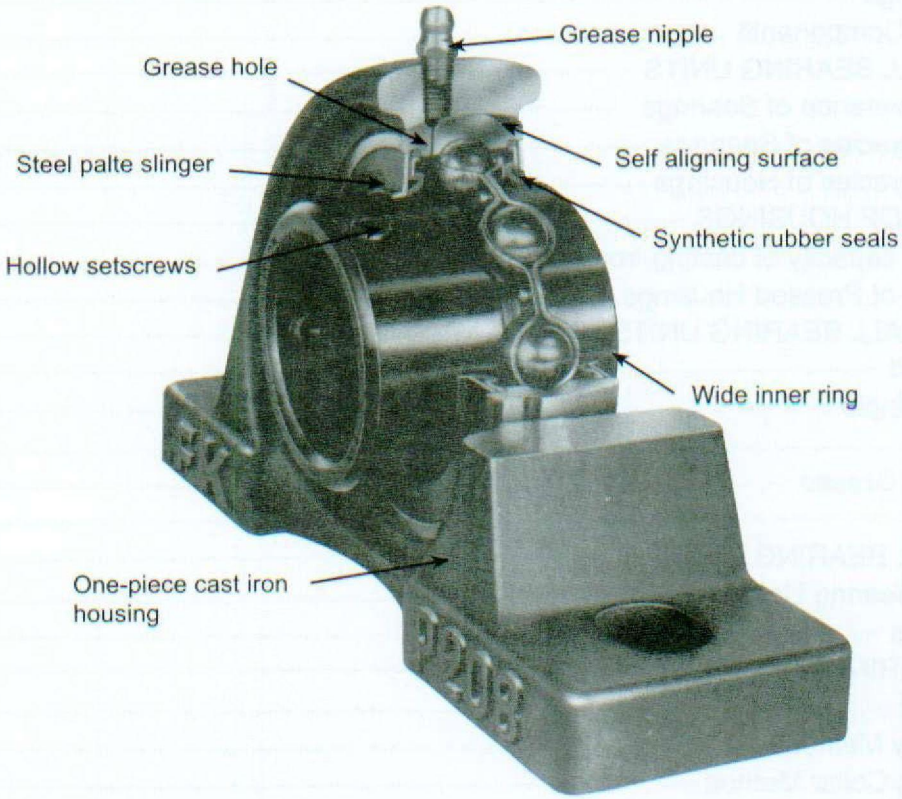
CONTENTS

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 three grease holes provides efficient flow of grease to ball and raceways.

(C). Hollow set screw .....Two hollow set screw ensures 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 BALL BEARING UNITS AND BEARING HOUSINGS

A ball bearing unit consists of a ball bearing and a bearing housing. There are many different ball bearing units available. **Table 1** shows some of the combinations of ball bearings and housings. Also, there are many kinds of ball 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 2** lists the ball bearings for bearing units. The solid circle ●means that the units or bearings are listed in the dimensional tables, while the white circle○ means that bearing units or bearings are not listed. Please contact FK for the availability of bearing units marked with ○symbol.

Table 1 Combinations of ball bearings and bearing housings

Housing model	Models of ball bearings for units											
	UC2	UC3	UCX	UK2	UK3	UKX	SB2	SA2	HC2	HC3	SC2	SC3
P(PX)	●	●	●	●	●	●	○	○	●	●		
F(FX)	●	●	●	●	●	●	○	○	●	●		
FL(FLX)	●	●	●	●	●	●	○	○	●	●		
FC(FCX)	●		●	●		○	○	○	◉			
T(TX)	●	●	●	●	●	●	○	○	●	●		
C(CX)	●	●	●	●	●	●	○	○	●	●		
PA	●			○			○	○	○			
PG	●			○			○	○	○			
PH	●			○			○	○	○			
PW	●			○			○	○	○			
FA	●			○			○	○	○			
FB	●			○			○	○	○			
FD							●	●				
FS		●			○					○		
FT	○								○			
FU	●								○			
FW							●	●				
HA	●			○			○	○	○			
HE	●			○			○	○	○			

