# Design of Rolling contact bearing:

Rolling Contact bearing:

Contact between the bearing surface is rolling instead of sliding. In Rolling bearing, the Starting friction is very low. They are called as "Antifriction bearing"

Types of Rolling Contact bearing: (Based on Type of rolling element)

- Ball bearing
- Roller bearing.

Based on the load carried:

- Radial Bearing.
- Thurst bearing
- Angular contact bearing.

PSGDB: 4.1.

Types of Radial Ball bearing:

- Deep Groove ball bearing.
- Self Aligning Ball bearing.

Angular Contact bearing Types:

- One Directional
- Two directional.

Types of Thrust ball bearing:

- One directional flat race.
- Two directional grooved race.
- Double directional Thrust ball bearing.

Types of Roller bearing:

- Cylindrical Roller bearing
- Needle Roller bearing.
- Taper Roller bearing.

Bearing life:

The life of ball bearing is usually expressed in Millions of revolutions. (Considering 90% reliability).

$$\frac{L}{L'_{10}} = \left[\frac{\ln(1/p)}{\ln(1/p_{10})}\right]^{1/b}$$

In Hrs.

From: PSG 4.2.

(or)

$$L = \frac{60 \cdot n \cdot L_h}{10^6}$$

Million revolutions

(X) Take value of 'b' from PSG DB 4.2.

Equivalent Bearing Load:

Equivalent bearing Load $p = (XF_r + YF_a)\,S$. (PSG 4.2)

Load life Relationship:

$$L = \left(\frac{C}{P}\right)^{\frac{10}{3}}, \text{ where } p = 10/3 \quad \text{PSG: 4.3.}$$

Life expectancy in Hours:

$$L_h = \frac{16666}{n}\left(\frac{C}{P}\right)^p \quad \text{PSG: 4.3.}$$

Note:

If $\frac{F_a}{F_r} < 0.7$ — Select Single row deep groove ball bearing

## Problem on Ball bearing:

(1.) Select a bearing for 40mm diameter shaft rotates at 400rpm. Due to a bevel gear mounted on the shaft, the bearing will have to withstand a 5000N radial load and a 3000N thrust load. The life of the bearing expected to be at least 1000 hrs.

Given:

| | |
|---|---|
| Diameter of Shaft | D = 40mm. |
| Speed | N = 400 rpm. |
| Radial Load, | Fr = 5000 N. |
| Thrust Load, | Fa = 3000 N. |
| Life, in hours, | Lh = 1000 hrs. |

Soln:

$$\frac{Fa}{Fr} = \frac{3000}{5000} = 0.6.$$

As, $\frac{Fa}{Fr} < 0.7$, the selected bearing is single row deep groove ball bearing.

For given diameter of shaft 40mm,
From PSG-D.B 4.13;
SKF 6208 Bearing is selected.

From PSG. DB; 4.13, For corresponding SKF 6208,
Static Load rating, $C_o$ = 1600kgf. = 16000N.
Dynamic Load rating $C$ = 2280kgf = 22800N.

Calculating $\frac{Fa}{Co}$;

$$\frac{Fa}{Co} = \frac{3000}{16000} = 0.1875.$$

From pSGDB 4.4:

Corresponding $\frac{Fa}{Co} = 0.1875$,

Eccentricity $e = \frac{(0.31 + 0.37)}{2} = 0.34$ (By Interpolation)

We know,

$$\frac{Fa}{Fr} = \frac{3000}{5000} = 0.6 > e,$$

∴ From PSG DB. 4.4, $y \Rightarrow$ Thrust load factor.

$X \Rightarrow$ Radial load factor,

$\frac{Fa}{Fr} > e$ ; $\Rightarrow$ $X = 0.56$ and $y = 1.3$ (By Interpolation)

Service factor $S = 1.2$ (Assume) (From PSG. 4.2)

Calculating equivalent load:

$$P = (XFr + YFa)\,S$$

$$= (0.56 \times 5000 + 1.23 \times 3000) \times 1.2$$

$$\boxed{P = 7788\,N.}$$

From PSG DB : 4.6 Graph:

For corresponding to 400rpm and 1000hrs of life.

