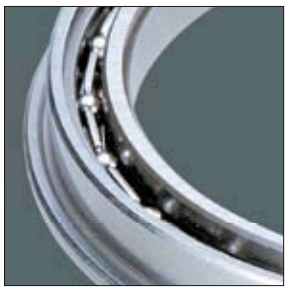
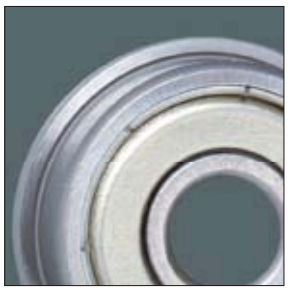
EZO
PRECISION BALL BEARINGS

HIGH PRECISION BALL BEARINGS

Extra Thin Type Bearings
Flanged Bearings
Stainless Bearings
Bore Dia,0.6mm To 90mm

SPB
SAPPORO PRECISION BEARING

SAPPORO PRECISION INC.

Technical Contents

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

MATERIAL

HIGH CARBON CHROMIUM STEEL
SUJ2、SAE 52100、100Cr6·····NO SYMBOL

STAINLESS STEEL
KS440(ACD34)、X65Cr13(d≦25＆D≦52mm Outer & INNER RING)
SUS440C、AISI440C、X102CrMo17
(OUTER & INNER RING EXCLUDING ABOVE AND BALL)

RADIAL CLEARANCE

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

STANDARD METRIC ·····H
MR、MF、MT AND INCH SERIES ··S

	BEARING TYPE		BEARING PART NO.		TOLERANCE CLASS		LUBRICATION
Ex.1			686	H	J	ZZ	MC3		SRL
Ex.2		F	608	H	TW	2RS	MC4	P6	SRL
Ex.3	S	MR	52		W	ZZ	MC2	P5	AF2
Ex.4	S	MF	128		W	TTS	MC3	P6	SRL
Ex.5	S	ER	1458		W	ZZS	C0	A3	SRL
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	AF2
Ex.9	S	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

BEARING PART NO.

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
ABMA ABEC1:	NO SYMBOL
ABMA ABEC3:	A3
ABMA ABEC5:	A5
ABMA ABEC7:	A7

·INSTRUMENT BALL BEARING

ABMA CLASS3P:	A3P
ABMA CLASS5P:	A5P
ABMA CLASS7P:	A7P

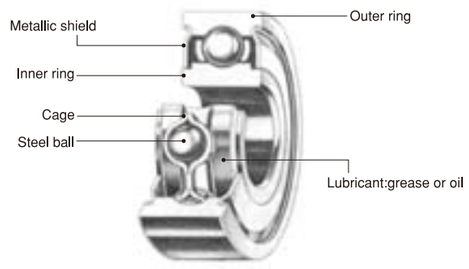
LUBRICATION

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

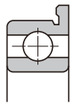
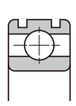
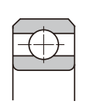
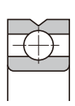
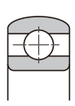
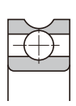
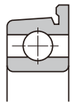
EX. OIL	CODE
AERO SHELL FLUID 12(STANDARD):	AF2
WINDSOR LUBE L-245X(SEMI STD):	WL2

Design and characteristics of radial ball bearings

STRUCTURE OF BEARING



DESIGN OF BEARING

 standard	 extended inner ring	 (V) full complement of balls	 (N) with snap ring groove	 (NR) with snap ring groove and snap ring	 (F) with flanged outer ring
 examples of special designs	 examples of special designs	 examples of special designs	 examples of special designs	 examples of special designs	 examples of special designs

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 in 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 obtation 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

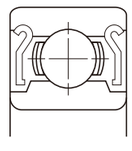
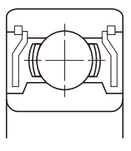
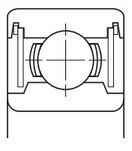
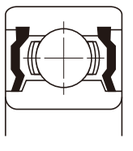
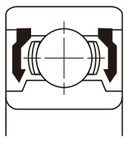
MATERIAL	SYMBOL	CHEMICAL COMPOSITION (Wt%)							EQUIVALENT	HARDNESS (HRC)
		C	Si	Mn	P	S	Cr	Mo		
HIGH CARBON CHROMIUM STEEL	SUJ2	0.95～1.10	0.15～0.35	≦0.50	≦0.025	≦0.025	1.30～1.60	≦0.08	SAE52100,100Cr6, ASTM52100, BS535A99,1.3505	60～64
STAINLESS STEEL	SUS440C	0.95～1.20	≦1.00	≦1.00	≦0.040	≦0.030	16.0～18.0	≦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℃	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.	Non-contact shield retained in outer ring. Low ingress of contaminants. Mainly used for smaller or narrower bearings.	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 intenal pressure changes. TEFLON SEAL operating temperature range:from -100 to +260℃	Rubber seal fitted into outer ring. Light contact with inner ring, retains grease and prevents ingress of extenal contaminants. NBR SEAL operating temperature range:from -40 to +120℃ FKM(VITON)SEAL operating temperature range:from -30 to +230℃	Non-contact rubber seal fitted into outer ring, still provides effective sealing. NBR SEAL operating temperature range:from -40 to +120℃ FKM(VITON)SEAL operating temperature range:from -50 to +230℃

Tolerance, class, chamfer dimension of bearings

TOLERANCES OF INNER RING AND OUTER RING WIDTH (ISO)

Unit μm

d (mm)		Δdmp				Δds	Vdp										Vdmp			
		P0		P6	P5	P4	P4	P0			P6			P5		P4		P0	P6	P5	P4
							Diameter series	Diameter series			Diameter series			Diameter series		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.
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 chamter 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.

ΔBs(ΔCs)(2)			VBs(VCs)(2)				Kia				Sd		Sia		d (mm)	
Single bearing			Inner/outer ring		Inne ring		P0	P6	P5	P4	P5	P4	P5	P4		
P0 P6	P5 P4		P0	P6	P5	P4										
Upper	Lower	Lower	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Over	Incl.
0	− 40	− 40	12	12	5	2.5	10	5	4	2.5	7	3	7	3	0.6(1)	2.5
0	−120	− 40	15	15	5	2.5	10	6	4	2.5	7	3	7	3	2.5	10
0	−120	− 80	20	20	5	2.5	10	7	4	2.5	7	3	7	3	10	18
0	−120	−120	20	20	5	2.5	13	8	4	3	8	4	8	4	18	30
0	−120	−120	20	20	5	3	15	10	5	4	8	4	8	4	30	50

Note (1) : 0.6mm is included in this classification.
Note (2) : The inner ring width variation is the same for the outer ring of the same bearing size.CLASS5 and CLASS4 referring to outer ring only.

TOLERANCES OF OUTER RING (ISO)

Unit μm

D (mm)		ΔDmp				ΔDs	VDp(3)									VDmp(3)			
		P0	P6	P5	P4	P4	P0			P6			P5	P4		P0	P6	P5	P4
							Open		Seal Shield	Open		Seal Shield	Open	Open					
						Diameter series	Diameter series			Diameter series			Diameter series	Diameter series					
						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.			
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	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	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	0	−6	14	11	8	16	11	9	7	13	7	5	6	5	8	7	4	3
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

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.

Kea				SD		Sea		VCs(3)		D (mm)		Flanged type ΔDis				d (mm)		Flanged type ΔCis			
P0	P6	P5	P4	P5	P4	P5	P4	P5	P4			P0 P6		P5 P4				P0 P6		P5 P4	
Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Over	Incl.	Upper	Lower	Upper	Lower	Over	Incl.	Upper	Lower	Upper	Lower
15	8	5	3	8	4	8	5	5	2.5	−	10	+220	−36	0	−36	0.6	2.5	0	−40	0	−40
15	8	5	3	8	4	8	5	5	2.5	10	18	+270	−43	0	−43	2.5	10	0	−120	0	−40
15	9	6	4	8	4	8	5	5	2.5	18	30	+330	−52	0	−52	10	18	0	−120	0	−80
20	10	7	5	8	4	8	5	5	2.5	30	50	+390	−62	0	−62	18	30	0	−120	0	−120
25	13	8	5	8	4	10	5	6	3	50	80	+460	−74	0	−74	30	50	0	−120	0	−120

Note (1) : Size 2.5mm is included in this classification.
Note (2) : Applicable without locating snap ring.
Note (3) : The outer ring width variations for CLASS0 and CLASS6 are the same as for the inner ring of the same bearing size.

TOLERANCES OF INNER RING AND OUTER RING WIDTH(ABMA)

Unit μm

d (mm)		Δdmp		Δds		Vdp	Vdmp	ΔBs(ΔCs)		VBs		Kia		Sia		Sd	
		ABEC 5P ABEC 7P		ABEC 5P ABEC 7P		ABEC 5P ABEC 7P	ABEC 5P ABEC 7P	Single bearing ABEC 5P ABEC 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.
—	10	0	−5	0	−5	2.5	2.5	0	−25	5	2.5	3.5	2.5	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
18	30	0	−5	0	−5	2.5	2.5	0	−25	5	2.5	3.5	2.5	7	3	7	3

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

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

Unit:mm

r smin	d(mm)		r smax		r amax
	Over	Incl.	Radial	Axial	
0.05	-	-	0.10	0.20	0.05
0.08	-	-	0.16	0.30	0.08
0.10	-	-	0.20	0.40	0.10
0.15	-	-	0.30	0.60	0.15
0.20	-	-	0.50	0.80	0.20
0.30	-	40	0.60	1.00	0.30
0.30	40	-	0.80	1.00	0.30
0.60	-	40	1.00	2.00	0.60
0.60	40	-	1.30	2.00	0.60
1.00	-	50	1.50	3.00	1.00
1.00	50	-	1.90	3.00	1.00
1.10	-	120	2.00	3.50	1.00
1.10	120	-	2.50	4.00	1.00
1.50	-	120	2.30	4.00	1.50
1.50	120	-	3.00	5.00	1.50

d : Nominal bore diameter
Δdmp : Single plane mean bore diameter deviation
Ads : Deviation of a single bore diameter
Vdp : Bore diameter variation in a single radial plane
Vdmp : Mean bore diameter variation
ΔBs(ΔCs) : Deviation of the single inner and outer ring width from the nommal dimension
VBs(VCs) : Variation Of the inner and outer ring width
Kia : Radial runout of assembled bearing inner ring
Sd : Face runout with bore
Sia : Assembled bearlng inner ring face runout with raceway

D : Nominal outside diameter
ΔDmp : Single plane mean outside diameter deviation
ΔDs : Deviation of a single outside diameter

VDp : Outside diameter variation in a single radial plane
VDmp : Mean outside diameter variation
Kea : Radial runout of assembled bearing outer ring
SD : Variation of outside surface generatrix inclination with face
Sea : Assembled bearing outer ring face runout with raceway
VCs : Variation of the outer ring width
ΔDis : Flange outside diameter deviation
ΔCis : Flange width deviation

r smin : Smallest permissible single chamfer dimension(minimum limit)
d : Nominal bore diameter
r smax : Largest permissible single chamfer dimension(maximum limit)
r amax : Largest permissible single shaft and housing fillet radius

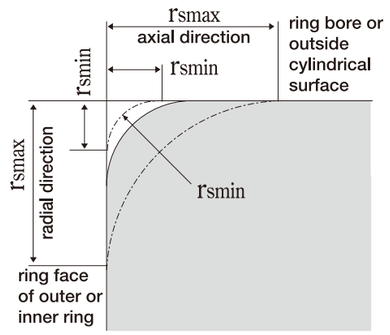
Note(1) : The value of r max in axial direction of bearing with nominal width of under 2mm is the same as the one in radial direction

TOLERANCES OF OUTER RING (ABMA)

Unit μm

D (mm)		ΔDmp			ΔDs						VDp,VDmp		△Bs(△Cs)		VCs(1)		SD		Kea		Sea		Flanged type ΔDis		ΔCis(1)		Sea1(2)	
					Open			Seal,Shield			ABEC 5P,7P		Single bearing										ABEC 5P		ABEC 5P		ABEC	ABEC
		ABEC 5P,7P	ABEC 5P	ABEC 7P	ABEC 5P,7P	ABEC 5P	ABEC 7P	ABEC 5P,7P	ABEC 5P	ABEC 7P	Open	Seal Shield	ABEC 5P ABEC 7P		ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 5P	ABEC 7P	ABEC 7P		ABEC 7P		5P	7P
Over	Incl.	Upper	Lower	Lower	Upper	Lower	Lower	Upper	Lower	Lower	Max.	Max.	Upper	Lower	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Upper	Lower	Upper	Lower	Max.	Max.
—	18	0	−5	−5	0	−5	−5	+1	−6	−6	2.5	5	0	−25	5	2.5	8	4	5	3.5	8	5	0	-25	0	-51	7.5	5
18	30	0	−6	−5	0	−6	−5	+1	−7	−6	2.5	5	0	−25	5	2.5	8	4	6	4	8	5	0	-25	0	-51	7.5	5
30	50	0	−6	−5	0	−6	−5	+1	−7	−6	2.5	5	0	−25	5	2.5	8	4	6	4	8	5	0	-25	0	-51	7.5	5

Note (1) : Applies to flange width variation of flanged bearing.
Note (2) : Applies to flange back face.



r s min=smallest permissible single chamfer dimension (minimum limit)
r s max=largest permissible single chamfer dimension (maximum limit)
r a max=largest permissible single shaft and housing fillet radius

NOTE: The exact shape of the chamfer surface is not specified, but its contour in an axial plane shall not be allowed to project beyond the imaginary circular arc, of radius r smin , tangential to the ring face and the bore or outside cylindrical surface of the ring (see figure).

