TECHNICAL INFORMATION T 1 - 16

The Spherical Outside Surface Ball Bearings of *HYC* are deep groove ball bearing with wide and narrow inner rings, consisting of insert bearings (SA200, SB200, UC200, UEL200, UK200, UCX00 and UC300) and various housings. The types of bearing units are defined according to the different mounting methods of the bearings to shafts : the set-screws type, the adapter type, the eccentric locking collar type.

The *HYC* housings are mainly casting housings. There are pressed steel plate housings as well align with ease during operation and can be conveniently mounted or dismounted.

The bearing units can operate satisfactorily under working conditions, especially for machines operating in dusty or muddy surroundings. Thus, they are widely used in agricultural, construction and transmission machineries, etc..

There are various types of sealing devices for our products, such as synthetic rubber seals, slinger with synthetic rubber seals and triple lip seals etc..

Sufficient lubricating grease has been put into the bearings during manufacturing, which can act as lubricating as well as rust proof. No more grease is needed to put in during the lubricating period when the bearings operate under normal conditions. Lubricating grease can be added from the fittings when the relubricate bearings operate under hard conditions.

The outer ring of the bearing has spherical outside surface which can be fitted to the concave spherical surface of the housing, and the fit between them can be clearance fit or interference fit according to different conditions. This combination provides self-alignment between the self-contained bearing and the housing, and compensates for a certain alignment errors or flexing of the shaft when the bearing is in operation. This definitely increases the bearing service life.

1. Lubrication

The Spherical Outside Surface Ball Bearings of *HYC* generally use rust proof lithium based lubricating grease, with physical chemical properties shown in the following Table 1.1. Grease is filled in the Spherical Outside Surface Ball Bearings during manufacturing.

Table 1.1 Physical chemical properties of lubricating grease

Density (1/mm)	Without operation	268
	Operated 60 times	260
Dropping point (°C)		128
Mechanical impurities	10-25 μm	within 1000
(pc / gram)	25-75 μm	within 500
	above 75 μm	0
Base oil kinematical Viscosity 40°C cst		80.3

The bearings usually operate below the temperature of 120℃ (the measuring temperature of the outer rings is 100℃) . Grease life reduction has to be taken into account when the bearing continues to operate at a temperature above 70℃. The lowest operating temperature should not be lower than - 20℃.

The permissible speed of rotation is connected with the fit between shaft and bearing . It is recommended that, under normal operating conditions, the fit between the bearing and the shaft is h7. Looser fit allowing lower speed is recommended when heavier load is applied.

2. Tolerance for Bearing Units

Table 2.1.1 Tolerances on inner rings of bearing with cylindrical bore   Unit:0.001 mm

Nominal bore diameter d		Cylindrical bore						Radial run-out
		Bore diameter				Width		
Over (mm)	Incl. (mm)	dm Deviations		d Deviations		Bi Deviations		
		High	Low	High	Low	High	Low	(Max.)
10	18	+18	0	+22	-4	0	-120	12
18	30	+21	0	+25	-4	0	-120	15
30	50	+25	0	+30	-5	0	-120	18
50	80	+30	0	+36	-6	0	-150	22
80	120	+35	0	+42	-7	0	-200	28
120	150	+40	0	+48	-8	0	-250	35

Note: dm is defined as the arithmetical mean of the largest and the smallest diameter obtained by two-point measurements.

Table 2.1.2 Tolerances on inner rings of bearings with tapered bore   Unit:0.001 mm

Nominal bore diameter d		Δd Deviations		$\Delta d_1 - \Delta d$	
Over (mm)	Incl. (mm)	High	Low	Max.	Min.
18	30	+33	0	+21	0
30	50	+39	0	+25	0
50	80	+46	0	+30	0
80	120	+54	0	+35	0
120	150	+63	0	+40	0

Note (1) The deviations from nominal taper are defined by the limits of (Δd_1 - Δd),
        where(Δd_1 is actual deviation of d_1 from nominal diameter at the largest
        end of bore and Δd is actual deviation of d from bearing bore nominal
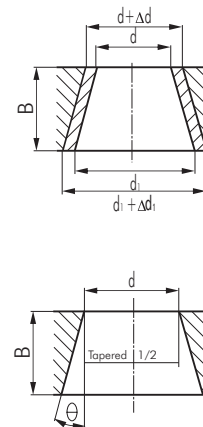   diameter.
     (2) d_1 is obtained by the following formula:
        $d_1 = d + 0.083333 B$
        Where B is width of the bearing inner ring.
     (3) The nominal taper angle = 2°23'9.4"
     (4) Pleas refer to the Figs. 2.1.2

