

Bearing Failures – Causes and Cures

Best Practices for Storage, Handling and Installation

» Proper Storage and Handling

Rolling element bearings are highly precise components with internal tolerances on the order of millionths of an inch. So they should be handled carefully to ensure that they perform as expected.

The critical factor in ensuring that a rolling element bearing reaches its expected life is cleanliness – before, during and after it is installed. Cleanliness is important because once dirt or debris enters a bearing, it acts like an efficient lapping compound. Even minute amounts of lint mixed with a lubricant can create an abrasive mixture.

Contaminants are generally miscellaneous particles that, when trapped inside a bearing, permanently indent rolling elements and raceways under the tremendous pressure generated. Because of the relatively small contact area between rolling elements and raceway, contact pressures are extremely high, even for lightly loaded bearings. When rolling elements roll over contaminants, contact areas are greatly reduced, and pressure is extremely high.

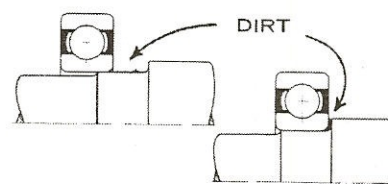
When abrasive material contaminates the lubricant, it is crushed into fine particles that wear the rolling elements and raceways. Therefore, it is important to maintain a clean environment when working on bearings. The assembly area should be isolated from all sources of contamination, including moisture and corrosive elements. Workbenches, tools, clothing and hands should be free of dirt, lint, dust and other contaminants that may harm the bearing. The work surface should be clean and rubber coated if possible. Plastic coating is also a good idea. This helps avoid nicking spindle parts on hard surfaces and allows the work surface to be wiped clean periodically. In addition, plastic and rubber coatings can be replaced easily and economically.

Also, never remove a bearing from its carton before it is to be used because moisture and dirt can contaminate the bearing. Bearings are wrapped in a special neutral, acid-free paper, and they should be rewrapped in such paper for storage. They should never be stored unwrapped, and they should never be wrapped in plastic. Plastic traps moisture that can rust the bearing.

Bearings shipped from the manufacturer are packed with a rust preventative to prevent corrosion. This rust preventative is compatible with common oils and greases, and need not be removed prior to installation.

When personnel handle clean bearings, particularly the rolling surfaces of separable bearings, they should wear surgical gloves. This prevents acid from the skin from leaving a deposit that can stain the bearing surface, leading to etching and corrosion. If gloves are not available, hands should be clean and dry.

Cleanliness is important not only for bearings, but also for shafts and housings. Dirt on the shaft can be pushed to the shoulder during bearing mounting, preventing proper seating and leading to possible fretting corrosion due to loose fits.



The tight fit in the inner race pushes the dirt to the shoulder, where it builds up and the bearing cannot be properly seated.

» Proper Installation

Several studies have shown that poor handling, particularly during installation, accounts for a high percentage of bearing failures. Depending on bearing type and size, mechanical, hydraulic or thermal methods are used for mounting. Regardless of the mounting method, care must be taken to prevent bearing rings, cages and rolling elements from receiving direct blows, and mounting force should not be directed through the rolling elements.

Mounting should preferably be done in a dry, dust-free room away from metalworking or other machines producing swarf and dust. When a bearing must be mounted in an unprotected area, which is often the case for large bearings, steps should be taken to protect the bearing and mounting position from contamination by dust, dirt and moisture until installation has been completed. This can be done by covering or wrapping bearings and machine components with waxed paper or foil.

Foreign matter entering a bearing shortens life and causes one or all of the following operating conditions:

- Increased noise
- Increased friction
- Ball skidding
- Increased heat
- Reduced lubricant life

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Bearings under four inches in diameter are usually cold press-fitted onto the rotating member. If the shaft rotates, press on the inner ring. If the housing rotates, press on the outer ring. Pushing on the wrong ring forces the rolling elements to indent the raceway, a condition called brinelling.

Bearings with large inner ring interference (and large bore bearings) require a considerable amount of force to mount at room temperature. Heating to expand the inner ring eases assembly in these cases. The recommended method for heating up a bearing for installation is an induction heater. A suitable induction heater will be equipped with a temperature sensor to attach to the inner ring and a demagnetization cycle.

Double-seal and double-shield bearings should not be heated above 250°F (120°C) to avoid damaging the seals or the special grease in which they are packed.

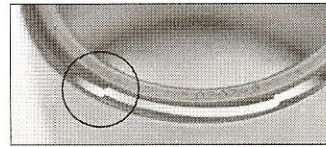
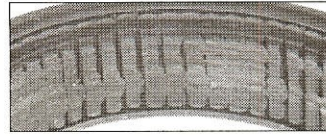
An induction heater is essentially a transformer that induces low-voltage, high-amperage energy into the bearing races, resulting in quick, even heating. It is essential to apply heat uniformly throughout the entire bearing. Torches should never be used to heat the inner ring during installation because they produce high localized heat that can damage bearing components and the lubricant.

Pay special attention to the shaft condition when installing a bearing. Dirt or a burr on the shaft can create a stress riser that can cause the bearing to fail quickly due to local overload.

