20	0.0079	—	—	—	—	MR104ZZ MF104ZZ 2RS 2RU —
		11.0	0.4331	12.5	0.4921	0.15	0.0059	4.0	0.1575	1.0	0.0394	694 F694 ⁽¹⁾ 694ZZ F694ZZ 2RS 2RU —
		12.0	0.4724	13.5	0.5315	0.20	0.0079	4.0	0.1575	1.0	0.0394	604 ⁽¹⁾ F604 ⁽¹⁾ 604ZZ F604ZZ 2RS 2RU —
		13.0	0.5118	15.0	0.5906	0.20	0.0079	5.0	0.1969	1.0	0.0394	624 ⁽¹⁾ F624 ⁽¹⁾ 624ZZ F624ZZ 2RS 2RU —
		16.0	0.6299	18.0	0.7087	0.30	0.0118	5.0	0.1969	1.0	0.0394	634 ⁽¹⁾ F634 ⁽¹⁾ 634ZZ F634ZZ 2RS 2RU TTS

1) Open type bearings have shield/seal grooves. 2) Single shield or seal types are also available; suffix Z, RS, RU or TS.

3) Prefix S or suffix H is added for stainless material type. Load ratings of stainless material types are calculated by Cr×0.85 or Cor×0.80 of SUJ2 material types.

Width: B1	Flange Width: Bf1	Load Rating		Max. Speed	Cage Type	Ball Complement			Weight (Reference)		
---------------------	--------------------------------	-------------	--	------------	-----------	-----------------	--	--	--------------------	--	--

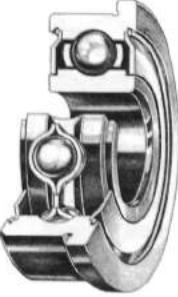
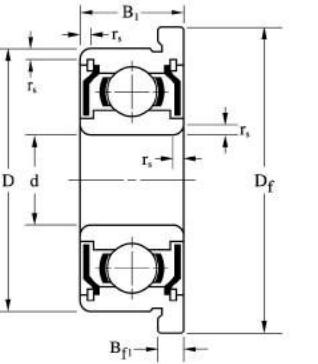
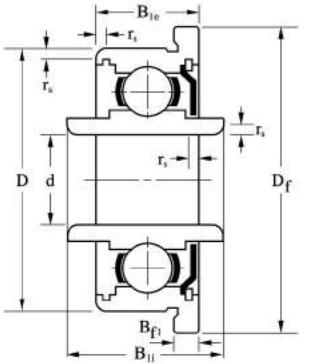
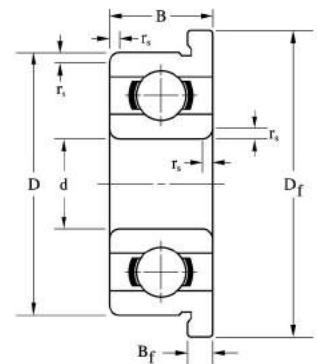
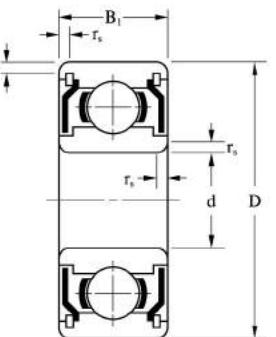
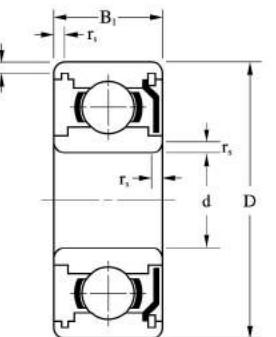
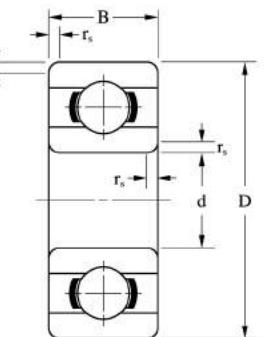
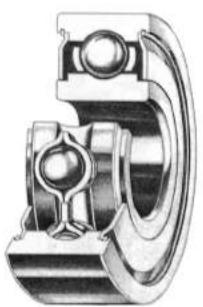
Metric series (5≤d≤9mm)



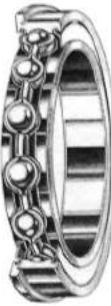
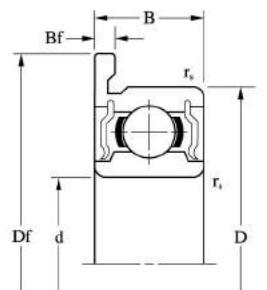
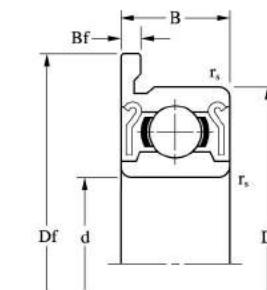
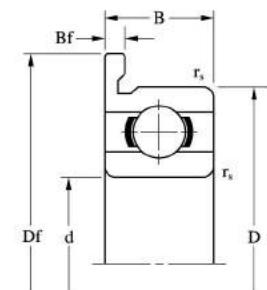
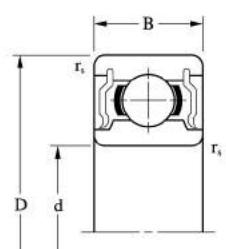
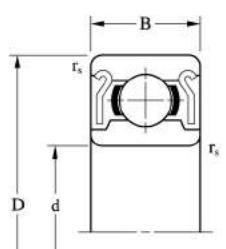
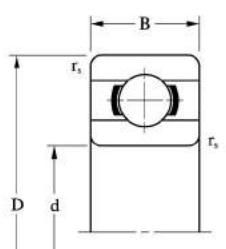
Technical