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:

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

whereby:
L_{10}=BASIC RATING LIFE
Cr=BASIC DYNAMIC LOAD RATING(N)
n=R.P.M.(REVOLUTIONS PER MINUTE)
$L_{10}h$=BASIC RATING LIFE IN OPERATING HOURS
P=EQUIVALENT LOAD(N)

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

OPERATING CONDITIONS	BASIC RATING LIFE $L_{10}h$
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:

$Lna=a_1\times a_2\times a_3\times(Cr/P)^3\times 10^6$ (Revolutions)

whereby:
Lna=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)
a_1=Factor for a reliabillity other than 90%
a_2=Factor for non-conventional materials
a_3=Factor for non-conventional operating conditions, in particular lubrication

(1) RELIABILITY FACTOR a_1

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

●RELIABILITY FACTOR a_1

Reliability	90	91	92	93	94	95	96	97	98	99	(99.6)	(99.9)
a1	1.00	0.92	0.84	0.77	0.64	0.62	0.53	0.44	0.33	0.21	(0.10)	(0.037)

(2) MATERIAL FACTOR a_2

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 a_2=1.

(3) OPERATING CONDITIONS FACTOR a_3

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 a_3=1.
In unfavourable conditions ($d_m\cdot n \leqq 10{,}000$), a factor $a_3 < 1$ must be selected.d_m = mean bearing diameter = (D+d)/2 , n = operating speed.
At temperatures above 120℃, 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 (℃)	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℃, 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/(ZD²)	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

$P=XFr+YFa(N)$

Fr=RADIAL LOAD(N)
Fa=AXIAL LOAD(N)

X=RADIAL LOAD FACTOR
Y=AXIAL LOAD FACTOR
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 js5 js5
	STANDARD LOAD=0.06～0.12Cr	10≦d≦18 18≦d≦30 30≦d≦50	js5 js5 js5	j5 k5 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	N5	N7
	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.

$$\Delta dF=0.08\times\sqrt{d/B\cdot Fr}\times10^{-3}\ (mm)$$
$$\Delta dF=0.02\times Fr/B\times10^{-3}(mm)$$

(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 ΔT(℃), that of the mating surface of the shaft and of the bearing is (0.10～0.15)ΔT.
Consequently, ΔdT, the decrease of the inner ring interference fit due to temperature change, is calculated from the following formula:

$$\Delta dT=(0.10\sim0.15)\times\Delta T\cdot a\cdot d\fallingdotseq0.0015\times\Delta T\cdot d\times10^{-3}(mm)$$

ΔdT : DECREASE OF INTERFERENCE DUE TO TEMPERATURE DIFFERENCE(mm)

ΔT : TEMPERATURE DIFFERENCE BETWEEN BEARING AND SURROUNDING HOUSING(℃)

a : COEFFICIENT OF THERMAL EXPANSION FOR BEARING STEEL≒12.5×10^{-6}(l/℃)

COEFFICIENT OF THERMAL EXPANSION FOR STAINLESS STEEL≒10.3×10^{-6}(l/℃)

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 : $\Delta d=d/(d+2)\cdot\Delta da$(mm)
Turned Shaft : $\Delta d=d/(d+3)\cdot\Delta da$(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:

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

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	≦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

TOLERANCE OF BORE DIAMETER / TOLERANCES OF OUTER DIAMETER	MARK	0～-D/2	-D/2～-D	0～-D
0～-d/2	1	C11 ZC3	C12 ZC1	C10
-d/2～-d	2	C21	C22	C20
0～-d	0	C01 ZC2	C02	

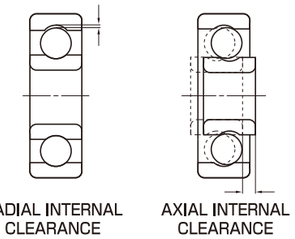
NOTE: 1.THIS IS APPLIED TO BOTH BEARINGS OF ABEC 5P AND P5.
2.UPON YOUR REQUEST, PLEASE SPECIFY THE MARK LISTED BELOW.
ZC1.... 2 SELECTIVE CLASSIFICATIONS FOR BORE DIAMETER TOLERANCE (0～-d/2、-d/2～-d)
1 SELECTIVE CLASSIFICATION FOR OUTER DIAMETER TOLERANCE (0～-D)
ZC2.... 1 SELECTIVE CLASSIFICATION FOR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

BEARING INTERNAL CLEARANCE



●RADIAL INTERNAL CLEARANCE OF SMALL AND MINIATURE BEARINGS

Unit μm

CLEARANCE SYMBOL		MC1	MC2	MC3	MC4	MC5	MC6
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.

Unit μm

CLEARANCE SYMBOL	MC1	MC2	MC3	MC4	MC5	MC6
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

Unit μm

NOMINAL BORE DIAMETER d(mm)		CLEARANCE									
		C2		CN(C0)		C3		C4		C5	
OVER	INCL.	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

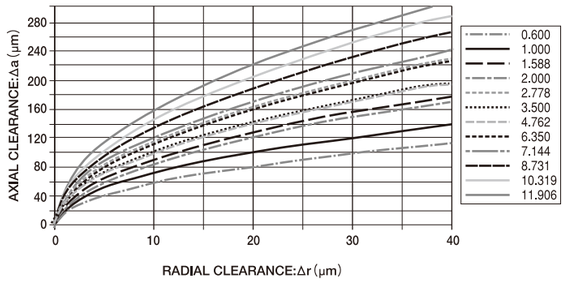
NOTE: 1.FOR MEASURING CLEARANCE, OFFSET BY COMPENSATION FACTOR LISTED BELOW.

Unit μm

BORE DIAMETER OF NOMINAL BEARING d(mm)		MEASURING LOAD	COMPENSATION FACTOR				
OVER	INCL.	N (kgf)	C2	CN(C0)	C3	C4	C5
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.



$$\Delta a=2\sqrt{\Delta r(r_o+r_i-Da)}\quad(mm)$$

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

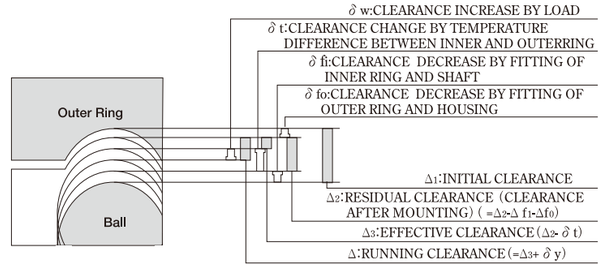
SELECTION OF BEARING CLEARANCE

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 interfence 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.

$$\Delta=\Delta_1-(\partial t+\partial f)+\partial w\,(mm)$$

(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.

$$\partial t\fallingdotseq a\times\Delta T\times Do\,(mm)$$

(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.

$$\delta f = \delta fi + \delta fo =$$
$$\Delta db \times d/db \times ((1-(do/d)^2))/(1-(do/db)^2)) +$$
$$\Delta Da \times Da/D \times ((1-(D/Dh)^2)/(1-(Da/Dh)^2)) \quad (mm)$$

(4) CLEARANCE INCREASE BY LOAD

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

$$\delta w = C \times ((5 \times Fr)/(Z \times \cos \alpha))^{(2/3)} \times (1/dw)^{(1/3)} \quad (mm)$$

The initial contact angle α_0 is calculated from the following two formulae:

$$\cos \alpha_0 / \cos \alpha = 1 + C/(2 \times m-1) \times (Fa/(9.8 \times Z \times Dw^2 \times \sin \alpha)^{(2/3)}$$
$$1-\cos \alpha_0 = \Delta r/(2 \times DW \times (2 \times m-1))$$

SYMBOLS

ΔT :	TEMPERATURE DIFFERENCE BETWEEN INNER AND OUTER RING	**m :**	OSCULATION
D_0 :	OUTER RING RACEWAY DIAMETER	**Z :**	NUMBER OF BALLS
Δdb :	CLEARANCE OF INNER RING ON SHAFT	**Dw :**	BALL DIAMETER
do :	BORE DIAMETER OF HOLLOW SHAFT	**α :**	CONTACT ANGLE
Dn :	OUTSIDE DIAMETER OF HOUSING SEAT	**α_0 :**	INITIAL CONTACT ANGLE
ΔDa :	CLEARANCE OF OUTER RING IN HOUSING	**Fa :**	AXIAL LOAD
db :	AVERAGE OUTSIDE DIAMETER OF INNER RING	**Fr :**	RADIAL LOAD
Da :	AVERAGE OUTSIDE DIAMETER OF OUTER RING	**Δr :**	RADIAL INTERNAL CLEARANCE
a :	COEFFICENT OF THERMAL EXPANSION FOR BEARING STEEL	**C :**	MATERIAL ELASTICITY FACTOR

General Bearing	C=0.00218	m=0.525
Instrument Bearing	C=0.00287	m=0.560

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.

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(℃)	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

●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 (≦0.06Cr)
STANDARD LOAD (≦0.12Cr)

●CRITERIA FOR LUBRICATING OIL SELECTION

OPERATING TEMPERATURE OF BEARING (℃)	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.dn = BEARING BORE DIAMETER d(mm) × ROTATING SPEED n(r.p.m)

●COMMON OIL BRANDS AND EFFICIENCY

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

●COMMON GREASE BRANDS AND EFFICIENCY

Manufacturer	Brand	Code	Thickening Agent	Lubricant Base	Drop Point (℃)	Cone Penetration: Worked (60 strokes)	Operating Temperature (℃)	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 RLQ2	AQ2	Lithium	Mineral	195	275	-30～+120	-
	Aero Shell NO.7	AG7	Microgel	Diester	260	296	-73～+149	MIL-PRF-83282D
	Aero Shell NO.14	AG4	Calsium	Diester	148	273	-54～+93	MIL-G-25537C
	Aero Shell NO.15	AG5	Fluorotelomer	Silicone	260	290	-73～+232	MIL-G-25013E
	Aero Shell NO.22	AG2	Microgel	Synthetic Hydorocarbon	260	275	-65～+204	MIL-PRF-81322F
	Aero Shell NO. 33MS	A3S	Lithium	Synthetic Hydorocarbon Ester	234	281	-73～+121	MIL-G-21164D
	Alvania EP2	AE2	Lithium	Mineral	184	284	-20～+110	-
	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	Diester,Mineral	190	275	-55～+130	-
	Multemp SRL	SRL	Lithium	Diester,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	Diester,Mineral	200	280	-40～+130	MIL-G-25760A
	Isoflex TOPAS NB52	B52	Barium	Synthetic Hydorocarbon	220	280	-60～+160	-
	Isoflex Alltime SL2	AS2	Lithium	Diester	180	280	-70～+150	-
	Isoflex LDS18 Special A	L8A	Lithium	Diester	190	280	-60～+130	MIL-G-23827B
	Isoflex Super LDS18	SL8	Lithium	Diester	190	280	-60～+130	MIL-G-7118A
	Isoflex PDB38 CX2000	PDC	Lithium	Synthetic	-	-	-70～+120	-
	Barielta IEL	IEL	PTFE	Fluorinated	-	280	-35～+220	-
	Barielta IEL/V	IEV	PTFE	Fluorinated	-	280	-65～+200	-
	Barielta IMI	IMI	PTFE	Fluorinated	-	280	-50～+220	-
	Barielta IMI/V	IMV	PTFE	Fluorinated	-	280	-50～+220	-
	Barielta L55/2 H1	L55	PTFE	Fluorinated	-	280	-35～+260	NSF(USDA)H2
	Barielta IS	BSI	PTFE	Fluorinated	-	280	-35～+260	-
	Klubersynth UH1 64-62	UH6	Silicate	Synthetic Hydorocarbon	-	280	-40～+150	NSF(USDA)H1
Dow Corning Co.	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	Beacon325	B32	Lithium	Diester	190	274	-60～+120	-
	Templex N3	TX3	Lithium Complex	Mineral	260	230	-30～+160	-
Mobil Oil Co.	Mobil NO.28	MG2	Bentnite	Synthetic Hydorocarbon	262	280	-62～+204	MIL-G-81322E
	Mobilux EP2	ME2	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

If the bearing operates at over 70% of the permissible speed value, a lubricant for high speed should be selected.
The values for the permissible speed are for applications with horizontal shafts and with appropriate lubrication. With vertical shafts, only 80% of the maximum speed value should be used. This is necessary due to the reduced cage guidance and reduced lubricant retention in this type of application.

