The Meaning of Life

Determining Lifespan for Lubed-for-Life Bearings

Ian Rubin, Regal Power Transmission Solutions

End users and OEMs frequently specify "lubed-for-life" mounted bearings, thinking the lubed-for-life bearings will deliver the same life—without lubrication—as bearings that currently require periodic lubrication. The truth is it depends on many factors, and only a detailed review of the application and testing will provide a more accurate answer.

As a bearing manufacturer, we are often asked why we cannot give a definitive answer. We would love to provide one, but it depends on many variables, even when application data is available.

Bearing manufacturers often provide "lubed-for-life" mounted bearings with a plug in the housing in place of a grease fitting, and some may add extra grease. In addition, you may see a tapered land design that helps direct lubrication back into the raceway. Then consider certain retainer designs can help a bearing run cooler. Even with these features and a very good seal, the most accurate answer to the question about bearing life still requires a detailed application review and testing. So, before you pull all of your bearing lubrication fittings and plug the holes, you need to understand why this is a gray area.

A retainer that rides on the outer ring land surface allows the balls to freely rotate in the cage pockets with a proper film of lube. A retainer that rides on the balls prevents the balls from rotating freely, so with every rotation grease is wiped from the ball.

First, let's clear up any misunderstanding that "life" means infinite life. Under correct application conditions, properly installed and properly maintained, your mounted bearing's life is limited to its L10 life or rating life calculated using industry standards.

What is L10? The L10 life is the number of revolutions or hours that 90 percent of a group of apparently identical bearings will complete or exceed before fatigue is expected to occur. In other words, 10 percent of the group is not expected to achieve the L10 life. The rating life can be calculated in terms of millions of revolutions or hours by using the bearing Basic Dynamic Rating (BDR). BDR is a calculated value, based on the bearing's geometry, and represents the constant load which 90 percent of a group of apparently identical bearings can endure for a rating life of 1 million revolutions (33⅓ rpm for 500 hours).

The basic load rating is a reference value only, to be used for selection of an adequately-sized bearing to provide the desired L10 life in a given application. The L10 rating standard was originally established by the American Bearing Manufacturers Association (ABMA). Based on years of analysis very few bearings actually fail because of "fatigue." The cause is usually another factor, such as lubricant failure or contamination.

Grease is the word

Precise answers for bearing life are challenging because L10 life is based on ideal conditions, while real applications seldom duplicate those conditions precisely. A critical element in bearing life is the condition of the grease in the bearing. When the grease fails or gets expelled or contaminated with water, chemicals or foreign matter, bearing failure follows.

Grease is made up of 80 to 90 percent oil and the balance a thickener (often referred to as "soap") and additives. The oil provides the protective film between the rolling elements and raceway surface. The bearing will run smoothly until the grease breaks down. As the lubricating film between the rolling elements and raceway degrades, metal-on-metal contact begins.

Grease is affected by application conditions and the environment. Application factors that affect grease life are load, speed and ambient and operating temperatures. Heavier loads and higher speeds increase bearing internal temperatures, hastening lubricant breakdown. Likewise, two identical bearings under the same loads and speeds will have vastly different grease lifespans when one is in a climate controlled facility, while another is positioned near a 500°F (260°C) oven. A good rule of thumb is that for every 18°F (10°C) of temperature rise, the grease maintenance cycle should double in frequency.

Environment often plays a bigger role in grease life. Is the environment wet, dry, or gritty? Is the equipment washed down—how? What chemicals or cleaners is the bearing exposed to? Is the bearing housing protected from water blasts or foreign material ingress? Does the bearing have appropriate seals?

There are many types of protection for mounted bearings, including protective end caps and backside seals. No single style or seal design is perfect for all applications.

Some seals last 10 times longer than others in lab test-

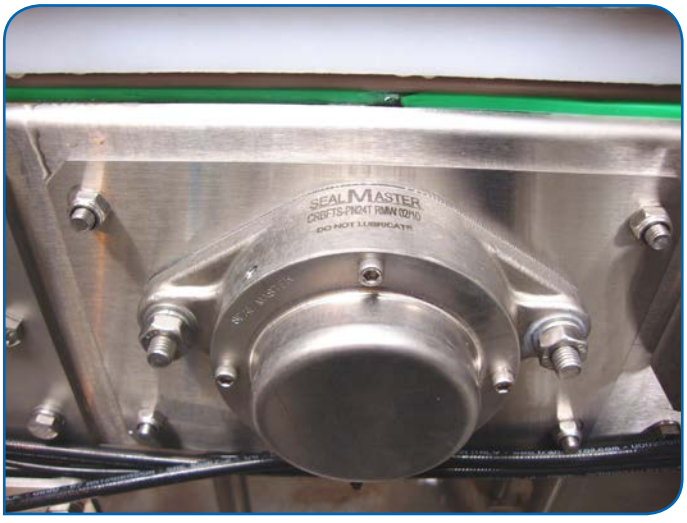
ing, but better sealing typically increases drag and frictional torque, which can be undesirable in some applications. The best seal for a given environment may not always be the best for the application. And even the best seals can be penetrated by overzealous cleaning crews with high-pressure spray equipment.