Figs. 2.1.2

Table 2.1.3 Tolerances on outer ring   Unit: 0.001 mm

| Nominal bore diameter D		Dm Deviations		Radial run-out
Over (mm)	Incl. (mm)	High	Low	(Max.)
40	50	0	-11	20
50	80	0	-13	25
80	120	0	-15	35
120	180	0	-18	40
180	250	0	-20	45

Note: (1) Dm is defined as the arithmetical means of the largest and the smallest diameter obtained by two-point measurement.
(2) The low deviation of outside diameter Dm does not apply within the distance of 1/4 the width of outer ring from the sides.

Table 2.1.4 Tolerance for distance "n" between the radial plane passing through center of outer ring and aside of inner ring
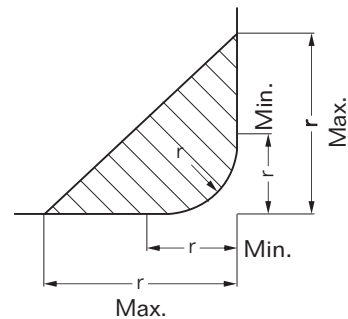### Unit: 0.001 mm

Nominal bore diameter d		n Deviations
Over (mm)	Incl. (mm)	
40	50	±200
50	80	±250
80	120	±300
120	160	±350
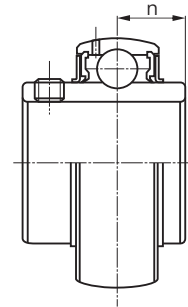
Please refer to Fig. 2.1.4

Fig. 2.1.4

Table 2.1.5 Chamfer dimensions

Nominal dimensions r (mm)	r	
	Max. (mm)	Min. (mm)
1.0	1.5	0.6
1.5	2.0	1.0
2.0	2.5	1.5
2.5	3.0	2.0
3.0	3.5	2.5
3.5	4.0	3.0
4.0	4.5	3.5
5.0	6.0	4.0

Please refer to Fig. 2.1.5

Fig. 2.1.5

2.2.1 Center height tolerances for pillow block type housings
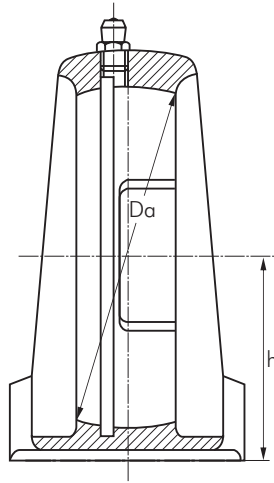
Please refer to below Figs. 2.2.1 and Table 2.2.1

Fig. 2.2.1

## Table 2.2.1 Center height tolerances for pillow block type housings (P, PA, PW, PH)

Unit: 0.001 mm

Housing No.						h Deviations
P 203			PA 203			
P 204			PA 204	PW 204	PH 204	
P 205	P X05	P 305	PA 205	PW 205	PH 205	
P 206	P X06	P 306	PA 206	PW 206	PH 206	±150
P 207	P X07	P 307	PA 207		PH 207	
P 208	P X08	P 308	PA 208	PW 208	PH 208	
P 209	P X09	P 309	PA 209		PH 209	
P 210	P X10	P 310	PA 210		PH 210	
P 211	P X11	P 311	PA 211		PH 211	
P 212	P X12	P 312	PA 212		PA 212	
P 213	P X13	P 313	PA 213		PH 213	
P 214	P X14	P 314			PH 214	
P 215	P X15	P 315			PH 215	±200
P 216	P X16	P 316			PH 216	
P 217	P X17	P 317				
P 218	P X18	P 318				
		P 319				
	P X20	P 320				
		P 322				
		P 324				
		P 326				±300
		P 328				