Dimension

Bore Diameter: d	Outer Diameter: D	Flange Diameter: Df	Radius r_s(min)	Open Bearings				Seal, Shield Bearings										
				Width: B		Flange Width: Bf		Bearing Reference			Seal							
				Open	Flange Open	Shield	Flange Shield	2RS	2RU	TTS	2RS	2RU	TTS	2RS	2RU			
5	0.1969	8	0.3150	9.2	0.3622	0.10	0.0039	2.0	0.0787	0.6	0.0236	MR85	MF85	—	—	—	—	
		8	0.3150	9.2	0.3622	0.10	0.0039	—	—	—	—	MR85ZZ	MF85ZZ	—	—	—	TTS	
		9	0.3543	10.2	0.4016	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR95	MF95	MR95ZZ	MF95ZZ	—	—	TTS
		10	0.3937	11.2	0.4409	0.15	0.0059	3.0	0.1181	0.6	0.0236	MR105	MF105	—	—	—	—	—
		10	0.3937	11.6	0.4567	0.15	0.0059	—	—	—	—	MR105ZZ	MF105ZZ	2RS	2RU	—	—	—
		11	0.4331	12.6	0.4961	0.15	0.0059	—	—	—	—	MR115ZZ	MF115ZZ	2RS	2RU	—	—	—
		11	0.4331	12.5	0.4921	0.15	0.0059	3.0	0.1181	0.8	0.0315	685	F685	685ZZ	F685ZZ	2RS	2RU	—
		13	0.5118	15.0	0.5906	0.20	0.0079	4.0	0.1575	1.0	0.0394	695 ⁽¹⁾	F695 ⁽¹⁾	695ZZ	F695ZZ	2RS	2RU	—
		14	0.5512	16.0	0.6299	0.20	0.0079	5.0	0.1969	1.0	0.0394	605	F605 ⁽¹⁾	605ZZ	F605ZZ	2RS	2RU	—
		16	0.6299	18.0	0.7087	0.30	0.0118	5.0	0.1969	1.0	0.0394	625 ⁽¹⁾	F625 ⁽¹⁾	625ZZ	F625ZZ	2RS	2RU	—
		19	0.7480	22.0	0.8661	0.30	0.0118	6.0	0.2362	1.5	0.0591	635 ⁽¹⁾	F635 ⁽¹⁾	635ZZ	F635ZZ	2RS	2RU	—
6	0.2362	10	0.3937	11.2	0.4409	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR106	MF106	—	—	—	—	—
		10	0.3937	11.2	0.4409	0.10	0.0039	—	—	—	—	MR106ZZ	MF106ZZ	—	—	—	—	—
		10	0.3937	—	—	0.10	0.0039	3.0	0.1181	—	—	676(TTS)	—	—	—	—	—	TTS
		12	0.4724	13.2	0.5197	0.20	0.0079	3.0	0.1181	0.6	0.0236	MR126	MF126	—	—	—	—	—
		12	0.4724	13.6	0.5354	0.20	0.0079	—	—	—	—	MR126ZZ	MF126ZZ	2RS	2RU	—	—	—
		13	0.5118	15.0	0.5906	0.15	0.0059	3.5	0.1378	1.0	0.0394	686	F686	686ZZ	F686ZZ	2RS	2RU	TTS
		15	0.5906	17.0	0.6693	0.20	0.0079	5.0	0.1969	1.2	0.0472	696 ⁽¹⁾	F696 ⁽¹⁾	696ZZ	F696ZZ	2RS	2RU	TTS
		16	0.6299	—	—	0.20	0.0079	5.0	0.1969	—	—	696A ⁽¹⁾	—	696AZZ	—	2RS	2RU	—
		17	0.6693	19.0	0.7480	0.30	0.0118	6.0	0.2362	1.2	0.0472	606 ⁽¹⁾	F606	606ZZ	F606ZZ	2RS	2RU	—
		19	0.7480	22.0	0.8661	0.30	0.0118	6.0	0.2362	1.5	0.0591	626 ⁽¹⁾	F626 ⁽¹⁾	626ZZ	F626ZZ	2RS	2RU	—
		19	0.7480	—	—	0.30	0.0118	6.0	0.2362	—	—	626(TTS)	—	—	—	—	—	TTS
		22	0.8661	—	—	0.30	0.0118	7.0	0.2756	—	—	636 ⁽¹⁾	—	636ZZ	—	2RS	2RU	—
7	0.2756	11	0.4331	12.2	0.4803	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR117	MF117	—	—	—	—	—
		11	0.4331	12.2	0.4803	0.15	0.0059	—	—	—	—	MR117ZZS	MF117ZZS	—	—	—	—	TTS
		13	0.5118	14.2	0.5591	0.20	0.0079	3.0	0.1181	0.6	0.0236	MR137	MF137	—	—	—	—	—
		13	0.5118	14.6	0.5748	0.15	0.0059	—	—	—	—	MR137ZZ	MF137ZZ	—	—	—	—	TTS
		14	0.5512	16.0	0.6299	0.15	0.0059	3.5	0.1378	1.0	0.0394	687	F687	687ZZ	F687ZZ	2RS	2RU	TTS
		17	0.6693	19.0	0.7480	0.30	0.0118	5.0	0.1969	1.2	0.0472	697 ⁽¹⁾	F697 ⁽¹⁾	697ZZ	F697ZZ	2RS	2RU	—
		19	0.7480	22.0	0.8661	0.30	0.0118	6.0	0.2362	1.5	0.0591	607 ⁽¹⁾	F607 ⁽¹⁾	607ZZ	F607ZZ	2RS	2RU	—
		19	0.7480	—	—	0.30	0.0118	6.0	0.2362	—	—	607(TTS)	—	—	—	—	—	TTS
		22	0.8661	25.0	0.9843	0.30	0.0118	7.0	0.2756	1.5	0.0591	627 ⁽¹⁾	F627 ⁽¹⁾	627ZZ	F627ZZ	2RS	2RU	TTS
		26	1.0236	—	—	0.30	0.0118	9.0	0.3543	—	—	637 ⁽¹⁾	—	637ZZ	—	2RS	2RU	—
8	0.3150	12	0.4724	13.2	0.5197	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR128	MF128	—	—	—	—	—
		12	0.4724	13.6	0.5354	0.10	0.0039	—	—	—	—	MR128ZZ	MF128ZZ	2RS	2RU	TTS	—	—
		14	0.5512	15.6	0.6142	0.20	0.0079	3.5	0.1378	0.8	0.0315	MR148	MF148	—	—	—	—	—
		14	0.5512	15.6	0.6142	0.15	0.0059	—	—	—	—	MR148ZZ	MF148ZZ	2RS	2RU	—	—	—
		16	0.6299	18.0	0.7087	0.20	0.0079	4.0	0.1575	1.0	0.0394	688	F688	688ZZ	F688ZZ	2RS	2RU	TTS
		19	0.7480	22.0	0.8661	0.30	0.0118	6.0	0.2362	1.5	0.0591	698 ⁽¹⁾	F698 ⁽¹⁾	698ZZ	F698ZZ	2RS	2RU	—
		22	0.8661	25.0	0.9843	0.30	0.0118	7.0	0.2756	1.5	0.0591	608 ⁽¹⁾	F608 ⁽¹⁾	608ZZ	F608ZZ	2RS	2RU	TTS
		24	0.9449	—	—	0.30	0.0118	8.0	0.3150	—</								