Frictional torque and temperature

FRICTIONAL TORQUE

Frictional torque of rolling bearings varies under changing load and lubrication conditions. When grease is used as a lubricant, the grease resistance must be added to the bearing frictional torque.
When adequate lubrication under normal loading conditions(Cr/P>12,Fa/Fr<0.2), the frictional torque of a bearing can be expressed as follows:

$M=\mu \cdot F \cdot d/2(N\cdot mm)$	M:FRICTIONAL TORQUE(N・mm) F:BEARING LOAD (N) d:SHAFT DIAMETER(mm) μ:=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.

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℃.

- 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.

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
	Regular noise	Rust and damage	Check and replace seals and relubricate
		Flaking of raceway surface	Improve lubrication and check fitting, clearance and fixing method
	Irregular noise	Ingress of foreign matter	Check and replace seals and relubricate
		Excessive clearance	Correct clearance
		Damege and flaking of rolling element	Reduce loads and/or clearance
	Variable noise	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
Heavy vibration		Flaking of raceway and rolling element	Improve lubrication and check fitting, clearance and fixing method
		Ingress of foreign matter	Check and replace seals and relubricate
		Excessive clearance	Correct clearance
		Poor location	Ensure abutment face and fitting diameter are perpendicular
Excessive heat generation		Clearance too small	Correct clearance
		Poor location	Ensure abutment face and fitting diameter are perpendicular
		Excessive load	Examine shaft and housing tolerances for closing effect
		Poor lubrication	Improve lubrication
		Creep	Maintain recommended shaft and housing fits
Lubrication failure		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	Check fitting Correct clearance Use correct lubricant quantity
		Clearance too small	
		Poor lubrication	
		Poor fitting	
		Corrosion	
	Flaking across the raceway	Poor fitting and eccentricity	Fitting and centering with care
		Shaft deflection	Use bearing with larger internal clearance
		Geometric inaccuracy of shaft and housing	Shaft and abutments to be square
	Flaking around raceway	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
		Excessive static load	Check static load
	Overrolling	Ingress of foreign matter	Ensure cleanliness of components and integrity of seals
Pick-up	Discolouration of raceway and rolling element surface Softening of surfaces	Excessive load	Check fitting
		Clearance too small	Correct clearance
		Poor lubrication	Use correct lubricant quantity
		Poor fitting	Check fitting method
Electrical erosion	Raceway eroded at regular intervals	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
		Ingress of foreign matter in bearing	Improve sealing
Skidding	Scoring of raceway and rolling element surfaces	Hard grease	Use soft grease
		High start-up acceleration	Control acceleration
Abrasion	Extreme abrasion of raceway, rolling element and cage	Ingress of foreign matter	Improve sealing Improve lubrication
		Corrosion	
		Poor lubrication	
	Creep	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 Use oil as lubricant Apply preload
		Small oscillations in application	
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	Check sealing
		Chemical reaction with lubricant	Use correct lubricant

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

YKA 4003532 YKA 4003532

Certificate No: ISO/TS16949 : YKA 4003532
ISO9001 : YKA 4003532
Scope of Organization: Head Office in Sappro and Shipping Center in Ashibetsu-city

KITANIHON SEIKI CO,LTD.

Proof of excellent environmental preservation and quality control system

Quality assurance supported by trust and actual achievement. We produce bearings with an eye on environmental preservation.

YKA 4003532 ISO14001 JQA-EM0554

Certificate No: ISO/TS16949 : YKA 4003532
ISO9001 : YKA 4003532
ISO14001 : JQA-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 controll system

Certificate No: ISO9001 NO.02010Q20364ROM
ISO14001 NO.02010E20428ROM
Scope of Registration: Production of Miniature Bearings

Dimension Contents

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

MATERIAL

HIGH CARBON CHROMIUM STEEL
SUJ2、SAE 52100、100Cr6·····NO SYMBOL

STAINLESS STEEL
KS440(ACD34)、X65Cr13(d≦25＆D≦52mm Outer & INNER RING)
SUS440C、AISI440C、X102CrMo17
(OUTER & INNER RING EXCLUDING ABOVE AND BALL)

STANDARD METRIC ·····H
MR、MF、MT AND INCH SERIES ··S

RADIAL CLEARANCE

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

Ex.1			686	H	J	ZZ	MC3		SRL
Ex.2		F	608	H	TW	2RS	MC4	P6	SRL
Ex.3	S	MR	52		W	ZZ	MC2	P5	AF2
Ex.4	S	MF	128		W	TTS	MC3	P6	SRL
Ex.5	S	ER	1458		W	ZZS	C0	A3	SRL
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	AF2
Ex.9	S	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

BEARING PART NO.

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
ABMA ABEC1:	NO SYMBOL
ABMA ABEC3:	A3
ABMA ABEC5:	A5
ABMA ABEC7:	A7

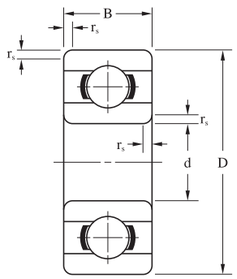
·INSTRUMENT BALL BEARING

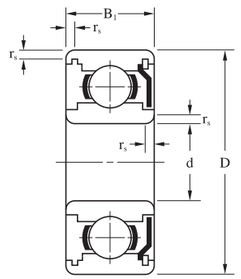
ABMA CLASS3P:	A3P
ABMA CLASS5P:	A5P
ABMA CLASS7P:	A7P

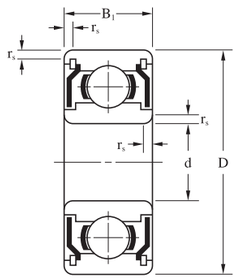
LUBRICATION

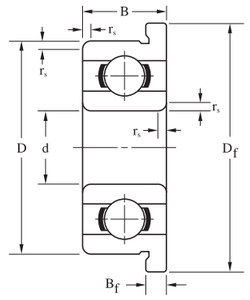
EX. GREASE	CODE
MULTEMP SRL(MINIATURE STD):	SRL
ALVANIA NO.2(STANDARD):	AV2
ISOFLEX SUPER LDS18(SEMI STD):	SL8
BEACON 325(SEMI STD):	B32
SHELL CASSIDA RLS2(FOOD):	RL2
MOLYKOTE 44M(HIGH TEMP):	M4M
KRYTOX 240AC(ULTRA HIGH TEMP):	K24

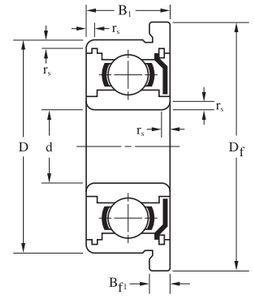
EX. OIL	CODE
AERO SHELL FLUID 12(STANDARD):	AF2
WINDSOR LUBE L-245X(SEMI STD):	WL2

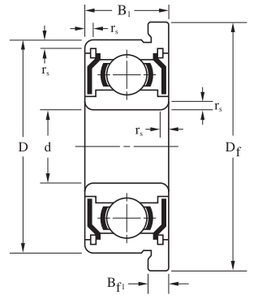










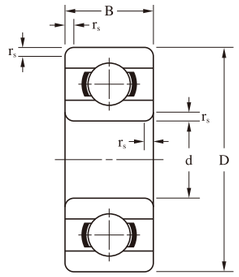


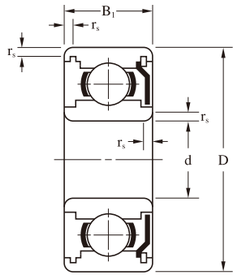
Bore Diameter: d		Outer Diameter: D		Flange Diameter: Df		Radius: r's(min)		Open Bearings				Seal, Shield Bearings					
								Width: B		Flange Width: Bf		Bearing Reference					
												Open	Flange Open	Shield	Flange Shield	Seal	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch					2RS	2RU	TTS
0.6	0.0236	2.5	0.0984	–	–	0.05	0.0020	1.0	0.0394	–	–	68/0.6	–	–	–	–	–	–
1.0	0.0394	3	0.1181	3.8	0.1496	0.05	0.0020	1.0	0.0394	0.3	0.0118	681	F681	–	–	–	–	–
		3	0.1181	–	–	0.05	0.0020	1.5	0.0591	–	–	MR31	–	–	–	–	–	–
		4	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	0.1575	4.8	0.1890	0.10	0.0039	1.8	0.0709	0.4	0.0157	MR41X	MF41X	MR41XZZ	–	–	–	–
1.5	0.0591	4	0.1575	5.0	0.1969	0.05	0.0020	1.2	0.0472	0.4	0.0157	681X	F681X	681XZZ	F681XZZ	–	–	–
		5	0.1969	6.5	0.2559	0.15	0.0059	2.0	0.0787	0.6	0.0236	691X	F691X	691XZZ	F691XZZ	–	–	–
		6	0.2362	7.5	0.2953	0.15	0.0059	2.5	0.0984	0.6	0.0236	601X	F601X	601XZZ	F601XZZ	–	–	–
2.0	0.0787	4	0.1575	–	–	0.05	0.0020	1.2	0.0472	–	–	672	–	672ZZ	–	–	–	–
		5	0.1969	6.1	0.2402	0.08	0.0031	1.5	0.0591	0.5	0.0197	682	F682	682ZZ	F682ZZ	–	–	–
		5	0.1969	6.2	0.2441	0.10	0.0039	2.0	0.0787	0.6	0.0236	MR52	MF52	MR52ZZ	MF52ZZ	–	–	–
		6	0.2362	7.5	0.2953	0.15	0.0059	2.3	0.0906	0.6	0.0236	692	F692	692ZZ	F692ZZ	–	–	TTS
		6	0.2362	7.2	0.2853	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR62	MF62	MR62ZZ	–	–	–	–
		7	0.2756	8.2	0.3228	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR72	MF72	MR72ZZS	MF72ZZS	–	–	TTS
		7	0.2756	8.5	0.3346	0.15	0.0059	2.8	0.1102	0.7	0.0276	602	F602	602ZZS	F602ZZS	–	–	TTS
2.5	0.0984	6	0.2362	7.1	0.2795	0.08	0.0031	1.8	0.0709	0.5	0.0197	682X	F682X	682XZZ	F682XZZ	–	–	–
		7	0.2756	8.5	0.3346	0.15	0.0059	2.5	0.0984	0.7	0.0276	692X	F692X	692XZZS	F692XZZS	–	–	TTS
		8	0.3150	9.2	0.3622	0.20	0.0079	2.5	0.0984	0.6	0.0236	MR82X	MF82X	–	–	–	–	–
		8	0.3150	9.5	0.3740	0.15	0.0059	2.8	0.1102	0.7	0.0276	602X	F602X	602XZZ	F602X	–	–	–
3.0	0.1181	6	0.2362	7.2	0.2835	0.10	0.0039	2.0	0.0787	0.6	0.0236	MR63	MF63	MR63ZZ	MF63ZZ	–	–	–
		7	0.2756	8.1	0.3189	0.10	0.0039	2.0	0.0787	0.5	0.0197	683	F683	683ZZ	F683ZZ	–	–	TTS [4]
		8	0.3150	9.2	0.3622	0.15	0.0059	2.5	0.0984	0.6	0.0236	MR83	MF83	MR83ZZ	–	–	–	–
		8	0.3150	9.5	0.3740	0.15	0.0059	3.0	0.1181	0.7	0.0276	693	F693	693ZZ	F693ZZ	2RS	–	–
		9	0.3543	10.2*	0.4016	0.20	0.0079	2.5	0.0984	0.6	0.0236	MR93	MF93	MR93ZZ	MF93ZZ	–	–	–
		9	0.3543	10.5	0.4134	0.15	0.0059	3.0	0.1181	0.7	0.0276	603	F603	603ZZ	F603ZZ	–	–	–
		10	0.3937	11.5	0.4528	0.15	0.0059	4.0	0.1575	1.0	0.0394	623	F623	623ZZ	F623ZZ	2RS	2RU	–
		13	0.5118	–	–	0.20	0.0079	5.0	0.1969	–	–	633	–	633ZZ	–	2RS	2RU	–
4.0	0.1575	7	0.2756	8.2	0.3228	0.10	0.0039	2.0	0.0787	0.6	0.0236	MR74	MF74	–	–	–	–	–
		7	0.2756	8.2	0.3228	0.10	0.0039	–	–	–	–	–	–	MR74ZZ	MF74ZZ	–	–	–
		8	0.3150	9.2	0.3622	0.15 0.10	0.0059 0.0039	2.0	0.0787	0.6	0.0236	MR84	MF84	MR84ZZ	MF84ZZ	–	–	–
		9	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	0.3937	11.2*	0.4409	0.20 0.15	0.0079 0.0059	3.0 3.0	0.1181 0.1181	0.6 0.6	0.0236 0.0236	MR104	MF104	MR104ZZ	MF104ZZ	2RS	2RU	–
		11	0.4331	12.5	0.4921	0.15	0.0059	4.0	0.1575	1.0	0.0394	694	F694	694ZZ	F694ZZ	2RS	2RU	–
		12	0.4724	13.5	0.5315	0.20	0.0079	4.0	0.1575	1.0	0.0394	604	F604	604ZZ	F604ZZ	2RS	2RU	–
		13	0.5118	15.0	0.5906	0.20	0.0079	5.0	0.1969	1.0	0.0394	624	F624	624ZZ	F624ZZ	2RS	2RU	–
		16	0.6299	18.0	0.7087	0.30	0.0118	5.0	0.1969	1.0	0.0394	634	F634	634ZZ	F634ZZ	2RS	2RU	TTS

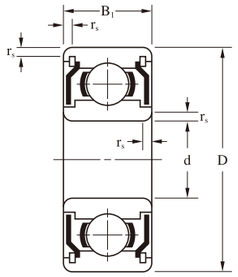
1) *This dimension is increased by 0.4mm for shielded or seal version.
2) Bearings also available with single shield or seal : suffix Z、RS、RU or TS
3) Bearings also available with stainless material : suffix S or H
4) TTS [4] is used smaller ball,load rating is lower than standard.

