

TECHNI/TIPS

A Publication of the Lubrication Engineers Technical Department

LEADERS IN LUBRICANTS

NUMBER 67

ANITIFRICTION BEARING MAINTENANCE AND LUBRICATION

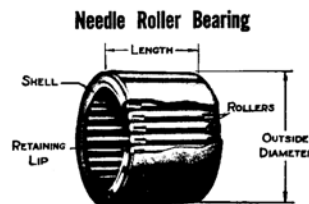
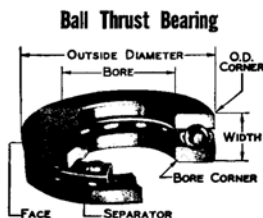
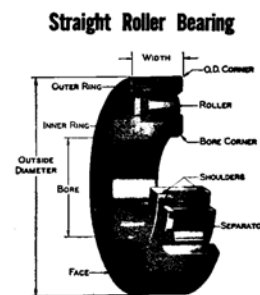
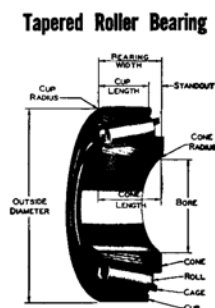
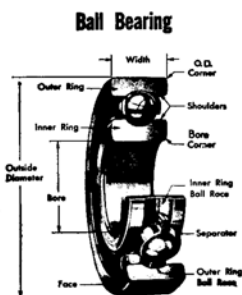
Proper lubrication of antifriction bearings is essential to their successful performance. Principles differ from the practices for plain or sleeve type bearings. These principles must be known and applied in order to properly maintain antifriction bearings.

After completely understanding these principles, you should consider one point of importance. We quote from *A Guide to Better Bearing Lubrication* by SKF Industries, Inc. "...that the characteristics of lubricants, particularly in the case of grease, are not assured on the basis of specifications alone." Specifications only outline the physical and, perhaps, the chemical description of a product. Performance is what counts and very few specifications deal with performance.

BEARING PARTS AND THEIR NAMES:

The parts common to standard ball and roller bearings have been given names, as shown below. Generally all manufacturers use these terms.

Basically all antifriction bearings consist of two hardened steel rings, hardened balls or rollers, and a separator or retainer which separates the balls or rollers. Many variations of these types are in use. Some types such as needle roller bearings may be used without an inner ring, the rollers running directly on the hardened shaft. Needle bearings do not use separators.



TYPES OF ANTIFRICTION BEARINGS:

As shown, there are two major types of antifriction bearings. These are ball bearings and roller bearings. Again, bear in mind that there are many variations on these basic configurations according to the manufacturer and to the specific use of the bearing.

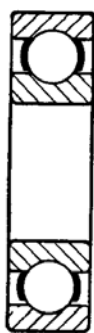
Types of Anti-friction Bearings

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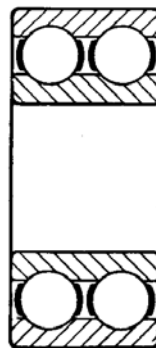
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BALL BEARINGS

4. Duplex bearings are specially face ground for use in pairs
5. Snap Ring bearings are used both with and without shields.
6. Shields may be on either one or both sides.
7. Sealed bearings may have seals on both sides – are then wider.
- 9 & 10. Magneto and Front Wheel bearings are splarable.



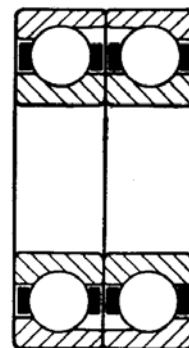
1. Single Row



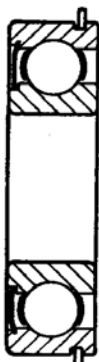
2. Double Row



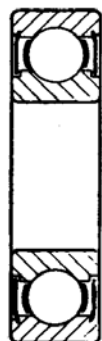
3. Radial-Thrust



4. Duplex



5. Snap Ring



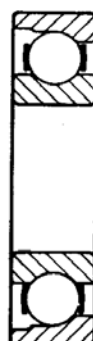
6. Shielded



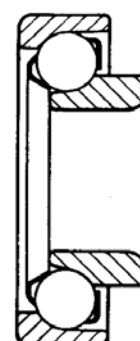
7. Single Seal



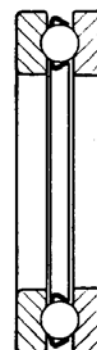
8. Self-aligning



9. Magneto



10. Front Wheel



11. Ball Thrust

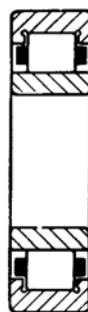
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ROLLER BEARINGS

- 1,2,4,5,6 & 8. These bearings are all separable either as to inner or outer rings.
5. Double Row tapered roller, adjustable through cones. Also made adjustable through the cups.
10. In some cases needle bearings may have inner rings which are separable.