2.2.2 Tolerances for flanged type housings (F, FL, FA, FB, FC)

Please refer to below Figs. 2.2.2 (a), 2.2.2 (b) and Table 2.2.2 (a), 2.2.2 (b).
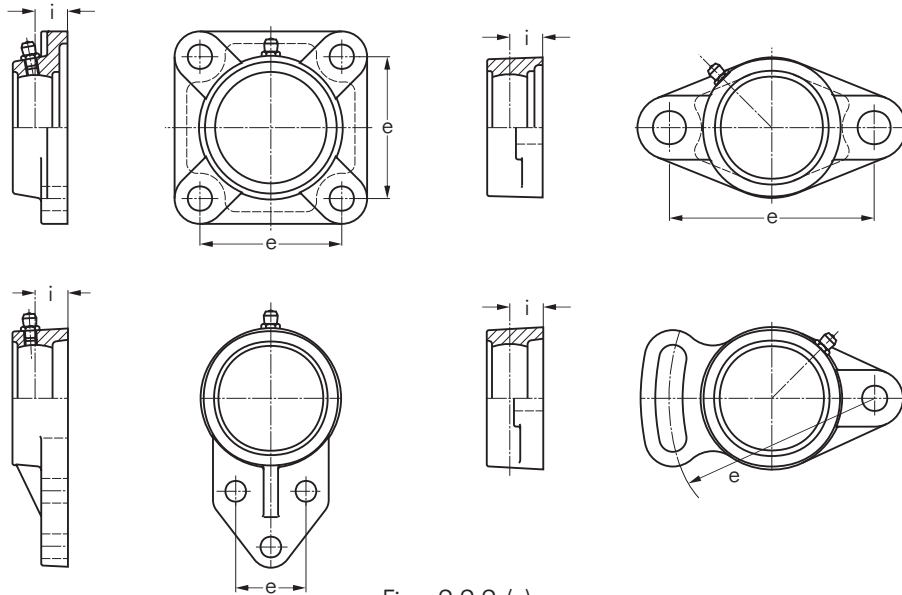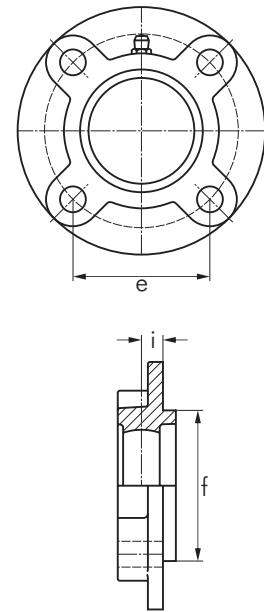

Figs. 2.2.2 (a)

Table 2.2.2 (a) Tolerances for flanged type housings (F, FL, FA, FB)

Unit: 0.001 mm

Housing number							e Deviations	i Deviations
F 204			FL 204			FA 204	FB 204		
F 205	F 305	F X05	FL 205	FL 305	FL X05	FA 205	FB 205		
F 206	F 306	F X06	FL 206	FL 306	FL X06	FA 206	FB 206		
F 207	F 307	F X07	FL 207	FL 307	FL X07	FA 207	FB 207	±700	±500
F 208	F 308	F X08	FL 208	FL 308	FL X08	FA 208	FB 208		
F 209	F 309	F X09	FL 209	FL 309	FL X09	FA 209	FB 209		
F 210	F 310	F X10	FL 210	FL 310	FL X10	FA 210	FB 210		
F 211	F 311	F X11	FL 211	FL 311	F X11	FA 211	FB 211		
F 212	F 312	F X12	FL 212	FL 312	F X12	FA 212	FB 212		
F 213	F 313	F X13	FL 213	FL 313	F X13	FA 213	FB 213		
F 214	F 314	F X14	FL 214	FL 314	F X14				
F 215	F 315	F X15	FL 215	FL 315	F X15				
F 216	F 316	F X16	FL 216	FL 316	F X16				
F 217	F 317	F X17	FL 217	FL 317	F X17			±1000	±800
F 218	F 318	F X18	FL 218	FL 318	F X18				
	F 319			FL 319					
	F 320	F X18		FL 320	F X18				
	F 322			FL 322					
	F 324			FL 324					
	F 326			FL 326					
	F 328			FL 328					

Table 2.2.2 (b) Tolerance for flanged type housing (FC)