Pillow block and flange bearings require some special attention to ensure that they are securely locked to the shaft. The most widely used method of locking the inner ring to the shaft employs an inner ring with locking set screw. The preferred locking mechanism for a mounted unit is a concentric locking sleeve.

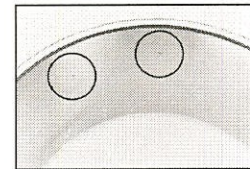
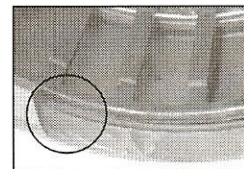
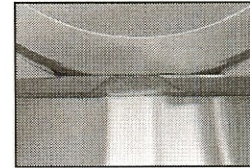
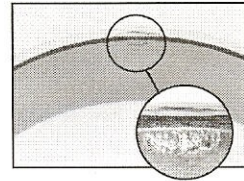
Tapered bore ball bearings and spherical roller bearings can be mounted on a tapered shaft or with an adapter that has a corresponding taper on the OD of the split sleeve.

Needle Bearing Installation Damage



During installation of tapered ball bearings, they should be tightened until there is a slight drag on the outer ring, then the washer tang can be set. With spherical roller bearings, the unloaded side of each bearing should be measured and a recommended amount of clearance removed before installation. Never mount a spherical roller bearing while the load is applied to the bearing.

Handling Damage



The inner ring of bearings with tapered bores is always mounted with an interference fit. The degree of interference is determined by how far the bearing is driven onto the tapered seat on the shaft or onto the adapter or withdrawal sleeve. This process reduces radial internal clearances. The amount of reduction provides information on the fit produced. Bearing manufacturers publish guidelines on how much these clearances can be reduced without affecting performance.

Small bearings can be driven onto a tapered journal or withdrawal sleeve using a nut; they can be driven onto adapter sleeves using the sleeve nut. A hook spanner or impact spanner can be used to tighten the nut. The seating surfaces of the shaft and sleeve should be lightly oiled before mounting.

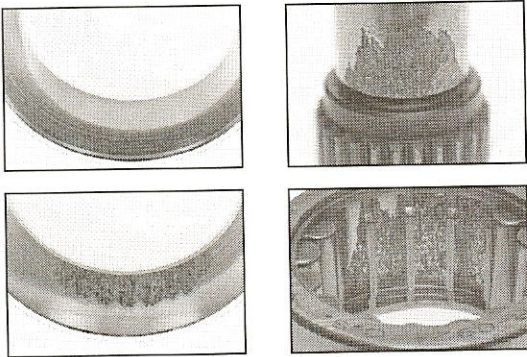
Larger bearings require considerably more force for mounting. Hydraulic nuts and oil injection equipment ease this process.

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» Misalignment and Loose Fits

Correct alignment is critical for bearings to operate properly. The misalignment capability of the bearing is determined by the type and series of the bearing. Misalignment can cause an abnormal temperature rise in the bearing or housing and heavy wear in the cage pockets of rolling elements. Misalignment can be detected on the raceway of the non-rotating ring by a tracking pattern that is not parallel to the raceway edges.

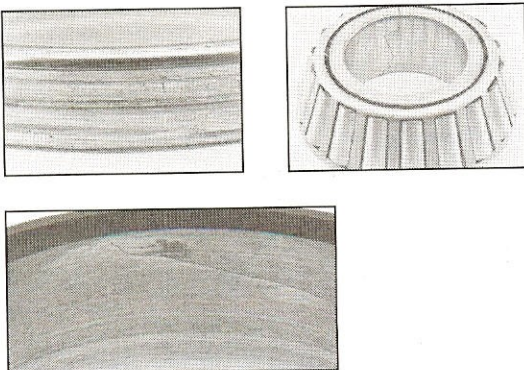
Misalignment



To prevent misalignment, shafts and housings should be checked for proper runout of shoulders and bearing seats. Also use single-point turned or ground threads on non-hardened shafts and ground threads only on hardened shafts. Precision locknuts also can prevent misalignment.

Loose fits can cause relative motion between mating parts. Slight but continuous relative motion can lead to fretting of bearing surfaces. If the looseness is sufficient to allow considerable movement of the outer or inner ring, the mounting surfaces (bore, outer diameters, faces) will wear and overheat, causing noise and runout problems. ☞

Improper Fit in Housing or Shafts



Keeping Bearings Clean

Follow these simple housekeeping rules when handling and installing bearings:

1. Work with clean tools in clean surroundings.
2. Remove all outside dirt from the housing before exposing bearings.
3. Handle with clean, dry hands.
4. Treat a used bearing as carefully as a new one.
5. Use clean solvents and flushing oils.
6. Lay bearings out on clean paper.
7. Protect disassembled bearings from dirt and moisture.
8. Use clean, lint-free rags if bearings are to be wiped.
9. Keep bearings wrapped in oil-proof paper when not in use.
10. Clean inside of housing before replacing bearings.
11. Install new bearings as removed from the package without washing.
12. Keep bearing lubricants clean when applying; Cover containers when not in use.