



Perfect Fit Industries, Inc.
Ball Bearing Failure Guide

Failures

Causes

Corrective Actions

Introduction

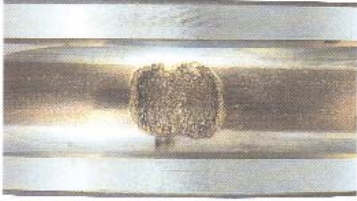
The service life of a ball bearing can be rated in terms of hours or rotations. This rating can be calculated by considering operating speed, temperature, axial and radial loads. Nonetheless, bearings sometimes fail prematurely due to several possible factors:

- Excessive loads
- Extreme temperatures
- Improper installation techniques
- Contamination by foreign particles
- Improper lubrication
- Defective shaft or housing

When a bearing failure occurs, it is important to consider the possible causes of such failure. Following is a description of the most common types of ball bearing failures, their likely causes, and suggested corrective actions to reduce the risk of failure.

Ball Bearing Failures, Causes and Corrective Actions

Flaking on inner ring



Flaking is a phenomena in which the bearing surface turns scaly and peels off due to contact load repeatedly received on the raceway and rolling surface during rotation. Causes can be due to one of the following conditions:

- During operation, bearing internal clearance becomes narrower than specified.
- Bearing ring is mounted at an inclination by mistake.
- Flaw is created during mounting or due to brinelling, nicks or rust occurring on the rolling surface.
- Inaccurate shape of shaft or housing.

Flaking can be corrected by:

- Use a bearing with heavier rated load.
- Check to see if abnormal load is being generated.
- Improve lubrication method to ensure better formation of lubricant film by increasing the viscosity.

Wear and Fretting



Wear is caused mainly by sliding abrasion on the guide surface of the bearing ring. Wear due to contamination by foreign matter and corrosion occurs not only to the sliding surface but also to the rolling surface. Causes can be due to one of the following conditions:

- Improper lubricant or shortage of lubricant.
- Contamination by foreign matters.

Fretting is a phenomena which occurs when slight sliding is repeatedly caused on the contact surface. On the fitting surface, fretting corrosion occurs generating a rust like powder. Causes could be due to one of the following conditions:

- Vibration load.
- Slight vibration on fitting surface caused by load.

Wear can be corrected by:

- Review and improvement of lubricant and lubrication method.
- Filtering of oil.
- Improvement of sealing.

Fretting can be corrected by:

- Investigation and correction of the source of vibration.
- Investigation and increase of interference.
- Enhancement of shaft rigidity.

Cracks



Cracks include slight cracks, splitting and fracture. Causes can be due to one of the following conditions:

- Heavy load.
- Excessively heavy internal load caused by improper installation.
- Instantaneous heat generation of bearing caused by sudden sliding at rolling surface, sliding surface or fitting surface.
- Abnormal heat is generated due to shortage of lubricant.

Cracks can be corrected by:

- Investigation followed by correction of excessively heavy load.
- Removal of thermal impact.
- Decrease of interference.

Ball Bearing Failures, Causes and Corrective Actions

Brinelling



Brinelling is depressions created on the part of the raceway surface which comes into contact with the rolling element and is due to plastic deformation. It is also small depressions on the rolling surface caused by contamination by solid foreign matters. Causes can be due to one of the following conditions:

- a) Extremely heavy load (static or impact load) applied to bearing.
- b) Solid foreign matter caught in bearing parts.

Brinelling can be corrected by:

- a) Investigation and correction for excessively heavy load or impact.
- b) Enhancement of sealing capability.
- c) Careful washing of shaft and housing to remove foreign matter.
- d) Filtering of oil.
- e) Investigation for cause of flaking in target bearing together with other bearings.

Rust and Corrosion



Rust is a film of oxide, hydroxide or carbonate produced on a metallic surface by chemical action. Cause can be due to one of the following conditions:

- a) When equipment is stopped and its temperature decreases to the dew point, humidity in the housing turns into drops of water. The water drops often contaminate the lubricant. As a result, rust is generated on the bearing surface.
- b) When bearings are stored in a humid place for a long time, rust is generated on the raceway surface at intervals equal to the rolling elements spacing.

Corrosion is the phenomena of oxidation occurring on the surface and is produced by chemical action (electric chemical action including combination or cell restructuring) with acid or alkali. Cause can be due to one of the following conditions:

- a) Corrosion occurs when a sulfur or chlorine compound contained in lubricant additives decomposes under high temperature.
- b) Corrosion occurs when water gets inside bearings.

