Lubrication

One of the major contributing factors to achieving bearing reliability is proper lubrication. Bearings operate on very thin films of lubricant, which have to be maintained to ensure that design life is achieved. To do this, operators must; select the right lubricant, apply it properly and maintain it in a clean condition. Neglect or failure in any of these areas will seriously increase the risk of premature bearing failures and interfere with running.

Lubricant selection

Selecting a suitable bearing lubrication is increasingly critical. Properly selected, a lubricant will:

- Reduce friction and wear by providing a hydrodynamic film of sufficient strength and thickness to support the load and separate the balls from the raceways, preventing metal-to-metal contact.
- Minimise cage wear by reducing sliding friction in cage pockets and land surfaces.
- Prevent oxidation/corrosion of the bearing rolling elements.
- Act as a barrier to contaminants.
- Serve as a heat transfer agent in some cases, conducting heat away from the bearing.

The selection of a particular type of bearing lubricant is generally governed by the operating conditions and limitations of a bearing system. The three main factors in selecting a lubricant are:

- The viscosity of the lubricant at operating temperature.
- The maximum and minimum allowable operating temperatures.
- The speed at which the bearing will operate.

Greases

The primary advantage of grease over oil is that the bearings can be pre-lubricated, eliminating the need for - and cost of - an external lubrication system. Besides simplicity, grease lubrication also requires less maintenance and has less stringent sealing requirements that oil systems. Grease tends to remain in proximity to bearing components, metering its oil content to operating surfaces as needed.

However, grease will not conduct heat away from a bearing as efficiently as oil. Additionally, it can increase the initial torque within a bearings a cause running torque to be slightly higher. Finally, speedability limits for greases (expressed as a dN value - dN = bore in mm x rpm) are generally lower than for oils due to the plastic nature of grease that tends to cause overheating at high speed.

Oils

While grease may be inherently simpler than oil lubrication, there are still applications where it remains the better choice. For example, in high speed spindle and turbine applications oil is supplied continuously and provides cooling as well as lubrication. Other examples are instrument bearings with extremely low values of starting and running torque. These require a minimal, single lubrication with each bearing receiving just a single drop of oil or less.

Limiting speeds for most oil-lubricated bearings are imposed by the bearing size and cage design, rather than by the lubricant. For example, petroleum or diester-based oils can accommodate bearing speeds of up to 1,500,00 dN or higher. However, in the case of silicone-based oils, the maximum speed rating drops to 20,000 dN. When calculating life expectancy for bearings lubricated with silicone-based oils, the Basic Load Rating should be reduced by two-thirds. In addition, to ensure long life at high speeds, the lubrication system should provide for retention, circulation, filtration and possible cooling of the oil.

Solid soft film lubricants

Solid soft films are primarily used to provide solid lubrication for bearings in extreme applications where traditional fluid lubricants would be rendered ineffective. Advantages include friction being independent of temperature (from cryogenic to extreme high temperature applications) and that they do not creep or evaporate in terrestrial vacuum or space environments.

The solid soft film can either be applied directly to the surface or transferred by rubbing contact from a sacrificial source such as a self-lubricating bearing cage. The processes are complimentary and have been used successfully in a variety of extreme aerospace applications.

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