SKF @ptitude Exchange

Maintenance tips for electric motor bearings

Summary

Up to 80% of all electric motors are rebuilt due to bearing failure. Few failures are the result of true bearing steel fatigue. Most failures are caused by improper bearing use or inadequate maintenance. SKF research shows that, with proper installation and maintenance, bearings in electric motors often function properly for over 10 years. The following maintenance tips help provide trouble-free bearing life.

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1. Create the best possible operating environment

The perfect bearing operating environment is contaminant free and has low humidity, an non-fluctuating temperature, and no vibration. In this perfect environment, bearings would be in constant use. Loads would be perfectly balanced, and bearings would be lubricated continuously to eliminate friction and wear.

Theoretically, bearings could last indefinitely under such conditions. However, in reality you can only strive to approximate the perfect environment. Some of the biggest contributors to bearing failure are found in areas overlooked in maintenance programs.

2. Manage moisture to extend life

Although it is not always possible to control moisture, it can be managed. When motors are running, humidity usually is not harmful, but when they are turned off and cool, condensation builds up.

You can not stop condensation, but you can guard against its harmful effects. Use grease fortified with rust inhibitors in bearing assemblies, and frequently rotate the shafts of idle motors whenever you suspect condensation.

When a motor is idle, lubricant is squeezed out, which allows moisture to make direct contact with the highly polished surfaces of the machine. Deterioration begins almost immediately.

3. Protect idle motors from vibration

Bearing wear does not only occur when motors are running. Some of the worst wear occurs when motors are subject to shock and vibration while idle. For example, a secondary motor may be mounted near a primary motor or on an assembly that is subject to vibration. When the motor is not running, the bearing's rolling elements vibrate in place, which creates depressions in the raceway (false brinelling).

False brinelling occurs when rolling elements break through the thin lubricating film that separates them from the raceway. When the motor is operated, rolling elements roll over these depressions, which shortens the bearing's working life.

Figure 1. Example of an electric motor bearing that was subjected to vibration during stand-still. It concerned an auxiliary motor on a ship. The result is false brinelling marks (SKF Belgium).

4. Align motor shafts carefully during installation

Misalignment between the electric motor shaft and the shaft of the driven equipment is another common cause of premature bearing failure. Such misalignment introduces excessive vibration and loads.

Although couplings are typically flexible to accommodate misalignment, don't take advantage of that flexibility. When shafts are misaligned, the working life of the electric motor is shortened.

A coupling has only one desired operating position: the position it takes when at rest. When a coupling operates in any other position, it creates unnecessary stress for motor bearings.

Couplings will not bend or twist during operation if equipment and motor shafts are properly aligned. Over-tightening belts also causes unnecessary loads. Only use enough tension to prevent belt slippage.

For ideal shaft alignment, first secure the driven equipment, then install the coupling. Only after the coupling is attached to the equipment should the motor be moved into proper alignment. Finally, secure the motor. If gaps are not set precisely to the coupling manufacturer's recommendations, stress on the coupling creates unnecessary operating loads (even when shafts are in alignment).

4.1. Keep motor vibration history

Take a vibration reading after a new motor is installed. Regularly scheduled readings provide a historical perspective on motor wear. See also related @ptitudeXchange articles on vibration monitoring and analysis.
When a laboratory technician sees a recurring spike in vibration data (measuring amplitude at a given frequency on the inner ring ball pass) but doesn't have historical reference points, he is unable tell if the data represents an actual problem. Vibration characteristics vary widely among motors and applications. Data that represents a "snapshot in time" is not likely to be of much value.

5. Know the "ins and outs" of lubrication

Proper lubrication includes the right quantity, interval, the type of lubricant, and the right lubrication method. Consult also the related lubrication articles and the lubrication advisory system on @ptitudeXchange.

5.1. Lubrication quantity

A new electric motor arrives with its bearings properly lubricated for the dimensions of the bearing envelope. The manufacturer could add additional lubricant, but that is potentially harmful to the bearing. When a bearing's rolling elements begin to move, they must push whatever grease is in the cavity. Rolling elements require more energy if there is too much grease. This places a greater burden on the motor.