Unit: 0.001 mm

Housing number	f Deviations High	f Deviations Low	e Deviations	i Deviations	Radial run-out of machined pilot Max.
FC 204					
FC 205	0	-46			
FC 206					
FC 207			±700	±500	200
FC 208					
FC 209	0	-54			
FC 210					
FC 211					
FC 212					
FC 213					
FC 214			±1000	±800	300
FC 215	0	-63			
FC 216					
FC 217					
FC 218	0	-72			

Figs. 2.2.2 (b)

2.2.3 Tolerance for take-up type housing (T)

Unit: 0.001 mm

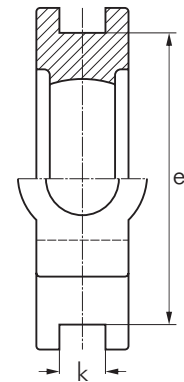| Housing No.	k Deviations High	k Deviations Low	e Deviations	Parallelism of guide Max.
T204	+200		0	500
~T210	0		-500	
T211	+300		0	600
~T217	0		-800	

Fig. 2.2.3

Table 2.2.4 Tolerance on spherical inside diameter — Unit: 0.001 mm

Nominal spherical inside diameter		Symbol H7				Symbol J7			
Da		Dam Deviations		Da Deviations		Dam Deviations		Da Deviations	
Over (mm)	Incl. (mm)	High	Low	High	Low	High	Low	High	Low
30	50	+25	0	+30	-5	+14	-11	+19	-16
50	80	+30	0	+36	-6	+18	-12	+24	-18
80	120	+35	0	+42	-7	+22	-13	+29	-20
120	180	+40	0	+48	-8	+26	-14	+34	-22
180	250	+46	0	+55	-9	+30	-16	+39	-25

Note: (1) Dam = (Damax + Damin)/2

 Damax - maximum measured value of Da

 Damin - minimum measured value of Da

 (2) Dimensional tolerances for spherical inside diameter of housing are classified as H7 for clearance fit and J7 for interference fit.

 (3) As the self-contained for bearings are equipped with locking-pin, clearance fit H7 is normally applied.

Table 2.2.5 Machining tolerances

Nominal dimension		Dimensional Tolerance
Over (mm)	Incl. (mm)	(mm)
4	16	±0.2
16	63	±0.3
63	250	±0.5

Table 2.2.6 Casting tolerances on length

Nominal dimension		Dimensional Tolerance
Over (mm)	Incl. (mm)	(mm)
Up	100	±1.5
100	200	±2.0
200	400	±3.0
400	800	±4.0

Table 2.2.7 Casting tolerances on thickness

Nominal dimension		Dimensional Tolerance
Over (mm)	Incl. (mm)	(mm)
Up	5	±1.0
5	10	±1.5
10	20	±2.0
20	30	±3.0
30	50	±3.5

Table 2.2.8 One side machining tolerances

Nominal dimension			Dimensional Tolerance
Over (mm)		Incl. (mm)	(mm)
Up	~	5	±1.0
5	~	100	±1.5
100	~	200	±2.0
200	~	400	±3.0

Note: (1) Dimensional tolerances and deviations are for ordinary grade.

 (2) Dimensional tolerances on length and thickness may be added with deviations on draft taper.

The radial internal clearance of the bearing for the unit is the same as the value of ISO 9628, the internal radial clearance for the Spherical Outside Surface Ball Bearing is usually greater than that for the same size of Deep Groove Ball Bearing. The clearance for the cylindrical bore bearing is shown in Table 3.1 while the clearance for the tapered bore bearing is shown in Table 3.2 .

Table 3.1 Radial internal clearance of cylindrical bore bearings
(with set-screws and eccentric locking collar)   Unit: 0.001mm

Nominal bore diameter d		Clearance symbol			
Over	Incl.	Normal		C 3	
(mm)	(mm)	Min.	Max.	Min.	Max.
10	18	10	25	18	33
18	20	12	28	20	36
20	32	12	28	23	41
32	40	13	33	28	46
40	50	14	36	30	51
50	65	18	43	38	61
65	80	20	51	46	71
80	100	24	58	53	84

Table 3.2 Radial internal clearance of tapered bore bearings (with adapter sleeve)
Unit: 0.001mm

Nominal bore diameter d		Clearance symbol			
Over	Incl.	Normal		C 3	
(mm)	(mm)	Min.	Max.	Min.	Max.
10	18	18	33	25	45
18	20	20	36	28	48
20	32	23	41	30	53
32	40	28	46	40	64
40	50	30	51	45	73
50	65	38	61	55	90
65	80	46	71	65	105
80	100	53	84	75	120

4.1 The bearing size is usually selected according to the required life and reliability under a specific type of load charged on the Spherical Outside Surface Ball Bearing

The load applied to the bearing operating under static or slow oscillating and rotating (n<10r/min) condition is defined as static load, while the load applied to the bearing operating under a speedy rotating (n>10 r/min) condition is defined as dynamic load.

