Issue 2: Bud's Take on Basic Dynamic Load Rating

In design stage, engineers select bearings based on basic dynamic load rating. You might ask "What is the basic dynamic load rating? Why is it so important?" These are great questions as bearing manufacturers compete for the highest rating in the industry.

What is the Basic Dynamic Load Rating?

Let's address the first question by defining the basic dynamic load rating. ISO281 states that the basic dynamic load rating is the pure load (radial or thrust) in which the bearing life will achieve 1 million revolutions. The basic dynamic load rating is **"C"** in the basic life equation.

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

Equation 1: Basic L_{10} Life Equation

Why "C" is important.

To best way to show the importance of **"C"** is to illustrate **L_{10}** bearing life calculations. In our examples all factors remain consistent except for **C**:

P = dynamic equivalent load, we'll use 10 lbs.

n = rotational speed (rpm), we'll use 1000 rpm

p = constant: ball bearing 3, roller bearing 10/3

Example 1, C=100 lbs.

L10 = (10^6/60*1000) (100/10^3 = 16,667 hours

Example 2, C=125 lbs.

L10 = (10^6/60*1000) (125/10)^3 = 32,552 hours

Example 3, C=150 lbs.

L10 = (10^6/60*1000) (150/10)^3 = 56,250 hours

From examples 1 and 2 the load rating was increased by 25%, doubling bearing life. In examples 1 and 3 it was increased by 50%, tripling bearing life. This verifies advantages of higher load ratings.

How is "C" Calculated?

There are differences in the equations based on ball size and bearings type. We will concentrate on ball bearings with a ball diameter less than or equal to 1 inch (25.4 mm)

$$C = b_m f_c \left(i \cos \alpha_0 \right)^{0.7} z^{2/3} D_w^{1.8} \quad (N)$$

Equation 2: Basic Dynamic Load Rating for Ball Bearings

We'll look at a 6209 and 6210. Normally each has ½ inch (12.7mm) balls. The 6209 has 9 balls and the 6210 has 10 balls.

Bm = 1.3 for single row ball bearings, factor related to material and production quality.

Fc = 59.9 curvature factor (same for 6209, 6210)

i = number of rolling element rows

$\alpha 0$ = nominal contact angle (0^0 for dgbb)

z = number of rolling elements

Dw = ball diameter

C 6209 = $1.3 * 59.9 * (1 \cos 0)^{0.7} * 9^{2/3} - 12.7^{1.8} = 32687$ N

C 6210 = $1.3 * 59.9 * (1 \cos 0)^{0.7} * 10^{2/3} - 12.7^{1.8} = 35066$ N

Boundary dimensions (mm)				Basic load ratings (kN)		Factor	Limiting speeds (min^{-1})		Bearing No.
d	D	B	r min.	C_r	C_{0r}	f_0	Grease lub.	Oil lub.	
45	85	19	1.1	32.7	20.3	14.0	7 700	9 200	6209
50	90	20	1.1	35.1	23.3	14.4	7 100	8 500	6210

Table 1: Bearing catalog dimension and ratings

Take my results and divide by 1000 to convert N to kN. This calculation matches the old 1960's ISO 281 numbers.

Important note, todays manufacturers have modified basic dynamic load ratings by changing factors such as the Bm (factor related to material and production quality) and Fc (curvature factor.) In other cases the C is factored by an additional amount (ex. C * 1.10, 10% increase). This is determined by experience and testing by the manufacturer.

I hope that you now have a better understanding on the importance of the basic dynamic load rating. If you would like more information feel free to contact me.

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