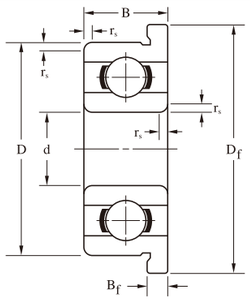
Width: B_1		Flange Width:B_{f1}		Load Rating		Max. Speed		Cage Type	Ball Complement			Weight (Reference)			
				Cr(N)	Cor(N)	Grease	Oil		Qty.:Z	Size:Dw		Open	Flange Open	Shield	Flange Shield
mm	inch	mm	inch			x1000rpm			pcs.	mm	inch	g			
–	–	–	–	68	16	142	160	W	5	0.500	0.0197	0.02	–	–	–
–	–	–	–	96	26	130	150	W	6	0.600	0.0236	0.03	0.04	–	–
–	–	–	–	96	26	130	150	W	6	0.600	0.0236	0.05	–	–	–
–	–	–	–	141	37	100	120	W	5	0.800	0.0315	0.11	0.14	–	–
2.5	0.0984	–	–	112	33	110	130	W	7	0.600	0.0236	0.10	0.12	0.14	–
2.0	0.0787	0.6	0.0236	112	33	100	120	W	7	0.600	0.0236	0.10	0.12	0.14	0.17
2.6	0.1024	0.8	0.0315	238	69	85	100	W	6	1.000	0.0394	0.20	0.26	0.25	0.33
3.0	0.1181	0.8	0.0315	330	99	75	90	W	6	1.200	0.0472	0.31	0.38	0.40	0.50
2.0	0.0787	–	–	124	40	91	104	W	8	0.600	0.0236	0.05	–	0.07	–
2.3	0.0906	0.6	0.0236	169	50	85	100	W	6	0.800	0.0315	0.15	0.19	0.20	0.24
2.5	0.0984	0.6	0.0236	169	50	85	100	W	6	0.800	0.0315	0.14	0.19	0.20	0.25
3.0	0.1181	0.8	0.0315	330	99	75	90	W,J,TW	6	1.200	0.0472	0.28	0.35	0.35	0.45
2.5	0.0984			330	99	75	90	W,J	6	1.200	0.0472	0.28	0.34	0.33	–
3.0	0.1181	0.6	0.0236	386	129	63	75	W	7	1.200	0.0472	0.43	0.50	0.53	0.60
3.5	0.1378	0.9	0.0354	386	129	60	71	W	7	1.200	0.0472	0.50	0.60	0.60	0.73
2.6	0.1024	0.8	0.0315	209	74	71	80	W	8	0.800	0.0315	0.20	0.24	0.35	0.42
3.5	0.1378	0.9	0.0354	386	129	63	75	W	7	1.200	0.0472	0.40	0.50	0.55	0.68
–	–	–	–	558	180	60	67	W	6	1.588	0.0625	0.52	0.60	–	–
4.0	0.1575	0.9	0.0354	552	177	60	71	W	6	1.588	0.0625	0.61	0.72	0.85	0.99
2.5	0.0984	0.6	0.0236	209	74	71	80	W	8	0.800	0.0315	0.20	0.26	0.28	0.34
3.0	0.1181	0.8	0.0315	311	112	63	75	W	8	1.000	0.0394	0.32	0.37	0.45	0.53
3.0	0.1181	–	–	395	141	60	67	J	7	1.200	0.0472	0.51	0.59	0.67	–
4.0	0.1575	0.9	0.0354	558	180	60	67	W,J,TW	6	1.588	0.0625	0.60	0.71	0.80	0.94
4.0	0.1575	0.8	0.0315	571	189	56	67	W	6	1.588	0.0625	0.75	0.83	1.15	1.30
5.0	0.1969	1.0	0.0394	571	189	56	67	W	6	1.588	0.0625	0.84	0.96	1.13	1.61
4.0	0.1575	1.0	0.0394	631	219	50	60	J,TW	7	1.588	0.0625	1.45	1.65	1.65	1.85
5.0	0.1969	–	–	1301	488	40	48	J	7	2.381	0.0937	3.27	–	3.43	–
–	–	–	–	311	115	60	67	W	8	1.000	0.0394	0.23	0.30	–	–
2.5	0.0984	0.6	0.0236	255	108	60	67	W	11	0.800	0.0315	–	–	0.33	0.40
3.0	0.1181	0.6	0.0236	395	141	56	67	W,J,TW	7	1.200	0.0472	0.39	0.47	0.56	0.64
4.0	0.1575	1.0	0.0394	641	227	53	63	W,J,TW	7	1.588	0.0625	0.65	0.74	1.00	1.15
4.0	0.1575	0.8	0.0315	711	272	48	56	J	8	1.588	0.0625	0.96	1.04	1.33	1.50
4.0	0.1575	1.0	0.0394	957	350	48	56	J	7	2.000	0.0787	1.69	1.91	1.75	1.97
4.0	0.1575	1.0	0.0394	957	350	48	56	J	7	2.000	0.0787	2.19	2.42	2.34	2.57
5.0	0.1969	1.0	0.0394	1301	488	40	48	J	7	2.381	0.0937	3.10	3.44	3.20	3.54
5.0	0.1969	1.0	0.0394	1340	523	36	43	J	7	2.381	0.0937	5.24	5.66	5.44	5.86

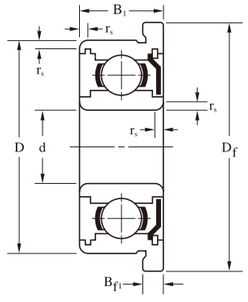
Metric series (continued)

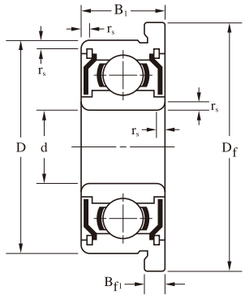










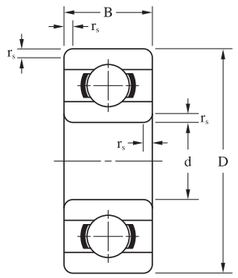


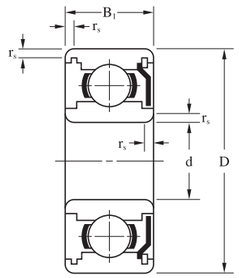
Bore Diameter: d		Outer Diameter: D		Flange Diameter: Df		Radius rs(min)		Open Bearings				Seal, Shield Bearings					
								Width: B		Flange Width: Bf		Bearing Reference					
												Open	Flange Open	Shield	Flange Shield	Seal	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch					2RS	2RU	TTS
5.0	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	MR95ZZS	MF95ZZS	–	–	TTS
		10	0.3937	11.2*	0.4409	0.15	0.0059	3.0	0.1181	0.6	0.0236	MR105	MF105	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	F695	695ZZ	F695ZZ	2RS	2RU	TTS [4]
		14	0.5512	16.0	0.6299	0.20	0.0079	5.0	0.1969	1.0	0.0394	605	F605	605ZZ	F605ZZ	2RS	2RU	–
		16	0.6299	18.0	0.7087	0.30	0.0118	5.0	0.1969	1.0	0.0394	625	F625	625ZZ	F625ZZ	2RS	2RU	TTS
		19	0.7480	22.0	0.8661	0.30	0.0118	6.0	0.2362	1.5	0.0591	635	F635	635ZZ	F635ZZ	2RS	2RU	–
6.0	0.2362	10	0.3937	11.2	0.4409	0.15 0.10	0.0059 0.0039	2.5	0.0984	0.6	0.0236	MR106	MF106	MR106ZZ	MF106ZZ	–	–	TTS [4]
		12	0.4724	13.2*	0.5197	0.20 0.15	0.0079 0.0059	3.0	0.1181	0.6	0.0236	MR126	MF126	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	F696	696ZZ	F696ZZ	2RS	2RU	TTS
		16	0.6299	–	–	0.20	0.0079	5.0	0.1969	–	–	–	–	696AZZ	–	2RS	2RU	–
		17	0.6693	19.0	0.7480	0.30	0.0118	6.0	0.2362	1.2	0.0472	606	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	F626	626ZZ	F626ZZ	2RS	2RU	TTS [4]
		22	0.8661	–	–	0.30	0.0118	7.0	0.2756	–	–	636	–	636ZZ	–	2RS	2RU	–
7.0	0.2756	11	0.4331	12.2	0.4803	0.15 0.10	0.0059 0.0039	2.5	0.0984	0.6	0.0236	MR117	MF117	MR117ZZS	MF117ZZS	–	–	TTS
		13	0.5118	14.2*	0.5591	0.20 0.15	0.0079 0.0059	3.0	0.1181	0.6	0.0236	MR137	MF137	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	F697	697ZZ	F697ZZ	2RS	2RU	–
		19	0.7480	22.0	0.8661	0.30	0.0118	6.0	0.2362	1.5	0.0591	607	F607	607ZZ	F607ZZ	2RS	2RU	TTS [4]
		22	0.8661	25.0	0.9843	0.30	0.0118	7.0	0.2756	1.5	0.0591	627	F627	627ZZ	F627ZZ	2RS	2RU	TTS
		26	1.0236	–	–	0.30	0.0118	9.0	0.3543	–	–	637	–	637ZZ	–	2RS	2RU	–
8.0	0.3150	12	0.4724	13.2*	0.5197	0.15 0.10	0.0059 0.0039	2.5	0.0984	0.6	0.0236	MR128	MF128	MR128ZZ	MF128ZZ	–	–	TTS
		14	0.5512	15.6	0.6142	0.20 0.15	0.0079 0.0059	3.5	0.1378	0.8	0.0315	MR148	MF148	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	F698	698ZZ	F698ZZ	2RS	2RU	–
		22	0.8661	25.0	0.9843	0.30	0.0118	7.0	0.2756	1.5	0.0591	608	F608	608ZZ	F608ZZ	2RS	2RU	TTS
		24	0.9449	–	–	0.30	0.0118	8.0	0.3150	–	–	628	–	628ZZ	–	2RS	2RU	–
		28	1.1024	–	–	0.30	0.0118	9.0	0.3543	–	–	638	–	638ZZ	–	2RS	2RU	–
9.0	0.3543	14	0.5512	15.5	0.6102	0.10	0.0039	3.0	0.1181	0.8	0.0315	679	F679	679ZZS	F679ZZS	–	–	TTS
		17	0.6693	19.0	0.7480	0.20	0.0079	4.0	0.1575	1.0	0.0394	689	F689	689ZZ	F689ZZ	2RS	2RU	–
		20	0.7874	23.0	0.9055	0.30	0.0118	6.0	0.2362	1.5	0.0591	699	F699	699ZZ	F699ZZ	2RS	2RU	–
		24	0.9449	27.0	1.0630	0.30	0.0118	7.0	0.2756	1.5	0.0591	609	F609	609ZZ	F609ZZ	2RS	2RU	–
		26	1.0236	–	–	0.60 [5]	0.0236 [5]	8.0	0.3150	–	–	629	–	629ZZ	–	2RS	2RU	–
		30	1.1811	–	–	0.60	0.0236	10.0	0.3937	–	–	639	–	639ZZ	–	2RS	2RU	–