Even bearings in a parcel distribution center can be contaminated by particles of paper or packaging material dust, and certainly gritty dusts in a wood processing plant, quarry, or grain handling operation require excellent seals — and re-lubrication, if possible.

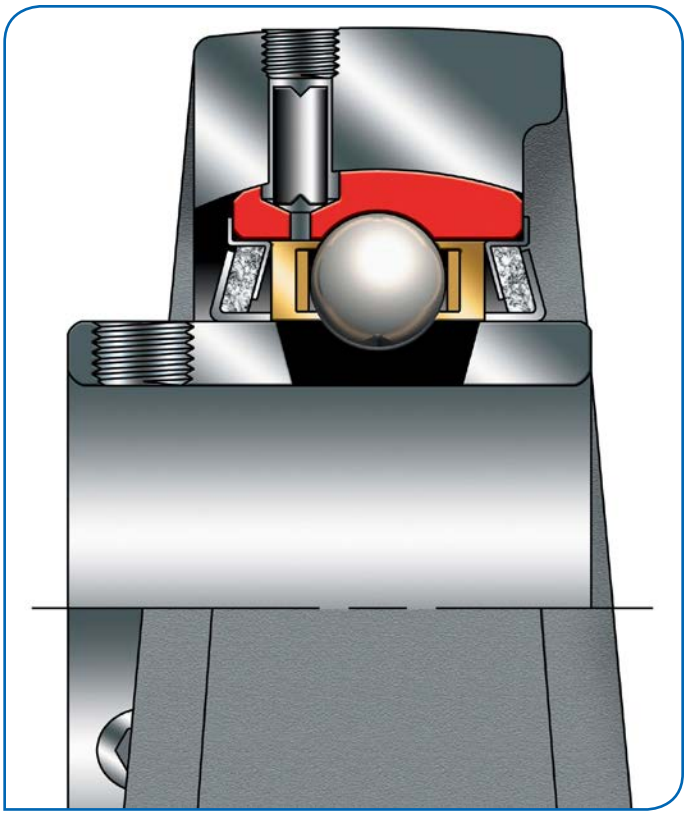
L10 adjusted and improved

The ABMA provides a means to modify the L10 rating with "adjustment" factors, known as a_1, a_2, a_3 that are applied to the standard L10 value in order to determine an adjusted rating life (L_{na}). The a_1 factor accounts for fatigue life based on reliability other than 90 percent. The a_2 factor accounts for the bearing material. For example, standard bearing quality steel sets a baseline factor of 1.0.

The a_3 factor adjusts for operating conditions, such as lubricant quality, presence of foreign matter, conditions that cause changes in material properties, unusual loading or mounting conditions. Mounted bearings are typically slip fitted to the shaft and rely on features such as inner race length and the locking device for support. ABMA recommends an a_3 factor of 0.456 for "slip fit" ball bearings. Shock and vibration can act as an additional load over and above the expected applied load, also requiring an a_3 life adjustment. Accurate determination of the a_3 factor often requires testing and in-field experience.



The added protection of end caps and backside shields can significantly prolong the life of a sealed bearing in clean-in-place and steam-in-place applications.



Seal design and grease capacity can make a difference in lifespan of a basic mounted bearing. Sliding contact between a rubber seal and the bearing inner ring can lead to seal breakdown when debris gets under the rubber. A flinger-equipped labyrinth felt seal (shown) eliminates this sliding contact, and the flinger repels debris.

Protecting and replacing grease

In any given application running side by side, a properly re-lubricated bearing will always outlast a sealed "lubed-for-life" bearing. Re-lubrication provides fresh grease to the raceway and pushes old or contaminated grease away from the raceway. "Proper" lubrication means to avoid over lubricating and make sure the grease fitting and gun nozzle are cleaned before use.

Re-lubrication may not always be practical. It can be costly and may introduce more problems than no lubrication. But when specifying a "lubed-for-life" bearing, make sure you understand how your environment and application will affect grease life, because "life" never means forever. **PTE**

For more information:

Regal Beloit Americas, Inc.
Phone: (859) 342-700
www.regalpts.com

For Related Articles Search
bearing life
at www.powertransmission.com