Housing	Models of ball bearings for units											
model	UC2	UC3	UCX	UK2	UK3	UKX	SB2	SA2	HC2	HC3	SC2	SC3
LF							●	●				
LP	●			●			○	○	○			
PF							●	●				
PFL							●	●				
PFT							●	●				
PP							●	●				
PPR							●	●				

Table 2 Variety of ball bearing models

Model	Models of ball bearings for units												
classification	UC2	UC3	UCX	UK2	UK3	UKX	SB2	SA2	HC2	HC3	SC2	SC3	SER
metric bore	●	●	●	●	●	●	●	●	●	●	●	●	●
inch outer ring outside	●	●	●	●	●	●	●	●	●	●	○	○	●
dimensional bore Cylindrical	●	○	○	○	○	○	●	●	○	○			●

3. MATERIALS OF BALL BEARING UNITS

3.1 Materials of 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 <JIS G4805>(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

Class	JIS Symbol	Chemical Composition (%)					
		C	Si	Mn	P	S	Cr
1	SUJ1	0.95-1.10	0.15-0.35	Under 0.50	Under0.025	Under0.025	0.90-1.20
2	SUJ2	0.95-1.10	0.15-0.35	Under 0.50	Under0.025	Under0.025	1.30-1.60
3	SUJ3	0.95-1.10	0.40-0.70	0.9-1.15	Under0.025	Under0.025	0.90-1.20

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 JIS-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.

Material of the Cage and the Rivet

The material of cage is JIS G3141 (Cold rolled carbon steel sheet and strip) SPCC, and it is formed by the press.

The material of the rivet is JIS G3507 (Low carbon steel wire rods) SWRCH 12A.

3.2 Materials of Housings

The material of the housings is HT200 JIS G5501(Gray iron casting) and the mechanical properties are shown in the following table.

Mechanical properties of Gray cast iron HT200

symbol	Thickness (mm)	Dia. Of testing bar (mm)	Tension test	Traverse braking test		Pressure strength	Hardness test
			Tensile strength	Bender strength	Deflection		Hardness
			(kgf/mm^2)	(kgf/mm^2)	(mm)	kgf/mm^2	(HB)
HT200 (FC200)	Over 6-8	13	Over 32	53	1.8	75	187-255
	Over 8-15	20	Over 25	45	2.5	75	170-241
	Over 15-30	30	Over 20	40	2.5	75	170-241
	Over 30-50	45	Over 18	34	3.0	75	170-241
	Over 50	60	Over 16	31	4.5	75	163-229

3.3 Materials of Other Components

Components	Materials used	JIS symbols	JIS number
Sleeve for adapter	Carbon steel for machine structural use	S25C	JIS G 4051
Nut for adapter	Carbon steel for machine structural use	S25C	JIS G 4051
Washer for adapter	Cold rolled carbon steel sheet and strip	SPCC	JIS G 3141
Oil seal	Synthetic nitrile rubber	-	-
Slinger	Cold rolled carbon steel sheet and strip	SPCC	JIS G 3141
Hexagon set screw	Nickel chromium molybdenum steel	SCM 435	JIS G 4105
Hexagon wrench key	Nickel chromium molybdenum steel	SNCM630	JIS G 4103
Grease nipple	Free cutting brass bar	C3604	JIS H 3250

4. ACCURACY OF BALL BEARING UNITS

4.1. Radial Internal Clearance of Bearings

The radial internal clearance of the bearing for the unit is same with the reference value of JIS B1520 deep-groove ball bearings. Generally, the Normal clearance is adopted for cylindrical bore bearings and C3 clearance which is a little greater is adopted for 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 bearings

Unit = 0.001mm

Bore diameter d (mm)		Clearance symbols							
		C2		Normal		C3		C4	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
10	18	0	9	3	18	11	25	18	33
18	24	0	10	5	20	13	28	20	36
24	30	1	11	5	20	13	28	23	41
30	40	1	11	6	20	15	33	28	46
40	50	1	11	6	23	18	36	30	51
50	65	1	15	8	28	23	43	38	61
65	80	1	15	10	30	25	51	46	71
80	100	1	18	12	36	30	58	53	84
100	120	2	20	15	41	36	66	61	97
120	140	2	23	18	48	41	81	71	114

4.1.2. Tapered bore bearings

Unit = 0.001mm

Bore diameter d (mm)		Clearance symbols							
		C2		Normal		C3		C4	
over	incl.	min.	max.	min.	max.	min.	max.	min.	max.
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

4.2. Dimensional Accuracies of Bearings

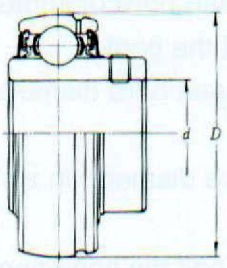
The dimensional accuracy of FK bearings follows the dimensional accuracy prescribed in ISO/TC4/SC6 ball bearings for rolling bearing units.