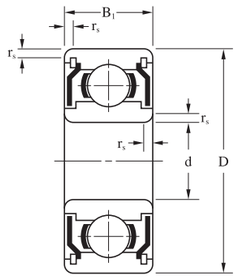
Width: B1		Flange Width:Bf1		Load Rating		Max. Speed		Cage Type	Ball Complement			Weight (Reference)			
				Cr(N)	Cor(N)	Grease	Oil		Qty.:Z	Size:Dw		Open	Flange Open	Shield	Flange Shield
mm	inch	mm	inch			x1000rpm			pcs.	mm	inch	9			
–	–	–	–	308	120	53	63	W	8	1.000	0.0394	0.25	0.33	–	–
2.5	0.0984	0.6	0.0236	218	90	53	63	W	9	0.800	0.0315	–	–	0.34	0.42
3.0	0.1181	0.6	0.0236	431	169	50	60	W	8	1.200	0.0472	0.54	0.62	0.58	0.66
4.0	0.1575	0.8	0.0315	431	169	50	60	W	8	1.200	0.0472	0.91	1.00	1.26	1.38
4.0	0.1575	0.8	0.0315	716	282	45	53	J	8	1.588	0.0625	–	–	0.62	0.81
5.0	0.1969	1.0	0.0394	716	282	45	53	J,TW	8	1.588	0.0625	1.16	1.33	1.93	2.15
4.0	0.1575	1.0	0.0394	1077	432	43	50	J	8	2.000	0.0787	2.39	2.73	2.31	2.65
5.0	0.1969	1.0	0.0394	1329	507	40	50	J,TW	7	2.381	0.0937	3.46	3.83	3.75	4.12
5.0	0.1969	1.0	0.0394	1729	675	36	43	J,TW	7	2.778	0.1094	4.95	5.37	5.10	5.52
6.0	0.2362	1.5	0.0591	2336	896	32	40	J,TW	6	3.500	0.1378	8.50	9.26	8.89	9.65
3.0	0.1181	0.6	0.0236	496	218	45	53	W	10	1.200	0.0472	0.55	0.64	0.70	0.79
4.0	0.1575	0.8	0.0315	716	295	43	50	W,J,TW	8	1.588	0.0625	1.25	1.44	1.66	1.86
5.0	0.1969	1.1	0.0433	1082	442	40	50	J,TW	8	2.000	0.0787	1.87	2.21	2.68	3.06
5.0	0.1969	1.2	0.0472	1340	523	40	45	J	7	2.381	0.0937	3.85	4.24	3.65	4.04
5.0	0.1969	–	–	1340	523	40	45	J	7	2.381	0.0937			4.59	
6.0	0.2362	1.2	0.0472	2263	846	38	45	J	6	3.500	0.1378	5.94	6.47	6.89	7.42
6.0	0.2362	1.5	0.0591	2336	896	32	40	J,TW	6	3.500	0.1378	8.12	9.25	8.65	9.78
7.0	0.2756	–	–	3333	1423	30	36	J,TW	7	3.969	0.1563	13.9	–	14.5	–
3.0	0.1181	0.6	0.0236	455	202	43	50	W	9	1.200	0.0472	0.59	0.69	0.71	0.81
4.0	0.1575	0.8	0.0315	541	276	40	48	W	12	1.200	0.0472	1.52	1.64	2.01	2.17
5.0	0.1969	1.1	0.0433	1173	513	40	50	J	9	2.000	0.0787	2.03	2.40	2.95	3.35
5.0	0.1969	1.2	0.0472	1605	719	36	43	J	9	2.381	0.0937	5.26	5.79	5.01	5.54
6.0	0.2362	1.5	0.0591	2336	896	36	43	J,TW	6	3.500	0.1378	7.80	8.93	8.24	9.37
7.0	0.2756	1.5	0.0591	3287	1379	30	36	J,TW	7	3.969	0.1563	12.7	14.0	13.1	14.4
9.0	0.3543	–	–	4563	1983	28	34	J	7	4.762	0.1875	24.2	–	25.8	–
3.5	0.1378	0.8	0.0315	543	274	40	48	W	12	1.200	0.0472	0.70	0.81	0.99	1.14
4.0	0.1575	0.8	0.0315	817	386	38	45	J	10	1.588	0.0625	1.90	2.13	2.19	2.42
5.0	0.1969	1.1	0.0433	1252	592	36	43	J,TW	10	2.000	0.0787	3.11	3.53	4.05	4.51
6.0	0.2362	1.5	0.0591	2237	917	36	43	J	7	3.175	0.1250	7.12	8.50	7.57	8.70
7.0	0.2756	1.5	0.0591	3293	1379	34	40	J,TW	7	3.969	0.1563	11.8	13.1	12.9	14.2
8.0	0.3150	–	–	3333	1423	28	34	J	7	3.969	0.1563	17.1	–	18.5	–
9.0	0.3543	–	–	4563	1983	28	34	J	7	4.762	0.1875	28.1	–	30.3	–
4.5	0.1772	0.8	0.0315	919	468	36	42	J	12	1.588	0.0625	1.35	1.57	1.98	2.20
5.0	0.1969	1.1	0.0433	1327	668	36	43	J	11	2.000	0.0787	3.41	3.85	4.38	4.87
6.0	0.2362	1.5	0.0591	2467	1081	34	40	J	8	3.175	0.1250	8.38	9.57	8.54	9.73
7.0	0.2756	1.5	0.0591	3356	1444	32	38	J	7	3.969	0.1563	14.7	16.1	16.0	17.4
8.0	0.3150	–	–	4563	1983	28	34	J	7	4.762	0.1875	19.0	–	21.8	–
10.0	0.3937	–	–	4659	2080	24	30	J	7	4.762	0.1875	36.2	–	37.1	–

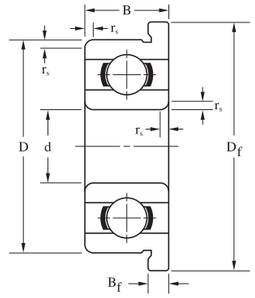
1) *This dimension is increased by 0.4mm for shielded or seal version.
2) Bearings also available with single shield or seal : suffix Z、RS、RU or TS
3) Bearings also available with stainless material : suffix S or H
4) TTS [4] is used smaller ball,load rating is lower than standard.
5) Value [5] isn't based upon JIS B 1521.

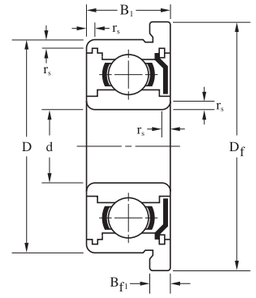
Inch series

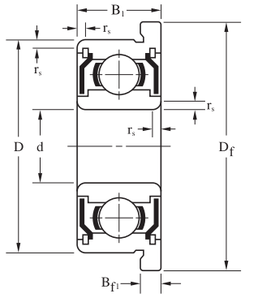










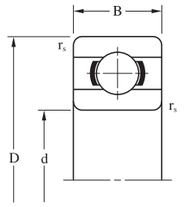


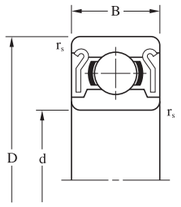
Bore Diameter: d		Outer Diameter: D		Flange Diameter: Df		Radius r's(min)		Open Bearings				Seal, Shield Bearings						
								Width: B		Flange Width: Bf		Bearing Reference						
												Open	Flange Open	Shield	Flange Shield	Seal		
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm					2RS	2RU	TTS
0.0400	1.016	0.1250	3.175	0.1710	4.343	0.0039	0.10	0.0469	1.191	0.0130	0.330	R09	–	FR09	–	–	–	–
0.0469	1.191	0.1562	3.967	0.2030	5.156	0.0039	0.10	0.0625	1.588	0.0130	0.330	R0*	FR0*	R0ZZ*	FR0ZZ*	–	–	–
0.0550	1.397	0.1875	4.762	0.2340	5.944	0.0039	0.10	0.0781	1.984	0.0230	0.584	R1*	FR1*	R1ZZ*	FR1ZZ*	–	–	–
0.0781	1.984	0.2500	6.350	0.2960	7.518	0.0039	0.10	0.0937	2.380	0.0230	0.584	R1-4*	FR1-4*	R1-4ZZ*	FR1-4ZZ*	–	–	TTS
0.0937	2.380	0.1875	4.762	0.2340	5.944	0.0039	0.10	0.0625	1.588	0.0180	0.457	R133	FR133	–	–	–	–	–
		0.1875	4.762	0.2340	5.944	0.0039	0.10	–	–	–	–	–	–	R133ZZS*	FR133ZZS*	–	–	–
		0.3125	7.938	0.3590	9.119	0.0059	0.15	0.1094	2.779	0.0230	0.584	R1-5*	FR1-5*	R1-5ZZS*	FR1-5ZZS*	–	–	TTS
0.1250	3.175	0.2500	6.350	0.2960	7.518	0.0039	0.10	0.0937	2.380	0.0230	0.584	R144J*	FR144J*	R144JZZ*	FR144JZZ*	–	–	TTS
		0.2500	6.350	0.2960	7.518	0.0039	0.10	0.0937	2.380	0.0230	0.584	R144*	FR144*	R144ZZ*	FR144ZZ*	–	–	TTS
		0.3125	7.938	0.3590	9.119	0.0039	0.10	0.1094	2.779	0.0230	0.584	R2-5*	FR2-5*	R2-5ZZ*	FR2-5ZZ*	–	–	TTS
		0.3750	9.525	0.4220	10.719	0.0059	0.15	0.1094	2.779	0.0230	0.584	R2-6*	FR2-6*	R2-6ZZ*	FR2-6ZZ*	2RS	2RU	TTS
		0.3750	9.525	0.4400	11.176	0.0118	0.30	0.1562	3.967	0.0300	0.762	R2*	FR2*	R2ZZ*	FR2ZZ*	2RS	2RU	–
		0.5000	12.700	–	–	0.0118	0.30	0.1719	4.366	–	–	R2A	–	R2AZZ	–	–	–	–
0.1562	3.967	0.3125	7.938	0.3590	9.119	0.0039	0.10	0.1094	2.779	0.0230	0.584	R155*	FR155*	R155ZZS*	FR155ZZS*	–	–	–
0.1875	4.762	0.3125	7.938	0.3590	9.119	0.0039	0.10	0.1094	2.779	0.0230	0.584	R156*	FR156*	R156ZZS*	FR156ZZS*	–	–	TTS
		0.3750	9.525	0.4220	10.719	0.0039	0.10	0.1250	3.175	0.0230	0.584	R166*	FR166*	R166ZZ*	FR166ZZ*	–	–	TTS
		0.5000	12.700	0.5650	14.351	0.0118	0.30	0.1960	4.978	0.0420	1.067	–	FR3*	–	–	–	–	–
		0.5000	12.700	0.5650	14.351	0.0118	0.30	0.1562	3.967	–	–	R3*	–	R3ZZ*	FR3ZZ*	2RS	2RU	TTS
		0.6250	15.875	–	–	0.0118	0.30	0.1960	4.978	–	–	R3A	–	R3AZZ	–	2RS	2RU	–
0.2500	6.350	0.3750	9.525	0.4220	10.719	0.0039	0.10	0.1250	3.175	0.0230	0.584	R168*	FR168*	R168ZZS*	FR168ZZS*	–	–	TTS
		0.5000	12.700	0.5470	13.894	0.0059	0.15	0.1250	3.175	0.0230	0.584	R188*	FR188*	R188ZZ*	FR188ZZ*	2RS	2RU	TTS
		0.6250	15.875	0.6900	17.526	0.0118	0.30	0.1960	4.978	0.0420	1.067	R4*	FR4*	R4ZZ*	FR4ZZ*	2RS	2RU	TTS
		0.7500	19.050	–	–	0.0157	0.40	0.2188	5.558	–	–	R4A	–	R4AZZ	–	2RS	2RU	–
0.3125	7.938	0.5000	12.700	0.5470	13.894	0.0059	0.15	0.1562	3.967	0.0310	0.787	R1810*	FR1810	R1810ZZS	FR1810ZZS*	–	–	TTS
0.3750	9.525	0.8750	22.225	0.9690	24.613	0.0157	0.40	0.2188	5.558	0.0620	1.575	R6	FR6*	R6ZZ	FR6ZZ*	2RS	2RU	TTS
0.5000	12.700	1.1250	28.575	1.2252	31.120	0.0157	0.40	0.2500	6.350	0.0620	1.575	R8	FR8*	R8ZZ	FR8ZZ*	2RS	2RU	TTS
0.6250	15.875	1.3750	34.925	1.4900	37.846	0.0315	0.80	0.2812	7.142	–	–	R10	–	R10ZZ	FR10ZZ	2RS	2RU	–
0.7500	19.050	1.6250	41.275	–	–	0.0315	0.80	0.3125	7.938	–	–	R12	–	R12ZZ	–	2RS	2RU	–

