

Antifriction Bearing Identification, Failure Recognition, Inspection, and Fit Analysis

Overview

Proper antifriction bearing identification is essential because the bearing number defines the size, type, internal design, and fit requirements needed for reliable operation. When a bearing is incorrectly identified or incorrectly selected, the machine may still run, but the bearing can operate with the wrong clearance, wrong load capacity, or wrong shaft and housing fit, which increases the chance of heat, vibration, early wear, and repeat failure.

This document combines practical guidance on bearing identification, signs of incorrect selection, distinguishing fatigue from installation damage, preventing installation damage, inspecting bearings after failure, and performing fit analysis before installation. It is written in a field-friendly format that can be adapted into a maintenance SOP or troubleshooting checklist.

Criticality of Proper Bearing Identification

Correct bearing identification is important for several reasons:

- It ensures the bearing fits the shaft and housing correctly.
- It helps match the bearing type to the actual load conditions.
- It helps confirm speed capability, internal clearance, sealing arrangement, and lubrication needs.
- It reduces the risk of installing a part that appears similar but is unsuitable for the application.

A small difference in designation can change internal clearance, cage design, sealing arrangement, or dimensional fit. In practice, this means a bearing may install physically but still perform poorly in service.

If identification is wrong, the consequences can include:

- Increased vibration.

- Unusual noise.
- Higher running temperature.
- Reduced service life.
- Premature failure.
- Additional downtime and labor.

Common Signs of Incorrect Bearing Selection During Operation

A bearing that is incorrectly selected often gives warning signs during operation before complete failure occurs. Common signs include:

- Unusual noise such as humming, growling, squealing, grinding, knocking, or rumbling.
- Higher than normal vibration or rough running.
- Excess heat in the bearing or housing.
- Reduced machine efficiency or sluggish performance.
- Visible wear, discoloration, scoring, or contamination in lubricant.
- Repeated failure shortly after replacement.

These symptoms often indicate that the bearing is operating outside its intended limits. The cause may be wrong type, wrong size, incorrect internal clearance, inadequate load capacity, unsuitable sealing arrangement, or improper fit for the operating conditions.

In troubleshooting, repeated failure in the same location should prompt a review of:

- Bearing selection.
- Shaft and housing condition.
- Installation method.
- Alignment.
- Lubrication practice.
- Load and speed conditions.

Differentiating Bearing Fatigue from Installation Damage

A useful way to separate fatigue from installation damage is to consider both the timing of failure and the appearance of the damage.

Bearing Fatigue

Bearing fatigue usually develops after a period of service rather than immediately after installation. It is associated with repeated cyclic loading over time.

Common fatigue indicators include:

- Spalling.
- Pitting.
- Flaking.
- Cracking on raceways.
- Surface breakdown that appears progressive and load-related.

Fatigue damage often looks more uniform and service-related than impact-related. It may occur after a normal or extended operating period, although poor lubrication, contamination, overload, or misalignment can accelerate it.

Installation Damage

Installation damage usually appears early in service, often during startup or run-in. It is frequently associated with improper mounting practices.

Common installation damage indicators include:

- Dents.
- Brinell-like marks.
- Scrape lines.
- Scuffing.

- Localized deformation.
- Damage concentrated at one area rather than distributed evenly.

Typical causes include:

- Hammering the bearing into place.
- Applying force through the rolling elements.
- Misalignment during mounting.
- Dirty assembly conditions.
- Burrs or damage on shaft or housing seats.
- Improper heating method or overheating.

Practical Differentiation Rule

A simple field rule is:

- If the bearing ran for a meaningful period and shows pitting, flaking, or spalling, fatigue is more likely.
- If the bearing failed quickly and shows dents, gouges, scrape marks, or signs of mechanical abuse, installation damage is more likely.

Best Practices for Avoiding Installation Damage

Preventing installation damage depends on preparation, cleanliness, proper tools, correct force application, and final verification.