Bore Diameter: d	Outer Diameter: D	Flange Diameter: Df	Radius rs(min)	Open Bearings								Bearings Reference							
				IR Width: Bi				OR Width: Be				Flange Width:Bf				Open	Flange Open	Shield	Flange Shield
				inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm				
1.016	0.0400	3.175	0.1250	4.343	0.1710	0.10	0.0039	1.191	0.0469	1.191	0.0469	0.330	0.0130	R09	FR09	—	—		
1.191	0.0469	3.967	0.1562	5.156	0.2030	0.10	0.0039	1.588	0.0625	1.588	0.0625	0.330	0.0130	R0	FR0	ROZZ	FROZZ		
		3.967	0.1562	5.156	0.2030	0.10	0.0039	2.380	0.0937	1.588	0.0625	—	—	RW0	—	RW0ZZ	FRW0ZZ		
1.397	0.0550	4.762	0.1875	5.944	0.2340	0.10	0.0039	1.984	0.0781	1.984	0.0781	0.584	0.0230	R1	FR1	R1ZZ	FR1ZZ		
		4.762	0.1875	5.944	0.2340	0.10	0.0039	3.571	0.1406	2.779	0.1094	0.787	0.0310	RW1 ⁽¹⁾	FRW1 ⁽¹⁾	RW1ZZ	FRW1ZZ		
1.984	0.0781	6.350	0.2500	7.518	0.2960	0.10	0.0039	2.380	0.0937	2.380	0.0937	0.584	0.0230	R1-4	FR1-4	R1-4ZZ	FR1-4ZZ		
		6.350	0.2500	7.518	0.2960	0.10	0.0039	3.175	0.1250	2.380	0.0937	0.584	0.0230	RW1-4	FRW1-4	RW1-4ZZ	FRW1-4ZZ		
2.380	0.0937	4.762	0.1875	5.944	0.2340	0.10	0.0039	1.588	0.0625	1.588	0.0625	0.457	0.0180	R133	FR133	—	—		
		4.762	0.1875	5.944	0.2340	0.10	0.0039	2.380	0.0937	1.588	0.0625	0.457	0.0180	—	FRW133	—	—		
		4.762	0.1875	5.944	0.2340	0.10	0.0039	—	—	—	—	—	—	—	R133ZZS	FR133ZZS			
		4.762	0.1875	5.944	0.2340	0.10	0.0039	3.175	0.1250	2.380	0.0937	—	—	—	RW133 ⁽¹⁾	—	RW133ZZS		
		7.938	0.3125	9.119	0.3590	0.15	0.0059	2.779	0.1094	2.779	0.1094	0.584	0.0230	R1-5	FR1-5	R1-5ZZ	FR1-5ZZ		
		7.938	0.3125	9.119	0.3590	0.15	0.0059	4.366	0.1719	3.571	0.1406	—	—	RW1-5 ⁽¹⁾	—	RW1-5ZZ	—		
3.175	0.1250	6.350	0.2500	—	—	0.10	0.0039	2.779	0.1094	2.779	0.1094	—	—	R144J ⁽¹⁾	—	R144JZZS	—		
		6.350	0.2500	7.518	0.2960	0.10	0.0039	2.380	0.0937	2.380	0.0937	0.584	0.0230	R144	FR144	R144ZZ	FR144ZZ		
		6.350	0.2500	7.518	0.2960	0.10	0.0039	3.175	0.1250	2.380	0.0937	0.584	0.0230	RW144	FRW144	RW144ZZ	FRW144ZZ		
		7.938	0.3125	9.119	0.3590	0.10	0.0039	2.779	0.1094	2.779	0.1094	0.584	0.0230	R2-5	FR2-5	R2-5ZZ	FR2-5ZZ		
		7.938	0.3125	9.119	0.3590	0.10	0.0039	3.571	0.1406	2.779	0.1094	0.584	0.0230	—	FRW2-5	RW2-5ZZ	FRW2-5ZZ		
		9.525	0.3750	10.719	0.4220	0.15	0.0059	2.779	0.1094	2.779	0.1094	0.584	0.0230	R2-6	FR2-6	R2-6ZZ	FR2-6ZZ		
		9.525	0.3750	10.719	0.4220	0.15	0.0059	3.571	0.1406	2.779	0.1094	—	—	RW2-6	—	RW2-6ZZ	FRW2-6ZZ		
		9.525	0.3750	11.176	0.4400	0.30	0.0118	3.967	0.1562	3.967	0.1562	0.762	0.0300	R2 ⁽¹⁾	FR2 ⁽¹⁾	R2ZZ	FR2ZZ		
		9.525	0.3750	11.176	0.4400	0.30	0.0118	4.762	0.1875	3.967	0.1562	0.762	0.0300	RW2 ⁽¹⁾	FRW2 ⁽¹⁾	RW2ZZ	FRW2ZZ		
		12.700	0.5000	—	—	0.30	0.0118	4.366	0.1719	4.366	0.1719	—	—	R2A ⁽¹⁾	—	R2AZZ	—		
3.967	0.1562	7.938	0.3125	9.119	0.3590	0.10	0.0039	2.779	0.1094	2.779	0.1094	0.584	0.0230	R155	FR155	R155ZZS	FR155ZZS		
		7.938	0.3125	9.119	0.3590	0.10	0.0039	3.967	0.1562	3.175	0.1250	0.914	0.0360	RW155 ⁽¹⁾	FRW155 ⁽¹⁾	RW155ZZS	FRW155ZZS		
4.762	0.1875	7.938	0.3125	9.119	0.3590	0.10	0.0039	2.779	0.1094	2.779	0.1094	0.584	0.0230	R156	FR156	R156ZZS	FR156ZZS		
		7.938	0.3125	9.119	0.3590	0.10	0.0039	3.967	0.1562	3.175	0.1250	0.914	0.0360	RW156 ⁽¹⁾	FRW156 ⁽¹⁾	RW156ZZS	FRW156ZZS		
		9.525	0.3750	10.719	0.4220	0.10	0.0039	3.175	0.1250	3.175	0.1250	0.584	0.0230	R166 ⁽¹⁾	FR166	R166ZZ	FR166ZZ		
		9.525	0.3750	10.719	0.4220	0.10	0.0039	3.967	0.1562	3.175	0.1250	0.584	0.0230	RW166 ⁽¹⁾	FRW166	RW166ZZ	FRW166ZZ		
		12.700	0.5000	14.351	0.5650	0.30	0.0118	4.978	0.1960	4.978	0.1960	1.067	0.0420	—	FR3	—	—		
		12.700	0.5000	14.351	0.5650	0.30	0.0118	3.967	0.1562	3.967	0.1562	—	—	R3	—	R3ZZ	FR3ZZ		
		12.700	0.5000	14.351	0.5650	0.30	0.0118	4.762	0.1875	3.967	0.1562	—	—	RW3	—	RW3ZZ	FRW3ZZ		
		15.875	0.6250	—	—	0.30	0.0118	4.978	0.1960	4.978	0.1960	—	—	R3A ⁽¹⁾	—	R3AZZ	—		
6.350	0.2500	9.525	0.3750	10.719	0.4220	0.10	0.0039	3.175	0.1250	3.175	0.1250	0.584	0.0230	R168 ⁽¹⁾	FR168	R168ZZS	FR168ZZS		
		9.525	0.3750	10.719	0.4220	0.10	0.0039	3.967	0.1562	3.175	0.1250	0.914	0.0360	RW168 ⁽¹⁾	FRW168 ⁽¹⁾	RW168ZZS	FRW168ZZS		
		12.700	0.5000	13.894	0.5470	0.15	0.0059	3.175	0.1250	3.175	0.1250	0.584	0.0230	R188	FR188	R188ZZ	FR188ZZ		
		12.700	0.5000	13.8															



Bore Diameter: d	Outer Diameter: D	Flange Diameter: Df	Radius r_s(min)	Width: B		Flange Width: Bf		Bearing Reference							
				Open	Flange Open	Shield	Flange Shield								
mm	inch	mm	inch	mm	inch	mm	inch								
10	0.3937	15	0.5906	16.5	0.6496	0.15	0.0059	3	0.1181	0.8	0.0315	6700	F6700	-	-
		15	0.5906	16.5	0.6496	0.15	0.0059	4	0.1575	0.8	0.0315	-	-	6700ZZ	F6700ZZ
		19	0.7480	21.0	0.8268	0.30	0.0118	5	0.1969	1.0	0.0394	6800 ⁽¹⁾	F6800 ⁽¹⁾	6800ZZ	F6800ZZ
		19	0.7480	21.0	0.8268	0.30	0.0118	7	0.2756	1.5	0.0591	63800 ⁽¹⁾	F63800 ⁽¹⁾	63800ZZ	F63800ZZ
		22	0.8661	25.0	0.9843	0.30	0.0118	6	0.2362	1.5	0.0591	6900 ⁽¹⁾	F6900 ⁽¹⁾	6900ZZ	F6900ZZ
12	0.4724	18	0.7087	19.5	0.7677	0.20	0.0079	4	0.1575	0.8	0.0315	6701 ⁽¹⁾	F6701 ⁽¹⁾	6701ZZ	F6701ZZ
		21	0.8268	23.0	0.9055	0.30	0.0118	5	0.1969	1.1	0.0433	6801 ⁽¹⁾	F6801 ⁽¹⁾	6801ZZ	F6801ZZ
		21	0.8268	23.0	0.9055	0.30	0.0118	7	0.2756	1.5	0.0591	63801 ⁽¹⁾	F63801 ⁽¹⁾	63801ZZ	F63801ZZ
		24	0.9449	26.5	1.0433	0.30	0.0118	6	0.2362	1.5	0.0591	6901 ⁽¹⁾	F6901 ⁽¹⁾	6901ZZ	F6901ZZ
15	0.5906	21	0.8268	22.5	0.8858	0.20	0.0079	4	0.1575	0.8	0.0315	6702 ⁽¹⁾	F6702 ⁽¹⁾	6702ZZ	F6702ZZ
		24	0.9449	26.0	1.0236	0.30	0.0118	5	0.1969	1.1	0.0433	6802 ⁽¹⁾	F6802 ⁽¹⁾	6802ZZ	F6802ZZ
		24	0.9449	26.0	1.0236	0.30	0.0118	7	0.2756	1.5	0.0591	63802 ⁽¹⁾	F63802 ⁽¹⁾	63802ZZ	F63802ZZ
		28	1.1024	30.5	1.2008	0.30	0.0118	7	0.2756	1.5	0.0591	6902 ⁽¹⁾	F6902 ⁽¹⁾	6902ZZ	F6902ZZ
17	0.6693	23	0.9055	24.5	0.9646	0.20	0.0079	4	0.1575	0.8	0.0315	6703 ⁽¹⁾	F6703 ⁽¹⁾	6703ZZ	F6703ZZ
		26	1.0236	28.0	1.1024	0.30	0.0118	5	0.1969	1.1	0.0433	6803 ⁽¹⁾	F6803 ⁽¹⁾	6803ZZ	F6803ZZ
		26	1.0236	28.0	1.1024	0.30	0.0118	7	0.2756	1.5	0.0591	63803 ⁽¹⁾	F63803 ⁽¹⁾	63803ZZ	F63803ZZ
		30	1.1811	32.5	1.2795	0.30	0.0118	7	0.2756	1.5	0.0591	6903 ⁽¹⁾	F6903 ⁽¹⁾	6903ZZ	F6903ZZ
20	0.7874	27	1.0630	28.5	1.1220	0.20	0.0079	4	0.1575	0.8	0.0315	6704 ⁽¹⁾	F6704 ⁽¹⁾	6704ZZS	F6704ZZS
		32	1.2598	35.0	1.3780	0.30	0.0118	7	0.2756	1.5	0.0591	6804 ⁽¹⁾	F6804 ⁽¹⁾	6804ZZ	F6804ZZ
		32	1.2598	-	-	0.30	0.0118	10	0.3937	-	-	63804 ⁽¹⁾	-	63804ZZ	-
		37	1.4567	40.0	1.5748	0.30	0.0118	9	0.3543	2.0	0.0787	6904 ⁽¹⁾	F6904 ⁽¹⁾	6904ZZ	F6904ZZ
25	0.9843	32	1.2598	34.0	1.3386	0.20	0.0079	4	0.1575	1.0	0.0394	6705 ⁽¹⁾	F6705 ⁽¹⁾	-	-
		37	1.4567	40.0	1.5748	0.30	0.0118	7	0.2756	1.5	0.0591	6805 ⁽¹⁾	F6805 ⁽¹⁾	6805ZZ	F6805ZZ
		37	1.4567	-	-	0.30	0.0118	10	0.3937	-	-	63805 ⁽¹⁾	-	63805ZZ	-
		42	1.6535	45.0	1.7717	0.30	0.0118	9	0.3543	2.0	0.0787	6905 ⁽¹⁾	F6905 ⁽¹⁾	6905ZZ	F6905ZZ
30	1.1811	37	1.4567	39.0	1.5354	0.20	0.0079	4	0.1575	1.0	0.0394	6706 ⁽¹⁾	F6706 ⁽¹⁾	-	-
		42	1.6535	45.0	1.7717	0.30	0.0118	7	0.2756	1.5	0.0591	6806 ⁽¹⁾	F6806 ⁽¹⁾	6806ZZ	F6806ZZ
		47	1.8504	50.0	1.9685	0.30	0.0118	9	0.3543	2.0	0.0787	6906 ⁽¹⁾	F6906 ⁽¹⁾	6906ZZ	F6906ZZ