Loading ratio, $C/P = 2.9$.

$\therefore C = 2.9 \times P$

$C = 2.9 \times 7788.$

$$\boxed{C = 22588.2\ N.}$$

Since, the dynamic load rating of the SKF 6208 bearing is more than the required load capacity, the selected bearing is suitable.

2. A 30BC03 deep groove ball bearing is to operate at 1600 rpm and carries 8kN radial load and 6kN thrust load. The bearing is subjected to a light shock load. Determine the rating life of the bearing.

Given:

Type of bearing = 30BC03.

Speed N = 1600 rpm.

Radial Load $F_r$ = 8 kN = $8 \times 10^3$ N.

Thrust Load $F_a$ = 6 kN = $6 \times 10^3$ N.

Solution:

From PSG DB : 4.14 :

For IS I NO : 30 BC 30 $\Rightarrow$ SKF6306 bearing is selected:

For corresponding SKF 6306 bearing.

$C_o$ = 1460 kgf = 14600 N.

$C$ = 2200 kgf = 22000 N.

$\therefore \frac{Fa}{Co} = \frac{6000}{14600} = 0.411$

For $\frac{Fa}{Co} = 0.411$, Corresponding value of $e = 0.405$ (By interpol)

(PSG 4.4).

(PSG 4.4).

Since $\frac{Fa}{Fr} = \frac{6000}{8000} = 0.75 > e$, (PSG 4.4).

Radial load factor } $X = 0.56$ and Thrust load factor $y = 1.1$ (By interpolation)

The service factor $S = 1.5$ (For Reciprocating M/c) (From 4.2)

$\therefore$ Equivalent load, $P = (X Fr + y Fa) \times S$.

$P = (0.56 \times 8000) + (1.083 \times 6000) \times 1.5$.

$P = 16467 N$.

From PSG DB 4.6.

Corresponding to 1600 rpm and $\frac{C}{P}$,

$$\frac{C}{P} = \frac{22000}{16467}$$

$$C/P = 1.34.$$

From Graph in ~~4.6~~ PSG 4.6,

The Estimated rating life of bearing 2 is 25 hrs (Assu
in hours

To find the Estimated life of bearing in revolutions

By relation,

$$L = \frac{60 \times n \times L_h}{10^6}$$

$$= \frac{60 \times 1600 \times 25}{10^6}$$

$L = 2.4$ million revolution.

∴ The Life of bearing in revolutions = 2.4 million rev

3. Select a suitable ball bearing to support the overhung countershaft. The shaft is 60mm diameter and rotating at 1250 rpm. The bearings are to have 99% reliability corresponding to a life of 4000 hrs. The bearing is subjected to an equivalent radial load of 6000N.

Given:

Speed $N = 1250$ rpm.

Diameter of shaft $D = 60mm$

Reliability required $p = 99\% = 0.99$.

Life of bearing $L = 4000$ hrs.

Equivalent load $P = 6000N$.

Solution:

From PSGDB: 4.2;

Expected life at 90% reliability ($L_{90}$) is obtained fro

$$\frac{L_{99}}{L_{90}} = \left( \frac{\ln (1/p)}{\ln (1/p_{10})} \right)^{1/b}$$

Take $b = 1.17$.

(From PSG 4.2).

$$\frac{1}{L'_{10}} = \left( \frac{\ln \left( \frac{1}{0.99} \right)}{\quad} \right)^{1/1.17}$$

From PSGDB 4.6,

- Corresponding to 29804.36 hrs and 1250 rpm,

The Loading ratio $C/P = 13.4$ (Taken from Graph)

$\therefore C = 13.4 \times 6000$

$C = 80400\,N.$

From PSGDB 4.15;

$C = 80400\,N$ and $d = 60\,mm$,

SKF 6412 is selected as it has 'C' value = 8