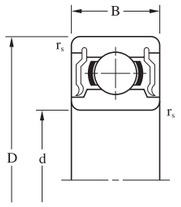
Width: B_1		Flange Width:Bf1		Load Rating		Max. Speed		Cage Type	Ball Complement			Weight (Reference)			
				Cr(N)	Cor(N)	Grease	Oil		Qty.:Z	Size:Dw		Open	Flange Open	Shield	Flange Shield
inch	mm	inch	mm			x1000rpm			pcs.	inch	mm	g			
–	–	–	–	106	28	130	150	W	6	0.0250	0.635	0.05	0.07	–	–
0.0937	2.380	0.0310	0.787	112	33	110	130	W	7	0.0236	0.600	0.10	0.12	0.15	0.20
0.1094	2.779	0.0310	0.787	232	67	90	110	W	6	0.0394	1.000	0.15	0.19	0.19	0.25
0.1406	3.571	0.0310	0.787	284	96	67	80	W	7	0.0394	1.000	0.40	0.46	0.53	0.61
–	–	–	–	189	60	80	95	W	7	0.0315	0.800	0.10	0.13	–	–
0.0937	2.380	0.0310	0.787	144	53	80	95	W	10	0.0236	0.600	–	–	0.15	0.21
0.1406	3.571	0.0310	0.787	552	176	60	71	W	6	0.0625	1.588	0.60	0.67	1.15	1.25
0.1094	2.779	0.0310	0.787	311	110	67	80	J	8	0.0394	1.000	0.27	0.33	0.32	0.40
0.1094	2.779	0.0310	0.787	284	96	67	80	W	7	0.0394	1.000	0.27	0.33	0.40	0.48
0.1406	3.571	0.0310	0.787	558	180	60	67	W,J	6	0.0625	1.588	0.50	0.57	0.74	0.84
0.1406	3.571	0.0310	0.787	640	227	53	63	J	7	0.0625	1.588	0.96	1.05	1.23	1.35
0.1562	3.967	0.0300	0.762	631	219	56	67	J	7	0.0625	1.588	1.04	1.20	1.37	1.53
0.1719	4.366	–	–	640	227	53	63	J	7	0.0625	1.588	3.30	–	3.30	–
0.1250	3.175	0.0360	0.914	359	150	53	63	W	10	0.0394	1.000	0.51	0.58	0.61	0.72
0.1250	3.175	0.0360	0.914	359	150	53	63	W	10	0.0394	1.000	0.40	0.47	0.45	0.56
0.1250	3.175	0.0310	0.787	709	272	50	60	J	8	0.0625	1.588	0.81	0.90	0.85	0.97
–	–	–	–	1301	488	43	53	J	7	0.0937	2.381	–	2.50	–	–
0.1960	4.978	0.0420	1.067	1301	488	43	53	J	7	0.0937	2.381	2.21	–	2.95	3.24
0.1960	4.978	–	–	1480	621	38	45	J	8	0.0937	2.381	4.75	–	5.08	–
0.1250	3.175	0.0360	0.914	373	172	48	56	W	11	0.0394	1.000	0.57	0.66	0.60	0.73
0.1875	4.762	0.0450	1.143	1082	442	40	50	J	8	0.0787	2.000	1.60	1.71	2.32	2.54
0.1960	4.978	0.0420	1.067	1480	621	38	45	J	8	0.0937	2.381	4.46	4.82	4.54	4.90
0.2812	7.142	–	–	2336	896	36	43	J	6	0.1378	3.500	7.48	–	10.0	–
0.1562	3.967	0.0310	0.787	542	276	40	48	W	12	0.0472	1.200	1.39	1.54	1.57	1.72
0.2812	7.142	0.0620	1.575	3332	1411	32	38	J	7	0.1563	3.969	9.02	9.71	11.7	12.4
0.3125	7.938	0.0620	1.575	5108	2413	27	32	J	8	0.1875	4.762	11.6	13.0	24.1	25.6
0.3438	8.733	0.0687	1.745	5999	3265	21	25	RJ	10	0.1875	4.762	23.5	–	38.1	40.40
0.4375	11.113	–	–	9384	5057	17	21	RJ,TW	9	0.2500	6.350	53.1	–	69.3	–

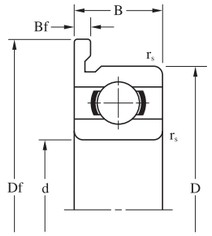
1) *Available with inner ring width extended by 0.015"(0.3962mm) each side.
2) Bearings also available with single shield or seal ：suffix Z、RS、RU or TS
3) Bearings also available with stainless material ：suffix S or H

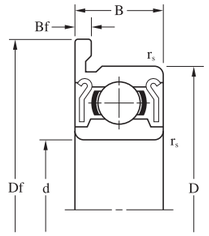
Extra thin metric series : 6700,6800,6900

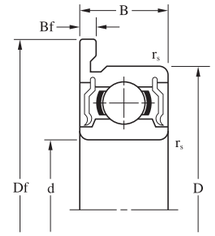










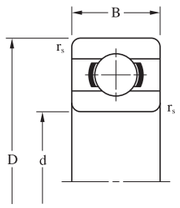


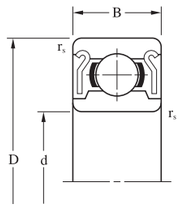
Bore Diameter: d		Outer Diameter: D		Flange Diameter: Df		Radius r's(min)		Width: B		Flange Width: Bf		Bearing Reference			
												Open	Flange Open	Shield	Flange Shield
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch				
10	0.3937	15	0.5906	16.5	0.6496	0.15	0.0059	3	0.1181	0.8	0.0315	6700	F6700	–	–
		15	0.5906	16.5	0.6496	0.15	0.0059	4	0.1575	0.8	0.0315	–	–	6700ZZS	F6700ZZS
		19	0.7480	21.0	0.8268	0.30	0.0118	5	0.1969	1.0	0.0394	6800	F6800	6800ZZ	F6800ZZ
		19	0.7480	21.0	0.8268	0.30	0.0118	7	0.2756	1.5	0.0591	63800	F63800	63800ZZ	F63800ZZ
		22	0.8661	25.0	0.9843	0.30	0.1181	6	0.2362	1.5	0.0591	6900	F6900	6900ZZ	F6900ZZ
12	0.4724	18	0.7087	19.5	0.7677	0.20	0.0079	4	0.1575	0.8	0.0315	6701	F6701	6701ZZS	F6701ZZS
		21	0.8268	23.0	0.9055	0.30	0.0118	5	0.1969	1.1	0.0433	6801	F6801	6801ZZ	F6801ZZ
		21	0.8268	23.0	0.9055	0.30	0.0118	7	0.2756	1.5	0.0591	63801	F63801	63801ZZ	F63801ZZ
		24	0.9449	26.5	1.0433	0.30	0.0118	6	0.2362	1.5	0.0591	6901	F6901	6901ZZ	F6901ZZ
15	0.5906	21	0.8268	22.5	0.8858	0.20	0.0079	4	0.1575	0.8	0.0315	6702	F6702	6702ZZS	F6702ZZS
		24	0.9449	26.0	1.0236	0.30	0.0118	5	0.1969	1.1	0.0433	6802	F6802	6802ZZ	F6802ZZ
		24	0.9449	26.0	1.0236	0.30	0.0118	7	0.2756	1.5	0.0591	63802	F63802	63802ZZ	F63802ZZ
		28	1.1024	30.5	1.2008	0.30	0.0118	7	0.2756	1.5	0.0591	6902	F6902	6902ZZ	F6902ZZ
17	0.6693	23	0.9055	24.5	0.9646	0.20	0.0079	4	0.1575	0.8	0.0315	6703	F6703	6703ZZS	F6703ZZS
		26	1.0236	28.0	1.1024	0.30	0.0118	5	0.1969	1.1	0.0433	6803	F6803	6803ZZ	F6803ZZ
		26	1.0236	28.0	1.1024	0.30	0.0118	7	0.2756	1.5	0.0591	63803	F63803	63803ZZ	F63803ZZ
		30	1.1811	32.5	1.2795	0.30	0.0118	7	0.2756	1.5	0.0591	6903	F6903	6903ZZ	F6903ZZ
20	0.7874	27	1.0630	28.5	1.1220	0.20	0.0079	4	0.1575	0.8	0.0315	6704	F6704	6704ZZS	F6704ZZS
		32	1.2598	35.0	1.3780	0.30	0.0118	7	0.2756	1.5	0.0591	6804	F6804	6804ZZ	F6804ZZ
		32	1.2598	35.0	1.3780	0.30	0.0118	10	0.3937	2.0	0.0787	63804	F63804	63804ZZ	F63804ZZ
		37	1.4567	40.0	1.5748	0.30	0.0118	9	0.3543	2.0	0.0787	6904	F6904	6904ZZ	F6904ZZ
25	0.9843	32	1.2598	34.0	1.3386	0.20	0.0079	4	0.1575	1.0	0.0394	6705	F6705	–	–
		37	1.4567	40.0	1.5748	0.30	0.0118	7	0.2756	1.5	0.0591	6805	F6805	6805ZZ	F6805ZZ
		37	1.4567	40.0	1.5748	0.30	0.0118	10	0.3937	2.0	0.0787	63805	F63805	63805ZZ	F63805ZZ
		42	1.6535	45.0	1.7717	0.30	0.0118	9	0.3543	2.0	0.0787	6905	F6905	6905ZZ	F6905ZZ
30	1.1811	37	1.4567	39.0	1.5354	0.20	0.0079	4	0.1575	1.0	0.0394	6706	F6706	–	–
		42	1.6535	45.0	1.7717	0.30	0.0118	7	0.2756	1.5	0.0591	6806	F6806	6806ZZ	F6806ZZ
		42	1.6535	45.0	1.7717	0.30	0.0118	10	0.3937	2.0	0.0787	63806	F63806	63806ZZ	F63806ZZ
		47	1.8504	50.0	1.9685	0.30	0.0118	9	0.3543	2.0	0.0787	6906	F6906	6906ZZ	F6906ZZ

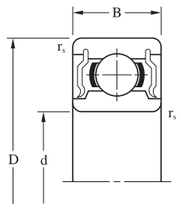
Seal			Load Rating		Max. Speed		Cage Type	Ball Complement			Weight (Ref.)	
			Cr(N)	Cor(N)	Grease	Oil		Qty.:Z	Size:Dw		Shield	Flange Shield
2RS	2RU	TTS			x1000rpm			pcs.	mm	inch	g	
–	–	–	855	435	15	17	W	11	1.588	0.0625	1.4	1.6
2RS	–	TTS	855	435	15	17	W	11	1.588	0.0625	1.9	2.1
2RS	2RU	–	1716	840	37	43	J,TW	10	2.381	0.0937	5.6	6.1
2RS	2RU	–	1716	840	37	43	J,TW	10	2.381	0.0937	7.4	8.1
2RS	2RU	–	2695	1273	34	41	J	9	3.175	0.1250	10.0	11.3
2RS	–	TTS	926	530	13	15	W	13	1.588	0.0625	3.1	3.4
2RS	2RU	–	1915	1041	33	39	J,TW	12	2.381	0.0937	6.5	7.1
2RS	2RU	–	1915	1041	33	39	J,TW	12	2.381	0.0937	8.5	9.3
2RS	2RU	–	2886	1466	31	36	J	10	3.175	0.1250	12.0	13.2
2RS	–	TTS	937	582	11	13	W	14	1.588	0.0625	3.6	3.9
2RS	2RU	–	2073	1253	28	33	J,TW	14	2.381	0.0937	7.6	8.3
2RS	2RU	–	2073	1253	28	33	J,TW	14	2.381	0.0937	10.0	10.9
2RS	2RU	–	4321	2259	26	30	J	10	3.969	0.1563	19.0	19.9
2RS	–	TTS	1000	658	9.5	11	W	16	1.588	0.0625	4.0	4.4
2RS	2RU	–	2233	1456	26	30	J,TW	16	2.381	0.0937	8.2	8.9
2RS	2RU	–	2233	1456	26	30	J,TW	16	2.381	0.0937	11.0	12.0
2RS	2RU	–	4588	2565	23	28	J	11	3.969	0.1563	20.0	21.4
2RS	–	TTS	1402	729	8.5	10	W	18	1.588	0.0625	5.9	6.3
2RS	2RU	–	4015	2462	21	25	J,RJ [3]	13	3.500	0.1378	18.0	19.8
2RS	2RU	–	4015	2462	21	25	J,RJ [3]	13	3.500	0.1378	24.0	26.5
2RS	2RU	–	6381	3682	19	23	RJ	11	4.762	0.1875	40.0	42.8
2RS	–	–	1091	838	7	8	W	21	1.588	0.0625	7.1	7.9
2RS	2RU	–	4303	2932	18	21	J,RJ [3]	15	3.500	0.1378	24.0	26.1
2RS	2RU	–	4303	2932	18	21	J,RJ [3]	15	3.500	0.1378	32.0	34.1
2RS	2RU	–	7001	4540	16	19	RJ	13	4.762	0.1875	47.0	50.2
–	2RU	–	1143	947	5.5	7	W	24	1.588	0.0625	8.3	9.2
2RS	2RU	–	4538	3402	15	18	J,RJ [3]	17	3.500	0.1378	27.0	29.4
2RS	2RU	–	4538	3402	15	18	J,RJ [3]	17	3.500	0.1378	36.0	39.2
2RS	2RU	–	7242	5003	14	17	RJ	14	4.762	0.1875	53.0	56.6

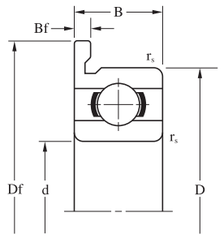
1) Bearings also available with single shield or seal ：suffix Z、RS、RU or TS
2) Bearings also available with stainless material ：suffix H
3) SUJ2 bearings use RJ type retainer,stainless bearings use J type retainer.