4.2.1.Accuracies of outer ring

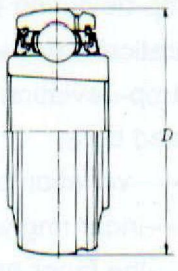
Unit = 0.001mm

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

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

Unit = 0.001mm

d (mm)		Cylindrical bore bearing								Kia
		Bore diameter						△Bs, Cs		
		UC,HC,SA,SB,SER			SC			△Bs, 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.

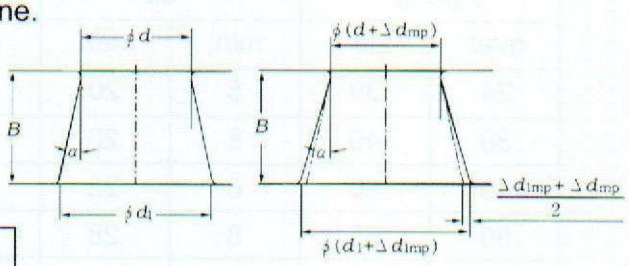
△dmp-deviation of mean bearing bore diameter in a single plane.

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

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.

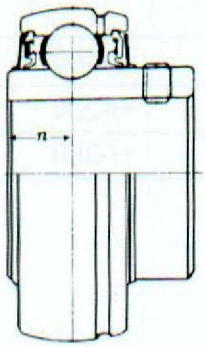
Vdp-----variation on bore diameter in a single radial plane.

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

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

a = 2° 23' 9.4" = 2.385 94°= 0.041 643 rad.

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



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 JIS B 1559 housings for rolling 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

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

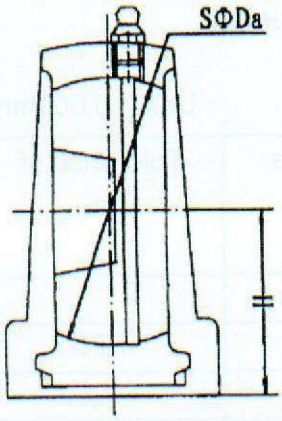
Notes: a).D1m is given by he following equation, where D1max and D1min in the equation are maximum and minimum values measured respectively.

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

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.

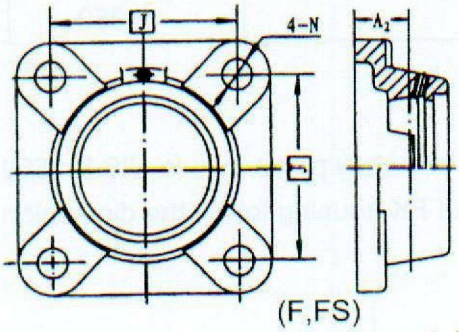
4.3.2. Dimensional Accuracies of Pillow Block-type Housings



Unit = 0.001mm

Housing nominal No. P.LP.PH.PA.PW.	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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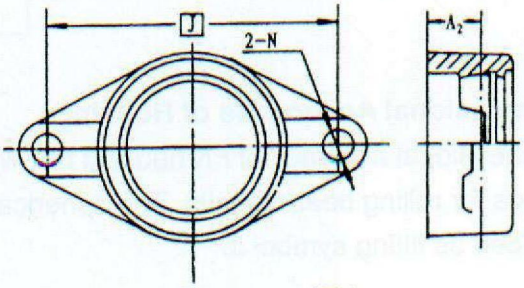

