MIDLAND BEARINGS

Sole UK Authorised Distributors for FK Bearing Units

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Introduction

FK ball bearing units provide simple and effective bearing arrangements capable of accommodating moderate initial misalignment from mounting errors. They are easily mounted onto commercial shafting and are particularly useful where fabricated machine frames are employed.

The units are available in a variety of pillow block, flange, cartridge and take-up mounted configurations with one piece cast iron, ductile iron, stainless steel, thermoplastic or two pressed steel housings.

FK inserts are wide inner ring ball bearings that are effectively and efficiently sealed, including the J type rubber seal, H type shield seal, SL type dual seal, L3 type triple seal, F type combine seal, Dust cap and end-cover. Simple fitting onto standard shafting is provided for by means of eccentric locking collar, set screws, adapter sleeve or squeeze Lock.

The reliablitiy, simplicity and ease of assembly of items in the FK ball bearing units range has resulted in their popularity for agricultural, extraction machinery,textile machinery, parking equipment, fan equipment and construction machinery as well as process and automation equipment.

Product Selection

The purpose of this catalogue is to introduce the FK Ball bearing units range and provide the necessary technical information for assisting in selecting the most appropriate bearing units product for most applications. FK can provide many other items which are covered in further publications and can provide additional advice. FK supply one-stop type services and product solutions of ball bearing units.

Examples of calculation methods used when making a selection are included within this catalogue together with advice and information about mounting.

In line with our policy of continuous improvement, we reserve the right to amend the details in this catalogue without prior notice. If you have any doubts when making an application selection, or if you require additional information, please contact FK.

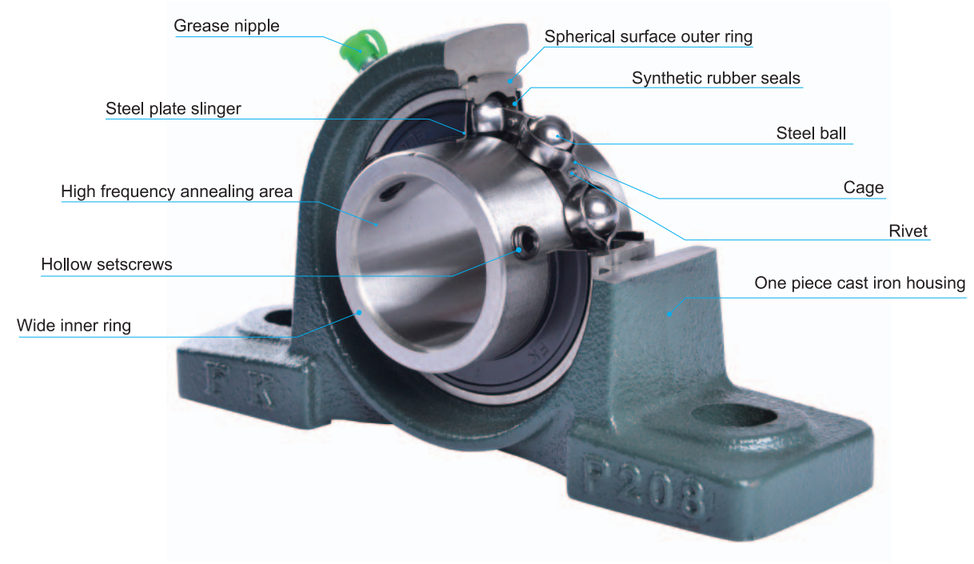
CONTENTS

FK Product Range

Popular shortcut Grease Nipple Sizes

FK PILLOW BLOCKS

1 STRUCTURE OF FK PILLOW BLOCKS



(A). Grease nipple for supplying lubricating grease.

(B). Grease hole..... Grease groove on outside of the outer race together with two grease holes provides efficient flow of grease to ball and raceways.

(C). Hollow set screw ..... Two hollow set screws ensure easy and firm mounting on a shaft.

(D). One piece cast iron housing.....of rigid structure and fault-free.

(E). Steel plate slinger..... Perfect sealing with steel slingers and synthetic rubber seals excludes dust efficiently. Centrifugal force generated by shaft rotation also prevents the grease from leaking out of bearing.

(F). Synthetic rubber seals..... Synthetic rubber seals placed between the inner ring and the outer ring prevent lubricating grease from leaking as well as preventing moisture and dust from entry.

(G). Self-aligning surface..... Self-aligning in any direction enable misaligned shaft to be centered and aligned without distorting seals.

2 COMBINATION TABLES OF INSERT BEARING AND BEARING HOUSINGS

A ball bearing unit consists of a insert bearing and a bearing housing. There are many different ball bearing units available. Following table shows some of the combinations of insert bearings and housings. Also, there are many kinds of insert bearings which are classified according to the method of mounting on the shaft, the bore diameter series, and the outer ring outside profiles,as well as the diameter series and the width series.

Table 1

Housing Type	Insert Bearing Type					
	UC2.. UC3.. UCX..	UK2.. UK3.. UKX..	HC2.. HC3..	SA2..	SB2..	NC2..
P PX LP AK PK	UCP2.. UCP3.. UCLP2.. UCPX.. UCAK2.. UCPK2..	UKP2.. UKP3.. UKLP2.. UKPX..	HCP2.. HCP3.. HCLP2..	SAP2.. SALP2..	SBP2.. SBLP2..	NCP2..
PE	UCPE2..	UKPE2..	HCPE2..			NCPE2..
F FX FS FU FN	UCF2.. UCF3.. UCFS2.. UCFS3.. UCFX.. UCFU2..	UKF2.. UKF3.. UKFX.. UKFU2..	HCF2.. HCF3.. HCFS2.. HCFS3.. HCFU2..	SAF2.. SAFN2..	SBF2.. SBFN2..	NCF2..
FL FLX FT FTN	UCFL2.. UCFL3.. UCFLX.. UCFT2..	UKFL2.. UKFL3.. UKFLX.. UKFT2..	HCFL2.. HCFL3.. HCFT2..	SAFL2.. SAFTN2..	SBFL2.. SBFTN2..	NCFL2..
T TX ST	UCT2.. UCT3.. UCTX.. UCST2..	UKT2.. UKT3.. UKTX..	HCT2.. HCT3.. HCST2..	SAT2..	SBT2..	NCT2..
FC FCX	UCFC2.. UCFCX..	UKFC2.. UKFCX..	HCFC2..	SAFC2..	SBFC2..	NCFC2..
C CX	UCC2.. UCC3.. UCCX..	UKC2.. UKC3.. UKCX..	HCC2.. HCC3.. HCCX..	SAC2..	SBC2..	
PH	UCPH2..	UKPH2..	HCPH2..	SAPH2..	SBPH2..	
PA PG PW TB	UCPA2.. UCPG2.. UCPW2.. UCTB2..	UKPA2.. UKPW2..	HCPA2.. HCPW2..	SAPA2.. SAPW2..	SBPA2.. SBPW2..	NCPA2..
FB	UCFB2..	UKFB2..	HCFB2..	SAFB2..	SBFB2..	
FA	UCFA2..	UKFA2..	HCFA2..	SAFA2..	SBFA2..	
HA	UCHA2..	UKHA2..	HCHA2..	SAHA2..	SBHA2..	

Housing Type	Insert Bearing Type				
	UC2.. UC3.. UCX..	UK2.. UK3.. UKX..	HC2.. HC3..	SA2..	SB2..
HE	UCHE2..				
FD FW				SAFD2.. SAFW2..	SBFD2.. SBFW2..
LF				SALF2..	SBLF2..
PFTD FX				SAPFTD2.. SAFX2..	SBPFTD2.. SBFX2..
FCT				SAFCT2..	SBFCT2..
CFTR				SACFTR2..	SBCFTR2..
SHE	UCSHE2..			SASHE2..	SBSHE2..
CJT CJTZ	UCCJT2..		HCCJTZ2..		
FE			HCFE2..		
ASE	UCASE2..		HCASE2..		
PSD				SAPSD2..	SBPSD2..
ME	UCME2..		HCME2..		
PP PR				SAPP2.. SAPR2..	SBPP2.. SBPR2..
PF				SAPF2..	SBPF2..
PFL				SAPFL2..	SBPFL2..
PFT				SAPFT2..	SBPFT2..

3 MATERIALS OF BALL BEARING UNITS

3.1 Materials of Insert Bearings

The materials of the race and ball of bearing require enough hardness and the following qualities:

(1).Large fatigue strength against repeated stress due to fatigue fracture of the race surface which governs the life of the bearing.

(2). High limit of elasticity and high yield strength to prevent deformation when a large load is applied per unit area.

(3). Large abrasion resistance against sliding friction between the retainer and the ball.

(4). High strength against crack due to impact load and failure caused by improper fitting etc.

(5). Small secular change in dimension and shape due to change of structure or internal stress.

GCr15 Steel <GB/T 18254>(High carbon chromium bearing steel) satisfies the above comparatively well, and its chemical composition is shown in the following table.

Chemical composition of high carbon chromium bearing steel

Table 2

Standard	Symbol	Chemical Composition (%)					
		C	Si	Mn	P	S	Cr
GB	GCr15	0.98~1.10	0.15~0.35	＜0.50	＜0.025	＜0.025	1.30~1.60
DIN	100Cr6						
ASTM	E5200						
JIS	SUJ2						

Chemical composition of stainless steel

Table 3

Standard	Symbol	Chemical Composition (%)					
		C	Si	Mn	P	S	Cr
GB	9Cr18	0.98~1.10	＜1.00	＜1.00	＜0.025	＜0.025	16.00~18.00
DIN	X105CrMO17						
ASTM	440C						
JIS	SUC440C						

In order to maintain uniform quality of materials, FK keeps fully equipped installations and performs strict acceptance tests and inspections based on the strict acceptance standards in addition to GB- standards.

Kinds of test done at the FK are mainly chemical analysis, magnetic exploration, ultrasonic exploration, corrosion by strong acid, inspection of structure by naked eyes, inspection of structure by microscope, crusher test and hardness etc.