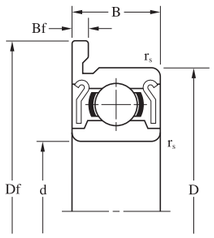
Extra thin metric series (continued) : 6700,6800, 6900

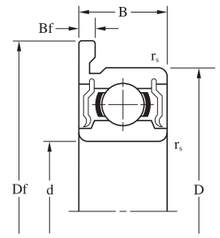










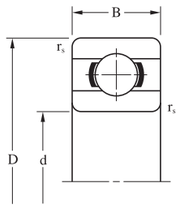


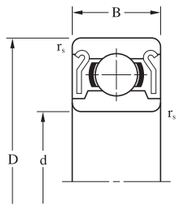
Bore Diameter: d		Outer Diameter: D		Flange Diameter: Df		Radius r's(min)		Width: B		Flange Width: Bf		Bearing Reference			
												Open	Flange Open	Shield	Flange Shield
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch				
35	1.3780	44	1.7323	–	–	0.30	0.0118	5	0.1969	–	–	6707	–	–	–
		47	1.8504	50.0	1.9685	0.30	0.0118	7	0.2756	1.5	0.0591	6807	F6807	6807ZZ	F6807ZZ
		55	2.1654	58.0	2.2835	0.60	0.0236	10	0.3937	2.5	0.0984	6907	F6907	6907ZZ	F6907ZZ
40	1.5748	50	1.9685	–	–	0.30	0.0118	6	0.2362	–	–	6708	–	–	–
		52	2.0472	55.0	2.1654	0.30	0.0118	7	0.2756	1.5	0.0591	6808	F6808	6808ZZ	F6808ZZ
		62	2.4409	65.0	2.5591	0.60	0.0236	12	0.4724	2.5	0.0984	6908	F6908	6908ZZ	F6908ZZ
45	1.7717	55	2.1654	–	–	0.3	0.0118	6	0.2362	–	–	6709	–	–	–
		58	2.2835	61	2.4016	0.3	0.0118	7	0.2756	1.5	0.0591	6809	F6809	6809ZZ	F6809ZZ
		68	2.6772	71	2.7953	0.6	0.0236	12	0.4724	2.5	0.0984	6909	F6909	6909ZZ	F6909ZZ
50	1.9685	62	2.4409	–	–	0.3	0.0118	6	0.2362	–	–	6710	–	–	–
		65	2.5591	68	2.6772	0.3	0.0118	7	0.2756	1.5	0.0591	6810	F6810	6810ZZ	F6810ZZ
		72	2.8346	75	2.9528	0.6	0.0236	12	0.4724	2.5	0.0984	6910	F6910	6910ZZ	F6910ZZ
55	2.1654	72	2.8346	–	–	0.3	0.0118	9	0.3543	–	–	6811	–	6811ZZ	–
		80	3.1496	–	–	1.0	0.0394	13	0.5118	–	–	6911	–	6911ZZ	–
60	2.3622	78	3.0709	–	–	0.3	0.0118	10	0.3937	–	–	6812	–	6812ZZ	–
		85	3.3465	–	–	1.0	0.0394	13	0.5118	–	–	6912	–	6912ZZ	–
65	2.5591	85	3.3465	–	–	0.6	0.0236	10	0.3937	–	–	6813	–	6813ZZ	–
		90	3.5433	–	–	1.0	0.0394	13	0.5118	–	–	6913	–	6913ZZ	–
70	2.7559	90	3.5433	–	–	0.6	0.0236	10	0.3937	–	–	6814	–	6814ZZ	–
		100	3.9370	–	–	1.0	0.0394	16	0.6299	–	–	6914	–	6914ZZ	–
75	2.9528	95	3.7402	–	–	0.6	0.0236	10	0.3937	–	–	6815	–	6815ZZ	–
		105	4.1339	–	–	1.0	0.0394	16	0.6299	–	–	6915	–	6915ZZ	–
80	3.1496	100	3.9370	–	–	0.6	0.0236	10	0.3937	–	–	6816	–	6816ZZ	–
		110	4.3307	–	–	1.0	0.0394	16	0.6299	–	–	6916	–	6916ZZ	–
85	3.3465	110	4.3307	–	–	1.0	0.0394	13	0.5118	–	–	6817	–	6817ZZ	–
		120	4.7244	–	–	1.1	0.0433	18	0.7087	–	–	6917	–	6917ZZ	–
90	3.5433	115	4.5276	–	–	1.0	0.0394	13	0.5118	–	–	6818	–	6818ZZ	–
		125	4.9213	–	–	1.1	0.0433	18	0.7087	–	–	6918	–	6918ZZ	–

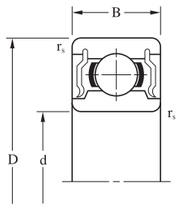
1) Bearings also available with single shield or seal : suffix Z、RS、RU or TS
2) Bearings also available with stainless material : suffix H
3) SUJ2 bearings use RJ type retainer,stainless bearings use J type retainer.

Seal			Load Rating		Max. Speed		Cage Type	Ball Complement			Weight (Ref.)	
			Cr(N)	Cor(N)	Grease	Oil		Qty.:Z	Size:Dw		Shield	Flange Shield
2RS	2RU	TTS			x1000rpm			pcs.	mm	inch	g	
2RS	–	–	1866	1635	4.9	6	W	26	2.000	0.0787	15.0	–
2RS	2RU	–	4729	3821	13	16	J,RJ 3)	19	3.500	0.1378	32.0	34.7
2RS	2RU	–	10900	7818	12	14	RJ	14	5.953	0.2344	87.0	92.2
2RS	–	–	2516	2233	4.3	5	W	25	2.381	0.0937	23.0	–
2RS	2RU	–	4923	4178	12	14	J,RJ 3)	21	3.500	0.1378	35.0	38.0
2RS	2RU	–	13678	9968	11	13	RJ	14	6.747	0.2656	131	137
2RS	–	–	2580	2397	3.9	4.6	W	27	2.381	0.0937	25.0	–
2RS	2RU	–	6187	5381	11.0	13.0	J,RJ 3)	21	3.969	0.1563	42.0	45.3
2RS	2RU	–	14100	10830	9.7	11.0	RJ	15	6.747	0.2656	147	153
2RS	–	–	2670	2640	3.5	4.1	W	30	2.381	0.0937	64.0	–
2RS	2RU	–	6170	5760	9.6	11.0	RJ	23	3.969	0.1563	52.0	–
2RS	2RU	–	14540	11710	9.0	11.0	RJ	16	6.747	0.2656	133	–
2RS	2RU	–	8800	8100	8.7	10.0	RJ	22	4.762	0.1875	83.0	–
2RS	–	–	16600	14100	8.1	9.6	RJ	17	7.144	0.2813	185	–
2RS	–	–	11500	10600	8.0	9.4	RJ	21	5.556	0.2187	104	–
2RS	–	–	20200	17300	7.5	8.9	RJ	17	7.938	0.3125	192	–
2RS	–	–	11900	11500	7.3	8.6	RJ	23	5.556	0.2187	126	–
2RS	–	–	17400	16100	7.1	8.4	RJ	19	7.144	0.2813	211	–
2RS	–	–	12100	11900	6.8	8.1	RJ	24	5.556	0.2187	134	–
2RS	–	–	23700	21200	6.4	7.6	RJ	17	8.731	0.3437	342	–
2RS	–	–	12500	12900	6.4	7.6	RJ	26	5.556	0.2187	142	–
2RS	–	–	24400	22600	6.1	7.2	RJ	18	8.731	0.3437	363	–
2RS	2RU	–	12700	13300	6.1	7.2	RJ	27	5.556	0.2187	150	–
2RS	–	–	25000	24000	5.7	6.8	RJ	19	8.731	0.3437	382	–
2RS	–	–	18700	19000	5.6	6.6	RJ	23	7.144	0.2813	266	–
2RS	–	–	31900	29600	5.3	6.3	RJ	17	10.319	0.4063	535	–
2RS	–	–	19000	19700	5.3	6.3	RJ	24	7.144	0.2813	279	–
2RS	–	–	32800	31600	5.1	6.0	RJ	18	10.319	0.4063	565	–

Large sized stainless series:6000H,6200H, 6300H





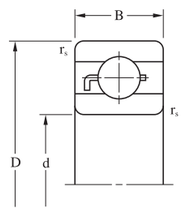


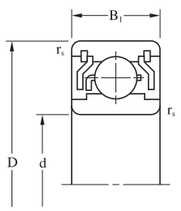
Bore Diameter: d		Outer Diameter: D		Width: B		Radius: rs(min)		Bearing Reference				
								Open	Shield	Seal		
mm	inch	mm	inch	mm	inch	mm	inch		ZZ	2RS	2RU	TTS
10	0.3937	26	1.0236	8	0.3150	0.3	0.0118	6000H*	ZZ	2RS	2RU	TTS
		30	1.1811	9	0.3543	0.6	0.0236	6200H*	ZZ	2RS	2RU	–
		35	1.3780	11	0.4331	0.6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

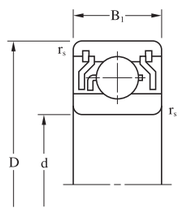
1) *Bearings also available with SAE52100 material ：suffix without H
2) Bearings also available with single shield or seal ：suffix Z、RS、RU or TS

Load Rating		Max. Speed		Cage Type	Ball Complement			Weight (Ref.)
Cr(N)	Cor(N)	Grease	Oil		Qty.:Z	Size:Dw		Shield
		x1000rpm			pcs.	mm	inch	g
3860	1570	31	36	J	7	4.762	0.1875	19
4340	1920	24	29	RJ,TW	8	4.762	0.1875	32
6870	2750	22	27	RJ	6	7.144	0.2813	53
4340	1910	27	32	J,TW	8	4.762	0.1875	22
5770	2450	22	27	RJ,TW	7	5.953	0.2344	37
8240	3360	20	25	RJ	6	7.938	0.3125	60
4750	2270	23	27	RJ,TW	9	4.762	0.1875	30
6490	3000	20	24	RJ,TW	8	5.953	0.2344	45
9710	4370	17	20	RJ	7	7.938	0.3125	82
5090	2630	21	25	RJ,TW	10	4.762	0.1875	39
8130	3850	17	21	RJ,TW	8	6.747	0.2656	65
11550	5330	15	18	RJ	7	8.731	0.3437	115
7960	4050	17	21	RJ,TW	9	6.350	0.2500	69
10910	5360	15	17	RJ,TW	8	7.938	0.3125	106
13490	6310	14	17	RJ	7	9.525	0.3750	144
8550	4690	15	18	RJ,TW	10	6.350	0.2500	80
11900	7390	13	15	RJ,TW	9	7.938	0.3125	128
17490	9060	11	13	RJ	8	10.319	0.4063	232
11240	6610	13	15	RJ,TW	11	7.144	0.2813	116
16530	9080	11	13	RJ,TW	9	9.525	0.3750	199
22630	12080	9.6	12	RJ	8	11.906	0.4687	346
13560	8250	11	13	RJ	11	7.938	0.3125	155
21810	12360	9.2	11	RJ	9	11.112	0.4375	288
28290	15270	8.5	10	RJ	8	13.494	0.5313	457
14250	9220	10	12	RJ	12	7.938	0.3125	192
24730	14330	8.3	10	RJ	9	11.906	0.4687	366
17800	12100	9.2	11	RJ	13	8.731	0.3437	245
27790	16300	7.7	9.2	RJ	9	12.700	0.5000	407
18510	13260	8.4	9.9	RJ	14	8.731	0.3437	261
29800	18610	7.1	8.5	RJ	10	12.700	0.5000	463