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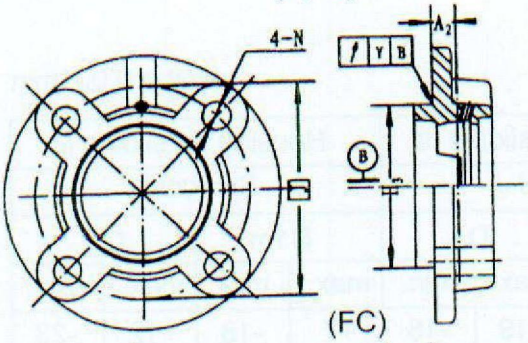

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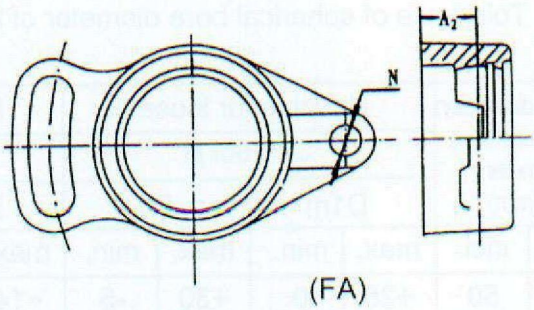

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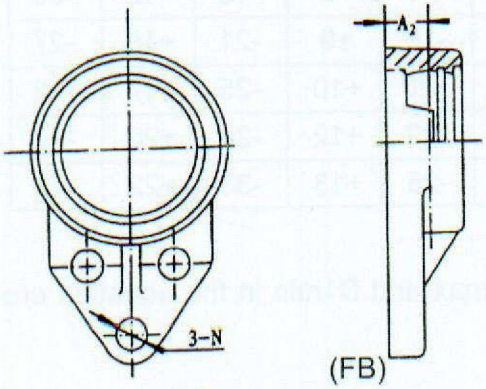

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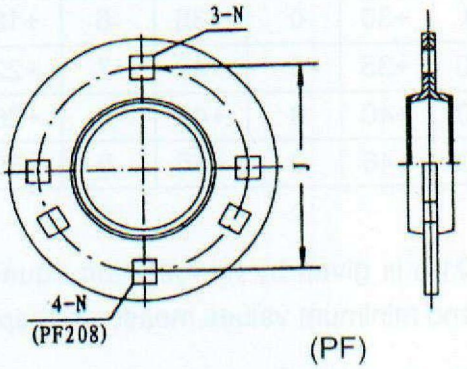

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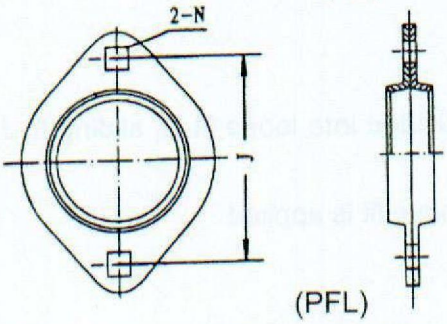

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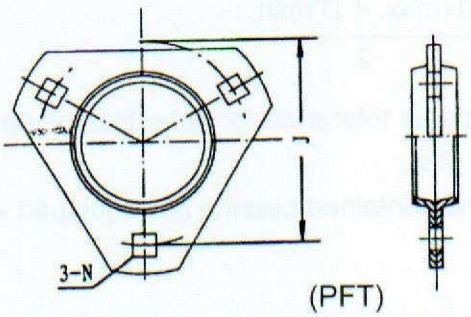


(PFT)

Unit = 0.001mm

Unit = 0.001mm

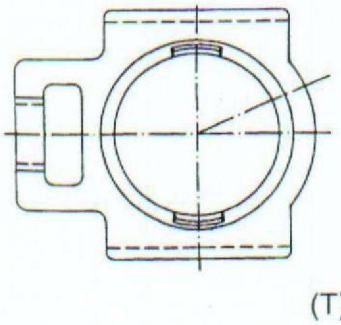
Housing nominal No.			Tole-rance of J	Tole-rance of A_2	Housing nomina No.			Tolerance of H_3						Tolerance of J	Tolerance of A_2	Tolerance of spigot run-out max. Y
								FC 2..		FCX..		FS 3..				
F,FL	F,FL	F,FL			FC	FC	FS	max.	min.	max.	min .	max.	min.			
204	-	-			204	-	-			-	-	-	-			
205	X05	305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