Materials of Insert Bearing Components

Table 4

Components	Materials used	Symbol	GB number
Cage*	Cold rolled carbon steel sheet and strip	08	GB/T 13237
Rivet	Heat-rolled round steel	ML15	GB/T 715
Seal	Nitrile Butadiene Rubber<NBR>	-	-
Slinger	Cold rolled carbon steel sheet and strip	08	GB/T 13237
Hexagon set screw	Nickel chromium molybdenum steel	35CrMo	GB/T 3077

* Nylon cage is available

3.2 Materials of Housings

The material of the housings is HT200 GB/T 9439(Cast iron) and the mechanical properties are shown in the following table.

Mechanical properties of cast iron HT200

Table 5

symbol	Thickness (mm)	Dia. Of testing bar (mm)	Tensile strength	Bend strength	Deflection	Pressure strength	Hardness
			(kgf/mm²)	(kgf/mm)	(mm)	kgf/mm²	(HB)
HT200	6~8	13	Over 23	53	1.8	75	187~255
	8~15	20	Over 22	45	2.5	75	170~241
	15~30	30	Over 20	40	2.5	75	170~241
	30~50	45	Over 17	34	3.0	75	170~241
	＞50	60	Over 16	31	4.5	75	163~299

Other Materials of Housings

Table 6

Materials used	Symbol	GB number
Ductile iron	QT400	GB/T 1348
Press steel	08	GB/T 13237
Stainless steel	0Cr18Ni9	GB/T 1220
Thermoplastic	PBT	-
Rubber	NBR	-

3.3 Materials of Other Accessories

Table 7

Accessories	Materials used	symbol	GB number
Sleeve for adapter	Carbon steel for machine structural use	45	GB/T 699
Nut for adapter	Carbon steel for machine structural use	45	GB/T 699
Washer for adapter	Cold rolled carbon steel sheet and strip	08	GB/T 13237
Hexagon wrench key	Nickel chromium molybdenum steel	45	GB/T 699
Grease nipple	Cold heading steel wires	08L	GB/T 6478

4 ACCURACY OF BALL BEARING UNITS

4.1. Radial Internal Clearance of Insert Bearings

The radial internal clearance of the insert bearing is same with the reference value of GB/T4604–2006 deep groove ball bearings. Generally, the N clearance is adopted for cylindrical bore bearings and tapered bore bearings. When the environmental temperature is very high or when the temperature difference between the outer and inner rings is large, a larger clearance must be adopted because the clearance decreases due to thermal expansion of the bearings materials and temperature gradient in the bearing.

4.1.1. Cylindrical bore insert bearings

Table 8
Unit = 0.001mm

Bore diameter d (mm)		C_2		N		C_4		C_5	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
10	18	3	18	11	25	18	33	25	45
18	24	5	20	13	28	20	36	28	48
24	30	5	20	13	28	23	41	30	53
30	40	6	20	15	33	28	46	40	64
40	50	6	23	18	36	30	51	45	73
50	65	8	28	23	43	38	61	55	90
65	80	10	30	25	51	46	71	65	105
80	100	12	36	30	58	53	84	75	120
100	120	15	41	36	66	61	97	90	140
120	140	18	48	41	81	71	114	105	160

4.1.2. Tapered bore insert bearings

Table 9
Unit = 0.001mm

Bore diameter d (mm)		C_2		N		C_4	
over	incl.	min.	max.	min.	max.	min.	max.
10	18	10	25	18	33	25	45
18	24	12	28	20	36	28	48
24	30	12	28	23	41	30	53
30	40	13	33	28	46	40	64
40	50	14	36	30	51	45	73
50	65	18	43	38	61	55	90
65	80	20	51	46	71	65	105
80	100	24	58	53	84	75	120
100	120	28	66	61	97	90	140
120	140	33	81	71	114	105	160

4.2. Dimensional Accuracies of Insert Bearings

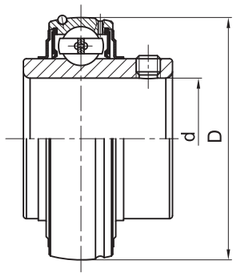
The dimensional accuracy of FK insert bearings follows the dimensional accuracy prescribed in ISO/TC4/SC6 insert bearings for ball bearing units.

4.2.1.Accuracies of outer ring

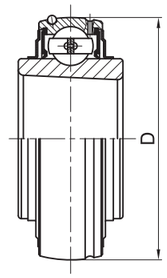
Table 10
Unit = 0.001mm

D (mm)		△Dmp		Kea
over	incl.	max.	min.	max.
30	50	0	-11	20
50	80	0	-13	25
80	120	0	-15	35
120	150	0	-18	40
150	180	0	-25	45
180	250	0	-30	50
250	315	0	-35	60

UC-type



UK-type



D--------outside diameter of bearing.

△Dmp---deviation of mean outside diameter

Kea-----radial runout of outer ring.

4.2.2. Accuracies of inner ring

Table11
Unit = 0.001mm

d (mm)		Cylindrical bore insert bearing								Kia
		Bore diameter						△Bs, △Cs		
		UC,HC,SA,SB,SER			CS					
		△dmp		Vdp	△dmp		Vdp			
over	incl.	max.	min.	max.	max.	min.	max.	min.	min.	max.
10	18	+15	0	10	0	-8	6	0	-120	15
18	30	+18	0	12	0	-10	8	0	-120	18
30	50	+21	0	14	0	-12	9	0	-120	20
50	80	+24	0	16	0	-15	11	0	-150	25
80	120	+28	0	19	-	-	-	0	-200	30
120	180	+33	0	22	-	-	-	0	-250	35

d----bore diameter.

△dmp-deviation of mean bearing bore diameter in a single plane.

Vdp----variation of bearing bore diameter in a single radial plane.

△Bs----deviation of a single inner ring width.

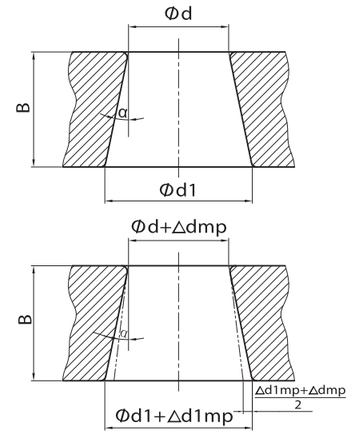
△Cs----deviation of a single outer ring width.

Kia----radial runout of inner ring.

4.2.3. Accuracies of tapered bore

Table12
Unit = 0.001mm

mm		△dmp		△d1mp- △dmp		Vdp[1)]
over	incl.	max.	min.	max.	min.	max.
18	30	+33	0	+21	0	13
30	50	+39	0	+25	0	15
50	80	+46	0	+30	0	19
80	120	+54	0	+35	0	25
120	180	+63	0	+40	0	31



1). Applies in any single radial plane of the bore.

d---- bore diameter

d1----diameter at the theoretical large end of a basically tapered bore d1=d + 1/12B.

△dmp-deviation of mean bore diameter in a single plane (for a basically bore, dmp refers to the theoretical small end of the bore).

△d1mp-deviation of mean bore diameter in a single plane at the theoretical large end of a basically tapered bore.

Vdp-----variation on bore diameter in a single radial plane.

B-------inner ring width.

a-------the taper angle (half the cone angle) is

$a = 2^{\circ}\ 23'\ 9.4'' = 2.385\ 94^{\circ} = 0.041\ 643$ rad.

Tolerance in distance n from center line of spherical outer ring to side of inner ring

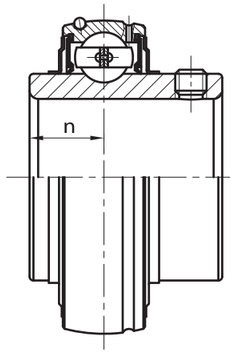


Table13
Unit = 0.001mm

Nominal dimensions of bore diameter d (mm)		Tolerance of n
over	incl.	
-	50	±200
50	80	±250
80	120	±300
120	-	±350

4.3 Dimensional Accuracies of Housings

The dimensional accuracy of FK housing follows the dimensional accuracy prescribed in GB/T27560 housings for ball bearing units. The spherical inside diameter of FK housing follow the dimension prescribed as fitting symbol J.

4.3.1. Tolerance of spherical bore diameter of housings

Table14
Unit = 0.001mm

Nominal dimension of spherical bore diameter D. (mm)		Housing for loose fit				Housing for sliding fit				Housing for sliding fit			
		Symbol H				Symbol J				Symbol K			
		D1m		D1		D1m		D1		D1m		D1	
over	incl.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
30	50	+25	0	+30	-5	+14	-11	+19	-16	+7	-18	+12	-23
50	80	+30	0	+36	-6	+18	-12	+24	-18	+9	-21	+15	-27
80	120	+35	0	+42	-7	+22	-13	+29	-20	+10	-25	+17	-32
120	180	+40	0	+48	-8	+26	-14	+34	-22	+12	-28	+20	-36
180	250	+46	0	+55	-9	+30	-16	+39	-25	+13	-33	+22	-42
250	315	+52	0	+62	-10	+36	-16	+46	-26	+16	-36	+26	-46

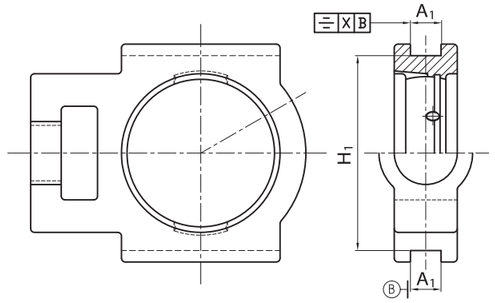
Notes: a).D1m is given by the following equation, where D1max and D1min in the equation are maximum and minimum values measured respectively.

$$D1m = \frac{D1max. + D1min.}{2}$$

b). Dimensional tolerance for spherical inside of housings are divided into loose fit H, sliding fit J and sliding fit K.

c). When the contained bearing are equipped with locking-pins, loose fit is applied.