Extra thin metric series : ET, ER



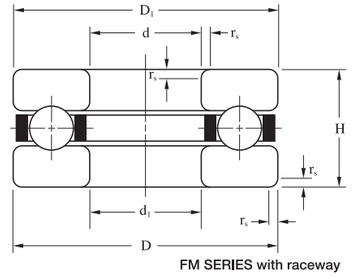




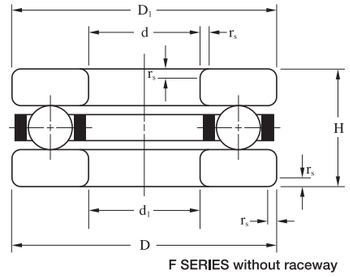
Bore Diameter: d		Outer Diameter: D		Open Type Width: B		Seal·Shield Type Width: B_1		Radius: rs(min)		Bearing References			Load Rating		Max. Speed		Cage Type	Ball Complement			Weight(Ref.)	
										Open	Shield	Seal	Cr (N)	Cor (N)	Grease	Oil		Qty.: Z	Size: Dw		Shield	Flange Shield
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch						X1000rpm			pcs.	mm	inch	g	
ET series																						
15	0.5906	20	0.7874	3.5	0.1378	–	–	0.15	0.0059	ET2015	–	–	942	582	22	26	W	14	1.588	0.0625	2.10	–
		21	0.8268	3.5	0.1378	–	–	0.15	0.0059	ET2115	–	–	939	581	22	26	W	14	1.588	0.0625	2.43	–
16	0.6299	22	0.8661	4.0	0.1575	–	–	0.15	0.0059	ET2216	–	–	968	619	20	24	W	15	1.588	0.0625	3.04	–
		23	0.9055	4.5	0.1772	4.5	0.1772	0.15	0.0059	ET2316	ZZS	TTS	968	619	20	24	W	15	1.588	0.0625	4.03	5.48
18	0.7087	24	0.9445	4.0	0.1575	–	–	0.15	0.0059	ET2418	–	–	988	654	18	21	W	16	1.588	0.0625	4.25	–
20	0.7874	25	0.9843	4.0	0.1575	4.0	0.1575	0.15	0.0059	ET2520	ZZS	TTS	1011	691	17	20	W	17	1.588	0.0625	3.55	4.12
ER series																						
9.525	0.3750	15.875	0.6250	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1038	ZZS	TTS	856	435	30	35	W	11	1.588	0.0625	2.71	2.98
12.700	0.5000	19.050	0.7500	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1212	ZZS	TTS	918	542	24	28	W	13	1.588	0.0625	3.49	3.84
15.875	0.6250	22.225	0.8750	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1458	ZZS	TTS	968	619	20	24	W	15	1.588	0.0625	4.18	4.60
19.050	0.7500	25.400	1.0000	3.967	0.1562	3.967	0.1562	0.25	0.0098	ER1634	ZZS	TTS	1011	691	17	20	W	17	1.588	0.0625	5.02	5.52

1) Bearings also available with single shield or seal : suffix ZS or TS
2) Bearings also available with stainless material : suffix S

Thrust series : FM, F



FM SERIES with raceway



F SERIES without raceway

FM series with raceway

Bearing Reference	Inner Ring Bore Dia. d		Outer Ring Outer Dia. D		Outer Ring Bore Dia. d_1		Inner Ring Outer Dia. D_1		Radius rs(min)		Hight H		Load Rating		Max Speed (x1000rpm)		Cage Type	Ball Complement			Weight (Ref.)
																		Qty.: Z	Size:Dw		
	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	Ca(N)	Coa(N)	Grease	Oil			mm	inch	g
F3-8M	3	0.1181	8	0.3150	3.2	0.1260	7.8	0.3071	0.15	0.0059	3.5	0.1378	993	590	19	28	TP	6	1.588	0.0625	0.9
F4-9M	4	0.1575	9	0.3543	4.2	0.1654	8.8	0.3465	0.15	0.0059	4.0	0.1575	944	640	17	25	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	4.0	0.1575	925	661	16	24	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	4.0	0.1575	1056	942	14	22	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	4.5	0.1772	1819	1588	14	20	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	5.0	0.1969	2155	1701	12	18	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	4.5	0.1772	1767	1645	13	20	TP	9	2.000	0.0787	2.6
F7-17M	7	0.2756	17	0.6693	7.2	0.2835	16.8	0.6614	0.30	0.0118	6.0	0.2362	3086	2675	10	15	TP	8	2.778	0.1094	6.5
F8-16M	8	0.3150	16	0.6299	8.2	0.3228	15.8	0.6220	0.30	0.0118	5.0	0.1969	3917	3394	11	17	TP	9	3.000	0.1181	4.5
F8-19M	8	0.3150	19	0.7480	8.2	0.3228	18.8	0.7402	0.30	0.0118	7.0	0.2756	3939	3476	9	13	TP	8	3.175	0.1250	9.1
F9-20M	9	0.3543	20	0.7874	9.2	0.3622	19.8	0.7795	0.30	0.0118	7.0	0.2756	3855	3571	8	13	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	5.5	0.2165	2470	2721	10	15	TP	10	2.381	0.0937	5.4

1)Bearings also available with stainless material : suffix H

F series without raceway

Bearing Reference	Inner Ring Bore Dia. d		Outer Ring Outer Dia. D		Outer Ring Bore Dia. d_1		Inner Ring Outer Dia. D_1		Radius rs(min)		Hight H		Load Rating		Cage Type	Ball Complement			Weight (Ref.)
																Qty.: Z	Size:Dw		
	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	Ca(N)	Coa(N)			mm	inch	g
F2-6	2.0	0.0787	6	0.2362	2.0	0.0787	6	0.2362	0.10	0.0039	3.0	0.1181	117	83	TD	6	1.000	0.0394	0.6
F2X-7	2.5	0.0984	7	0.2756	2.5	0.0984	7	0.2756	0.10	0.0039	3.5	0.1378	156	117	TD	6	1.200	0.0472	0.9
F3-8	3.0	0.1181	8	0.3150	3.0	0.1181	8	0.3150	0.10	0.0039	3.5	0.1378	166	137	TD	7	1.200	0.0472	0.6
F4-9	4.0	0.1575	9	0.3543	4.0	0.1575	9	0.3543	0.15	0.0059	4.0	0.1575	166	156	TD	8	1.200	0.0472	1.5
F4-10	4.0	0.1575	10	0.3937	4.0	0.1575	10	0.3937	0.15	0.0059	4.5	0.1772	274	245	TD	7	1.588	0.0625	2.0
F5-11	5.0	0.1969	11	0.4331	5.0	0.1969	11	0.4331	0.15	0.0059	4.5	0.1772	284	284	TD	7	1.588	0.0625	2.4
F6-12	6.0	0.2362	12	0.4724	6.0	0.2362	12	0.4724	0.15	0.0059	4.5	0.1772	274	284	TD	9	1.588	0.0625	2.5
F7-15	7.0	0.2756	15	0.5906	7.0	0.2756	15	0.5906	0.20	0.0079	5.0	0.1969	558	548	TD	8	2.381	0.0937	4.4
F8-16	8.0	0.3150	16	0.6299	8.0	0.3150	16	0.9299	0.20	0.0079	5.0	0.1969	597	627	TD	8	2.000	0.0787	5.0
F9-17	9.0	0.3543	17	0.6693	9.0	0.3543	17	0.6693	0.20	0.0079	5.0	0.1969	437	542	TD	9	2.000	0.0787	5.1
F10-18	10.0	0.3937	18	0.7087	10.0	0.3937	18	0.7087	0.20	0.0079	5.5	0.2165	617	705	TD	9	2.381	0.0937	6.0

1) Bearings also available with stainless material : suffix H(Cage material : Brass)

Lubrication

●COMMON OIL BRANDS AND EFFICIENCY

Manufacturer	Brand	Code	Lubricant Base	Flash Point (℃)	Viscosity (m²/s)	Operating Temperature (℃)	Approved Standard
Shell Oil Co.	Aero Shell Fluid 31	AF1	Diester	237	14.33 (40℃)	-40～+204	MIL-PRF-83282D
	Aero Shell Fluid 12	AF2	Diester	220	8.9 (54.4℃)	-54～+135	MIL-PRF-6085D
	Aero Shell Fluid 3	AF3	Mineral	155	10.0 (38℃)	-47～+115	MIL-PRF-7870C
Anderson Oil Co.	Windsor Lube L-245X	WL2	Diester	215	14.0 (38℃)	-55～+175	MIL-PRF-6085D
Dupont,E.I.	Krytox 143AZ	KAZ	Fluorinated	-	12.4 (40℃)	-54～+149	-
Kluber Lub.	Isoflex PDB38	PD8	Diester	210	12.0 (40℃)	-55～+100	-
Anderol Co.	Anderol 402	A42	Diester	227	12.4 (40℃)	-54～+177	MIL-PRF-6085D

●COMMON GREASE BRANDS AND EFFICIENCY

Manufacturer	Brand	Code	Thickening Agent	Lubricant Base	Drop Point (℃)	Cone Penetration: Worked (60 strokes)	Operating Temperature (℃)	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 RLQ2	AQ2	Lithium	Mineral	195	275	-30～+120	-
	Aero Shell NO.7	AG7	Microgel	Diester	260	296	-73～+149	MIL-PRF-83282D
	Aero Shell NO.14	AG4	Calsium	Diester	148	273	-54～+93	MIL-G-25537C
	Aero Shell NO.15	AG5	Fluorotelomer	Silicone	260	290	-73～+232	MIL-G-25013E
	Aero Shell NO.22	AG2	Microgel	Synthetic Hydorocarbon	260	275	-65～+204	MIL-PRF-81322F
	Aero Shell NO.33MS	A3S	Lithium	Synthetic Hydorocarbon Ester	234	281	-73～+121	MIL-G-21164D
	Alvania EP2	AE2	Lithium	Mineral	184	284	-20～+110	-
	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	Diester,Mineral	190	275	-55～+130	-
	Multemp SRL	SRL	Lithium	Diester,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	Diester,Mineral	200	280	-40～+130	MIL-G-25760A
	Isoflex TOPAS NB52	B52	Barium	Synthetic Hydorocarbon	220	280	-60～+160	-
	Isoflex Alltime SL2	AS2	Lithium	Diester	180	280	-70～+150	-
	Isoflex LDS18 Special A	L8A	Lithium	Diester	190	280	-60～+130	MIL-G-23827B
	Isoflex Super LDS18	SL8	Lithium	Diester	190	280	-60～+130	MIL-G-7118A
	Isoflex PDB38 CX2000	PDC	Lithium	Synthetic	-	-	-70～+120	-
	Barielta IEL	IEL	PTFE	Fluorinated	-	280	-35～+220	-
	Barielta IEL/V	IEV	PTFE	Fluorinated	-	280	-65～+200	-
	Barielta IMI	IMI	PTFE	Fluorinated	-	280	-50～+220	-
	Barielta IMI/V	IMV	PTFE	Fluorinated	-	280	-50～+220	-
	Barielta L55/2 H1	L55	PTFE	Fluorinated	-	280	-35～+260	NSF(USDA)H2
	Barielta IS	BSI	PTFE	Fluorinated	-	280	-35～+260	-
	Klubersynth UH1 64-62	UH6	Silicate	Synthetic Hydorocarbon	-	280	-40～+150	NSF(USDA)H1
Dow Corning Co.	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	Beacon325	B32	Lithium	Diester	190	274	-60～+120	-
	Templex N3	TX3	Lithium Complex	Mineral	260	230	-30～+160	-
Mobil Oil Co.	Mobil NO.28	MG2	Bentnite	Synthetic Hydorocarbon	262	280	-62～+204	MIL-G-81322E
	Mobilux EP2	ME2	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

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SAPPORO PRECISION INC.

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

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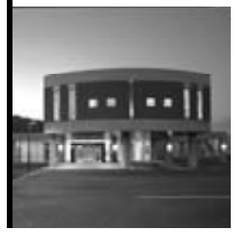
Certificate No: ISO/TS16949 : YKA 4003532
ISO9001 : YKA 4003532
Scope of Organization: Head Office in Sappro and Shipping Center in Ashibetsu-city

KITANIHON SEIKI CO,LTD.

Proof of excellent environmental preservation and quality control system



Quality assurance supported by trust and actual achievement. We produce bearings with an eye on environmental preservation.

YKA 4003532 YKA 4003532 ISO14001 JQA-EM0554

Certificate No: ISO/TS16949 : YKA 4003532
ISO9001 : YKA 4003532
ISO14001 : JQA-EM0554
Scope of Registration: The design/Development and manufacture of ball bearing

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ISO14001 NO.02010E20428ROM
Scope of Registration: Production of Miniature Bearings

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ISO 9001
NO. 0210Q20364ROM

ISO 14001
NO. 02010E20428ROM

Cat.No 915-2010-12