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

Unit = 0.001mm

Unit = 0.001mm

Housing nominal No.			Tole-rance of A_1	Tole rance of H_1	Paral lelism of sliding solt	Housing nominal No.			Tolerance of H						Tolerance of Y	Tolerance of A
									C 2..		CX..		C 3..			
T2	TX	T3			max.	C2	CX	C3	max.	min.	max.	min .	max.	min.		
204	-	-	+200 0	0 -500	500	204	-	-			-	-	-	-	200	±200
205	X05	305				205	X05	305	0	-30						
206	X06	306				206	X06	306			0	-35	0	-35		
207	X07	307				207	X07	307								
208	X08	308				208	X08	308								
209	X09	309				209	X09	309	0	-35						
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	0	-40						
213	X13	313				213		313			-	-				
214	X14	314				-	-	314	-	-						
215	X15	315				-	-	315					0	-46		
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								



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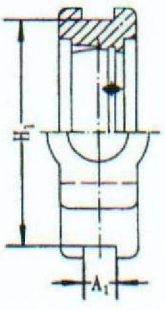

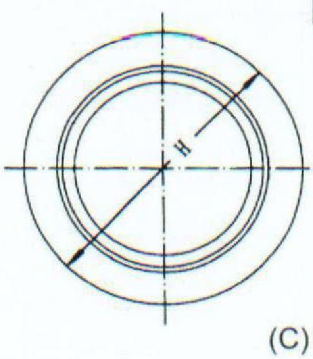

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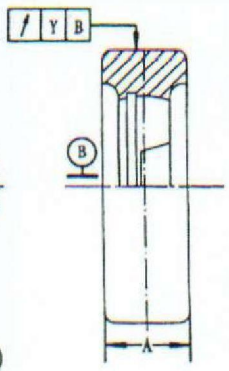


4.3.5 .Dimensional accuracies which are not prescribed individually in dimensional accuracy of housings

The accuracies of machining parts which are not prescribed in the foregoing dimensional accuracies of housings follow **JIS B 0405** [permissible machining deviations in dimensions without tolerance indication] middle class accuracy of machining.

Unit = mm

Dimensions	over 0.5 incl. 6	over 6 incl. 30	over 30 incl. 120	over 120 incl. 315	over 315 incl. 1000
Middle class dimensional tolerance	±0.1	±0.2	±0.3	±0.5	±0.8

4.3.6.Tolerance of castings.

Dimensional accuracies of casting follow JIS B 0407 [Permissible deviations in dimensions without tolerance indication for iron castings] medium class accuracy.

Unit = mm

Tolerance in length			Tolerance in thickness		
Nominal dimensions		Tolerance	Nominal dimensions		Tolerance
over	incl.		over	incl.	
-	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

5. ALLOWABLE LOAD OF HOUSINGS

The allowable loading capacities of the housings differ substantially, depending on the housing shape and the load direction. Since the ball bearing units is complicated in form, it is difficult to calculate their allowable loading capacities. In many cases, such values are entirely different from the actual ones.

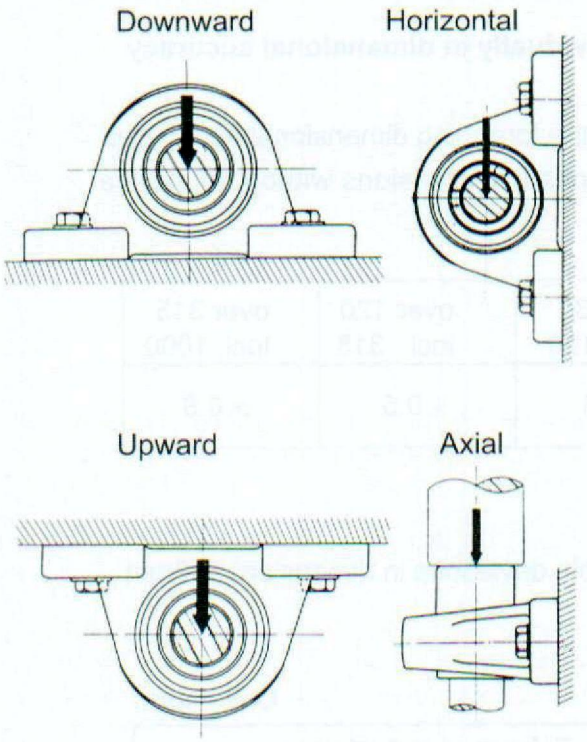
For such reason, the P type housings is taken up here as the most popular example. The strength to the load from each direction is shown here as obtained from the actual test.