4.3.4. Dimensional accuracies of Take-up and Cartridge type housings



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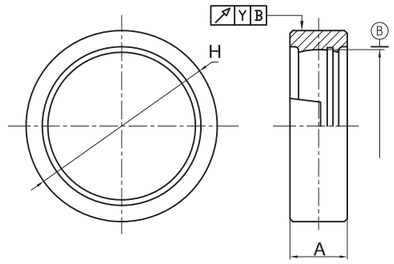


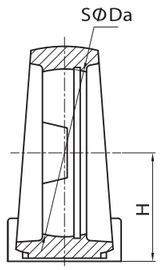
(C,CX)

Tolerance of Housings

Table15
Unit = 0.001mm

Housing No. T			$\triangle A_1$	$\triangle H_1$	x (≤)	Housing No. C			△H						Y (≤)	△A
									C 2..		CX..		C 3..			
									max.	min.	max.	min .	max.	min.		
204	-	-	+200 0	0 -500	500	204	-	-	0	-30	0	-35	0	-35	200	±200
205	X05	305				205	X05	305								
206	X06	306				206	X06	306	0	-35						
207	X07	307				207	X07	307								
208	X08	308				208	X08	308					0	-40		
209	X09	309				209	X09	309								
210	X10	310				210	X10	310								
211	X11	311	+300 0	0 -800	600	211	X11	311	0	-40	-	-	0	-40	300	±300
212	X12	312				212	X12	312								
213	X13	313				213		313								
214	X14	314				-	-	314	-	-			0	-46		
215	X15	315				-	-	315								
216	X16	316				-	-	316								
217	X17	317				-	-	317								
-	-	318				-	-	318								
-	-	319			700	-	-	319							400	
-	-	320				-	-	320					0	-52		
-	-	321				-	-	321								
-	-	322				-	-	322								
-	-	324			800	-	-	324					0	-57		
-	-	326				-	-	326								
-	-	328				-	-	328								

4.3.2. Dimensional Accuracies of Pillow Block-type Housings

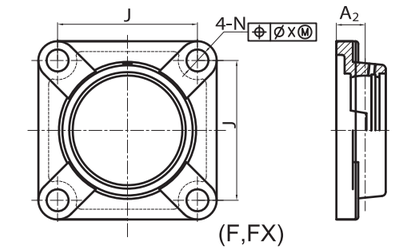


Tolerance of pillow block center height Table16

Unit = 0.001mm

Housing No. P.LP.PH.PA.PW.PE.PK	Tolerance of H
203-210 X05-X10 305-310	±150
211-218 X11-X18 311-318	±200
- X20 319-328	±300

4.3.3. Dimensional Accuracies of Flange-type Housings



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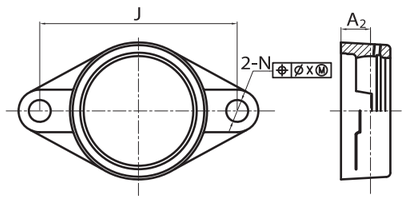

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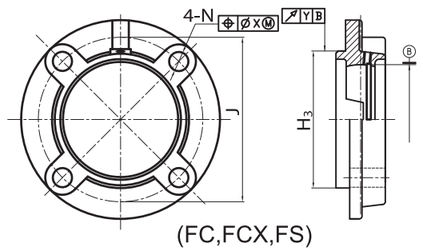

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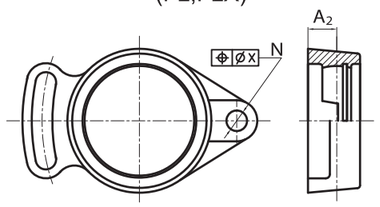

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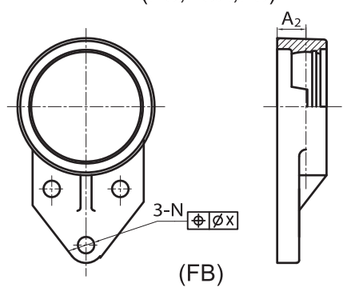

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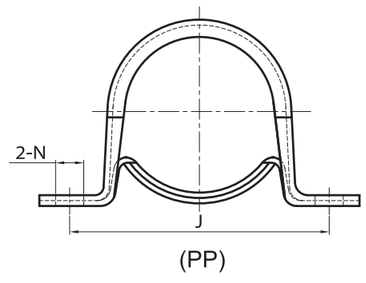

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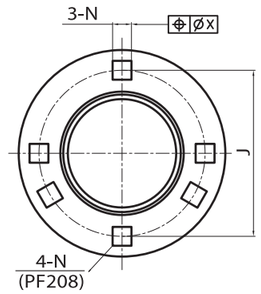

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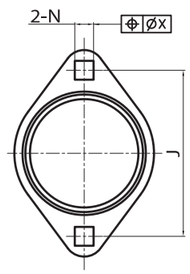
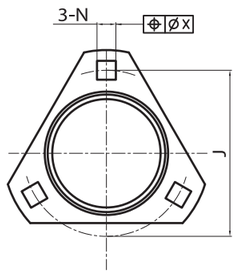


(PFL)



(PFT)

Tolerance of Housings Table17

Unit = 0.001mm

Housing No. F,FL,FA,FB			X (≤)	△A_2	Housing No. FC , FS			Tolerance of △H_3 FC 2.. max	FC 2.. min.	FCX.. max.	FCX.. min .	FS 3.. max.	FS 3.. min.	X (≤)	△A_2	Y (≤)
204	-	-	700	±500	204	-	-	0	-46	-	-	-	-	700	±500	200
205	X05	305			205	X05	305			0	-46	0	-46			
206	X06	306			206	X06	306									
207	X07	307			207	X07	307	0	-54	0	-54	0	-54			
208	X08	308			208	X08	308									
209	X09	309			209	X09	309									
210	X10	310			210	X10	310									
211	X11	311	1000	±800	211	X11	311	0	-63	0	-63	0	-63	1000	±800	300
212	X12	312			212	X12	312									
213	X13	313			213	X13	313									
214	X14	314			214	X14	314									
215	X15	315			215	X15	315									
216	X16	316			216	X16	316									
217	X16	317			217	X16	317									
218	X18	318			218	X18	318	0	-72	0	-72	0	-72			
-	-	319			-	-	319	-	-	-	-	0	-81			400
-	X20	320			-	X20	320									
-	-	321			-	-	321									
-	-	322			-	-	322									
-	-	324			-	-	324									
-	-	326			-	-	326					0	-89			
-	-	328			-	-	328									

Unspecified tolerance of castings Table18

Unit = 1mm

Thickness over	Thickness incl.	Tolerance△	Thickness over	Thickness incl.	Tolerance△
-	120	±1.5	-	-	-
120	250	±2.0	-	10	±1.5
250	400	±3.0	10	18	±2.0
400	800	±4.0	18	30	±3.0
800	1600	±6.0	30	50	±3.5

Tolerance of pressed steel housings Table19

Unit = 1mm

Housing No.	△N	Tolerance of J	Housing No.	△N	Tolerance of mounting hole position
PP203-208	±0.5	±0.4	PF203-208 PFL203-208 PFT203-208	±0.2	0.4

5 Allowable loading capacity of cast iron housing

FK cast iron housing is produced by high quality HT200 material, and designed to meet insert bearing loading capacity. However, housing strength must be taken into consideration under low speed heavy load or impact load and other special application.

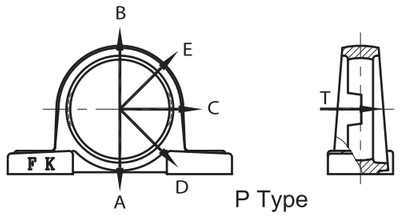
5.1 Destruction strength of cast iron housing

FK housing lab gets following data by many years research and test. This is the average destruction strength under static loading, so ±30% deviation must be considered. Cast iron housing has many good properties, but it is fragile under impact load, so safety factor must be considered.

Table20

Load type	Static load	Dynamic load		
		Repeated load	Alternating load	Variable load Impact load
Safety factor	4	6	10	15

* Some applications may have impact load, such as crane, windlass, air compressor, rolling mill etc, must consider cast steel or ductile iron housing for these applications.



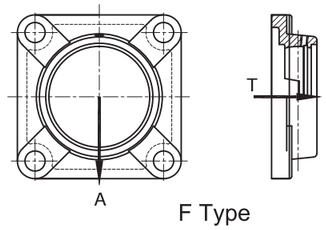
P Type

Table21

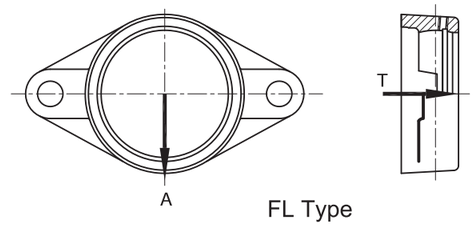
KN

Destruction strength of cast iron housing

Housing No.	Direction A,D	Direction C	Direction B	Direction E	Direction T	Housing No.	Direction A,D	Direction C	Direction B	Direction E	Direction T
P204	70.4	50.8	31.9	25.5	13.8	P307	122.4	74.0	54.8	44.0	26.0
P205	80.0	53.5	33.7	27.5	15.0	P308	145.6	63.2	61.6	50.0	28.0
P206	91.5	59.4	37.6	31.5	17.0	P309	172.0	94.4	68.8	56.8	30.8
P207	104.6	67.2	43.0	36.6	20.0	P310	198.4	105.2	76.4	64.4	34.4
P208	119.0	76.6	49.2	42.3	23.0	P311	228.0	117.6	84.8	72.0	38.4
P209	135.3	87.0	56.5	48.5	26.6	P312	258.4	131.2	93.6	80.8	42.4
P210	153.7	98.9	64.4	55.7	31.0	P313	292.8	146.8	103.2	90.4	48.4
P211	172.9	110.8	72.5	63.1	34.5	P314	328.0	164.0	113.6	101.6	54.0
P212	195.4	123.8	81.7	71.0	39.8	P315	363.2	182.4	125.2	111.2	60.8
P213	217.5	137.4	91.1	79.2	44.7	P316	398.4	203.2	138.0	124.0	67.2
P214	242.6	151.8	100.9	88.2	50.5	P317	437.6	227.2	152.8	136.8	75.2
P215	270.2	166.6	111.6	97.5	56.4	P318	478.4	253.6	167.2	150.4	83.6
P216	297.6	182.2	122.4	107.1	62.4	P319	520.0	280.8	185.2	164.8	92.8
P217	327.8	198.0	133.8	117.7	69.1	P320	564.0	312.0	204.0	180.4	102.8
P218	360.0	213.2	144.9	128.2	76.5	P321	607.2	344.8	224.0	196.8	113.2
						P322	651.2	380.0	246.4	214.4	123.2
P305	79.2	57.6	42.4	35.2	21.6	P324	740.0	452.8	292.0	251.2	146.8
P306	100.0	64.8	48.8	39.2	23.2	P326	834.4	532.0	340.0	292.8	172.4



