Remember to follow the ABCs of bearing inspection

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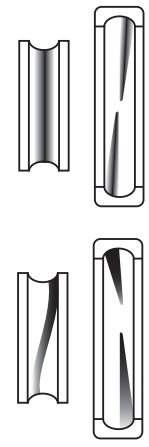
Many of your customers have good in-house predictive maintenance departments and others outsource that skill. Either way, they should know when a bearing is deteriorating and remove the motor from service before it turns into a catastrophic failure. That saves a lot of maintenance dollars, which is great. But if the customer stops there, without discovering ***why*** that bearing is bad, your repaired motor could be returned with the same problem again. Defective bearings often hold a great deal of evidence, if we only look for it.



The load zone of the bearing at top, shown as a shadowed path, indicates that the outer ring is misaligned to the shaft. The load zone of the bearing at botttom indicates the inner ring is misaligned relative to the housing.

Figure 1. Diagonal wear paths indicate misalignment.

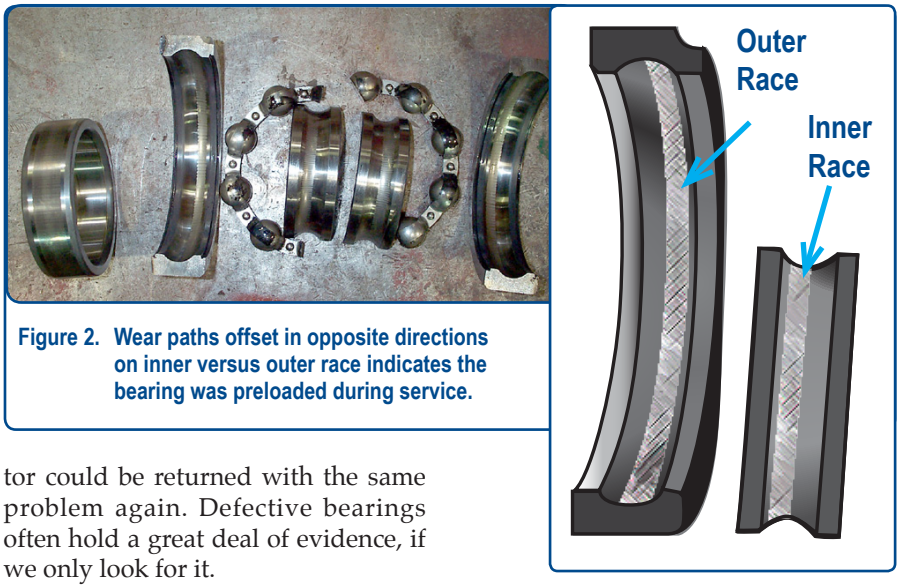


Figure 2. Wear paths offset in opposite directions on inner versus outer race indicates the bearing was preloaded during service.

The key is communication with the customer so that we repairers know that the motor was removed for bearing faults, and so that we can go a step further in the diagnostic process. Especially with the prevalence of variable frequency drives (VFDs), bearing currents cause a significant number of bearing failures. If you know the motor is operating from a drive, there are corrective measures to prevent future failures of the same type. And those extra steps are billable extras. Neglecting these additional inspection steps is like leaving money on the table, for both the service center and the customer.

Follow the clues

Here are steps to avoid missing important clues:

A. Mark the bearings to indicate which end of the motor (or generator, pump, blower, etc.) each came from. By marking the side facing out, you also will know the orientation of both bearings. That's useful when you discover evidence of preloading or misalignment. Also, mark each half of outer race before cutting in half.

B. Dismantle the bearing. The easiest way to do this is to use a die grinder or chop saw to cut the outer race in half. Another option is to use a grinder to remove the rivet heads that hold the bearing retainer together. Do not use a torch! It is likely to destroy the evidence in your search.

C. Wipe the grease out of the inner and outer races and examine the ball wear paths to determine the cause of the problem.

Consider the evidence

- **Misalignment.** A diagonal wear path, as shown in **Figure 1**, indicates misalignment.
- **Preloading.** If the wear path is offset in opposite directions on inner versus outer race, the bearing was preloaded during service (**Figure 2**).

  Are both ends preloaded outward? That means the motor does not have sufficient room for thermal expansion of the shaft. Corrective machining is required to prevent a repeat failure.

  If only the drive end bearing was preloaded, that means the preload was the result of external forces, specifically during the alignment and coupling phase. Let your customer know, as soon as possible, that the alignment procedures

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need to be reviewed. The motor might be bolt-bound, in which case there are two viable options. The first is to shift the driven equipment during the alignment process. The other option, which is often more practical, is to drill the base bolt holes one nominal size larger to gain the necessary room for a proper alignment.

- **Shaft currents and contamination**. A washboard appearance called fluting (**Figure 3**) is indicative of shaft currents (also known as bearing currents), which are increasingly common when motors are powered by variable-frequency drives (VFDs).

  A highly frosted wear path is either caused by VFD-related shaft currents or dirt embedded in the grease. Use a 20x magnifier to look more closely. Electrical pitting on the race or rolling element will have a melted appearance along the edges, whereas contamination causes a rougher cratering.

Whatever you find and however you solve the problem–don't just change the bearings. An internal preload condition requires the non-locating bearing housing to be machined deeper to gain sufficient room for thermal expansion of the shaft. A good rule of thumb is to provide 0.010" per foot (0.75 mm per meter) of shaft length between bearings.

Figure 3. Bearing fluting due to shaft currents.

Shaft/bearing currents call for insulation of the non-drive end if the motor is operating from sinusoidal power (or for DC machines). A motor operating from a VFD, however, requires more steps to solve the fluting issue. Both ends should be insulated, and a shaft grounding brush should be installed. There are several good options for each. First, insulating the bearings can be accomplished by insulating the bearing housing (good), by insulating the shaft journal (better), or by installing hybrid bearings (best). The shaft grounding brush can be provided by several suppliers, but the brush must be a low-resistance brush. That means a high-silver-content brush, not a carbon brush as used in DC machines. ●