Issue 20: Basic Bearing Life Rating

Note from Author: I wrote this article back in 2013 and it was only seen by those receiving our mailings. Now that we have gone digital with email and posting on our website we felt it was time to roll out all of my older articles. They are still relevant and I hope you enjoy! --Bud

Basic Bearing Life Rating

As a bearing engineer I have been asked thousands of times, "How long should the bearing last?" My response is normally, "How long do you need it to last?"

The design or application engineer works with the customer to determines how long the bearings need to last to meet the end users requirements. They discuss the operating conditions such as: 24 hour operation (zero failure), daily operation over 8 hours, intermittent but may be over 8 hours, not extended operation but stable, short or intermittent operation.

To give an idea of how different the requirements can be; if you look at household items such as an electric tool, its design life is around 5,000 hours where paper manufacturing equipment requires over 100,000 hours.

The Basic Bearing Life Equation

The result of using the basic bearing life equation is often called L10 life. The 10 reflects the 10% that will not meet the requirement or will fail due to fatigue prior to meeting the designed number of hours. This could also be called 90% reliability.

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

Equation 1: Basic L10 Life Equation

The basic life equation consists of the following:

L10 = basic rating life
P = dynamic equivalent load
C = basic dynamic load rating
n = rotational speed (rpm)
p = constant: ball bearing 3, roller bearing 10/3

These sets of equations are considered theoretical due to the fact that the fatigue of steel has so many factors that cannot be accurately predicted.

$$P = X F_r + Y F_a$$

Equation 2: Dynamic equivalent load

Time has proven, that even being theoretical, the results of the basic bearing life or L10 equation are extremely accurate. It is important to understand that these equations do not account for incorrect mounting, lubrication, temperature, etc. The equation assumes all other factors that can affect bearing life have been accounted for.

More Than One Bearing

In many cases we pay close attention to the most heavily loaded bearing, but it is important to also review the entire system. The weakest link will dictate the entire system life.

$$\frac{1}{L^e} = \frac{1}{L_1{}^e} + \frac{1}{L_2{}^e} + \frac{1}{L_3{}^e} + \cdots\cdots\cdots$$

Equation 3: System Life Equation

Conclusion:

The story does not end here! The basic bearing life equation is very good at getting into the ball park for most applications. In many applications it is necessary to take a look at modified reliability and other correction factors to fine tune your calculated bearing life. These materials, lubrications, temperature, etc. can dramatically change your final result and are topics within themselves. I will save for a later date!

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