F Type



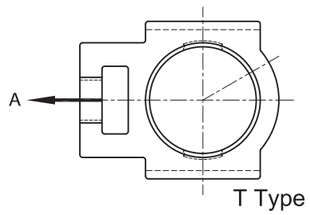
FL Type

Table22

KN

Destruction strength of cast iron housing

Housing No.	Direction A	Direction T	Housing No.	Direction A	Direction T
F204	66.8	15.0	FL204	44.2	16.1
F205	71.6	17.8	FL205	54.2	20.1
F206	77.0	19.6	FL206	63.4	24.0
F207	83.7	22.5	FL207	73.8	28.7
F208	91.0	26.5	FL208	84.0	32.9
F209	99.0	31.1	FL209	93.7	36.8
F210	107.3	36.4	FL210	102.9	40.8
F211	115.9	42.2	FL211	111.3	44.7
F212	125.0	48.7	FL212	118.8	48.0
F213	134.5	55.8	FL213	126.2	51.6
F214	144.9	63.4	FL214	133.5	54.3
F215	155.2	71.4	FL215	140.0	58.4
F216	166.3	79.4	FL216	146.3	61.6
F217	176.8	87.8	FL217	152.4	65.6
F218	187.9	95.8	FL218	157.8	72.9
F305	86.8	21.6	FL305	47.4	21.9
F306	89.6	27.2	FL306	57.5	28.2
F307	108.0	32.8	FL307	68.9	34.2
F308	121.2	38.4	FL308	80.6	40.8
F309	134.8	45.2	FL309	93.6	47.0
F310	149.6	51.6	FL310	106.6	53.8
F311	162.4	58.8	FL311	117.8	59.4
F312	177.6	66.4	FL312	129.0	65.4
F313	193.2	74.0	FL313	139.5	71.0
F314	208.8	83.2	FL314	151.1	76.9
F315	226.4	92.8	FL315	161.1	82.4
F316	243.2	102.4	FL316	171.0	87.9
F317	262.0	113.6	FL317	181.0	93.7
F318	281.6	125.6	FL318	190.5	99.2
F319	300.0	138.0	FL319	199.8	104.6
F320	319.2	151.2	FL320	209.5	110.4
F321	337.6	164.8	FL321	218.3	116.0
			FL322	225.8	121.0



Destruction strength of cast iron housing

Table23
KN

Housing No.	Direction A	Housing No.	Direction A	Housing No.	Direction A
T204	26.7	T216	115.0	T313	113.5
T205	32.6	T217	124.6	T314	126.2
T206	38.6	T218	134.2	T315	140.2
T207	45.0			T316	154.1
T208	51.9	T305	38.9	T317	168.4
T209	59.1	T306	44.6	T318	184.9
T210	66.8	T307	51.3	T319	199.1
T211	74.2	T308	59.3	T320	216.7
T212	82.0	T309	67.4	T321	232.1
T213	89.8	T310	77.6	T322	249.5
T214	98.2	T311	89.0	T324	285.0
T215	106.5	T312	100.8	T326	320.8

5.2 Allowabale Load of Pressed Housings

Pressed housing shows deformation when subjected to heavy load. The deformation depends upon direction and amount of the load, form of the housing and thickness of steel plate. Therefore, the allowable load of the pressed housing must be such an amount that deformation of the housing may not disturbed the function.

The allowable radial load of pressed housing is approximately 1/6 of the bearing basic dynamic load raing (Cr), and allowable axial load of pressed housing is approximately 1/18 of the bearing basic dynamic load rating (Cr).

6 LUBRICATION OF BALL BEARING UNITS

6.1 Permissible Speed

Permissible speed of a insert bearing is expressed normally in terms of dn value (Bearing bore diameter mm x operating speed r.p.m.), although it is influenced by the shape, size, lubricant type and seal device. The permissible speed can be roughly determined by the sliding speed at the friction part of the holding device and rolling body. In the case of ball bearing unit, it is provided with grease sealed by the oil seals and slingers. Accordingly, the friction resistance at seal contact yields also a large influence on the permissible speed.

When such factors are taken into consideration, the permissible speed is given as follows:

Dn ⩽ 150,000 [dn=d x n]

Whereas, **d:** Bearing bore diameter **(mm)**

n: Operating speed **(r.p.m.)**

6.2 Type of Grease Nipple

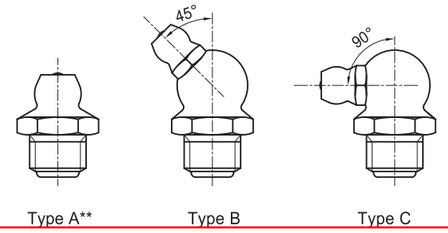


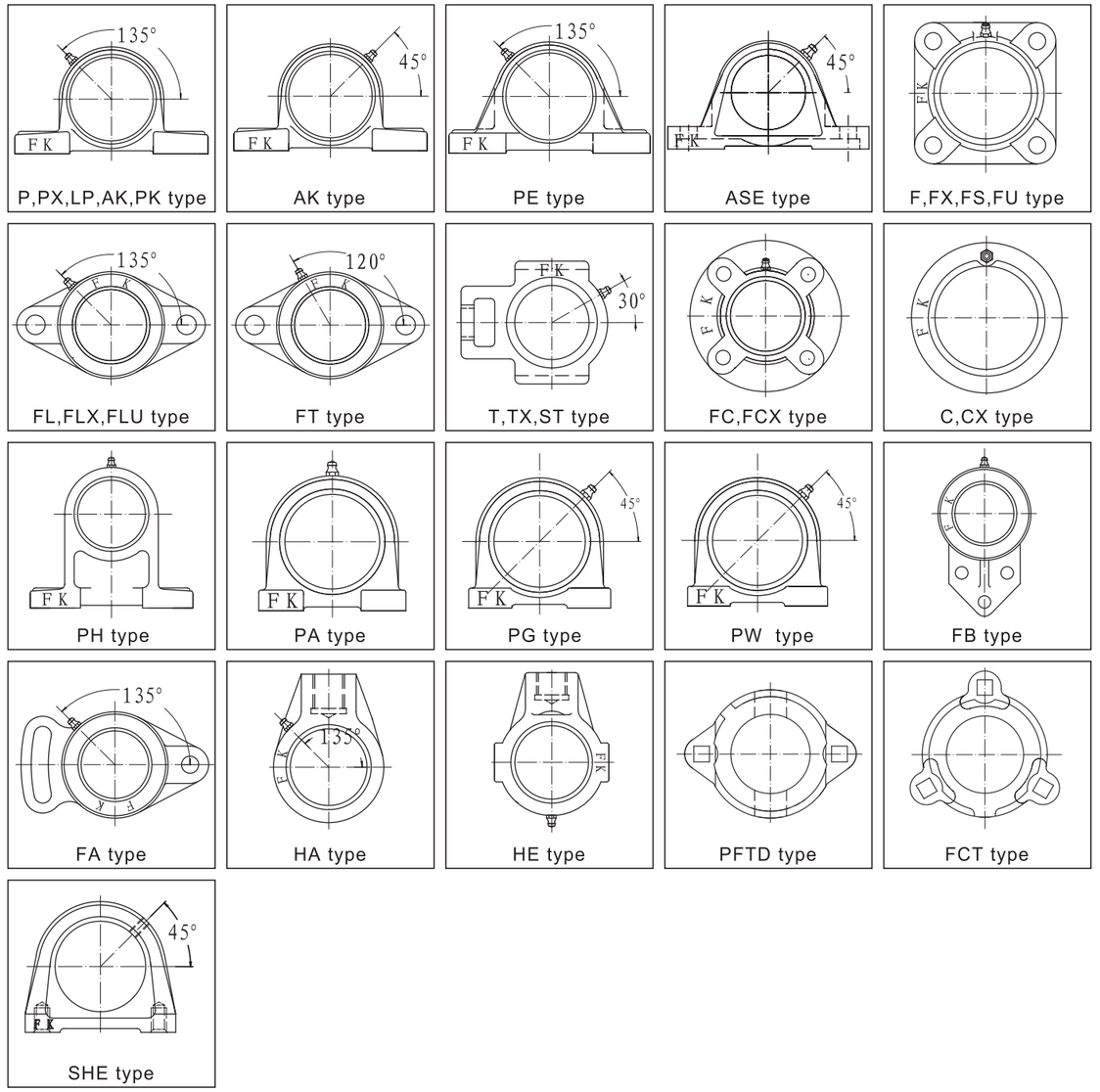
Table24

Applicable housing		Type of grease nipple*
Type	No.	
P(PX),F(FX), FL(FLX),FC(FCX) T(TX),C(CX),PH PA,PW,PG,LP, FS,FD,FW,FT,FU, FA,FB,HA,HE,LF AK,PK,PE,FLU	203(S)~210 305~309 X05~X09	M6X1
	211~215 310~315 X10~X14	M8X1
	216~218 316~328 X15~X20	M10X1

* Inch size grease nipple is available

** Type A is standard on all relubricatable housings

6.3 Locating of Grease Nipple



6.4 Lubricant Grease

Ball bearing units adopts the lubrication mechanism by grease. Since the insert bearing itself is required high precision, the grease must be in particularly fine quality.