1) Open type bearings have shield/seal grooves.

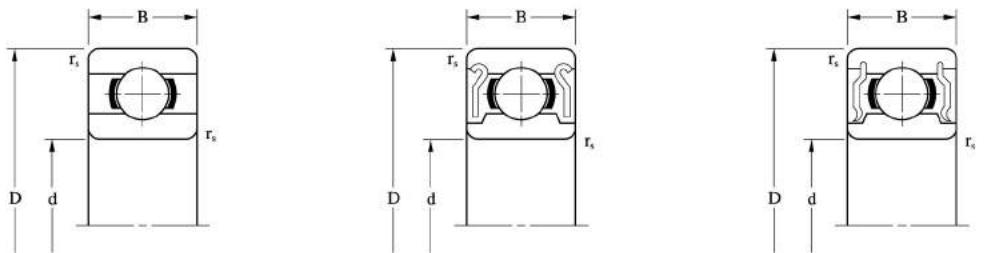
2) Single shield or seal types are also available; suffix Z, RS, RU or TS.

3) Prefix S or suffix H is added for stainless material type. Load ratings of stainless material types are calculated by Cr×0.85 or Cor×0.80 of SUJ2 material types.

4) SUJ2 bearings use RJ type retainers, but stainless bearings use J type retainers.

5) Weight of open type.

			Load Rating		Max. Speed		Cage Type	Ball Complement		Weight(Ref.)		
			Seal	Cr(N)	Cor(N)	Grease		Qty.:Z	Size:Dw	Shield	Flange Shield	
2RS	2RU	TTS	(N)	x1000rpm				pcs.	mm	inch	g	
-	-	-	857	435	15	17	W	11	1.588	0.0625	1.6 ⁽⁵⁾ 1.8 ⁽⁵⁾	
2RS	-	TTS	857	435	15	17	W	11	1.588	0.0625	1.8	2.0
2RS	2RU	-	1720	840	34	40	J,TW	10	2.381	0.0937	5.1	5.6
2RS	2RU	-	1720	840	34	40	J,TW	10	2.381	0.0937	7.0	7.8
2RS	2RU	-	2700	1270	31	37	J	9	3.175	0.1250	9.4	10.6
2RS	-	TTS	928	532	13	15	W	13				



Technical

Dimension

Bore Diameter: d mm inch	Outer Diameter: D mm inch	Radius r_s(min) mm inch	Width: B mm inch	Bearing Reference			
				Open	Flange Open	Seal	
						2RS	2RU
35 1.3780	44 1.7323	0.3 0.0118	5 0.1969	6707 ^(t)	—	2RS	—
	47 1.8504	0.3 0.0118	7 0.2756	6807	6807ZZ	2RS	2RU
	55 2.1654	0.6 0.0236	10 0.3937	6907 ^(t)	6907ZZ	2RS	2RU
40 1.5748	50 1.9685	0.3 0.0118	6 0.2362	6708 ^(t)	—	2RS	—
	52 2.0472	0.3 0.0118	7 0.2756	6808	6808ZZ	2RS	2RU
	62 2.4409	0.6 0.0236	12 0.4724	6908 ^(t)	6908ZZ	2RS	2RU
45 1.7717	55 2.1654	0.3 0.0118	6 0.2362	6709 ^(t)	—	2RS	—
	58 2.2835	0.3 0.0118	7 0.2756	6809	6809ZZ	2RS	2RU
	68 2.6772	0.6 0.0236	12 0.4724	6909 ^(t)	6909ZZ	2RS	2RU
50 1.9685	62 2.4409	0.3 0.0118	6 0.2362	6710 ^(t)	—	2RS	—
	65 2.5591	0.3 0.0118	7 0.2756	6810 ^(t)	6810ZZ	2RS	2RU
	72 2.8346	0.6 0.0236	12 0.4724	6910 ^(t)	6910ZZ	2RS	2RU
55 2.1654	72 2.8346	0.3 0.0118	9 0.3543	6811 ^(t)	6811ZZ	2RS	2RU
	80 3.1496	1.0 0.0394	13 0.5118	6911 ^(t)	6911ZZ	2RS	2RU
60 2.3622	78 3.0709	0.3 0.0118	10 0.3937	6812	6812ZZ	2RS	2RU
	85 3.3465	1.0 0.0394	13 0.5118	6912 ^(t)	6912ZZ	2RS	2RU
65 2.5591	85 3.3465	0.6 0.0236	10 0.3937	6813 ^(t)	6813ZZ	2RS	—
	90 3.5433	1.0 0.0394	13 0.5118	6913 ^(t)	6913ZZ	2RS	—
70 2.7559	90 3.5433	0.6 0.0236	10 0.3937	6814 ^(t)	6814ZZ	2RS	2RU
	100 3.9370	1.0 0.0394	16 0.6299	6914 ^(t)	6914ZZ	2RS	—
75 2.9528	95 3.7402	0.6 0.0236	10 0.3937	6815 ^(t)	6815ZZ	2RS	—
	105 4.1339	1.0 0.0394	16 0.6299	6915 ^(t)	6915ZZ	2RS	—
80 3.1496	100 3.9370	0.6 0.0236	10 0.3937	6816	6816ZZ	2RS	2RU
	110 4.3307	1.0 0.0394	16 0.6299	6916 ^(t)	6916ZZ	2RS	—
85 3.3465	110 4.3307	1.0 0.0394	13 0.5118	6817 ^(t)	6817ZZ	2RS	—
	120 4.7244	1.1 0.0433	18 0.7087	6917 ^(t)	6917ZZ	2RS	—
90 3.5433	115 4.5276	1.0 0.0394	13 0.5118	6818 ^(t)	6818ZZ	2RS	—
	125 4.9213	1.1 0.0433	18 0.7087	6918 ^(t)	—	2RS	—
95 3.7402	120 4.7244	1.0 0.0394	13 0.5118	6819 ^(t)	—	—	2RU

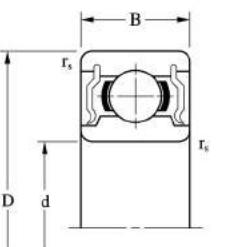
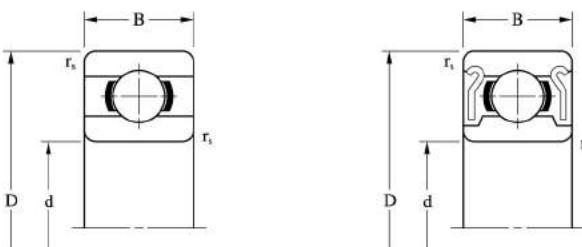
1) Open type bearings have shield/seal grooves.