The load capacity of the bearing is expressed by the basic dynamic load rating which is shown in the Spherical Outside Surface Ball Bearing's table.

Under normal mounting, lubricating and maintaining conditions, the operating bearing will have fatigue flaking due to the repeating action of variable load charged on the contact area between the rings and rolling elements. Generally, the fatigue flaking is the cause of normal damage of rolling bearings. Therefore, the usual bearing life refers to the bearing fatigue life. The life of group of apparently identical bearings operating under a considerable dispersion. For this reason, the bearing life is closely connected with the damaging probability or the reliability requirement.

The radial rating load of ball bearing with 90% reliability and 500 hours minimum life is shown in Fig. 4.1 (Refer to page 18).

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

Reliability: The reliability is the percentage of the bearings 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 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 revolution that 90% of the bearings can be expected to complete or exceed.

Basic Rating life

The fatigue rating life of Spherical Outside Surface Ball Bearing is calculated by the following formula:

$$L_{10} = \left(\frac{C}{P}\right)^3 \text{ or } \frac{C}{P} = L_{10}^{1/3}$$

Where
L_{10} = basic rating life (10^6 r)
P = basic dynamic load rating (N)
N = equivalent dynamic bearing load (N)

The basic dynamic load rating C is a hypothetical constant load with a fixed direction under which the bearing can attain a basic life of one million revolutions theoretically. For radial bearings , the load refers to the radial load.

The equivalent dynamic bearing load P 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 bearing operating with a constant rotation speed, the basic rating life can be expressed in terms of operating hours:

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

Where: L_{10h} = basic rating life (h)

n = bearing operating speed of rotation (r/min)

For easier calculation, 500 hours as base of rating life is taken, and the speed factor f_n and the life factor f_h is introduced.

$$f_n = \left(\frac{33 1/3}{n}\right)^{1/3} \qquad f_h = \left(\frac{L_{10h}}{500}\right)^{1/3}$$

In this way, the formula is simplified to:

$$C = \frac{f_h}{f_n}P$$

The values of f_h and f_n can be found in Fig. 4.1 by referring to the operation speed n and the anticipated bearing service life L_{10h}. Then, with the radial load (or the equivalent dynamic bearing load), the basic dynamic load rating can be determined. By this way, the bearing size can be determined according to the basic dynamic load rating value in the Spherical Outside Surface Ball Bearing's table.

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

Fig. 4.1

$$Pm = \sqrt[3]{\frac{1}{N}\int_0^N P^3 dN}$$

Where Pm = mean equivalent dynamic bearing load (N)

P = equivalent dynamic bearing load (N)

N = total revolution numbers within one load changing cycle (r)

4.2 Anticipated bearing service life

Where selecting a bearing, one should usually predetermine an appropriate service life according to the relevant machine type, operating condition and reliability requirement. Generally the anticipated bearing service life can be determined by referring to the maintenance period of a machine.

Calculating method of equivalent dynamic bearing load P
The basic equivalent dynamic bearing load is determined under a hypothetical condition. When calculating the bearing life, the actual load has to be converted to dynamic bearing load which is in conformity with the load condition determining the dynamic load rating. General equation for calculating the equivalent dynamic bearing load:
P = XFr + YFa
Where: P --- equivalent dynamic bearing load (N)

Fr --- actual radial load (N)

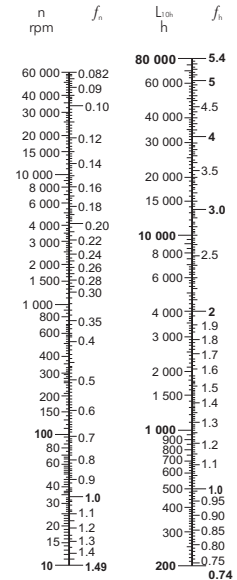Fa --- actual axial load (N)

X --- radial factor

Y --- thrust factor

The values of X and Y are determined by the ratio between the applied axial load Fa and the basic static load rating Co. The axial load which the Spherical Outside Surface Ball Bearing can carry is determined by the mounting method of the bearing on the shaft.