Various types of grease are sold in the market; each having different combination of mineral oil and metal saponification radical. Among them, lithium saponification radical grease is usually called, “Multi-purpose Grease”. It has outstanding properties of heat resistance, low temperature resistance, water expellent and mechanical stability; it is most suitable for a ball bearing unit.

At present, “Lithium-base grease 2” grease is used for the standard product of FK and is lithium saponification radical grease. It is most suitable for the insert bearing.

6.5 Replenishment of Grease

Since. the high quality grease is used for the ball bearing unit, the grease can be used for a considerable time without the grease supply, if the insert bearing working condition is favorable and the operation temperature is not too high.

However, even if the best quality grease is used, the quality deterioration cannot be prevented as the time passes by. When the dust or moisture surrounds the insert bearing too much or the insert bearing is subjected to the high temperature, the grease must be supplied periodically according to the grease deterioration.

FK ball bearing unit has such a construction so as to allow the grease replenishment during the use. Grease is injected into the grease nipple by use of the grease gun. Through the oil groove provided in the bearing outer ring and the oil hole, it is supplied to the inside of bearing.

The grease supply interval is dependent on the kind and quality of the grease to be used as well as the operations conditions of the bearing. Under the normal operation condition, however, the value as obtained by the following formula is recommended.

$$N = 10^{10} / d$$

Whereas, **N**: Total rotation number until the replenishment or replacement

d: Bearing bore diameter(mm)

If the revolution number per minute constant, the replenishment interval is expressed in terms of the time as tollows:

Whereas **H**: Replenishment interval(hr)

n:Operating speed(r.p.m.)

$$H = \frac{1 \times 10^{10}}{60n \cdot d}$$

Different from the previous calculation data, the following table shows the approximate grease supply interval obtained empirically from various ambient conditions and bearing operation temperatures.

Grease supply period

Table25

Ambient condition	Bearing operation temp(℃)		Supply period	
	over	below	dn: under 50000	dn: over 50000
Fairly clean	-	50	Non~supply	1.5~3 years
	50	70	1~2 years	6~12 months
	70	100	4~8 months	1~3 months
	100	-	2~4weeks	1~2 weeks
Somewhat dusty	-	50	1~2 years	6~12 months
	50	70	4~8 months	2~4 months
	70	100	3~6 weeks	2~4 weeks
	100	-	1~2 weeks	Every week
Considerably dust	-	70	1~2 months	3~6 weeks
	70	100	2~4 weeks	1~2 weeks
	100	-	1~7 days	1~3 days
Much moisture and water splash	-	-	1~3 days	Every day

6.6 Range of operating temperature

As Bearing Units are used not only in normal temperature but also in high or low temperature in many applications.

Bearing Units for heat-resistance or cold-resistance application are available by using suitable kind of rubber seal and grease for specific operating temperature as shown in Following table.

For heat-resistance application, decrease of load rating of the insert bearing must be taken into consideration and larger radial internal clearance of the insert bearing than normal application be taken.

Standard radial internal clearances for heat-resistance application are C_5 HT20 for cylindrical bore insert bearing, and C_4 for tapered bore insert bearing.

When temperature differential between bearing inner ring and outer ring is extremely large, suitable radial internal clearance must be determined.

Note: For application where operating temperature exceeds 150℃,consult us along with data of specification and operating condition.

Range of operating temperature

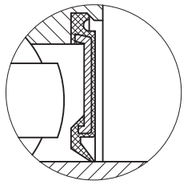
Table26

Type	Range of operating temperature C (F)	Grease	Rubber seal	Color of slinger
Ordinary application	-15 to +100 (-5 to +212)	Lithium-Base Grease 2	Nitril rubber (NBR)	Black
Heat resistance application HT20	Normal to +200 (Normal to +392)	Egols-8604	Silicon rubber	red
Cold resistance application LT4	-40 to Normal (-40 to normal)	Esso Beacon 325	silicon rubber	Silver

7 SEALING DEVICES

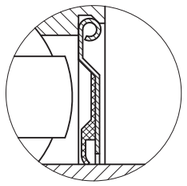
Following kinds seals are used as the sealing device of FK ball bearing units. By selecting the sealing device which is most suitable to the application condition, longer bearing life can be guaranteed.

7.1 Sealing devices of insert bearings:



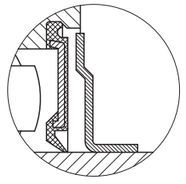
J type rubber seal

Synthetic rubber is adhered by baking to the core piece. It is inserted into groove of the outer ring and fitted on the inner ring outer diameter. It has low friction, high property in oil resistance and good mechanical stability.
Applicable bearing：SB，SA，JB， CS series
▲ J type rubber seal is standard on SB,JB,CS series



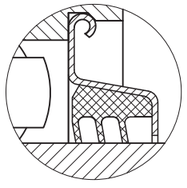
H type metal seal

Synthetic rubber is baked at the inside of steel plate and is fixed with the outer ring of bearing. The inner ring outer diameter contacts synthetic rubber reasonably so that the friction resistance will be lessened. The steel plate protects the rubber seal. This combined effect ensures the long service life even under considerably unfavorable conditions.
Applicable bearing： SA，SB，JA series
▲ H type metal seal is standard on SA,JA series



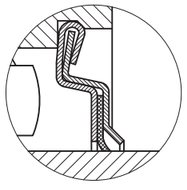
SL type Dual seal

This is the original sealing device. Oil seal is fixed in the outer ring inner diameter groove, while the slinger is set at the inner ring outer diameter. Furthermore, the simultaneous revolution with inner ring generates the wind pressure for dust-proof property. This constitutes the ideal labyrinth, effective dust-proof property is thus guaranteed.
Applicable bearing：UC，HC，UK，UCX，SER，NC，ERC series
▲ SL type dual seal is standard on UC,HC,UK,UCX,SER series



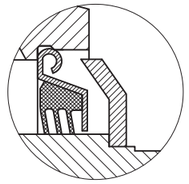
L_3 type Triple-lip seal

The metal cap and synthetic rubber seal are baked together to form a single seal. Seal lip has sufficient tightening allowance. Furthermore, the lip layers are of triple construction and the foreign matters such as dust, water etc are completely shut out. This sealing shows its outstanding performance under bad conditions.
Applicable bearing：UC,HC,UCX,SER,NC,ERC series



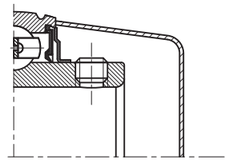
F type seal

F seal consists of inner steel plate, outer steel plate and a rubber washer, it is fixed in the outer ring groove, therefore, it will not be loose which may be caused by over grease or impact vibration during assembly.
Applicable bearing：UC,HC,UK,UCX,SA,SB,SER,NC,JA,JB,ERC series



Combined seal

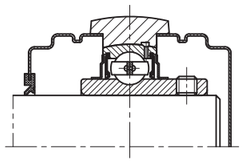
A protection shield or slinger is added base on triple lip seal, better seal performance is got for severe ambient conditions.



Bearing cover

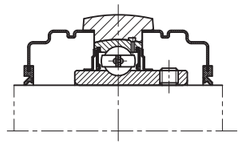
A cover is installed on the bearing outer ring outer diameter, it can protect the bearing seal under severe ambient conditions.

7.2 End-cover of Housing



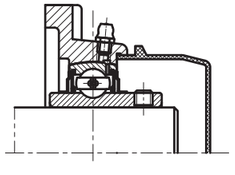
With closed press steel cover

Closed cover are installed on the housing, results in housing cover and bearing seal double sealing devices construction. This construction can guarantee bearing life even under severe ambient conditions.
Avoid touching rotation part to ensure security



With opened press steel covers

Opened covers are installed on the housing, results in housing cover and bearing seal double sealing devices construction. This construction can guarantee bearing life even under severe ambient conditions.
Avoid touching rotation part to ensure security



With closed plastic cover

Closed cover are installed on the housing, results in housing cover and bearing seal double sealing devices construction. This construction can guarantee bearing life even under severe ambient conditions.
Avoid touching rotation part to ensure security

8 HANDLING OF BALL BEARING UNITS

8.1 Bearing life

Even in bearings operating under normal conditions, the surfaces of the raceway and rolling elements are constantly being subjected to repeated compressive stresses which cause flaking of these surfaces to occur. This flaking is due to material fatigue and will cause the bearings to fail. The bearing life of a insert bearing is usually defined in terms of a insert bearing can undergo before flaking.

Some insert bearing failure is caused by seizing, abrasions, cracking, chipping, gnawing, rust etc, since these are caused by improper installation, insufficient or improper lubrication, faulty sealing or inaccurate bearing selection, they must be considered separately from bearing life.

8.1.1 Basic load rating and rated life

Basic load rating includes basic dynamic load rating and basic static load rating. The load applied to the insert bearing operating under a speedy rotating (n>10r/min) condition is defined as dynamic load C , while the load applied to the bearing operating under a static or slow oscillating and rotating (n≤10r/min) condition is defined as static load Co. Insert bearing is a kind of radial ball bearing, mainly take radial force. So, the basic load rating is radial basic dynamic load Cr and radial basic static load Cor.

Basic dynamic load rating Cr: the basic dynamic load rating is an expression of the load capacity of a bearing based on a constant load which the bearing can sustain for one million revolutions.

Basic static load rating Cor: the maximum applied radial load for contact stress occurring at the rolling element and raceway contact points.

——4600MPa for self aligning ball bearing
——4200MPa for radial ball bearing
——4000MPa for radial roller bearing

The load capacity of the bearing is expressed by the basic dynamic load rating and basic static load rating which is shown in the bearing dimension page.

Life: The life of a rolling bearing is defined as the total number of revolutions which the bearing is capable of enduring before the first evidence of fatigue flaking develops on any one of the rings or rolling elements.

Reliability: The reliability is the percentage of the bearing of a group of apparently identical bearings operating under identical conditions which can expect to attain or exceed a certain defined life. The reliability of an individual bearing is the probability of the bearing to attain or exceed a defined life.

