

What factors affect bearing life?

The life of a bearing is affected by a number of factors. Some of these factors are related to the environment in which the bearing operates, while others are related to the quality and design of the bearing.

Temperature

When it comes to bearings, temperature is everything.

[Bearings](#) are designed to operate within a specific temperature range. If the operating temperature is outside this range, the bearing life will be significantly shortened and failure may occur.

Temperature affects metal fatigue, which causes the bearing to crumble and break apart. The higher the operating temperature of the bearing, the faster metal fatigue will occur.

Temperature also affects lubricant viscosity and oil thickness. As temperature increases so does viscosity, which causes more friction within the bearing and reduces its ability to move freely. This can result in premature failure or insufficient lubrication leading to increased wear rates on both components of the system.

Lubricating

Lubrication is the process of reducing friction and wear between moving parts. A lubricant is a fluid, usually a liquid, whose main purpose is to reduce friction, resistance and wear between moving parts. It also helps to keep the materials making up the moving part from oxidizing. Lubricants are often used on parts that have metal-to-metal contact

(friction) or metal-to-plastic contact as well as plastic-to-plastic contact.

Lubricants are generally designed to prevent corrosion; however, they can be used as sealers, which can either prevent corrosion or aid in its detection by forming an oxide film on the surface of the lubricant. The application of lubrication can reduce friction by 50%. Lubrication is also used for cooling purposes in many types of machinery such as internal combustion engines and transmissions in automobiles.

Speed

The speed of a bearing is a critical factor in its service life. The faster the speed, the shorter the life of the bearing. However, there are limits to how fast any bearing can operate before it fails.

In general, the faster you make a bearing spin, the shorter its life will be. There are several reasons for this:

Bearing balls become rounded as they try to keep up with the high speed and heat up due to friction. This causes them to lose their round shape, which reduces their contact area with raceways. This also makes it harder for lubricant to reach all parts of the rolling elements and ball cage, resulting in increased wear and decreased lubrication.

The higher speeds cause more stress on bearings because there are more loads acting on them than at lower speeds. As speeds increase, so does centrifugal force (the force pulling outward due to rotation). This increases friction between rolling elements and raceways, causing more heat buildup and premature failure of both components.

Load

A load is any force placed on a bearing, and this load has the potential to degrade its life. The amount of load that can be tolerated depends on the type of bearing used, its rotational speed and operating temperature.

The maximum allowable load depends on the type of bearing being used.

A journal bearing has a large surface area in contact with its rollers or shaft, so it is able to support high loads. A thrust bearing supports only axial loads, so it can handle only relatively low loads. A spherical roller bearing must carry both radial and axial loads, which limits its maximum allowable load rating.

Bearings that operate at high speeds must be designed for high rotational speeds. Their internal components are made from harder steel alloys and are mass produced in factories rather than handcrafted by machinists at machine shops. They also use lubricants that remain stable at higher temperatures than those used in low-speed bearings. High-speed bearings generally have better load ratings than low-speed bearings because they are designed for higher rotational speeds and higher operating temperatures.

Pollutants

Pollutants are detrimental to the life of bearings. Pollutants can be defined as any substance that is present in a liquid or gas form in excess of its normal concentration. The pollutants may be natural or artificial and their origin can be biological, chemical or physical.

Pollutants may cause corrosion, rusting and/or oxidation of bearings which will lead to bearing failure. The following are some examples of common pollutants:

Water – Water droplets are usually formed when bearing components come into contact with oil, grease or dirt while rotating at high speed. Water contamination can also occur when water enters from the side of the bearing through seals or lubrication holes.

Air – Air bubbles are formed when there is no pressure difference between two spaces in the bearing. Air bubbles cause excessive friction between rolling elements and raceways resulting in overheating and increased wear rate of both rolling element and raceway surfaces. In addition, air bubbles cause noise generation due to vibration generated during rotation of shafts containing air-filled bearings. This is known as “noise pollution”.

Surface Quality

The surface quality of the bearing is very important in determining its life. Bearing with high surface quality will have a longer service life than those with lower quality.

The surface finish of a bearing determines its smoothness and lubrication capability. The smoother the finish, the less resistance there will be to sliding or rolling motion between contacting surfaces. This means less friction and heat generation, which leads to longer bearing life and lower energy consumption.

The surface quality of a bearing is usually measured by its Ra value (roughness average). For example, if the Ra value of a bearing is $0.02\ \mu\text{m}$, it means that there is an average roughness over one square millimeter of $0.02\ \mu\text{m}$ or less.

All of the factors can have a serious impact on bearing life. Variables in the lubrication of an axis include the temperature of the environment, the temperature that the grease is stored at and even certain contaminants can be detrimental to its life expectancy. In addition to this,

variables in how a bearing is mounted can also negatively impact its life. For example if a bearing is installed sideways or is over-tightened it will wear much faster and may fail prematurely.