REPAIRING SLEEVE BEARINGS

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Sleeve bearings have been used in almost all sizes of electric motors since motors were invented. Although most motors now have ball bearings for economic reasons, sleeve bearings are still used in fractional horsepower motors, as well as in large motors where the desired bearing life cannot be achieved with rolling-element bearings. The limiting factors in larger motors are the diameter of the bearing and the speed of its rolling element. Sleeve bearings do not work well with radial loads or belted applications. This article focuses on large motor designs (500 to 5000 hp). Pedestal bearings are not specifically treated, although many of the principles are the same.

In this age of specialization, sleeve bearing repair has largely become an industry niche. Due to economies of scale, many service centers now outsource this work, a trend that has resulted in a general loss of knowledge and associated skills in this area.

PRINCIPLES OF SLEEVE BEARINGS

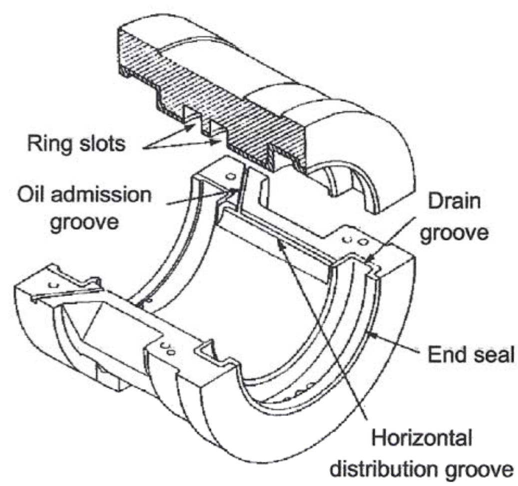
Sleeve bearings are deceptively simple in appearance. Made of soft metal called babbitt (an alloy made mostly of tin and lead; see Table 1), they conform to the shape of the shaft and support the load. A film of oil continuously lubricates the bearing and shaft, minimizing surface wear while efficiently cooling the parts. Foreign matter that gets between the bearing and the shaft becomes embedded in the soft babbitt material, thus protecting the harder (and more costly) shaft.

Clearance. Proper clearance between the shaft and bearing keeps the shaft position stable. Too little clearance results in excessive heat due to friction between the shaft and bearing. Too much clearance can lead to unwanted movement (vibration or loss of concentric orbit).

One rule of thumb for bearing-shaft clearance is .001" + .001" per inch of shaft diameter. Factors such as rotational speed, bearing diameter/length ratio, oil viscosity and load also each play a role in determining the optimal clearance for a particular bearing.

Lubrication. The key to sleeve bearing life is adequate lubrication to maintain minimum friction. A continuous flow of oil is provided by one or more oil rings or a forced-oil system. Oil is delivered to the top of the shaft where it fills the oil distribution groove (Figure 1). As the shaft rotates, the oil rings (resting on the shaft) also turn, lifting oil from the sump and transferring it to the bearing and shaft. The oil exits the drain groove at either end and is cooled by recirculating with oil in the reservoir/sump.

FIGURE 1: TYPICAL MOTOR BEARING



The horizontal distribution groove is critical to bearing performance. The diagonal groove visible at the split line is a channel for forced oil systems. A forced oil system increases the volume of oil through the bearing, which acts to cool the bearing.

Some sleeve bearing designs incorporate guides or wipers that improve the transfer of oil from each ring to the shaft and bearing. Guides also keep the rings tracking straight, which is especially important in high-speed machines. A ring that tracks erratically turns slower and moves less oil, thereby increasing bearing temperature. Oil rings must be round (within about .002") in order to rotate at a consistent speed.

The oil distribution groove (Figure 1), sometimes called a fly-cut or side-pocket, holds in reserve a continuous supply of oil. This reserve provides sufficient static head pressure to maintain a constant oil film between the bear-