Basic rating life: For a group of apparently identical rolling bearings operating under identical conditions, the basic rating life is defined as the total number of revolutions that 90% of the bearings can be expected to complete or exceed.

According to national standard GB/T6391-2003 (equaling to ISO281: 1990), the basic rating life of radial ball bearing is calculated by following formula:

$$L_{10} = \left(\frac{Cr}{Pr}\right)^3$$

or $$\frac{Cr}{Pr} = L_{10}^{1/3}$$

Where: L_{10}: basic rating life(10^6 r)
C_r: basic dynamic load rating
P_r: equivalent dynamic load

Equivalent dynamic load P_r: the equivalent dynamic load is a constant load with a fixed direction under which the bearing life is identical to that of the bearing operating under actual load.

For a insert bearing operating with a constant rotation speed, the basic rating life can be expressed in terms of hours of operation, and is calculated in following formula:

$$L_{10h} = \frac{10^6}{60n}\left(\frac{C}{P}\right)^3$$

or $$L_{10h} = \frac{10^6}{60n}L_{10}$$

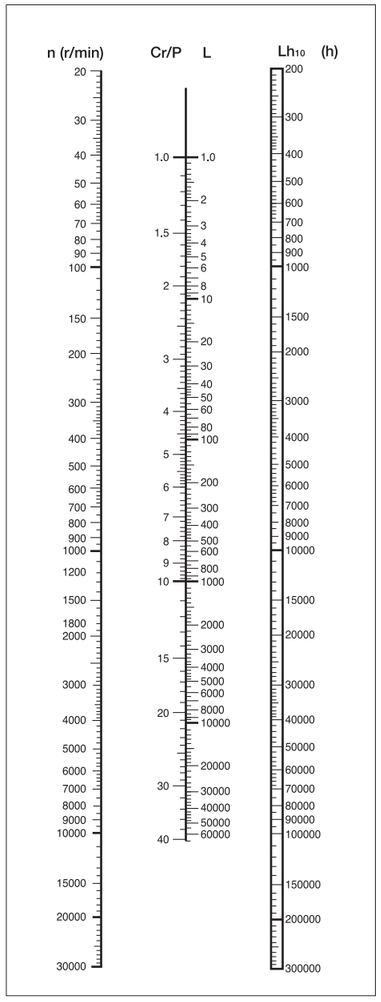
$$= \frac{16666}{n}\left(\frac{C}{P}\right)^3$$

Where: L_{10h} = basic rating life (hours)
n = bearing rotation speed (r/min)

If the bearing operates under indeterminate loads and rotation speed, the following formula should be applied when calculating bearing rating life:

$$P_m = \sqrt[3]{\frac{\int_0^N P^3 dN}{N}}$$

Where: P_m = mean equivalent dynamic load
P = equivalent dynamic load
N = total revolution numbers within one load changing cycle



8.1.2 Calculation method of equivalent dynamic load

The basic equivalent dynamic load is determined under a hypothetical condition. When calculating the bearing life, the actual load has to be converted into equivalent dynamic load which is in confirm with the load condition determining the equivalent dynamic load rating.

General equation for calculating the equivalent dynamic load:

$$P = XFr + YFa$$

Where P = equivalent dynamic load (N);
Fr = actual radial load (N)
Fa = actual axial load (N)
X = radial factor
Y = thrust factor

The axial load which insert bearing can carry is determined by the mounting method of the bearings on the shafts.

For the setscrews locking type or eccentric locking collar type bearings, if flexible shafts are applied and the setscrews are tightened enough, the axial load Fa which the bearing can carry must not surpass 20% of the radial load Fr.

For the adapter sleeve locking type bearing, if the nuts are properly tightened, the axial load Fa can be maximum 15%～20% of the radial load Fr.

The values of radial and thrust factors X and Y for insert bearings can be obtained from the following table:

Table27

$\frac{F_a}{C_O}$	$\frac{F_a}{F_r} \leqslant e$ p=F_r		C2			N			C3		
			$\frac{F_a}{F_r} > e$		e	$\frac{F_a}{F_r} > e$		e	$\frac{F_a}{F_r} > e$		e
	X	Y	X	Y		X	Y		X	Y	
0.025	1	0	0.56	2.0	0.22	0.46	1.75	0.31	0.44	1.42	0.40
0.040	1	0	0.56	1.8	0.24	0.46	0.62	0.33	0.44	1.36	0.42
0.070	1	0	0.56	1.6	0.27	0.46	1.46	0.36	0.44	1.27	0.44
0.130	1	0	0.56	1.4	0.31	0.46	1.30	0.41	0.44	1.16	0.48
0.250	1	0	0.56	1.2	0.37	0.46	1.14	0.46	0.44	1.05	0.53

When twist load is applied to the bearings, the equivalent dynamic bearing load is calculated by:

$P_m = f_m \cdot P$

Where: P_m = equivalent dynamic load when considering twist load
f_m = when twist load is big :f_m=2

When shocking load is applied, equivalent dynamic load can be calculated by:

$P_d = f_d \cdot P$

Where: P_d = equivalent dynamic load when considering shocking load （N）
f_m = shocking load factor; which is defined as follows:

When no shocking load or minor shocking load is applied:

f_d = 1～1.2

When adequate shocking load is applied:

f_d = 1.2～1.8

8.1.3 Adjusted rating life equation

Normally the basic rating life L10 can be applied to calculate the bearing rating life, the bearing life is with 90% reliability.

However, in some applications a bearing life over 90% reliability may be required, moreover, the effect of bearing quality and operation conditions are expected to take into consideration when calculating bearing life, the adjusted bearing life L_{nm} (n means failure rate,(100-n) means reliability) meet these requirements.

Bearing life Lnm, is adjusted bearing life under （100-n） % reliability、speicified bearing quality and operation conditions, it can be calculated by:

$L_{nm} = a_1 a_{xyz} L_{10}$

Life adjustment factor for reliability a_1 please refers to following table.

Life adjustment factor for reliability a_1

Table28

Reliability	L_{nm}	a_1
90	L_{10m}	1
95	L_{5m}	0.62
96	L_{4m}	0.53
97	L_{3m}	0.44
98	L_{2m}	0.33
99	L_{1m}	0.21

Life adjustment factor axyz include followings:

——material,
——lubrication,
——environment,
——Impurity particle,
——Internal stess,
——mounting,
——bearing load.

The bearing life is affected by any of above factors, so all factors must be taken into consideration when selecting bearing to avoid failure.

Please refer to national standard GB/T6391-2003 for bearing life calculating method.

8.1.4 Example of insert bearing selection

One ball bearing is to operate at at rotation speed of 800r/min, under only a radial load of Fr = 3000N, with a basic rating life of at least 30000 hours, select the bearing.

Solution 1:

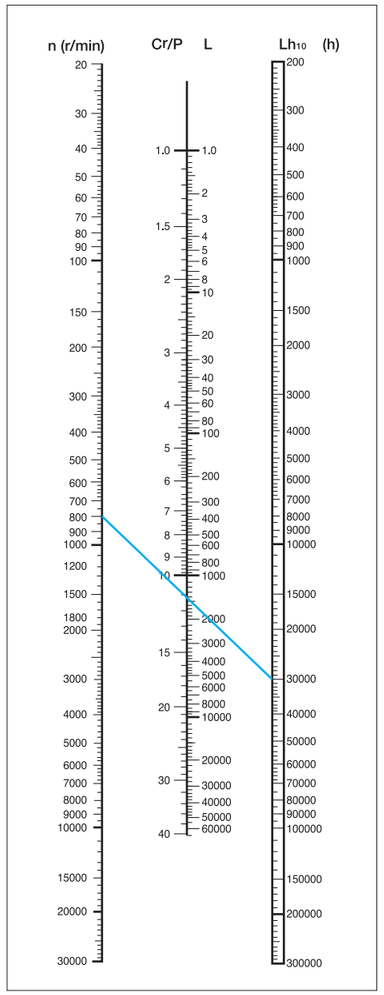
According to formula

$$L_{10h} = \frac{10^6}{60n} L_{10} = \frac{16666}{n}\left(\frac{C}{P}\right)^3$$

From L_{10h} = 30000 hours, rotation speed = 800r/m,
Under only a radial load, i.e. P = Fr = 3000N,
Therefore, C = 33877N.

Solution 2:

By connecting n(800r/m) and the required basic rating life L_{10h} （30000hours） with a straight line on the fig,it can be found that C/P value is 11.3, C/P = 11.3, P = Fr = 3000N, thus the required basic dynamic load rating is C = 33900N



8.2 Selection of ball bearing units

As the excellent characteristics of ball bearing unit is recognized, its application fields are always expanded and at present it is used in all aspects of industrial activities in general.

Its expected service life can be extended twice by using the ball bearing unit correctly. On the contrary, inappropriate selection and handling will shorten the expected service life.

Therefore, it is necessary to examine the following items thoroughly, when the ball bearing unit is selected.

1. Size and nature of the working load.
2. Desirable minimum expected service life.
3. Operating speed of the shaft.
4. Bearing number and parallel application arrangement on the shaft in question.
5. Available space for assembling and disassembling work.
6. Appearance at the place to be used.
7. Gas generation and dust condition at the installation place.

8. Ambient temperature at the installation place.
9. Machining precision of the facility, to which the bearing is applied.
10. Maintenance and control, including the lubrication system.

The above items are regarded as the selection conditions, and the items 1,2 and 3 can be examined by the service life calculation of the ball bearing unit.

As to the item 4, such a type as allows the alignment adjustment through the installation modification, must be selected, since the mutual alignment work becomes necessary even in the case of automatic alignment adjusting type, where many sets of bearing can be applied to one shaft.

Regarding the item 5, it must be examined if enough installation space is available or not, in order to know in what manner the installation work can be done.

Item 6 may suggest the necessity of the clean and aesthetic design, depending on the application purpose of the machine involved. For example, such consideration will be needed for the application to the electric appliance or sewing machine.

Items 7 and 8 mean that it must be studied if the gas and chemicals, or high temperature, which are harmful to ball bearing, are existing or not.

As suggested in Item 9, the ball bearing unit must suit to the processing precision of the installation section.