For bearings of set-screw Locking type or eccentric Locking collar type, if flexible shafts are applied and the set-screws are tightened enough, the axial load Fa which the bearings can carry not surpass 20% of the radial load Fr.

For bearing of adapter sleeve Locking type, if the nut is properly tightened, the axial load Fa can be maximally 15% to 20% of the radial load.

The value of radial and thrust factors X and Y for Spherical Outside Surface Ball Bearings can be obtained from the following Table 4.3.1.

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

Where: $Pm = fm \cdot P$
          Pm --- equivalent dynamic bearing load when considering twist load
          fm --- twist load factor, which is defined as follows:
                  when the twist load is small :   fm=1.5
                  when the twist load is big   :   fm=2

4.3 Example of bearing size selection

When shocking load is applied to the bearing, the equivalent dynamic bearing load can be calculated by the following equation:
              $Pd = fd \cdot P$
Where: Pd --- equivalent dynamic bearing load when considerating shocking load
               fd --- shocking load factor, which is defined as follows:
                   when no shocking load or mirror shocking load is applied: fd = 1 - 1.2
                   when adequate shocking load is applied: fd = 1.2 - 1.8

Table 4.3.1 Radial and thrust factors X and Y for Spherical Outside Surface Ball Bearings

$\dfrac{Fa}{Ca}$	Clearance for normal				e	Clearance for C 3				e
	$\dfrac{Fa}{Fr} \leqslant e$		$\dfrac{Fa}{Fr} > e$			$\dfrac{Fa}{Fr} \leqslant e$		$\dfrac{Fa}{Fr} > e$		
	X	Y	X	Y		X	Y	X	Y	
0.025	1	0	0.56	2.0	0.22	1	0	0.46	1.74	0.3
0.04	1	0	0.56	1.8	0.24	1	0	0.46	1.61	0.33
0.07	1	0	0.56	1.6	0.27	1	0	0.46	1.46	0.36
0.13	1	0	0.56	1.4	0.31	1	0	0.46	1.30	0.41
0.25	1	0	0.56	1.2	0.37	1	0	0.46	1.14	0.47
0.5	1	0	0.56	1.0	0.44	1	0	0.46	1.00	0.54

How to select the size of bearing
One Spherical Outside Surface Ball Bearings is to operate at a rotation speed of 1000 r/min under only a radial load of Fr = 3000 N , with a basic rating life of at least 20,000 hours. Select the bearing size.

From the required rotation speed it can be found that:
f_n = 0.322 (Fig. 4.1 shows about 0.32, refer to page 18)
From the required basic rating life (anticipated service life), it can be found that:
f_h = 3.42 (Fig. 4.1 shows about 3.4, refer to page 18)
Under only radial load, i.e.
P = Fr = 3000 N
Therefore,

$$C = \frac{f_h}{f_n}P = \frac{3.42}{0.322} \times 3000 = 31{,}863(\,N\,)$$

A simplified way to calculate the bearing life can be applied by using Fig. 4.3: By connecting n and the required basic rating life L_{10h} with a straight line, it can be found that C/P value is 10.6 . As is known, P = Fr = 3000 N, thus the required basic dynamic load rating is:

C = 3000 × 10.6 = 31,800(N)

In this way, we can select the Spherical Outside Surface Ball Bearings inside this catalogue(Refer to pages 116-127).
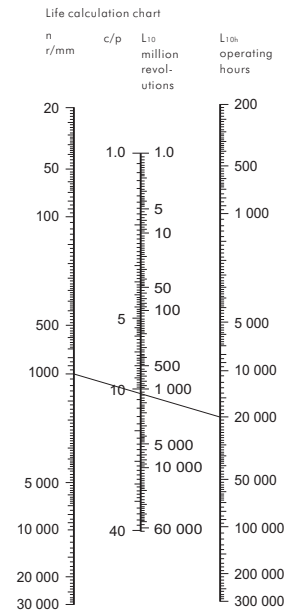

Life calculation chart

Fig. 4.3

4.4 Adjusted rating life equation

The basic rating life L_{10} calculated with the bearing life calculation formula can be applied to calculate the rating life of bearing made of ordinary bearing steel (i.e. bearing life with reliability of 90%).