5.1 Allowable loading capacity of Cast-iron Housing

As to the P type housing the destruction strength of downward, upward, horizontal and axial directions is shown below.

The difference between the Loading capacity and the destruction of the housing represents the safely of the housing.

Destruction strength of Pillow type housing



Nominal number	Downward direction destruction strength (kgf)	Upward direction destruction strength (kgf)	Horizontal direction destruction strength (kgf)	Axial direction destruction strength (kgf)
P203	7100	3000	5000	1100
P204	8100	3300	5600	1700
P205	9400	3700	6100	1800
P206	12300	5000	9000	2200
P207	16200	6100	10100	2400
P208	18100	6600	10900	2500
P209	18800	7000	12400	2600
P210	19400	7500	13800	3200
P211	21000	8200	15200	3400
P212	27500	10500	17300	4400
P213	29000	11500	19000	5100
P314	39900	16400	27000	9500
P315	42600	18300	30000	11100
P316	46800	19400	34500	12300
P317	49100	20900	36000	12700
P318	54900	22400	38400	13400
P319	59900	24000	41800	14000
P320	67800	27100	56300	17400
P322	83000	33000	60400	19000

5.2 Allowable Load of Pressed Housings

Pressed housing shows deformation when subjected to the 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 housings must be such an amount that deformation of the housing may not disturbed the function.

The allowable load of the plate housing is approximately 1/3 of the basic load rating in the radial direction, and approximately 1/3 of allowable radial load in the axial (thrust) direction.

6. LUBRICATION OF BALL BEARING UNITS

6.1 Permissible Speed

Permissible speed of a ball 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.

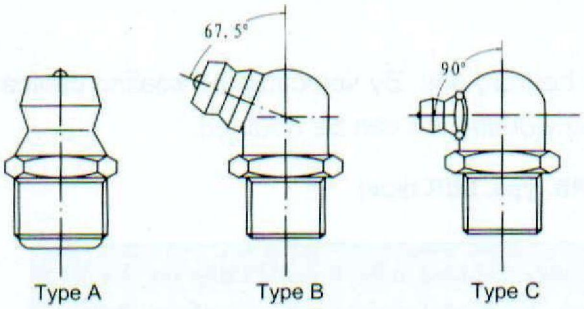
When such factors are taken into consideration, the permissible speed is given as follows:

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



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	203(S)~210 305~309 X05~09	M6X1
	211~215 310~315 X10~14	M8X1
	216~218	M10X1
	316~328 X15~20	

6.3 Lubricant Grease

Ball bearing units adopts the lubrication mechanism by grease. Since the ball 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, "Gold Pillow Lube" grease is used for the standard product of F K and is lithium saponification radical grease. It is most suitable for the ball bearing.

6.4 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 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 bearing too much or the bearing is subjected to the high temperature, the grease must be supplied periodically according to the grease deterioration.

F K 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 follows:

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.

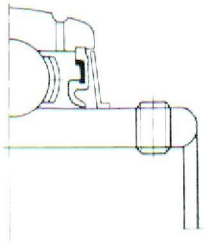
Grease supply period

Ambient condition	Bearing operation temp (°C)		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

7. SEALING DEVICES

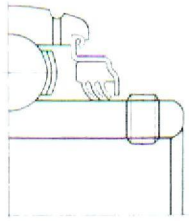
Following kinds are used as the sealing device of FK ball bearing unit. By selecting the sealing device which is most suitable to the application condition, the bearing working life can be doubled.

7.1 B-type sealing device (Applicable bearing...UC type, HC type, RB type, SER type)



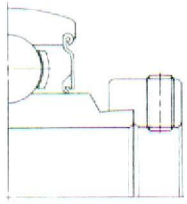
This is the original sealing device. Oil seal is fixed in the outer ring inner diameter groove, while the slinger is set at the inner with inner ring outer diameter .Furthermore, the simultaneous revolution with inner ring generates the wind pressure for dust-proof property This constitute the ideal labyrinth. Effective dust-proof property is thus guaranteed.