2) Single shield or seal types are also available; suffix Z, RS or RU.

3) Prefix S or suffix H is added for stainless material type. Load ratings of stainless material types are calculated by Cr×0.85 or Cor×0.80 of SUJ2 material types.

4) SUJ2 bearings use RJ type retainers, but stainless bearings use J type retainers.

Load Rating		Max. Speed		Cage Type	Ball Complement			Weight(Ref.)	
Cr(N) (N)	Cor(N)	Grease	Oil		Qty.:Z	Size:Dw			
		x1000rpm			pcs.	mm	inch		
1860	1630	4.9	6.0	W	26	2.000	0.0787	15.0	
4740	3820	13	16	J,RJ ⁽⁴⁾	19	3.500	0.1378	28.2	
10900	7750	12	14	RJ	14	5.953	0.2344	73.3	
2510	2230	4.3	5.0	W	25	2.381	0.0937	23.3	
4930	4180	12	14	RJ	21	3.500	0.1378	30.3	
13700	9920	11	13	RJ	14	6.747	0.2656	108	
2570	2400	3.9	4.6	W	27	2.381	0.0937	25.6	
6210	5380	11	13	RJ	21	3.969	0.1563	35.8	
14100	10900	10	11	RJ	15	6.747	0.2656	130	
2670	2650	3.5	4.1	W	30	2.381	0.0937	36.6	
6170	5760	9.5	11	RJ	23	3.969	0.1563	49.5	
14500	11700	9.0	11	RJ	16	6.747	0.2656	131	
8800	8080	8.6	10	RJ	22	4.762	0.1875	78.3	
16600	14100	8.1	9.6	RJ	17	7.144	0.2813	177	
11500	10600	7.9	9.4	RJ	21	5.556	0.2187	99.4	
20200	17300	7.5	8.9	RJ	17	7.938	0.3125	186	
11900	11500	7.3	8.6	RJ	23	5.556	0.2187	125	
17300	16000	7.0	8.3	RJ	19	7.144	0.2813	208	
11600	11800	6.8	8.1	RJ	24	5.556	0.2187	134	
23700	21100	6.4	7.6	RJ	17	8.731	0.3437	342	
12300	12800	6.4	7.6	RJ	26	5.556	0.2187	142	
24000	22600	6.0	7.1	RJ	18	8.731	0.3437	363	
12600	13300	6.0	7.1	RJ	27	5.556	0.2187	150	
24800	23900	5.7	6.7	RJ	19	8.731	0.3437	382	
18700	19000	5.6	6.6	RJ	23	7.144	0.2813	266	
31900	29600	5.3	6.2	RJ	17	10.319	0.4063	535	
18300	19500	5.3	6.2	RJ	24	7.144	0.2813	279	
32400	31600	5.0	5.9	RJ	18	10.319	0.4063	565	
18800	20300	5.0	5.9	RJ	25	7.144	0.2813	285	



Technical

Dimension

Bore Diameter: d	Outer Diameter: D	Width:B	Radius: r_s(min)	Bearing Reference								
				Open	Shield	Seal						
mm	inch	mm	inch	mm	inch	mm	inch	ZZ	2RS	2RU	TTS	
10	0.3937	26	1.0236	8	0.3150	0.3	0.0118	6000H ^{(1),(2)}	ZZ	2RS	2RU	—
		30	1.1811	9	0.3543	0.6	0.0236	6200H ^{(1),(2)}	ZZ	2RS	2RU	—
		35	1.3780	11	0.4331	0.6	0.0236	6300H ⁽¹⁾	ZZ	2RS	2RU	—
12	0.4724	28	1.1024	8	0.3150	0.3	0.0118	6001H ^{(1),(2)}	ZZ	2RS	2RU	TTS
		32	1.2598	10	0.3937	0.6	0.0236	6201H ⁽¹⁾	ZZ	2RS	2RU	—
		37	1.4567	12	0.4724	1.0	0.0394	6301H	ZZ	2RS	2RU	—
15	0.5906	32	1.2598	9	0.3543	0.3	0.0118	6002H ^{(1),(2)}	ZZ	2RS	2RU	—
		35	1.3780	11	0.4331	0.6	0.0236	6202H ⁽¹⁾	ZZ	2RS	2RU	—
		42	1.6535	13	0.5118	1.0	0.0394	6302H ⁽¹⁾	ZZ	2RS	2RU	—
17	0.6693	35	1.3780	10	0.3937	0.3	0.0118	6003H ^{(1),(2)}	ZZ	2RS	2RU	—
		40	1.5748	12	0.4724	0.6	0.0236	6203H ⁽¹⁾	ZZ	2RS	2RU	—
		47	1.8504	14	0.5512	1.0	0.0394	6303H ⁽¹⁾	ZZ	2RS	2RU	—
20	0.7874	42	1.6535	12	0.4724	0.6	0.0236	6004H ⁽¹⁾	ZZ	2RS	2RU	—
		47	1.8504	14	0.5512	1.0	0.0394	6204H ⁽¹⁾	ZZ	2RS	2RU	—
		52	2.0472	15	0.5906	1.1	0.0433	6304H ⁽¹⁾	ZZ	2RS	2RU	—
25	0.9843	47	1.8504	12	0.4724	0.6	0.0236	6005H ⁽¹⁾	ZZ	2RS	2RU	—
		52	2.0472	15	0.5906	1.0	0.0394	6205H ⁽¹⁾	ZZ	2RS	2RU	—
		62	2.4409	17	0.6693	1.1	0.0433	6305H ⁽¹⁾	ZZ	2RS	2RU	—
30	1.1811	55	2.1654	13	0.5118	1.0	0.0394	6006H ⁽¹⁾	ZZ	2RS	2RU	—
		62	2.4409	16	0.6299	1.0	0.0394	6206H ⁽¹⁾	ZZ	2RS	2RU	—
		72	2.8346	19	0.7480	1.1	0.0433	6306H ⁽¹⁾	ZZ	2RS	2RU	—
35	1.3780	62	2.4409	14	0.5512	1.0	0.0394	6007H ⁽¹⁾	ZZ	2RS	2RU	—
		72	2.8346	17	0.6693	1.1	0.0433	6207H ⁽¹⁾	ZZ	2RS	2RU	—
		80	3.1496	21	0.8268	1.5	0.0591	6307H ⁽¹⁾	ZZ	2RS	2RU	—
40	1.5748	68	2.6772	15	0.5906	1.0	0.0394	6008H ⁽¹⁾	ZZ	2RS	2RU	—
		80	3.1496	18	0.7087	1.1	0.0433	6208H ⁽¹⁾	ZZ	2RS	2RU	—
45	1.7717	75	2.9528	16	0.6299	1.0	0.0394	6009H ⁽¹⁾	ZZ	2RS	2RU	—
		85	3.3465	19	0.7480	1.1	0.0433	6209H ⁽¹⁾	ZZ	2RS	2RU	—
50	1.9685	80	3.1496	16	0.6299	1.0	0.0394	6010H ⁽¹⁾	ZZ	2RS	2RU	—
		90	3.5433	20	0.7874	1.1	0.0433	6210H ⁽¹⁾	ZZ	2RS	2RU	—
55	2.1654	90	3.5433	18	0.7087	1.1	0.0433	6011H ⁽¹⁾	ZZ	2RS	2RU	—
		100	3.9370	21	0.8268	1.5	0.0591	6211H ⁽¹⁾	ZZ	2RS	2RU	—
60	2.3622	95	3.7402	18	0.7087	1.1	0.0433	6012H ⁽¹⁾	ZZ	2RS	2RU	—
		110	4.3307	22	0.8661	1.5	0.0591	6212H ⁽¹⁾	ZZ	2RS	2RU	—

