

Dodge® mounted bearings: extending life by examining failure modes

Bearings will fail; it's that simple. However, anti-friction bearings are designed to meet a desired L_{10} life. L_{10} life is the predicted time at which 90% of a given group of bearings will successfully operate under a given load and speed prior to fatigue failure. This equation assumes a bearing will operate within a specific operating speed range and be properly maintained. However, anti-friction bearings rarely achieve the predicted L_{10} life. It's not due to a problem with the L_{10} prediction model, but rather due to improper preventative maintenance practices; practices which, when performed correctly, will extend bearing life and minimize production downtime. In fact, 80% of bearing failures can be attributed to ineffective lubrication, contamination, or a combination of the two.

Ineffective Lubrication

The most common mode of premature failure is ineffective lubrication, which accounts for approximately 55% of all bearing failures. Ineffective lubrication includes insufficient, unsuitable, or aged lubrication. Lubrication is a necessity for bearings because it prevents metal to metal contact between rolling elements and raceways. Without this protective film barrier, the bearing will wear, overheat, and fail.

Although many users do have preventative maintenance programs, routine lubrication schedules are often not part of the program. Insufficient lubrication occurs when a lubricant breaks down and dries up. Not only do speed and load have an effect on lubricant life, but environmental influences such as temperature, humidity, and contamination play a role as well. If fresh grease is not added to the bearing on a regular basis, then the bearing life is limited to the service life of the grease. In effect, the bearing will never reach its desired L_{10} life. When the lubricant breaks down the bearing will fail. The insufficient lubrication failure mode is most commonly evidenced by severe cage and roller damage within a dry bearing cavity.

Choosing the wrong lubricant is another cause for premature failure. Too often users lubricate bearings with the most readily available grease gun from the storage room, focusing little attention on the specific type of grease. This can cause problems because there are a variety of grease formulations, and not all of them are compatible. A high quality grease may actually do damage to a bearing if an incompatible grease is already present in the bearing cavity.

Using grease with the incorrect consistency or base may also harm a bearing. Grease with a soft consistency (low NLGI ranking) may not be ideal for high speed applications; likewise grease with a harder consistency (high NLGI ranking) may not be ideal for slow speed applications. Another potential problem is due to differences of oil viscosity within the grease. Oil viscosity changes with temperature. Therefore, certain greases may not be suitable for an application based on the operating conditions to which the bearing is subject. If you have doubts about your selection, it's best to contact the lubricant or

bearing manufacturer for assistance. Raceway pitting, or spalling with lubricant present, are typical signs that an unsuitable lubrication is being used.

Contamination

Contamination includes the ingress of either solid particles or fluids into the bearing cavity. In all, contamination accounts for nearly 25% of premature bearing failures. Environmental factors have a major influence on contamination. Bearings mounted in dirty, dusty, or moist environments are at highest risk of contamination failures. Complex sealing systems help, but even the most effective bearing seals will not completely protect a bearing from contamination.

Solid particle contamination is the most common contamination failure mode. Solid particles can enter a bearing cavity three ways. First, particles can bypass the sealing area. Ingress of contamination in this scenario is minimized by increasing the frequency of lubrication intervals and purchasing bearings with multiple contacting lip seals. A fresh flow of grease away from the bearing helps prevent contaminants from entering the bearing cavity while forcing out any contaminants which may be present. Secondly, contaminants can enter during lubrication by using contaminated lubrication ports and tools. Cleaning grease nipples and grease gun heads help prevent the manual addition of harmful contaminants to the bearing cavity. Finally, contamination can occur during installation. Handling naked bearings in dirty environments or installing them with dirty tools and hardware increases the potential for contamination failures. Best bearing installation practices include using clean tools and, when possible, installing in a clean area. If clean areas are not practical for the application then consider installing pre-sealed or unitized bearing cartridges.

Fluid contamination is caused by moisture accumulation in the bearing cavity. Fluids from muddy or moisture laden environments can bypass most bearing seals. Additionally, as bearings pump air through the seals, humid air combined with temperature changes will deposit condensation within the bearing cavity. The best strategy to combat moisture contamination is frequent lubrication intervals. If the fluid contamination is water, lubricate regularly with grease with emulsifying properties, such as a lithium based grease. Emulsifying greases will absorb the water rather than repel it. Bearings are most often damaged by fluid contamination during shutdown periods. Without emulsifying grease, the water would stagnate on the raceways. During these periods, moisture can puddle on raceways resulting in corrosion or moisture stains. Lubricating prior to shut down will drive out the moisture and provide fresh grease to critical areas.

Ineffective lubrication and contamination account for 80% of premature bearing failures. In other words, 80% of downtime associated with bearing failures can be prevented by proper preventative maintenance techniques. Adding regular lubrication schedules to the preventative maintenance plan, and addressing potential contamination issues will extend bearing life and prevent costly downtime.