7.2 L-III type Sealing Device (Applicable bearing ... UC type, UK type, HC type, RB type, SER type)



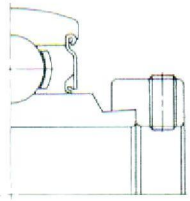
This is an epochmaking new seal. which can be said to be a revolution in the bearing sealing. The metal cap and synthetic rubber seal are baked together to form a single seal. Seal lip has sufficient tightening allowance. Furthermore, the lip layers are of double or triple construction and the foreign matters such as dust, water, etc. are completely shut out. This sealing system shows its outstanding performance under such severe ambient conditions as dust, dirty water, gas and chemicals, where it has been so difficult to be controlled.

7.3 J type Sealing Device (Applicable bearing ... SA type, SB type, SC type)



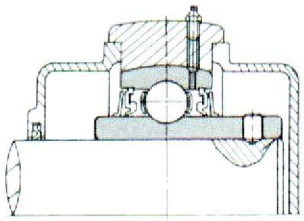
Synthetic rubber is adhered by baking to the core piece.
It is inserted into groove of the outer ring and fitted the inner ring Outer diameter.
It has low friction, high property in oil resistance and good mechanical stability.

7.4 K type Sealing Device (Applicable bearing ... SA type)

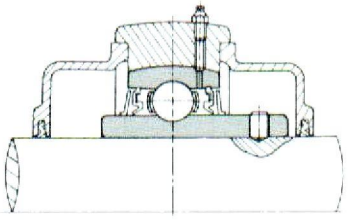


Special synthetic rubber is baked at the inside of thick steel shield plate and is fixed with the outer ring of bearing. The inner ring Outer diameter special synthetic rubber contacts reasonably tight so that the friction resistance will be lessened. The thick steel plate protects the rubber seal. This combined effect ensures the long service life even under considerably unfavorable conditions.

Dust-proof Unit with end-covers:opened



Dust-proof Unit with end-covers:one opened,another closed



8. HANDLING OF BALL BEARING UNITS

8.1 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.

8.2 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 bearing (Loose fit)

Unit = 0.001mm

Shaft Diameter (mm)		for lower speed symbol h 9		for medium speed symbol h 8		for rather high speed symbol h 7		for high speed 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 a convenient method that can be used as the intermediate bearing of a 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 bearing (Tight fits case). unit = 0.001mm

Shaft Diameter (mm)		Deviation of tolerance in shafting for higher speed symbol m6		for rather heavy load symbol m7		for highest speed symbol n6		for heavy load 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 bearing. unit = 0.001mm

Shaft Diameter (mm)		Deviation of tolerance in shafting for short shaft symbol h 9		for long shaft 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

9. MOUNTING OF BEARING ON SHAFTS

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.

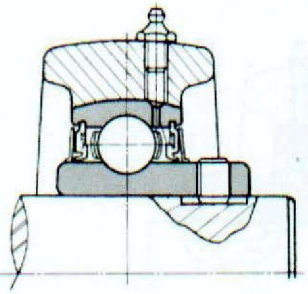
F K setscrews are of self-locking knurled cup point types. This self-locking knurled cup point type setscrew has peculiar edge points as shown in the figure and counter-clockwise knurl to prevent loosing back. The material is special alloyed steel (Nickel chromium molybdenum steels) which has high tensile 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.

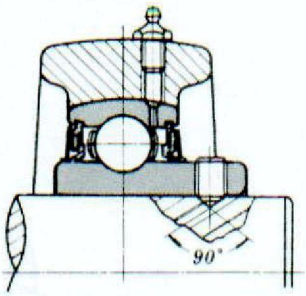
Proper tightening torque of setscrews

Bearing No.				Setscrew	Tightening torque (kgf-cm)
SB201~203				M5x0.8	35
SB204~206	UC201~UC206	UCX05	UC305~UC306	M6x1.0	55
SB207~209	UC207~UC209	UCX06~UCX08	UC307	M8x1.0	115
SB210~212	UC210~UC213	UCX09~UCX12	UC308~UC309	M10x1.0	220
	UC214~UC218	UCX13~UCX17	UC310~UC314	M12x1.5	330
		UCX18	UC315~316	M14x1.5	420
		UCX20	UC317~319	M16x1.5	640
			UC320~UC324	M18x1.5	750
			UC326~UC328	M20x1.5	1200