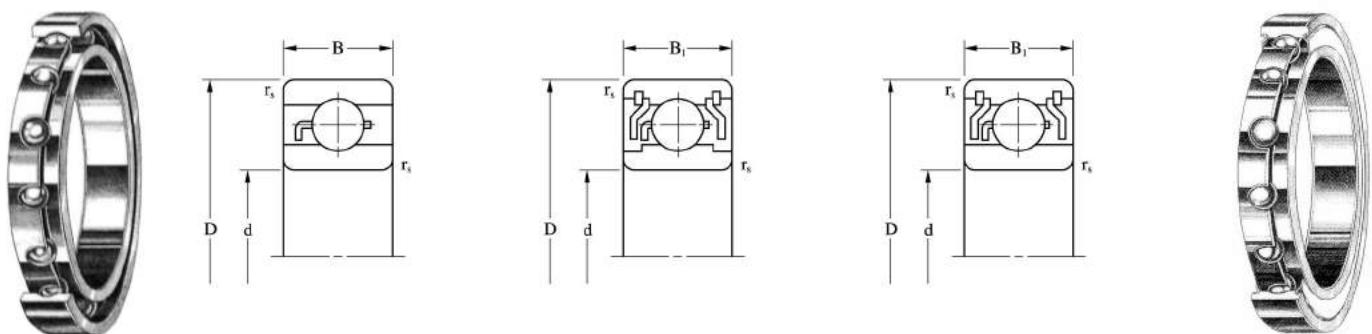
1) Open type bearings have shield/seal grooves.

2) SUJ2 material type (without suffix H) is also available. Load ratings of SUJ2 material types are calculated by Cr/0.85 or Cor/0.80 of stainless material types.

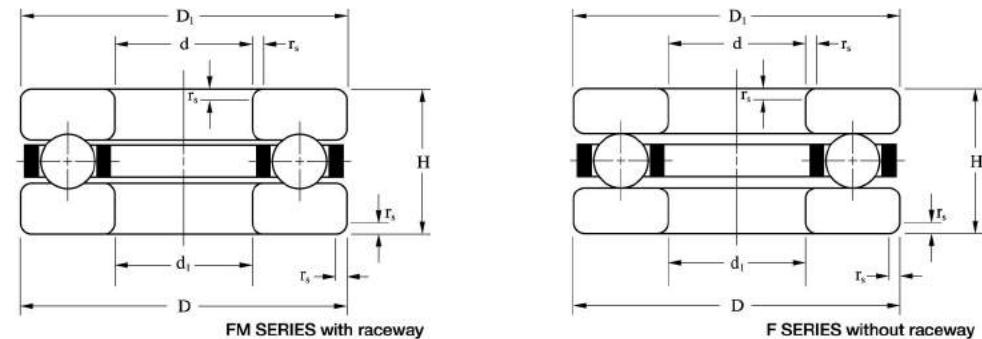
3) Single shield or seal types are also available; suffix Z, RS, RU or TS.

Load Rating		Max. Speed		Cage Type	Ball Complement			Weight (Ref.)	
Cr(N)	Cor(N)	Grease	Oil		Qty. :Z	Size:Dw			
(N)		x1000rpm			Qty.	mm	inch		
3890	1570	28	33	J	7	4.762	0.1875	18	
4350	1910	25	30	RJ,TW	8	4.762	0.1875	30	
6880	2750	23	27	RJ	6	7.144	0.2813	52	
4350	1910	25	30	J,TW	8	4.762	0.1875	20	
5780	2440	24	28	RJ,TW	7	5.953	0.2344	35	
8250	3350	22	25	RJ	6	7.938	0.3125	58	
4750	2270	22	26	RJ,TW	9	4.762	0.1875	28	
6490	2980	21	25	RJ,TW	8	5.953	0.2344	44	
9720	4350	18	21	RJ	7	7.938	0.3437	81	
5100	2610	20	24	RJ,TW	10	4.762	0.1875	38	
8130	3830	18	22	RJ,TW	8	6.747	0.2656	65	
11600	5290	16	19	RJ	7	8.731	0.4687	111	
7980	4050	17	20	RJ,TW	9	6.350	0.2500	64	
10900	5320	16	19	RJ,TW	8	7.938	0.3125	104	
13500	6270	15	18	RJ	7	9.525	0.3750	141	
8550	4680	15	18	RJ,TW	10	6.350	0.2500	77	
11900	6300	14	16	RJ,TW	9	7.938	0.3125	128	
17500	9000	12	14	RJ	8	10.319	0.4063	232	
11200	6620	13	15	RJ,TW	11	7.144	0.2813	111	
16500	9070	12	14	RJ,TW	9	9.525	0.3750	193	
22700	12000	11	12	RJ	8	11.906	0.4687	340	
13600	8240	11	13	RJ	11	7.938	0.3125	146	
21800	12300	10							

Extra thin metric series : ET, ER



Thrust series : FM, F



Bore Diameter: d	Outer Diameter: D	Open Type Width: B	Seal-Shield Type Width: B ₁	Radius: r _s (min)	Bearing References		Load Rating		Max. Speed		Ball Complement			Weight(Ref.)								
					Open	Shield	Seal	Cr (N)	Cor (N)	Grease	Oil	Cage Type	Qty.: Z	Size: Dw	Shield	Flange Shield	pcs.	mm	inch	g		
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	(N)	x1000rpm											
ET series																						
15	0.5906	20	0.7874	3.5	0.1378	-	-	0.15	0.0059	ET2015	-	-	943	583	11	13	W	14	1.588	0.0625	2.14	-
		21	0.8268	3.5	0.1378	-	-	0.15	0.0059	ET2115	-	-	937	581	11	13	W	14	1.588	0.0625	3.04	-
16	0.6299	22	0.8661	4.0	0.1575	4.0	0.1575	0.15	0.0059	ET2216	ZZS	TTS	971	620	10	12	W	15	1.588	0.0625	3.66	3.70
		23	0.9055	4.5	0.1772	4.5	0.1772	0.15	0.0059	ET2316 ⁽¹⁾	ZZS	TTS	971	620	10	12	W	15	1.588	0.0625	4.98	5.29
20	0.7874	25	0.9843	4.0	0.1575	4.0	0.1575	0.15	0.0059	ET2520 ⁽¹⁾	ZZS	TTS	1010	691	8.5	10	W	17	1.588	0.0625	2.96	3.30
ER series																						
9.525	0.3750	15.875	0.6250	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1038 ⁽¹⁾	ZZS	TTS	857	435	15	17.5	W	11	1.588	0.0625	2.40	2.60
12.700	0.5000	19.050	0.7500	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1212 ⁽¹⁾	ZZS	TTS	919	537	12	14	W	13	1.588	0.0625	3.01	3.26
15.875	0.6250	22.225	0.8750	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1458 ⁽¹⁾	ZZS	TTS	971	620	10	12	W	15	1.588	0.0625	3.64	3.95
19.050	0.7500	25.400	1.0000	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1634 ⁽¹⁾	ZZS	TTS	1010	691	8.5	10	W	17	1.588	0.0625	4.22	4.56

1) Open type bearings have shield/seal grooves.

2) Single shield or seal types are also available; suffix ZS or TS.

3) Prefix S is added for stainless material type.