Over-lubricating (pushing excessive grease into the cavity) can cause undesirable heat buildup as the rolling elements try to push the extra grease out of the way. Heat buildup represents friction and wear, and reduces grease life.

Follow the recommendations that come with the electric motor to ensure it is not over-lubricated. If the recommendations have been lost or misplaced, the motor manufacturer can supply an additional set.

5.2. Interval

There is not a rule of thumb for identifying correct electric motor lubrication intervals. Bearing manufacturers make recommendations based on bearing size, bearing type, speed of operation, general operating environment (contaminated environments for example, require more frequent lubrication), and the type of electric motor (vertical motors require lubrication twice as often as horizontal motors).

Guidance on lubrication intervals is usually provided with a motor; if not, the information can be obtained from the bearing supplier.

5.3. Type of lubricant

Not all greases are compatible. Many deep groove ball bearings come lubricated with polyurea-based grease, a high-temperature all-purpose lubricant. Polyurea lubricants are sensitive to other lubricants, particularly lithium-based greases, which cause the lubricants to drain out of the bearing cavity. Before lubricating a bearing, the technician must know what grease is currently being used and select either the same type of grease or a compatible product. Compatibility charts are available from lubricant manufacturers.

5.4. Lubrication method

Most large electric motors come with a grease fitting and a drain plug (smaller motors may not have these ports, as they contain smaller bearings that are factory-lubricated for the life of the motor).
The proper lubrication method is to pump new grease into the bearing through the appropriate fitting and allow the old grease to exit through the drain plug. However, if the drain plug is closed or clogged, too much grease will be pumped into the bearing. After the recommended amount of grease is injected, stop greasing and begin, or continue, to run the motor with the drain plug open. Run the motor long enough to allow the bearing to purge the excess grease. Cap the plug when grease stops exiting the drain plug. The motor has the proper amount of lubrication.
SKF does not recommend that technicians purge old grease through seals as old and excessive grease will be retained in the cavity. When these over-lubricated motors run hot, technicians may believe they have under-lubricated and attempt to force more grease in.

6. Consider all requirements when rebuilding

The following tips can be used as a guide or as discussion points to ensure that new bearings are properly installed.

- Use a puller to remove old bearings and take care not to damage the motor shaft. Damaging the old bearing is of no consequence, as it will be discarded.
- Use hydraulic-assisted removal techniques if bearings are repeatedly removed. Before bearings are installed, a small hole is drilled through the center of the shaft. To remove the bearing, hydraulic fluid is forced into the hole, which expands the inner ring of the bearing and allows it to be lifted by hand.
- Put in what you take out. The original bearings in the motor were carefully selected for compatibility with the motor's functional capacity. If the original bearings cannot be matched (or if the bearings are not originals and are inadequate substitutes) the bearing manufacturer can help in a good choice.
- Heat new bearings uniformly before they are fitted over a shaft. Use an induction heater or a hot plate... never a blowtorch. Bearings should be heated to a maximum of 110° C (230° F). Higher temperatures can alter the microstructure of the steel, which causes changes in bearing shape or hardness.
- Decide between seals and shields for bearing protection. Seals offer the best protection from contaminant-laden operating environments because they make positive contact with the rotating inner ring of the bearing. However, seals may not be practical for all motors, as contact creates drag and heat. In such cases, a shielded bearing may be more appropriate. A bearing supplier can provide speed limits of sealed versus shielded bearings. Shields are practical for most motors because they extend close to the inner ring but do not make direct contact. Although they do not provide the same degree of protection, they will not limit bearing speed.
- Be sure that the electric current can not pass the bearing. Many electric motor bearings fail due to electric current passage.

7. Are there bearings designed specifically for electric motors?

Most electric motors do not contain "special" bearings. The only differences between an electric motor bearing and any other bearing are the higher noise standard and possible electric insulation to prevent electric current passage through the bearing. To reduce noise, process tolerances are much closer, which keeps the bearing running quieter.