Let's Get Practical

The pump bearings ...

Ross Mackay, Contributing Editor

As one of the parts that is manufactured to the most exacting of tolerances, the ball bearing does not deserve its reputation in the process pump market as being one of the two parts of a pump that is constantly failing. Yet that is the reality. To alleviate this situation, we need some understanding of *what bearings do* and *what we need to do* in order to correct this widespread misconception.

The bearings in every process pump accomplish three important functions:

1. They locate the rotating element in its correct position relative to the stationary parts of the pump.
2. They allow the shaft to rotate with the least amount of friction to maximize the pump operating efficiency.
3. They absorb all the radial and axial loads, which are transmitted through the shaft during the different operating modes.

The most commonly used bearing in the pump market is the **single row, deep groove ball bearing**. In addition to its ability to handle radial loads, it is also capable of handling an axial thrust load in either direction. Therefore, this bearing also is used as the thrust bearing on certain lighter-duty pumps, where the axial thrust load is relatively low.

The **double row, deep groove ball bearing** is a thrust bearing that has substantial thrust capacity in both directions. It also can handle very high radial loads. This bearing is gradually being replaced in heavy-duty process pumps by the double row angular contact bearing.

The **single angular contact bearing** is designed to support a heavy thrust load in one direction only. It also can handle a moderate radial load. The contact angle is achieved by a high shoulder on the inner race and another shoulder that is diametrically opposite on the outer race.

The **double row angular contact bearing** can be configured in three different ways to accommodate the expected thrust loads.

The *tandem arrangement* can accommodate axial loads in one direction only, but evenly divided between the two bearings.

The *face-to-face* arrangement and the *back-to-back* arrangement can both accommodate axial loads in either direction, but only by one bearing at a time. In view of this similarity, it is frequently assumed that these arrangements are interchangeable. *Not in process pumps!*

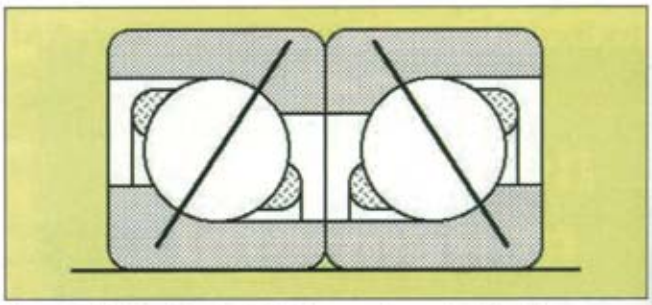

Figure 1. The back-to-back double angular contact bearing

The back-to-back arrangement (Figure 1) is the only one that can accommodate a tilting moment. Consequently, this one must be used when the thrust bearing is located close to the source of a tilting moment. Since that can occur as a result of shaft misalignment, the back-to-back arrangement must always be used in an end-suction pump, where it is close to the shaft coupling.

The thrust bearing in a "double-ender" type of pump is located at the opposite end of the shaft from the coupling. But Let's Get Practical, if we continue to use the back-to-back arrangement in this pump style, it will ensure that the maintenance team doesn't have to remember which bearing style goes in which pump. Thus, every time a double angular contact bearing is used, it should be mounted in the back-to-back arrangement.

Total Bearing Arrangement

To ensure that these bearings provide long-lasting, trouble-free service, it must be recognized that they are only a part of the total bearing arrangement. Other important aspects include

the support and the protection of these bearings. Such support includes a strong shaft and housing to minimize the effect of any externally induced stresses or vibration.

In the July issue of *Pumps & Systems*, we discussed the rigidity of the pump shaft in relation to the mechanical seal. Similarly, a strong shaft that will minimize the effect of vibration is essential to the support of the pump bearings.

In view of the tendency of some companies to make their own spare shafts, it must be noted that the machining profile and accuracy of the bearing fits are essential for reliable operation.

Bearing Lubrication

The lubricant separates the rolling elements and raceway contact surfaces, and minimizes the effect of friction. The selection of the lubricant is a consideration of its viscosity, and depends on the operating temperature, the bearing size and its rotational speed. While the bearing manufacturer can identify the minimum viscosity required for these conditions, the selected lubricant should provide a higher viscosity than the minimum identified.