FM series with raceway

Bearing Reference e	Inner Ring Bore Dia.	Outer Ring Outer Dia.	Outer Ring Bore Dia.	Inner Ring Outer Dia.	Radius	Hight	Load Rating		Max Speed		Cage Type	Ball Complement		Weight(Ref.)	
	d	D	d ₁	D ₁			r _s (min)	H	Ca(N)	Coa(N)		Qty.: Z	Size:Dw		
	mm	inch	mm	inch	mm	inch	mm	inch	(N)	x1000rpm	mm	inch	g		
F3-8M	3	0.1181	8	0.3150	3.2	0.1260	7.8	0.3071	0.15	0.0059	TP	6	1.588	0.0625	0.8
F4-9M	4	0.1575	9	0.3543	4.2	0.1654	8.8	0.3465	0.15	0.0059	TP	6	1.588	0.0625	1.2
F4-10M	4	0.1575	10	0.3937	4.2	0.1654	9.8	0.3858	0.15	0.0059	TP	6	1.588	0.0625	1.5
F5-12M	5	0.1969	12	0.4724	5.2	0.2047	11.8	0.4646	0.20	0.0079	TP	8	1.588	0.0625	2.1
F6-12M	6	0.2362	12	0.4724	6.2	0.2441	11.8	0.4646	0.20	0.0079	TP	9	2.000	0.0787	2.2
F6-14M	6	0.2362	14	0.5512	6.25	0.2461	13.8	0.5433	0.20	0.0079	TP	7	2.381	0.0937	3.5
F7-13M	7	0.2756	13	0.5118	7.2	0.2835	12.8	0.5039	0.20	0.0079	TP	9	2.000	0.0787	2.4
F7-17M	7	0.2756	17	0.6693	7.2	0.2835	16.8	0.6614	0.30	0.0118	TP	8	2.778	0.1094	6.3
F8-16M	8	0.3150	16	0.6299	8.2	0.3228	15.8	0.6220	0.30	0.0118	TP	9	3.000	0.1181	3.9
F8-19M	8	0.3150	19	0.7480	8.2	0.3228	18.8	0.7402	0.30	0.0118	TP	8	3.175	0.1250	9.3
F9-20M	9	0.3543	20	0.7874	9.2	0.3622	19.8	0.7795	0.30	0.0118	TP	8	3.175	0.1250	9.9
F10-18M	10	0.3937	18	0.7087	10.2	0.4016	17.8	0.7008	0.30	0.0118	TP	10	2.381	0.0937	5.3

1) Bearings also available with stainless material : suffix H

F series without raceway

Bearing Reference	Inner Ring Bore Dia.	Outer Ring Outer Dia.	Outer Ring Bore Dia.	Inner Ring Outer Dia.	Radius	Hight	Load Rating		Cage Type		Qty.: Z	Ball Complement		Weight(Ref.)
d	D	d₁	D₁	r_s(min)	H	Ca(N)	Coa(N)	Size:D						

< Metric Series >

● OPEN BEARINGS

EZO	KOYO	NMB	NSK	NTN
681	681	L-310	681	681
MR31	ML1003	L-310W51	MR31	-
691	691	R-410	691	691
MR41X	ML1204	R-412	MR41X	BC1.2-4
681X	681.5	L-415	681X	681.5
691X	691.5	R-515	691X	691.5
601X	ML1506	R-615	601X	601.5
672	-	-	672	672
682	682	L-520	682	682
MR52	ML2005	L-520W02	MR52	BC2-5
692	692	R-620	692	692
MR62	ML2006	R-620W02	MR62	BC2-6
MR72	ML2007	R-720Y52	MR72	BC2-7
602	602	R-720	602	602
682X	682.5	L-625	682X	682.5
692X	692.5	R-725	692X	692.5
MR82X	ML2508/1B	R-825Y52	MR82X	BC2.5-8
602X	ML2508	R-825	602X	602.5
MR63	ML3006	L-630	MR63	673
683	683	L-730	683	683
MR83	ML3008	R-830Y52	MR83	BC3-8
693	693	R-830	693	693
MR93	ML3009	R-930Y52	MR93	BC3-9
603	603	R-930	603	603
623	623	R-1030	623	623
633	633	-	633	633
MR74	ML4007	L-740	MR74	674
MR84	ML4008	L-840	MR84	BC4-8
684	684	L-940	684	684
MR104	ML4010	L-1040X2	MR104	BC4-10
694	694	R-1140	694	694
604	604	R-1240	604	604
624	624	R-1340	624	624
634	634	R-1640X4	634	634
MR85	ML5008	L-850	MR85	675
MR95	ML5009	L-950	MR95	BC5-9
MR105	ML5010	L-1050	MR105	BC5-10
685	685	L-1150	685	685
695	695	R-1350	695	695
605	605	R-1450	605	605
625	625	R-1650X4	625	625
635	635	R-1950	635	635
MR106	ML6010	L-1060	MR106	676
MR126	ML6012	L-1260	MR126	BC6-12
686	686	L-1360	686	686
696	696	R-1560	696	696
606	606	R-1760X2	606	606
626	626	R-1960	626	626
636	636	-	636	636
MR117	ML7011	L-1170	MR117	677
MR137	ML7013	L-1370	MR137	BC7-13
687	687	L-1470	687	687
697	697	-	697	697
607	607	R-1970	607	607
627	627	R-2270	627	627
637	637	-	637	637
MR128	ML8012	L-1280	MR128	678
MR148	ML8014	L-1480	MR148	BC8-14
688	688	L-1680	688	688
698	698	R-1980	698	698
608	608	R-2280	608	608
628	628	-	628	628
638	638	-	638	638
679	679	-	679	679
689	689	L-1790	689	689
699	699	L-2090	699	699
609	609	-	609	609
629	629	R-2690	629	629
639	639	-	639	639
6800	6800	L-1910W7	6800	6800
6900	6900	-	6900	6900
6000	6000	R-2610	6000	6000
6200	6200	-	6200	6200
6801	6801	-	6801	6801
6901	6901	-	6901	6901
6802	6802	-	6802	6802
6902	6902	-	6902	6902
6803	6803	-	6803	6803
6903	6903	-	6903	6903

● FLANGED OPEN BEARINGS

EZO	KOYO	NMB	NSK	NTN
F681	F681	LF-310	F681	FL681
F691	F691	RF-410	F691	FL691
MF41X	OBF05	RF-412	MF41X	FLBC1.2-4
F681X	F681.5	RF-415	F681X	FL681.5
F691X	F691.5	RF-515	F691X	FL691.5
F601X	MLF1506	RF-615	F601X	FL601.5
F682	F682	LF-520	F682	FL682
MF52	MLF2005	LF-520W02	MF52	-
F692	F692	RF-620	F692	FL692
MF62	MLF2006	RF-620W52	MF62	FLBC2-6
MF72	MLF2007	RF-720Y52	MF72	-
F602	F602	RF-720	F602	FL602
F682X	F682.5	LF-625	F682X	FL682.5
F682X	F69/2.5	RF-725	F682X	FL69/2.5
MF82X	MLF2508/1B	RF-825Y52	MF82X	FLBC2.5-8
F602X	MLF2508	RF-825	F602X	FL602.5
MF63	MLF3006	LF-630	MF63	FL673
F683	F683	LF-730	F683	FL683
MF83	MLF3008	RF-830Y52	MF83	FLBC3-8
F693	F693	RF-830	F693	FL693
MF93	MLF3009	RF-930Y52	MF93	FLBC3-9
F603	F603	RF-930	F603	FL603
F623	F623	RF-1030	F623	FL623
MF74	MLF4007	LF-740	MF74	FL674
MF84	MLF4008	LF-840	MF84	FLBC4-8
F684	F684	LF-940	F684	FL684
MF104	MLF4010	LF-1040X2	MF104	FLBC4-10
F694	F694	RF-1140	F694	FL694
F604	F604	RF-1240	F604	FL604
F624	F624	RF-1340	F624	FL624
F634	F634	RF-1640	F634	FL634
MF85	MLF5008	LF-850	MF85	FL675
MF95	MLF5009	LF-950	MF95	FLBC5-9
MF105	MLF5010	LF-1050	MF105	FLBC5-10
F685	F685	LF-1150	F685	FL685
F695	F695	RF-1350	F695	FL695
F605	F605	RF-1450	F605	FL605
F625	F625	RF-1650X4	F625	FL625
F635	F635	RF-1950	F635	FL635
MF106	MLF6010	LF-1060	MF106	FL676
MF126	MLF6012	LF-1260	MF126	FLBC6-12
F686	F686	LF-1360	F686	FL686
F696	F696	RF-1560X2	F696	FL696
F606	F606	RF-1760X2	F606	FL606
F626	F626	RF-1960	F626	FL626
MF117	MLF7011	LF-1170	MF117	FL677
MF137	MLF7013	LF-1370	MF137	FLBC3-17
F687	F687	LF-1470	F687	FL687
F697	F697	-	F697	FL697
F607	F607	RF-1970	F607	FL607
F627	F627	RF-2270	F627	FL627
MF128	MLF8012	LF-1280	MF128	FL678
MF148	MLF8014	LF-1480	MF148	FLBC8-14
F688	F688	LF-1680	F688	FL688
F698	F698	RF-1980	F698	FL698
F608	F608	RF-2280	F608	FL608
F679	-	-	F679	FL679
F689	F689	LF-1790	F689	FL689
F699	F699	LF-2090	F699	FL699
F609	F609	-	F609	FL609
F6800	F6800	LF-1910	F6800	FL6800
F63800	F63800	LF-1910W7	F63800	FL63800
F6900	F6900	-	F6900	FL6900