Due to more and more of machinery products demanding higher reliability and better quality steel (ISO 281/1-1977), an adjusted rating life calculation equation is suggested, i. e.
$L_n = a1 \cdot a2 \cdot a3 \cdot L_{10}$
For Spherical Outside Surface Ball Bearing:
$L_n = a1 \cdot a2 \cdot a3 \cdot (\,C/P\,)^3$
Where Ln---under specified material and lubricating conditions, bearing life with (100-n)% no breaking probability (i. e. reliability).

a1 ---- life adjustment factor for reliability (Table 4.4.1)
a2 ---- life adjustment factor materials (Table 4.4.2)
a3 ---- life adjustment factor for operating conditions (Table 4.4.3)

Table 4.4.1 Life adjustment factor for reliability a1

Reliability%	90	95	96	97	98	99
Ln	L10	L5	L4	L3	L2	L1
a1	1	0.62	0.53	0.44	0.33	0.21

Table 4.4.2 Life adjustment factor for materials a2

Normal chromium bearing steel		$a2 = 1$
Special smelted bearing steel	--- Vacuum degassed bearing steel	$a2 = 3$
	--- Vacuum resmelted bearing steel	$a2 = 5$
When material hardness lowered by high frequency tempering		$a2 < 1$

Table 4.4.3 Life adjustment factor for operating conditions a3

When under normal operating conditions: (1) Properly mounted, (2) Sufficiently lubricated, (3) Without outside matters intrusion.	$a3 = 1$
When under operating temperature, the Spherical Outside Surface Ball Bearings lubricating grease viscosity lower than 13 mm^2/s	$a3 < 1$

5. Selection of Shaft

The shaft on which bearing units are mounted shall be free from bend and flexure.

For the units with cylindrical bore (with set-screws or eccentric locking collar) clearance fit is usually adopted for mounting the units on the shaft, and shaft tolerances in Table 5.1 are recommended for such loose fit, but for high speed or highly accurate operation or such application which is accompanied by heavy shock loads, interference fit is to be adopted. Table 5.2 shows recommended shaft tolerances for interference fit, when bearing units with eccentric locking collar are mounted on the shaft with interference fit, the eccentric locking collar may be omitted.

Tapered bore bearings permit wider tolerances of the shaft since they are locked to the shaft by means of adapted sleeves.

Recommended shaft tolerances for tapered bore bearings listed in Table 5.3.

Table 5.1 Shaft tolerances for clearance fit for bearing with cylindrical bore

Shaft diameter		Deviation of tolerances in shaft							
		For lower speed		For medium speed		For rather high speed		For high speed	
Over	Incl.	h9		h8		h7		J6	
mm	mm	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

Table 5.2 Shaft tolerance for interference fit for bearing with cylindrical bore

Shaft diameter		Deviation of tolerances in shaft							
		Higher speed		Rather heavy load		Highest load		Heavy load	
Over	Incl.	m6		m7		m6		m7	
mm	mm	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

Table 5.3 Shaft tolerances for bearing with tapered bore

Shaft diameter		Deviation of tolerances in shaft			
		For shot shaft		For shot shaft	
Over	Incl.	h9		h10	
mm	mm	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

6. Mounting of Bearing Units on Shaft

The bearing units can be easily installed in principle at any place. However, in order to have a long service life, it is desirable that the mounting base if flat and rigid.

In case of either the vibration is caused to the bearing, the alternating movement takes place, the load applied to the bearing is large, or the shaft rotation speed is rapid, it is desired to provide with the filed seat or concave section at the part where the set-screws contact with the shaft. If large thrust load is charged, it is recommended that joggling tightened with nuts be used to install the bearing most effectively to the shaft: As shown in Fig 6.1.
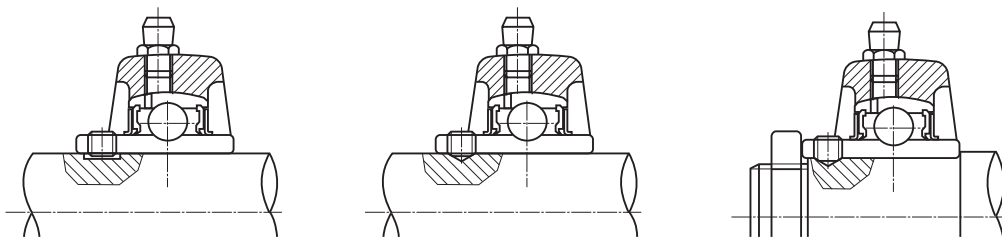
Fig 6.1