Grease Lubrication

Lubricating grease is essentially a soap-thickening agent in a mineral or synthetic oil. When selecting the right grease, the base oil should be able to satisfy the bearing's lubrication requirements. When using grease, two rules must be followed:

1. Do not apply too much grease to a bearing, as it will cause the grease to overheat and reduce the lubricating effectiveness.
2. Do not mix different types of grease, as many of their contents and preservatives are incompatible.

Oil Lubrication

Mineral oils are still the most common lubricating oil in general service pumps, while synthetic oils tend to be more resistant to higher temperatures and seem to require less frequent change in these applications.

The oil level in the bearing housing should be maintained at the centerline of the lowest ball in the race, and the oil must be able to enter the bearing from both sides.

An increasingly popular method of pump bearing lubrication is the oil mist system, where the mist is a collection of atomized oil droplets that are sprayed in the bearings by compressed air.

There are two main types of oil mist systems. The *purge oil mist system* incorporates a static oil bath for the bearings, while the *pure oil mist system* comprises the only form of lubrication used. Both types are used to fill the bearing housing with as much oil as possible, so as to minimize the entry of contaminants.

Lubrication Protection

Other methods of protecting the lubricant from external contaminants involve sealing the bearings themselves or sealing the bearing housing.

Sealed bearings are fitted with seals on each side of the bearing and are considered sealed for the life of the bearing. In these bearings, the bearing cavity is filled to approximately 25 – 35 percent with grease.

The most common method of sealing the housing is with the lip seal, in spite of the fact that it is misapplied when installed in most process pumps. Lip seals are designed to operate in a well-lubricated environment where they can achieve an effective life of approximately 1,000 operating hours. However, most process pumps have little or no lubricant in the immediate area of the lip seals. But, even if we did get the full 1,000 operating hours, it still would be totally inadequate in an application where we should be able to expect 25,000 hours from the bearings.

A less damaging option is a *non-contacting labyrinth seal or bearing isolator* (Figure 2). These seals are not new. The concept has been around for well over 25 years and they have proved to be infinitely more effective in protecting the bearing lubricant and extending the life of the bearings.

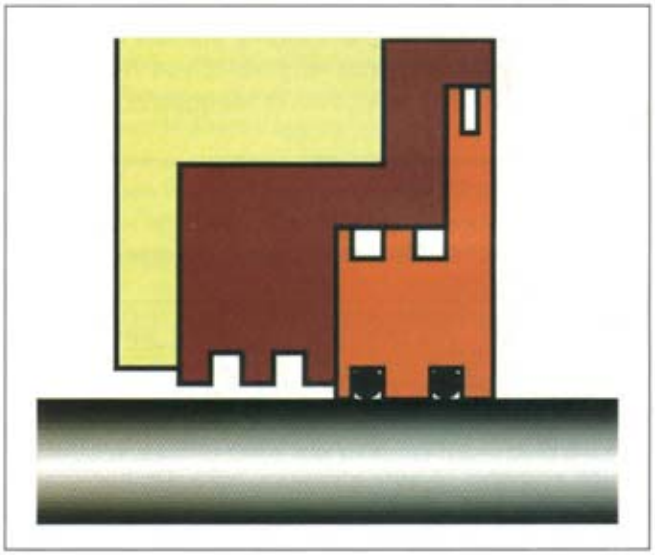

Figure 2. A labryrinth seal or bearing isolator

So Let's Get Practical!

- Install the right bearing in the right place.
- Mount it correctly in a strong housing and on a strong shaft.
- Use an appropriate lubricant.
- Protect that lubricant continuously against contamination.
- That way, we can eliminate the unjustified reputation of the ball bearings in your pumps, and increase the pump reliability.

Ross Mackay specializes in helping companies increase their pump reliability and reduce operating and maintenance costs through consulting and education. He can be reached at 1-800-465-6260, or through his web site at www.rossmackay.com.