● SHIELDED BEARINGS

EZO	KOYO	NMB	NSK	NTN

<tbl_r cells="5" ix="1" maxcspan="1" maxrspan="1"

<Inch Series>

●OPEN BEARINGS

EZO	KOYO	NMB	NSK	NTN
R09	OB63	RI-2	R09	R01
R0	OB65	RI-2 1/2	R0	R0
R1	OB67	RI-3	R1	R1
R1-4	OB69	RI-4	R1-4	R1-4
R133	OB71	RI3332	R133	R133
R1-5	OB72	RI-5	R1-5	R1-5
R144	OB74	RI-418	R144	R144
R2-5	OB75	RI-518	R2-5	R2-5
R2-6	OB76	RI-618	R2-6	R2-6
R2	EE0	R-2	R2	R2
R2A	EE1/2	—	R2A	RA2
R155	OB79	RI-5532	R155	R155
R156	OB81	RI-5632	R156	R156
R166	OB82	RI-6632	R166	R166
R3	EE1	R-3	R3	R3
R168	OB87	RI-614	R168	R168
R188	OB88	RI-814	R188	R188
R4	EE11/2	R-4	R4	R4
R4A	EE2	RI-1214	R4A	RA4
R1810	OB92-1	RI-8516	R1810	R1810
R6	EE3	RI-1438	R6	R6
R8	—	RI-1812	R8	R8
R10	—	—	R10	R10
R12	—	—	R12	R12

●FLANGED OPEN BEARINGS

EZO	KOYO	NMB	NSK	NTN
FR0	OBF65	RIF-2 1/2	FR0	FLR0
FR1	OBF67	RIF-3	FR1	FLR1
FR1-4	OBF69	RIF-4	FR1-4	FLR1-4
FR133	OBF71	RIF-3332	FR133	FLR133
FR1-5	OBF72	RIF-5	FR1-5	FLR1-5
FR144	OBF74	RIF-418	FR144	FLR144
FR2-5	OBF75	RIF-518	FR2-5	FLR2-5
FR2-6	OBF76	RIF-618	FR2-6	FLR2-6
FR2	OBF77	RF-2	FR2	FLR2
FR155	OBF79	RIF-5532	FR155	FLR155
FR156	OBF81	RIF-5632	FR156	FLR156
FR166	OBF82	RIF-6632	FR166	FLR166
FR3	OBF84	RF-3	FR3	FLR3
FR168	OBF87	RIF-614	FR168	FLR168
FR188	OBF88	RIF-814	FR188	FLR188
FR4	OBF89	RF-4	FR4	FLR4
FR1810	OBF92-1	RIF-8516	FR1810	FLR1810
FR6	OBF93	RIF-1438	FR6	FLR6
FR8	—	RI-1812	FR8	FLR8
FR10	—	—	FR10	FLR10
FR12	—	—	FR12	FLR12

●SHIELDED BEARINGS

EZO	KOYO	NMB	NSK	NTN
R0ZZ	WOB65ZZ	RI-2 1/2ZZ	R0ZZ	RA0ZZA
R1ZZ	WOB67ZZ	RI-3ZZ	R1ZZ	RA1ZZA
R1-4ZZS	WOB69ZZX	RI-4ZZ	R1-4ZZS	RA1-4ZZA
R133ZZS	WOB71ZZX	RI-3332ZZ	R133ZZS	RA133ZZA
R1-5ZZS	WOB72ZZX	RI-5ZZ	R1-5ZZS	RA1-5ZZA
R144ZZS	WOB74ZZX	RI-418ZZ	R144ZZS	RA144ZZA
R2-5ZZ	WOB75ZZ	RI-518ZZ	R2-5ZZ	RA2-5ZZA
R2-6ZZ	WOB76ZZ	RI-618ZZ	R2-6ZZ	RA2-6ZZA
R2ZZ	EE0ZZ	R-2ZZ	R2ZZ	R2ZZA
R2AZZ	EE1/2ZZ	—	R2AZZ	RA2ZZ
R155ZZS	WOB79ZZX	RI-5532ZZ	R155ZZS	RA155ZZA
R156ZZS	WOB81ZZ	RI-5632ZZ	R156ZZS	RA156ZZA
R166ZZ	WOB82ZZ	RI-6632ZZ	R166ZZ	R166ZZA
R3ZZ	EE1SZZ	R-3ZZ	R3ZZ	RA3ZZ
R168ZZS	WOB87ZZX	RI-614ZZ	R168ZZS	R168ZZA
R188ZZ	WOB88ZZ	RI-814ZZ	R188ZZ	RA188ZZA
R4ZZ	EE11/2ZZ	R-4ZZ	R4ZZ	R4ZZ
R4AZZ	EE2ZZ	RI-1214ZZ	R4AZZ	RA4ZZ
R1810ZZS	WOB92ZZX	RI-8516ZZ	R1810ZZS	RA1810ZZA
R6ZZ	EE3SZZ	RI-1438ZZ	R6ZZ	R6ZZ
R8ZZ	—	RI-1812ZZ	R8ZZ	R8ZZ
R10ZZ	—	—	R10ZZ	R10ZZ
R12ZZ	—	—	R12ZZ	R12ZZ



SAPPORO PRECISION GROUP'S EFFORTS TOWARD ISO

SAPPORO PRECISION INC.

International quality management system standard ISO 9001

Sapporo Precision Inc. establishes a system for continuously providing services for higher customer confidence and satisfaction for the customers throughout the world

Certificate No : ISO/TS16949 : YKA 4003532/TS-A
ISO9001 : YKA 4003532

Scope of Organization: Head Office in Sapporo and Shipping Center in Ashibetsu-city

KITANIHON SEIKI CO, LTD.

Proof of excellent environmental preservation and quality control system

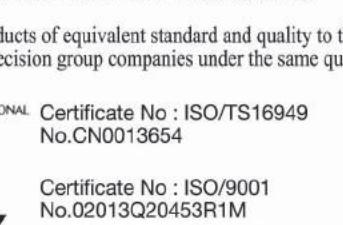
ISO14001
YKA-EM0554Quality assurance supported by trust and actual achievement. We produce bearings with an eye on environmental preservation.
Certificate No : ISO/TS16949 : YKA 4003532/TS-A
ISO9001 : YKA 4003532

ISO14001 : YKA-EM0554

Scope of Registration:The design/Development and manufacture of ball bearing

SHANGHAI PRECISION BEARING CO, LTD

Quality improvement meeting international standards



It provides products of equivalent standard and quality to the world market as one of the Sapporo Precision group companies under the same quality control system

Certificate No : ISO/TS16949
No.CN0013654Certificate No : ISO/9001
No.02013Q20453R1M
Certificate No : ISO/14001
No.02013E20163R1M

Scope of Registration:Production of Miniature Bearings



SAPPORO PRECISION INC.

8-2 South 1, East 2, Chuo-ku

Sapporo, Hokkaido 060-0051 Japan

PHONE:81- (0)11-251-9261 FAX:81- (0)11-251-9266

URL: <http://www.sppc.co.jp>

E-mail : info@sppc.co.jp



YKA 4003532/TS-A



YKA 4003532



KITANIHON SEIKI CO., LTD.

26-23 Kamiashibetsu-Chō

Ashibetsu, Hokkaido 079-1397 Japan

PHONE:81- (0)124-22-1250 FAX:81- (0)124-22-1038

URL: <http://www.ezo-brg.co.jp>



YKA 4003532/TS-A



YKA 4003532



JQA EM0554

SHANGHAI PRECISION BEARING CO., LTD.

345 Minshen Road , Songjiang

Industrial Zone , Shanghai , 201612 China

PHONE:86- (0)21-67600758 FAX:86- (0)21-67600777

URL: <http://www.spb.com.cn>



ISO9001
NO.CN0013654



ISO14001
NO.02013Q20453R1M



ISO14001
NO.02013E20163R1M