1.3. Selecting a Spherical Bearing

When selecting a Spherical Bearing, follow the instructions below while referring to the basic dynamic load rating (C) and the basic static load rating (C_0) indicated in the corresponding dimensional table in the "THK General Catalog - Product Specifications," provided separately, as a measuring stick.

Spherical Bearing Service Life G

The basic dynamic load rating (C) is used to calculate the service life when the bearing rocks under a load.
The basic dynamic load rating is calculated based on the contact surface pressure of the spherical sliding section.
The bearing service life G is expressed in the total number of rocking motions until it becomes impossible for the bearing to perform normal operation due to the increase in the radial clearance or in the temperature of the bearing as a result of wear on the spherical sliding section.
Since the bearing service life is affected by various factors such as the material of the bearing, magnitude and direction of the load, lubrication conditions and sliding speed, the calculated value can be used as an empirical, practical value.

$$G = b_1 \cdot b_2 \cdot b_3 \cdot b_4 \cdot b_5 \frac{3}{Da \cdot \beta} \cdot \frac{C}{P} \times 10^8$$

where

- G : Bearing service life (total number of rocking motions or total number of revolutions)
- C : Basic dynamic load rating (N)
- P : Equivalent radial load (N)
- b_1 : Load direction factor (see table 1)
- b_2 : Lubrication factor (see table 1)
- b_3 : Temperature factor (see table 1)
- b_4 : Dimension factor (see Fig. 1)
- b_5 : Material factor (see Fig. 2)
- Da : Spherical diameter (see the dimensional table in the "THK General Catalog - Product Specifications," provided separately) (mm)
- β : Rocking radius (degree) (for rotary motion, β=90°)

Table 1

Model No.		b_1 Load direction		b_2 Regular lubrication		b_3 Temperature ℃		
		Fixed	Alternating	Not provided	Provided	−30 ~ +80	+ 80 ~ +150	+150 ~ +180
Spherical Bearing	Without seal	1	5	0.08	1	1	1	0.7
	With seal	1	5	0.08	1	1	—	—

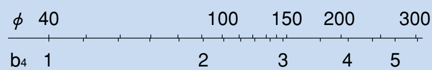

Fig. 1 Dimension Factor

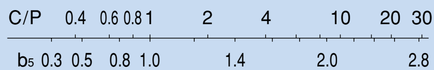

Fig. 2 Material Factor

Equivalent Radial Load

The Spherical Bearing is capable of receiving a radial load and a thrust load simultaneously. If the magnitude and direction of the load applied are constant, the equivalent radial load is obtained from the following equation.

$$P = Fr + YFa$$

where

- P : Equivalent radial load (N)
- Fr : Radial load (N)
- Fa : Thrust load (N)
- Y : Thrust load factor (see table 2)

Table 2 Thrust Load Factor

Fa/Fr≦	0.1	0.2	0.3	0.4	0.5
Thrust load factor (Y)	0.8	1	1.5	2.5	3

Static Safety Factor f_S

If the Spherical Bearing is to be used under a stationary load or in slight rocking motion, select a model using the basic static load rating (C_0) as a guide. The basic static load rating refers to the stationary load that the bearing can receive without damaging the bearing and without causing permanent deformation that would prevent smooth motion.

In general, set the safety factor at three or greater taking into account the rigidity of the shaft and the housing.

$$f_S = \frac{C_0}{P} \geqq 3$$

where

f_S : Static safety factor

C_0 : Basic static load rating

P : Equivalent radial load

pV Value

The permissible sliding speed at which the Spherical Bearing can be used varies depending on the load, lubrication conditions and cooling status. The recommended pV value for continuous motion under a load applied in a constant direction is calculated as follows.

$$pV \leqq 400\ N/mm^2 \cdot mm/sec$$

If the Spherical Bearing performs adiabatic operation or the load direction changes, the heat produced on the sliding surface easily radiates. Therefore, it is possible to set a higher pV value.

The contact surface pressure (p) of the Spherical Bearing is obtained from the following equation.

$$p = \frac{P}{Da \cdot B}$$

where

p : Contact surface pressure (N/mm^2)

P : Equivalent radial load (N)

Da : Spherical diameter (see the corresponding dimensional table in the "THK General Catalog - Product Specifications," provided separately) (mm)

B : Outer ring width (see the corresponding dimensional table in the "THK General Catalog - Product Specifications," provided separately) (mm)

The sliding speed is calculated as follows.

$$V = \frac{\pi \cdot Da \cdot \beta \cdot f}{90 \times 60}$$

where

V : Sliding speed (mm/sec)

β : Rocking half angle (degree)

f : Number of rocking motions per minute (min^{-1})

The Spherical Bearing can be used at sliding speed of up to 100 mm/sec in rocking motion, or up to 300 mm/sec in rotary motion in favorable lubrication status.

[Example of calculating a pV value]

Assuming that model SB25 is used in a location where the shaft rotates 60 turns per minute at an angle of 40° and the maximum varying load of 1,500 N is applied, determine whether the model number is appropriate and calculate the service life under these conditions. Assume that the bearing temperature is +80℃ or less and the product is regularly provided with sufficient lubrication.

Calculate the pV value and examine if the bearing size is appropriate.

The contact surface pressure (p) is calculated as follows.

$$p = \frac{P}{Da \cdot B} = \frac{1500}{36 \times 18} = 2.31\ N/mm^2$$

(B : outer ring width of model SB25 = 18
ϕ : spherical diameter of model SB25 = 36)

The sliding speed (V) is obtained from the following equation.

$$V = \frac{\pi \cdot Da \cdot \beta \cdot f}{90 \times 60} = \frac{3.14 \times 36 \times 20 \times 60}{90 \times 60} = 25.12\ mm/sec$$

The pV value is obtained from the following equation.

$$pV = 58.0\ N/mm^2 \cdot mm/sec$$

Since both the pV value and the sliding speed (V) meet the requirements, model SB25 can be used.

Next, calculate the service life of the bearing (G) as follows.

$$G = b_1 \cdot b_2 \cdot b_3 \cdot b_4 \cdot b_5 \frac{3}{Da \cdot \beta} \cdot \frac{C}{P} \times 10^8$$

$$= 5 \times 1 \times 1 \times 1 \times 2.2 \times \frac{3}{36 \times 20} \times \frac{15300}{1500} \times 10^8 = 4.7 \times 10^7\ min^{-1}$$