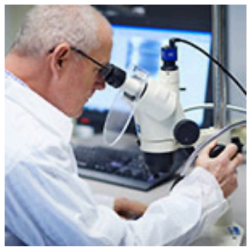
Manufacturers in nearly every industry — food processing, steel fabrication, aerospace, and medical devices, to name a few —are increasingly raising the performance expectations of rolling-element bearings, while at the same time exposing them to a variety operating and environmental conditions. While expectations are always going to be performance excellence, often overlooked is that extreme conditions profoundly impact bearing life, reducing the basic rating life by as much as 90 percent.

Bearing life, explained



Traditionally, bearing life calculations are based on a statistical formula that utilizes the dynamic load rating that is determined by the bearing manufacturer. After selecting a bearing type, loads, speeds and duty cycle are assessed in arriving at a basic rating life, which one compares to the desired design life to determine appropriate sizing.

However, when subjected to harsh environments in operation, bearing life can be greatly reduced. Design modifications are typically required to maintain life expectancy (i.e. changes may include materials for rings and rollers, coatings, seals, retainer materials and lubricants). It's rarely a one-size-fits-all solution. Before making any requisite modifications, designers must consider all the environmental factors in arriving at the most appropriate change.

Three common and challenging operating environments that impact bearing life include: high temperature, exposure to corrosive chemicals, and vacuum environments. To adequately plan for and meet production goals and milestones, manufacturers must account for these variables.

High-temperature environments

Custom bearings can accommodate temperatures exceeding 350° Celsius. To design a custom bearing used in such environments, manufacturers must consider both the bearing material and lubrication.

52100 chrome steel is a common ball and roller bearing material and it can withstand temperatures to approximately 125 ° Celsius. Therefore, at higher temperatures, look to heat-stabilized materials, which can operate in temperatures above 350 ° Celsius.

Additionally, oil viscosity decreases as temperatures increase, which in turn impacts the load-carrying capacity of the lubricant film. Standard bearing greases typically operate at temperatures up to 175 ° Celsius. Choose a high-temperature grease or oil, which can operate up to 285 ° Celsius.

Corrosive environments

Water and chemicals can have a profound impact on the longevity of bearings. In food processing plants, for instance, bearings are routinely subjected to high-pressure water, while irrigation systems are exposed to both water and fertilizers. Both environments compromise bearings and lubricants.

While rings and components are commonly made of stainless steel, in corrosive environments, consider nitrogen-enhanced martensitic stainless steel, which offers five times the corrosive resistance. Similarly, ceramic can be used for rolling elements, which deliver exceptional performance in corrosive environments.

Vacuum environments

Finally, vacuum environments, including those encountered in space, impact retainers and lubricants, with outgassing materials condensing on optical elements (lenses, solar cells, navigation sensors). The rate of outgassing increases at higher temperatures, requiring solid lubricants, including gold, silver, molybdenum disulfide and polytetrafluoroethylene. Additionally, austenitic stainless steel AISI 304 cages are preferred in retainer materials, reducing the torque between the rolling element and the cage.

For more information on the impact of operating bearings in extreme or harsh environments, read, "Three Life-Changing Environments for Bearings," written by AST Bearings Vice President of Operations, John Wallace.

Let our team of experts help with your bearing needs. Contact them here or learn more about our custom solutions.

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