Item 10 covers the maintenance and inspection problem, namely, how easily the maintenance can be done, or if the unit is installed inside the machine where the lubrication can hardly be done or if the lubrication must be and how etc. The optimum selection of bearing unit, right unit for right place, will ensure the full development of performance of ball bearing unit.

8.3 Selection of Shafts

The ball bearing unit is provided with hexagonal hollow set screws at two spots located at 120° one side of inner ring. Mounting on the shaft normally adopts loose fit. In this case, the following relationship between the shaft and the inner bore is recommended.

Dimensional accuracy of the shaft to be used in the cylindrical bore insert bearing (Loose fit)

Table29
Unit = 0.001mm

Shaft Diameter (mm)		for lower speed		for medium speed		for rather high speed		for high speed	
		symbol h 9		symbol h 8		symbol h 7		symbol j 6	
over	incl.	max.	min.	max.	min.	max.	min.	max.	min.
10	18	0	-43	0	-27	0	-18	+8	-3
18	30	0	-52	0	-33	0	-21	+9	-4
30	50	0	-62	0	-39	0	-25	+11	-5
50	80	0	-74	0	-46	0	-30	+12	-7
80	120	0	-87	0	-54	0	-35	+13	-9
120	180	0	-100	0	-63	0	-40	+14	-11

However, if the ball bearing unit is used at high rotation speed or under heavy load, the shaft fit must adapt a tight fit.

The bearing can be also installed to the shaft by use of the adapter assembly. This is convenient method that can be used as the intermediate bearing of relatively long shaft or a slight difference is found at the

shaft dimension. In this method, the bearing inner diameter makes 1:12 taper and the corresponding tapered adapter sleeve is applied, followed by nut tightening:

Therefore, a slight difference in shaft diameter does not cause much trouble.

Dimensional accuracy of the shaft to be used in cylindrical bore insert bearing(Tight fits case).

Table30
unit = 0.001mm

Shaft Diameter (mm)		Deviation of tolerance in shafting							
		for higher speed		for rather heavy load		for highest speed		for heavy load	
		symbol m6		symbol m7		symbol n6		symbol n7	
over	incl.	max.	min.	max.	min.	max.	min.	max.	min.
10	18	+18	+7	+25	+7	+23	+12	+30	+12
18	30	+21	+8	+29	+8	+28	+15	+36	+15
30	50	+25	+9	+34	+9	+33	+17	+42	+17
50	80	+30	+11	+41	+11	+39	+20	+50	+20
80	120	+35	+13	+48	+13	+45	+23	+58	+23
120	180	+40	+15	+55	+15	+52	+27	+67	+27

Dimensional accuracy of the shaft to be used in the taper bore insert bearing.

Table31
unit = 0.001mm

Deviation of tolerance in shafting					
Shaft Diameter (mm)		for short shaft		for long shaft	
		symbol h 9		symbol h 10	
over	incl.	max.	min.	max	min.
10	18	0	-43	0	-70
18	30	0	-52	0	-84
30	50	0	-62	0	-100
50	80	0	-74	0	-120
80	120	0	-87	0	-140
120	180	0	-100	0	-160

8.4 Limiting speed

The limiting speed of ball bearing units are mainly determined by the fit between the bearings and the shafts. Normally, clearance fit is used between setscrews type and eccentric collar type bearing units and shafts, then h7 shaft tolerance is selected. h8 or h9 tolerance is applied for light load and slow speed application. And tighter j7 tolerance is applied for heavy load and high speed. The shaft applied to the adapter sleeve bearing is h9 with IT5 class tolerances.

The speed ratings for insert bearing of CS200-2RS series are the same as deep groove ball bearings which are shown in following table.

The limiting speeds for the ball bearing units with different fits are shown in following table.

Table32
r/m

d (mm)	200 Series				300 Series				CS200–2RS
	Shaft tolerance				Shaft tolerance				
	JS7(h9/IT5)	h7	h8	h9	JS7(h9/IT5)	h7	h8	h9	
12	6700	5300	3800	1400	--	--	--	--	--
15	6700	5300	3800	1400	--	--	--	--	11000
17	6700	5300	3800	1400	--	--	--	--	10000
20	6000	4800	3400	1200	--	--	--	--	9000
25	5600	4000	3000	1000	5000	3600	2600	900	8000
30	4500	3400	2400	850	4300	3000	2200	800	6700
35	4000	3000	2000	750	3800	2800	2000	700	6000
40	3600	2600	1900	670	3400	2400	1700	630	5600
45	3200	2400	1700	600	3000	2200	1500	560	5000
50	3000	2200	1600	560	2600	2000	1400	500	4800
55	2600	2000	1400	500	2400	1800	1300	450	--
60	2400	1800	1200	450	2200	1700	1100	430	--

Table33

d (mm)	200 Series				300 Series				CS200–2RS
	Shaft tolerance				Shaft tolerance				
	JS7(h9/IT5)	h7	h8	h9	JS7(h9/IT5)	h7	h8	h9	
65	2200	1700	1100	430	2000	1500	1100	400	--
70	2200	1600	1100	400	1900	1400	1000	360	--
75	2000	1500	1000	380	1800	1300	900	340	--
80	1900	1400	950	340	1700	1200	850	320	--
85	1800	1300	900	320	1600	1100	800	300	--
90	1700	1200	800	300	1500	1100	750	280	--
95	--	--	--	--	1400	1000	700	260	--
100	--	--	--	--	1300	950	670	240	--
105	--	--	--	--	1200	900	630	220	--
110	--	--	--	--	1200	800	600	200	--
120	--	--	--	--	1100	750	530	190	--
130	--	--	--	--	1000	670	480	180	--
140	--	--	---	--	900	600	430	160	--

Note: 1. The JS7(h9/IT5) column fit for adapter sleeve type ball bearing units, and the rest j7～h9 column fit for the setscrews type and eccentric locking collar type ball bearing units.

2. Above table data is reference for J type seal, H type seal, SL type dual seal, F type seal products only.

9 MOUNTING OF BALL BEARING UNITS

9.1 Setscrew method

This method is to mount the bearing unit to the shaft with two set screws located at two places on one side of wide inner ring which make 120° each other.

FK setscrews are of self-locking knurled cup point types. This self-locking knurled cup point type setscrew has peculiar edge points as shown in the figure and counter-clockwise knurl to prevent loosing back. The material is special alloyed steel (Nickel chromium molybdenum steels) which has high tensile and shear strength. The hexagon hollow of setscrew is deeper than before and hence enough tightening force can be applied. The head is never broken nor deformed.

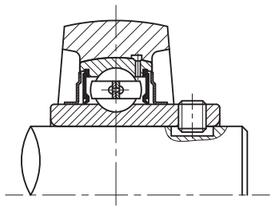
Installation to the shaft can be sufficiently made, if the grub screws are tightened by application of the tightening torque as shown in the following table.

Proper tightening torque of setscrews

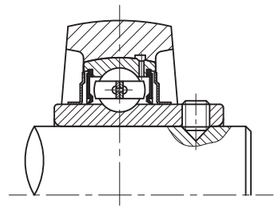
Table34

Setscrew (mm)	Tightening torque (N-M) (max)	Setscrew (inch)	Tightening torque (lbf-inch) (max)
M5x0.8	3.4	10-32UNF	30
M6x1.0	5.4	1/4-28UNF	48
M8x1.0	11.3	5/16-24UNF	100
M10x1.0	21.6	3/8-24UNF	192
M12x1.5	32.4	7/16-20UNF	210
M14x1.5	41.2	1/2-20UNF	287
M16x1.5	62.8	9/16-18UNF	365
M18x1.5	73.4	5/8-18UNF	556
M20x1.5	117.7		

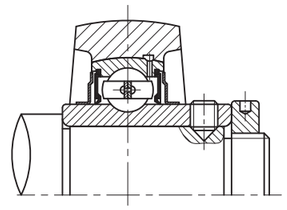
In case either the vibration is caused to the insert bearing, the reciprocal movement takes place,the load charged on the insert bearing is large, or the shaft revolution speed is rapid, then it is desired to provide with the filed seat or concave section at the part where the setscrews with the shaft. If the thrust load is large, it is more effective to use joggling tightened with nuts.



File the shaft surface where the setscrews are positioned.

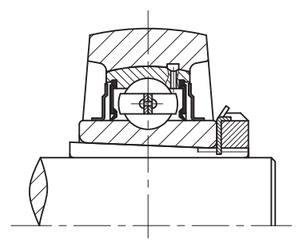


Make the concave section at the shaft surface where the set-screws are positioned.



When a large thrust load is charged, it is better to use joggling tightened with nuts.

9.2 Adapter assembly method



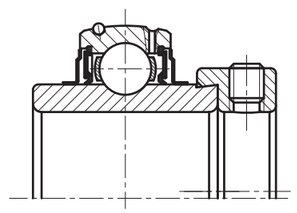
According to this system, the inner ring diameter of bearing has the taper of 1:12. Prior to the bearing installation the sleeve is installed to an arbitrary position as shown in the right drawing. After the shake-proof washer is inserted, the nut is tighted.

"The proper nut tightening condition can be obtained if it is tightened enough by a hand and is then rotated by 2/5 ~ 3/5 revolution with a spanner".

After the nut is tightened, bend the shake proof washer within the slot. If not, the nut may be loosened and the creep may be caused between the shaft and sleeve.

If tightened too hard, the clearance between the shaft and the sleeve may be reduced, and the exothermic and burning phenomenon may be caused.

9.3 Eccentric Locking Collar Method



The bearing installation to the shaft by using the eccentric locking collar is one of the methods. The eccentric part of the collar mates with section of inner ring, and in this way, the bearing is Locked to the shaft.

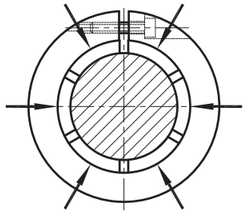
In the normal hexagonal hollow setscrew or adapter assembly case, the shaft and inner ring are simply locked. Different from such a method, the revolving force of shaft is utilized as the tightening force in this case.