General Rules

- Inspect the bearing, shaft, and housing before installation.
- Clean all contact surfaces and remove dirt, rust, burrs, and old debris.
- Keep the bearing in its packaging until it is ready for use.
- Use only proper installation tools such as presses, fitting kits, or induction heaters.

- Never strike the bearing directly with a hammer.
- Never apply mounting force through the rolling elements.
- Apply force only to the ring being fitted.
- Follow the correct fit and mounting method for the application.
- Verify alignment and proper seating before the machine is returned to service.

Heating Practices

For interference fits, controlled heating may be used when appropriate. Good practice includes:

- Use an induction heater or other approved controlled heating method.
- Heat only to the recommended temperature range.
- Avoid overheating, which can affect material properties and internal clearance.
- Never use an open flame.
- If using an induction heater, make sure to demagnetize the bearing before installing.

Cleanliness Practices

Contamination introduced during assembly can cause early failure even when the bearing itself is correct. Good cleanliness practice includes:

- Work in a clean, organized area.
- Wear clean gloves where appropriate.
- Protect bearings from moisture and airborne dirt.
- Inspect lubrication points and seals before assembly.

Installation Verification

Before startup, confirm the following:

- The bearing is fully seated against the shoulder.

- There is no visible cocking or misalignment.
- Locking devices are installed correctly.
- Lubrication is correct in type and quantity.
- Rotation feels smooth where manual turning is possible.

Step-by-Step Checklist for Bearing Inspection After Failure

This checklist can be used after a bearing failure to improve root cause identification.

1. Secure the Equipment

- Shut down the machine safely.
- Apply lockout and tagout.
- Isolate all stored energy sources.
- Confirm the machine cannot restart unexpectedly.

2. Record Failure Symptoms

Before disassembly, document:

- Noise reported before failure.
- Vibration changes.
- Temperature changes.
- Leakage or lubricant loss.
- Load or speed changes.
- Time in service since installation.
- Whether the failure was sudden or progressive.

3. Photograph the Assembly

Take clear photos of:

- The complete machine.
- The bearing location.
- The housing and cover.
- Seals, spacers, collars, and locking devices.
- Any visible external damage.

These photos help preserve evidence that can be lost during disassembly.

4. Inspect Lubricant Condition

Check grease or oil for:

- Metal particles.
- Dark color or burnt appearance.
- Burnt smell.
- Water contamination.
- Dirt or process contamination.
- Too much or too little lubricant.

5. Clean Exterior Before Opening

- Clean the outside of the housing and surrounding area.
- Prevent outside dirt from entering during teardown.
- Remove covers carefully to avoid adding damage.

6. Remove and Inspect the Bearing

Inspect the:

- Inner ring.
- Outer ring.

- Rolling elements.
- Cage.
- Seals or shields.

Look for:

- Spalling.
- Pitting.
- Smearing.
- Scoring.
- Cracks.
- Brinelling.
- Heat discoloration.
- Cage fracture or wear.
- Seal damage.

7. Inspect Shaft and Housing Seats

Check for:

- Fretting.
- Corrosion.
- Scratches.
- Dents.
- Wear.
- Evidence of creep.
- Shoulder damage.
- Bore damage or looseness.

The shaft and housing should always be inspected because the damaged bearing may only be part of the actual failure story.

8. Identify Probable Failure Mode

Compare the evidence against likely causes such as:

- Fatigue.
- Installation damage.
- Lubrication failure.
- Contamination.
- Misalignment.
- Overload.
- Improper fit.
- Looseness.
- Electrical damage where applicable.

9. Decide on Corrective Action

Determine what must be corrected before reassembly, such as:

- Replace the bearing.
- Repair or replace the shaft.
- Repair the housing.
- Improve sealing.
- Change lubrication type or quantity.
- Revise mounting method.
- Review operating load or alignment.

10. Document Findings

Create a failure record that includes:

- Equipment identification.
- Bearing part number.
- Time in service.
- Symptoms observed.
- Photos.
- Measured damage.
- Probable root cause.
- Corrective action taken.