Rust and corrosion can be corrected by:

- a) Enhancement of sealing capability.
- b) Periodic inspection of lubricant.
- c) Provision for adequate rust prevention during storage of bearings.

Pear skin



Pear skin is a condition of the rolling surface where small depressions are created entirely as a result of foreign matters being caught between parts.

Pear skin can be corrected by:

- a) Careful washing of shaft and housing.
- b) Enhancement of sealing capability.
- c) Filtering of oil.
- d) Review of lubricant and lubrication method.

Ball Bearing Failures, Causes and Corrective Actions

Discoloration



Discoloration is a phenomena in which the bearing surface is discolored by staining or heat generated during operation. Discoloration can be caused by:

- a) Discoloration (staining) is caused by deterioration of the lubricant or adhesion of colored substances to the bearing surface.
- b) A brown discoloration of the rolling or slide surface is caused by adhesion of acidic powders generated by abrasion during operation. In general, these powders adhere uniformly to the bearing circumference.

Discoloration can be classified as follows: staining, electric pitting, rust, corrosion and temper color. Stains can be removed by wiping with an organic solvent (acetone). When observed by microscope, electric pitting is small depressions caused by electric discharge. If unevenness remains on the surface after wiping with sand paper, the phenomena is judged to be rust and corrosion. If unevenness is completely removed, the phenomena is judged to be temper color caused by heat. These can be corrected by:

- a) Improvement of heat dissipation from bearings.
- b) Improvement of lubrication.
- c) Review followed by countermeasure for bearing operating conditions.

Smearing



Smearing is a phenomena where minute seizure is concentrated on the rolling surface. In smearing, the surface is partially melted by heat or high temperature generated by friction, and on some parts, the surface damaged becomes significantly rough. Smearing can be caused by:

- a) Occurs if the oil film disappears as rolling elements stop rotation due to inappropriate use or improper lubrication, and then start to slide on the raceway surface.
- b) By sliding or spinning of the balls.

Smearing can be corrected by:

- a) Review followed by countermeasure to improve the formation of oil film.
- b) Provision for extreme-pressure lubricant.
- c) Adoption of countermeasure to prevent sliding (by diminishing mounting clearance).

Creep



Creep is the displacement during operation of a bearing ring, relative to the shaft or housing. Creep occurs when interference is too small in relation to the heat or load generated during operation.

Creep can be corrected by review of interference between inner ring and shaft and between outer ring and housing. (Increase of interference)

Ball Bearing Failures, Causes and Corrective Actions

Electric Pitting



Electric pitting is a phenomena in which the bearing surface is partially melted by sparks generated when electric current enters the bearing and passes through an extremely thin oil film at the rolling contact point.

Significant electric pitting causes flaking. Electric pitting can be classified into pitting or ridge marks, which the rolling contact surface propagates. Depressions like craters can be observed when pitting is magnified, indicating that the surface has been melted by sparks.

Significant electric pitting causes flaking. In addition, since the hardness of the rolling contact surface deteriorates, the surface tends to be easily worn.

Electric pitting can be corrected by:

- a) Improvement of grounding or grounding maintenance.
- b) Provision of insulation for bearings or for the section near the bearings.
- c) Provision of non-conductive grease.

Failure of Cage

1) Flaw and Distortion

Since cages are made from soft material, they tend to be damaged or become distorted by external forces or from contact with other parts. And since cages with serious flaws also have distortion, their accuracy may decrease. The motion of the rolling element will consequently be affected. Therefore both the size and location of the flaw should be checked with care.

2) Wear

Cages under the following conditions can no longer be used because proper rotation of the rolling element is hindered:

- a) Cages whose pocket surface has been worn down in the shape of the rolling elements.
- b) Cages which cannot maintain the rolling element.
- c) Cages whose guide surface for the bearing ring has been eccentrically or severely worn.



Wear can be caused and corrected by:

- a) Improper lubricant or shortage of lubricant which can be corrected by investigation followed by countermeasure involving lubricant and lubrication method.
- b) Contamination by foreign matter corrected by improvement of sealing capability.

3) Looseness and Improper Riveting

Looseness of the rivet is caused by an error in bearing mounting, moment load, variable, load, vibration, etc. If a bearing is operated with improper riveting, the bearing cannot be returned to service because the rivets may break.

Looseness and improper riveting can be caused and corrected by:

- a) Improper bearing mounting corrected by reduction of inclination.