6.1 Bearings units with adapter sleeve

Bearing unit with adapter sleeve permits wider shaft tolerance and can be used in applications where vibrations and shocks are heavy.

Mounting processes of these units are as follows:
First, the sleeve is installed to an arbitrary position. After the shark proof washer is inserted, the nut is tightened. The proper nut tightening condition can be obtained if it is tightened enough by hand and then rotated by 2/5 to 3/5 revolution with a spanner.

After tightening the nut, bend the shark proof washer within the slot. Otherwise, the nut may be loosened and creep may be caused between the shaft and sleeve. It is necessary the nut can not be tightened too much.

6.2 Bearings units with eccentric locking collar

The eccentric part of the collar mates with the inner ring of the bearing which is made eccentric with the collar. When locked to the shaft by hand in direction of the shaft rotation, the eccentric locking collar tightens automatically to the shaft by force of working radial load. Then, lock the set-screws provided on the collar to fix the eccentric collar to the shaft. At the shaft rotation force or load is not charged on the set-screws directly, it will not loosen during operation.

7. Bearing units with set-screws

There are two set-screws located at two places on one side of the wide inner ring 120 apart with which the bearing units can be mounted to the shaft. When mounting the bearing to the shaft, the torque shown in the following Table 7.1 is recommended to tighten the set-screws to shaft.

Table 7.1 Proper tightening torque of set-screws

Set-screws tap (mm)	Bearing No.	Tightening torque	
		(N.m)	(lbf.in)
M 5X0.8	SB 201 D1~SB 203 D1, UC 201 D1~UC 203 D1	3.9	34
M 6X1	SB 204 D1~SB 207 D1, UC 204 D1~UC 206 D1 UC X05 D1, UC 305 D1~UC 306 D1	5.8	52
M 8X1	SB 208 D1~SB 211 D1, UC 207 D1~UC 209 D1 UC X06 D1~UC X08 D1, UC 307 D1	9.8	86
M 10X1.25	UC 210 D1~UC 212 D1, UC X09 D1~UC X11 D1 UC 308 D1~UC 309 D1,SB 212 D1	24.5	216
M 12X1.5	UC 213 D1~UC 218 D1, UC X12 D1~UC X16 D1 UC 310 D1~UC 314 D1	34.3	303
M 14X1.5	UC 315 D1~UC 316 D1	34.3	303
M 16X1.5	UC 317D1~UC 319 D1	54.2	478
M 18X1.5	UC 320 D1~UC 324 D1	58.0	496
M 20X1.5	UC 326 D1~UC 328 D1	78.0	

The material of cast iron housing under ISO / DIS GG20, the mechanical properties please refer to Tabel 8.1.

Table 8.1 The mechanical properties of cast iron housing

Number	Major wall thickness of casting piece	Strain stress σ_b	Hardness
	(mm)	(N/mm^2)	HB
ISO / DIS GG20	2.5 - 10	220	
U.S.A Grade 35	>10 - 20	195	170 - 220
JIS FC20	>20 - 30	170	
	>30 - 50	160	

The mechanical properties of cast iron housing

Items	Country	Cast iron material		
1	China	HT250	HT200	HT150
2	Japan	FC250	FC200	FC150
3	America	NO.35	NO.30	NO.20
4	Germany	GG25	GG20	GG15
5	Belgium	FGG25	FGG20	FGG15
6	ISO Standard	250	200	150

Standard		Material
Japanese industrial standard (JIS)	JIS	SUJ 2
International Organization for Standardization (ISO)	ISO	100Cr6
Deutsches Institut fur Normung(ISO)	DIN	100Cr6
China	China	Gcr15

C	Cr	Si	Mn	S	P
0.95-1.05	1.30-1.65	0.15-0.35	0.20-0.40	⩽ 0.020	⩽ 0.027