How to Perform a Bearing Fit Analysis Before Installation

Bearing fit analysis should be completed before installation so the bearing will operate with the intended support, clearance, and stability.

1. Verify Bearing Information

Confirm:

- Exact bearing number.
- Bearing type.
- Internal clearance class.
- Seal or shield arrangement.
- Cage design if relevant.
- Any manufacturer-specific suffixes.

2. Understand the Application

Determine:

- Whether the bearing position is fixed or floating.
- Whether the load is radial, axial, or combined.
- Which ring rotates relative to the load.
- Operating speed.
- Temperature range.
- Shock or vibration conditions.
- Lubrication method.

This step matters because the required fit depends on how the bearing is loaded and how the shaft and housing behave in service.

3. Measure the Shaft

Use suitable precision tools to measure:

- Shaft diameter at the bearing seat.
- Roundness.
- Straightness where relevant.
- Shoulder condition.
- Surface finish.

Take measurements at multiple positions to identify taper or out-of-round conditions.

4. Measure the Housing

Check:

- Housing bore diameter.
- Roundness.
- Shoulder squareness.
- Surface condition.

- Signs of wear, fretting, or distortion.

5. Inspect Seat Condition

Before installation, inspect all seating surfaces for:

- Burrs.
- Nicks.
- Corrosion.
- Scratches.
- Embedded debris.
- Wear patterns from previous bearing movement.

Any irregularity can alter the effective fit or create misalignment.

6. Determine Required Fit Type

Based on the application, determine whether each ring needs:

- Interference fit.
- Transition fit.
- Clearance fit.

General practice is to provide a tighter fit on the ring that rotates relative to the load so it does not creep on its seat.

7. Consider Internal Clearance Changes

Fit analysis is not only about dimensions. It must also consider how mounting and operating temperature affect internal clearance.

Check for:

- Reduced internal clearance due to interference fit.

- Thermal expansion differences between shaft and housing.
- Possibility of preload if the fit is too tight.
- Risk of looseness if the fit is too loose.

8. Select the Mounting Method

Choose the installation method that matches the fit:

- Mechanical press fit.
- Thermal expansion using approved heating.
- Mounting sleeve or approved fitting tool.

The selected method should allow the bearing to be mounted squarely and with force applied only to the ring being fitted.

9. Verify Seating After Mounting

After mounting, confirm:

- Full contact against the shaft or housing shoulder.
- No visible gap.
- Correct axial position.
- Smooth rotation where appropriate.
- No binding, excessive drag, or obvious misalignment.

10. Record the Fit Analysis

Document:

- Bearing number.
- Shaft measurements.
- Housing measurements.

- Selected fit.
- Clearance considerations.
- Mounting method.
- Final observations after installation.

This record supports future troubleshooting and helps identify repeat fit problems.

Combined Field Checklist

After Failure Inspection

- Lock out and secure the machine.
- Record symptoms and service history.
- Photograph the assembly.
- Check lubricant condition.
- Inspect bearing surfaces.
- Inspect shaft and housing seats.
- Identify probable failure mode.
- Decide corrective action.
- Document all findings.

Before Installation Fit Analysis

- Verify bearing identity.
- Review application requirements.
- Measure shaft dimensions.
- Measure housing dimensions.
- Inspect surface condition.
- Determine fit type.

- Consider internal clearance changes.
- Select proper mounting method.
- Verify final seating.
- Record measurements and observations.

Practical Maintenance Notes

Several field lessons apply across all stages of bearing work:

- Repeated failure in the same location often means the problem is not just the bearing itself.
- Shaft and housing condition are just as important as the replacement part.
- Cleanliness during installation is one of the lowest-cost and highest-value preventive steps.
- Early noise, vibration, or heat after installation should be treated as a warning sign and investigated immediately.
- Good documentation makes future troubleshooting faster and more accurate.

Closing Guidance

Successful bearing work depends on getting the full chain right: correct identification, correct selection, careful installation, accurate inspection after failure, and proper fit analysis before replacement. When these steps are handled systematically, bearing life improves and repeat failures are reduced.