The assembly to the shaft is done only by tightening the eccentric locking collar to the shaft by use of the setscrew.

The tightening force of the setscrew can be the same level as that of common setscrew type. Since the shaft revolution force or load does not directly act on the setscrew, the setscrew is not loosened.

9.4 Concentric Locking Collar Method

The concentric locking collar, with a single standard hex head cap screw and relief slot, provides great holding power. The collar, installed over the slotted inner ring, locks the bearing on the shaft concentrically without marring or burring and provides a 360 degrees clamping force to the shaft. The roundness of ball path on concentric locking bearings results in better operation and longer life. Concentric locking bearings can replace either setscrew or eccentric locking collar bearings.

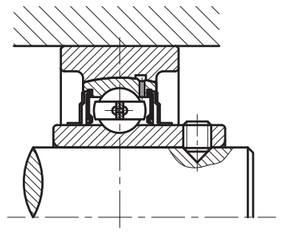


360°LOCKING

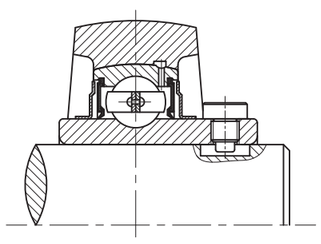
9.5 Axial movement due to expansion and shrinkage

It is often that under some driving conditions the shaft expands or shrinks, the bearing is moved. The wheel shafts of truck, for example, must be moved in thrust direction while to some extent. When the shaft is used at high temperature, the thermal expansion of shaft becomes larger as the shaft is longer. If the all bearing are fixed to the shaft in this case, an extraordinary thrust load is applied to the bearings due to thermal expansion and it may cause failure of the bearings.

For this reason, if there exist expansion and shrinkage of shaft or movement of bearing, a fixed type unit must be used at one and a moving type unit at the other.



As shown it is desirable to use cartridge type bearing of cylindrical outer diameter in a same manner with ordinary bearings. When using cartridge type housings, be careful not to cause creep at the time of insertion. every type of housing with above shown structure is prepared by **F K** for use at high temperature.



A key way is machined on the shaft and a dog point hexagon hollow setscrew is generally used in place of the setscrew. Axial movement due to shaft expansion and shrinkage is adjusted by this.

9.6 Mounting of the housing

It is desired to install the unit in the order of mounting housing firstly, and then mounting the shaft and bearing. The bearing unit can be installed in principle at any place in an easy way. However:

A. The mounting surface must be sufficiently rigid, the surface on which the housing is mounted should be as flat as possible, normally the requested flatness is 0.10-0.15mm or less.

B. It is desirable that the angle between the surface on which the pillow block or flange unit housing is mounted and the shaft be maintained to a tolerance less than ±2°. When the housing is installed with a open cover, the tolerance should be less than ±1°.

C. Cartridge unit is installed on the cylindrical hole of body as a free-end. H7 tolerance is applied for normal operation conditions. When working temperature is too high, G7 tolerance is suggested. If shocking load is applied, then special tolerance is necessary to be used. Please refer to following table:

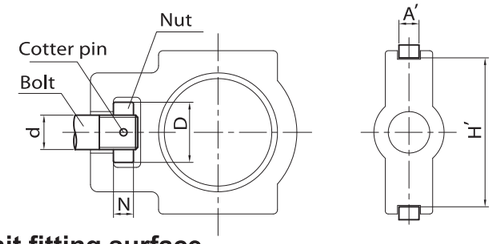
Table35

Unit = 0.001mm

Diameter/mm		Tolerance of dimension		
Over	Incl.	H7	Special tolerance	G7
50	80	+30～0	+25～0	+40～+10
80	120	+35～0	+29～0	+47～+12
120	180	+40～0	+33～0	+54～+14
180	250	+46～0	+38～0	+61～+15
250	315	+52～0	+42～0	+69～+17
315	400	+57～0	+47～0	+75～+18

D. Take up unit is installed on parallel guide rails, the housing moves on the guide rails by adjusting bolt to adjust distance to shaft center.

Mounting dimension and tolerance of take up unit.



Tolerance of take up unit fitting surface

Unit = 0.001mm

Table36

Housing No.	H′ ± 0.5	A′	d	D	N	Housing No.	H′ ± 0.5	A′	d	D	N
T204	77	11	16	28	12	ST204	77	12.5	16	28	12
T205	77	11	16	28	12	ST205	77	12.5	16	28	12
T206	90	11	18	32	12	ST206	90	12.5	18	32	12
T207	90	11	18	32	12	ST207	90	12.5	18	32	12
T208	103	15	24	42	14	ST208	103	16.5	24	42	14
T209	103	15	24	42	14	ST209	103	16.5	24	42	14
T210	103	15	24	42	14	ST210	103	16.5	24	42	14
T211	131	20	30	56	20	ST211	131	25	30	56	20
T212	131	20	30	56	26	ST212	131	25	30	56	26
T213	152	24	36	60	26						
T214	152	24	36	60	26						
T215	152	24	36	60	26						
T216	167	24	36	60	26						
T217	175	28	42	65	30						

9.7 Maintenance of bearing unit

9.7.1 After mounting the bearing unit, check that it has been done correctly:

A. Turn the shaft by hand to make certain that it rotates smoothly.

B. Run the machine at low speed under 0 load, check there are no abnormalities.

C. Run the machine at normal operation conditions, check working temperature rising trend and stable working temperature.

Main abnormalities and causes in bearing unit test running:

Table37

Abnormalities	Causes
Too high torque, Rotation torque is unstable	① Bad mounting，pre–tightening force is applied on the bearing at axial direction ② Seal contacts with flinger ③ Too small internal clearance.
Abnormal noise Abnormal vibration	① Setscrews on bearing or bolts on housing are not firmly tightened ② Too big internal clearance ③ Shaft is bent ④ Low shaft accuracy ⑤ Mounting surface is not flat and rigid
Abnormal temperature rising	① Too small internal clearance. ② Bad mounting，pre–tightening force is applied on the bearing at axial direction ③ Too heavy load ④ Exceed limiting speed ⑤ Mounting surface is not flat ⑥ Seal contacts with flinger

9.7.2 Inspection during operation

In order to have the long service life, it is necessary to inspect the bearing units regularly during operation. While the interval between inspections varies from case to case, according to the degree of importance and the rate of operation, it is usually some time between two weeks and a month. Main regular inspections:

A. Bolt B. Setscrews C. Noise or vibration D. Working temperature E. Relubrication

Main abnormalities and causes in bearing unit regular inspection

Table38

Abnormalities	Causes
Too high torque	①Grease degradation ②Too much grease, seal contacts with flinger ③Deformated flinger contacts with seal ④Abnormal load
Abnormal noise Abnormal vibration	①Setscrews or bolt loose ②Wear of contact surface between shaft and inner ring ③Foreign matter invade into bearing ④Fatigue of bearing raceway ⑤Indentation on bearing raceway ⑥Shaft is bent
Abnormal temperature rising	①Grease degradation ②Too much grease, seal contacts with flinger ③Deformated flinger contacts with seal ④Setscrews loose ⑤Abnormal load ⑥Fatigue of bearing raceway

10 MOUNTED UNITS NUMBERING SYSTEM

The FK bearing numbering system utilizes a basic bearing number to indicate the appropriate bearing series, and a complementary set of prefex and suffix designations which allow a complete description of any bearing configuration. The sequence of FK designations and their meanings is shown below.

Table39

First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth	Tenth	Eleventh	Twelfth
Bearing Material	Bearing O.D. Modification	Bearing Insert Type	Housing Type	Basic Bearing Series	Housing Material	Shaft Size in 1/16" for Inch Type Bearings	Special Seals	Relube Type When Non-Standard	Snap Ring	Internal Clearance	Max operating temperature
		UC	P	210	D	- 31	L3				
SS	C	SB		205		- 16		G	NR	C_4	HT20

FK PREFIXES

C..... Cylindrical O.D. on Bearing

SS..... 440C Stainless Steel Material

FK SUFFIXES

B-MN..... Housing with back groove for fiting back seal

BO..... Bearing with Black Oxid.

C_1..... With an Open Type Pressed Steel End-cover&Rubber Seal.

D_1..... With a Close Type Pressed Steel End-cover

FH..... Housing with Special Dimension of Fixed Bore

HT20.....High temperature operating + 200℃

MN.....Housing with groove for fitting End-cover.

NC.....No collar on SA or HC type, or
Nylon coated Set Screw if SB; UC or SER types.

Q..... Ductile iron housing

S.....Solid base housing

WB.....Without anti-Rotation Ball

ZP.....Bearing with Zinc Plated

Special Seals

L_3.....Triple Lip Seal

F..... F Type Seal

Relubrication

Blank..... Standard feature (See footnote 1 and 2)

N ..... Non-relube housing

G ..... Relubrication Groove and Holes

Snap ring

N ..... Groove Without Ring

NR .....Groove With Ring

Internal Clearance

Blank (CN) .... Standard

C_2 ..... Tight

C_4 ..... Loose

C_5 ..... Extra Loose

EXAMPLES

UC P 205 – 16

1. Bearing Insert Type
   Housing Type
   Basic Bearing Series
   Bearing Shaft Size in 1/16 of an inch

UC 205–16 C_4 HT20

2. Bearing Insert Type
   Basic Bearing Series
   Bearing Shaft Size in 1/16 of an inch
   Bearing Clearance and extra loose
   Operating high temperature +200℃

SS–SB 205–16 G

3. Bearing Raw Material
   Stainless Steel AISI 440C
   Basic Insert Type
   Basic Bearing Series
   Bearing Shaft SIze in 1/16 of an inch
   Relubrication Groove and Holes

NOTES:

1.UC, HC, UCX,NC and SER type inserts are relubricatable as standard; no "G" suffix is required.

2.SA, SB, JA,JB type inserts are non–relubricatable as standard. To specify as relubricatable type, add "G" suffix (e.g., SA205–16G).

3.As there is only one metric bore size per basic bearing series, no shaft size specification is necessary (e.g., UC205 Indicates 25 mm bore).