A BARDEN

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Improving Speedability in Ball Bearings

What is Speedability?

Speedability is the measure of a bearing's ability to perform at high rotational speeds. It is commonly measured in units of dN (bore diameter of the bearing in millimeters x rpm). Today, certain Barden Precision Bearings run at speeds in excess of 2 million dN.

Limits on Speedability

Speedability is determined largely by the self-induced bearing temperature and the effect on components comprising the bearing. These components include the balls, rings, retainer, lubricant, shields/seals, etc. Actual limiting speeds are a function of bearing design, application design, installation and operating conditions for the bearing system. An effective way to improve speedability is to reduce the self-induced operating temperature by modifying the parameters above.

Ways to improve Speedability

Bearing Design Heat is produced in the bearing by the contact of the balls on the raceway and by the rubbing of the retainer and seals on the bearing rings. The size and number of balls as well as the ball material in the bearing will also influence the amount of heat generated. Because smaller balls and ceramic balls are lighter, less centrifugal ball loading against the outer raceway will result.

The use of seals affects speedability. Heat caused by the rubbing of stationary seals against the rotating inner ring can contribute to the overheating of the bearing. Retainer design will also affect speedability. The highest speeds are obtained using angular contact bearings and a balanced one-piece land riding retainer. Two-piece and snap-in retainers tend to fail under high speed, shearing rivets or deforming the material. One-piece retainers eliminate both of these problems and maximize the structural integrity of the bearing.

Open raceway curvatures help speedability, too. The raceway curvature is expressed as a percentage of the ball diameter, typically 52-57%. A wider curvature reduces the contact area, lowering friction and heat generation. The penalty is lower load capacity which may be less important.

Application Design One of the most important factors affecting speedability is the lubricant and the way it is applied to the bearing system. Proper selection of grease and oil will minimize lubricant shear and thereby reduce temperatures. The newer accurately metered air/oil and air/oil mist systems also reduce oil shear by optimizing oil quantity. Continuous flow oil can provide the cooling and cleansing essential to high-speed operation. Unlike grease, which stays in the bearing, oil will effectively cool the bearing by carrying heat away from it. In addition, the bearings should be kept away from heat sources whenever possible.

Installation & Operating Conditions How Barden Precision Bearings are mounted and the conditions under which they are used greatly affect their speedability. When using rigidly preloaded pairs of bearings, a DB ("back to back") mounting system will allow higher speeds than a DF ("face to face") mount. Spring preloading will allow still higher speeds. If possible, reducing the amount of preload on the bearing system will also improve speedability.

When the bearing is in operation, heat is generated on the raceway surfaces, transferred through the bearing onto the shaft and into the housing. A good fit of the inner ring to the shaft and the outer ring to the housing enhances heat dissipation. Because of this, Barden recommends the use of controlled fits on shafts and in housings. Keeping the drive motor, pulley system and other components running smoothly, and thereby cooler, is also important. This will help lower the operating temperature of the bearings and enhance their speed capability.

If your bearing application can benefit from these recommendations, contact your Barden Sales or Application Engineer. He can help you evaluate the potential of speedability improvements in your product.

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