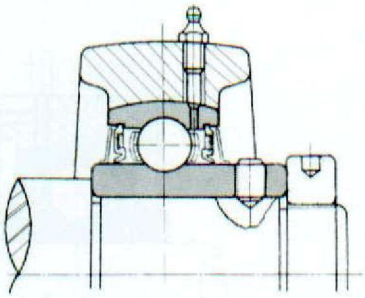
In case either the vibration is caused to the bearing, the reciprocal movement takes place, the load charged on the bearing is large, or the shaft revolution speed is rapid, then it is desired to provide with the filed seat or concave section at the part where the setscrews with the shaft. If the thrust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

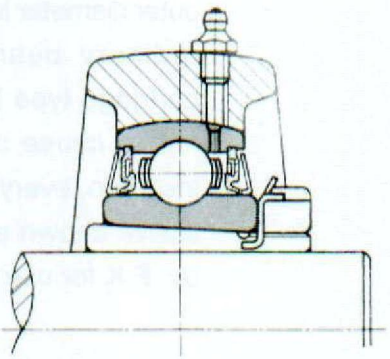
9.2 Adapter assembly method

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.

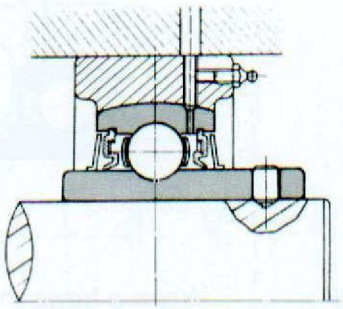
The assembly to the shaft is done only by tightening the eccentric locking collar to the shaft by use of the setscrew.

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.

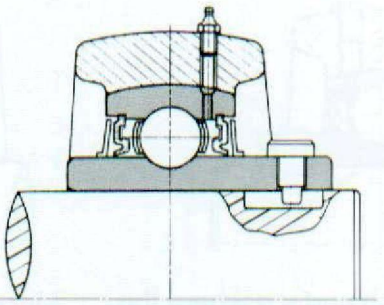
9.4 Axial movement due to expansion and shrinkage

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.

9.5 Mounting method of housings

It is desired to install the unit in the order of housing ⟶ shaft and bearing .

The bearing unit can be installed in principle at any place in an easy way. However, in order to have the long service life, it is desired that mounting base is flat and rigid. The mounting base should have in principle the bearing center alignment angle of less than ± 3° , when the unit is installed there. In the case of the unit with covers the bearing center alignment angle should be less than ± 1° form point of view of covers used.

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.

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	C4	HT20

FK PREFIXES

C.....Cylindrical O.D. on Bearing
S..... 440C Stainless Steel Material

FK SUFFIXES

B-MN..... Housing with back groove for fiting back seal
BO..... Bearing with Black Oxid.
C1 ..... With a Open Type Pressed Steel End-cover&Rubber Seal.
D1 ..... With a Close Type Pressed Steel End-cover
FH ..... Housing with Spercial Dimension of Fixed Bore
HT20 .....High temperature operating + 200°C
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.
WB .....Without anti-Rotation Ball
ZP ..... Bearing with Zinc Plated

Special Seals

L3.....Triple Lip Type Armor Seal

Relubrication

Blank.....Standard feature (See footnote 1 and 2)
N ..... Non-relube housing
G .....Relubrication Groove and/or Holes

Snap ring

N ..... Groove Without Ring
NR ..... Groove With Ring

Internal Clearance

Blank (C0) ... Standard
C2 ..... Tight
C3 ..... Loose
C4 ..... 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 C4 HT20

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

C SB 205–16 G

3. Cylindrical O.D.
Basic Insert Type
Basic Bearing Series
Bearing Shaft SIze in 1/16 of an inch
Relubrication Groove and Holes

NOTES:

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