Root Causes of Bearing Failure Cheat Sheet

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1. Fatigue

Stress over time, which is fatigue failure, is the right reason why bearings should eventually stop rotating. This cause of failure is different than wear. Fatigue failure is related to the stress the bearing is subjected to over time. Fatigue failures in bearings typically originate sub-surface and eventually will propagate to the surface, and in time, will appear in what is referred to as a spall

Fatigue failure is, in part, interrelated to the purity and the quality of the steel. With advances in steel making over the last few decades, micro-inclusion impurities within the bearing steel are minimal. Calculating the fatigue life of a bearing takes into consideration, load, speed and cycles or time. Bearing engineers use the L10 life of a bearing, along with dimensional restrictions and the bearing's design, for selecting a bearing. L10 life is a life calculation where 90% of identical bearings are handled, installed, lubricated and run under the same operating and environmental conditions, without metal fatigue. This is the ideal reason for the cause of failure..

2. Handling/Installation

What to look for in the analysis

1. Save the failed parts and mark them (date, time, direction, location, etc.).
2. Order the analysis. Use a problem-solving system such as 5-Whys for RCFA.
3. Use a multi-faceted approach to condition monitoring by incorporating, vibration analysis, thermography, lubricant sampling and ultrasound data collection.
4. Take pictures and document.
5. Analyze the collected data. Watch for trends.
6. Separate and differentiate cause, effect and non-auditory noise. Determine the root cause of failure.
7. Use a team of employees and industry specialists and implement the team's recommendations.
8. Avoid blaming individuals.
9. Change the culture away from run to failure.
10. Hold regular training sessions; education is important.
11. Follow up.
12. Expand on and communicate the successful solution to others.

3. Operational issues

Improper handling and installation practices often kill the bearing before it has been installed or rotated. Storage in a wet or highly contaminated environment is detrimental to the bearing's life.
Bearings should be stored, flat, dry, clean and in good order. The temperature should not vary widely from summer to winter. Humid environments are not conducive to extended bearing life. Access should be controlled to prevent unnecessary opening and movement.
If bearings are stored, or a machine is idle for an extended time, the lubricant within the bearing may leach out and puddle at roller intervals-causing an acid etching of the surfaces.
Ambient vibration during storage should be minimized, and bearings should never be stored upright on a shelf. False brinelling of the metal surfaces is caused when the roller and ring are in contact with each other and subjected to vibration over time, resulting in the wearing away of the metal.
If the bearing is dropped while it is being handled, a form of mechanical damage referred to as a true brinelling will result. This material displacement or dent, where the rollers and races contact each other, may also be caused by force fitting the bearing (see Figure 3), or through the use of an improper mounting tool, such as a hammer.
Striking a steel bearing directly with a hammer is dangerous and could result in the bearing exploding. The human condition that all too often leans towards carelessness and urgency is a big part of this failure equation.
If the fit between the shaft and inner ring, or the housing and outer ring, is not within the recommended specifications for the application, fretting-corrosion on the surfaces will be evident. This is a different type of corrosion than that caused by invasive water and oxygen.
Fretting-corrosion occurs when there is movement between a bearing ring and shaft or housing because the fit is too loose. Microscopic steel particles break off due to movement and oxidize.
This will result in the appearance of areas of corrosion on the surfaces of the rings. In extreme cases of inadequate fit, the outer or inner ring may turn or creep, resulting in galling of the surfaces. The remedy for this is to measure all mating components prior to installation and make sure they are within the fit recommendations. If not, it's time for a new shaft or housing

This category includes negative operating conditions other than those related to the environment. Excessive thrust loads, misalignment, extreme vibration or the passage of stray current through the bearing, known as electrical erosion, are a few of the major faults seen while the bearing is in operation. Many of these types of failures are evident when examining the ball or roller path on the raceway surface, especially in the load zone of the rings.
If the bearing is misaligned beyond its capacity, the path of the rollers will appear to skew from one side to the other. Proper alignment is critical to extending the operating life of rotating components.
Extreme thrust will be evident by observing an off-center roller path.
In ball bearings, a disproportionate thrust load will result in the roller path being offset in the raceway groove and not in the bottom of the arc. Taper roller bearings subjected to misalignment will cause edge-loading and localized spalling at the ends of the rollers and the mating portion of the raceway.
Excessive vibration in the operating machine due to out-of-round rotating components will cause the bearing rollers or balls to bounce and skid as they come in and out of the load zone. This wavy or wash-board pattern is referred to as false-brinelling. Keep in mind that static false-brinelling may occur while the bearing is idle (see Figure 4). A dynamic false-brinelling pattern is usually more extreme than that which occurs while the bearing is static.
Fluting associated with electrical erosion. Courtesy: Motion IndustriesWith the increased use of variable frequency drives, bearing failures attributed to electrical erosion have become more common.
Electrical erosion occurs when there are improper grounding or rotor issues that allow for the passage of current from the race to the rolling elements, creating arc pits in the steel. The first stage is micro-pits, some of which cannot be seen by the human eye. These soon turn into a pattern referred to as fluting. It usually can be prevented by shunt brushes retrofitted onto the motor or by installing ceramic-ball or ceramic-coated outer rings..