1. Straight Roller
Separable outer ring



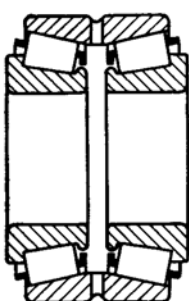
2. Straight Roller
Separable inner ring



3. Straight Roller
Non-separable



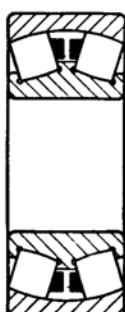
4. Tapered
Roller



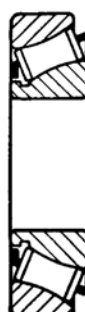
5. Tapered Roller
Double Row



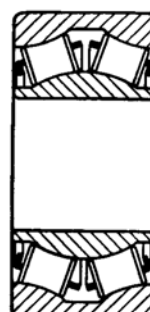
6. Barrel
Roller



7. Barrel Roller
Double Row



8. Concave
Roller



9. Concave Roller
Double Row



10. Needle
Roller

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FUNCTIONS OF LUBRICATION:

Antifriction bearing lubricants serve the following primary functions:

1. To lubricate the sliding contact between the retainer and other parts of the bearing.
2. To lubricate any contact between the races and rolling elements which is not true rolling.
3. To lubricate the sliding contact between the roller and guiding elements in roller bearings.
4. To lubricate all true rolling contacts in the bearing.

Secondary functions are:

5. To protect highly finished surfaces from corrosion.
6. To help seal housings against foreign material. Grease contributes to this objective.
7. To provide a means to transfer heat (cool).

LUBRICATING WITH OIL:

The resistance to turning in a bearing lubricated with oil consists of 1) the bearing design and the load, and 2) the viscosity and quantity of oil and the speed of the bearing.

Friction torque is lowest with a quantity of oil just sufficient to form a thin film over the contacting surfaces. Friction increases with a greater quantity and with a higher viscosity of oil. However, the desire to maintain safe lubrication with little regard for friction loss, usually predominates. This means that more oil, and usually a heavier oil, will be used in order to reduce loss from evaporation or leakage.

Generally, however, it should be kept in mind that heavily loaded bearings and low speeds usually need heavy oils. Light loads and high speeds require lighter oils.

LUBRICATING WITH GREASE:

When greasing antifriction bearings, the use of high pressure guns may be undesirable unless used very carefully. High pressure can damage the bearings, waste grease, create the danger of overheating due to overgreasing and produce unsightly conditions around the bearing. A ball or roller bearing, in most applications, will have adequate lubrication if the grease level is at one-third to one-half the capacity of the bearing housing space. Usually a greater amount will be discharged by the seals and wasted.

Applications exist where it will be necessary to use either more or less than the recommended amount. Where low torque is a requirements, the bearings may be lubricated with a very small amount of grease. Where the speed is very low and the bearing is exposed to dirt or moisture, the bearing may be packed nearly full. High speed and high temperature usually require more frequent greasing than normal.

Store grease in clean containers. Handle grease with clean paddles or grease guns. Keep grease containers covered. Don't overfill bearings. The lubricant will ooze out of the overfilled housings, collect dirt and cause trouble. Too much lubricant can also cause overheating. This is particularly true of high speed bearings where churning of the lubricant will cause overheating.

A. OPERATING TIPS

Where you have no operating experience with a particular bearing, follow the manufacturer's directions on lubrication periods. Top quality lubricants will allow longer lubrication periods, but most bearings need cleaning and relubrication at least once a year. Lubricate more often if the bearing is large, if it operates at high speeds or if the operating temperature is over 140°F. Especially relubricate at shorter intervals where the bearings are subject to contamination.

If possible, inspect the lubricant occasionally. It may show you when service is needed. If the grease is dark, it means that it has begun to oxidize. A change in the original color may indicate moisture. Hardened grease should always be replaced.

Compare used and unused oil. Cloudy oil indicates water. Darkened oil may show sludging. Dark, tacky coatings may mean that the oil is dirty or it has begun to carbonize. Quality lubricants, or lubricants with special application tailored characteristics, will last much longer than ordinary commercial grade lubricants.

Do not overlubricate. Only the grease that actually touches the bearing lubricates. If a roller element bearing is overgreased, the rollers will "plow" through the excess grease and generate heat. The higher the speed, the more

sensitive the bearing is to excess lubricant. Generally, as speeds increase, the lubricant should be lighter and higher in quality. Heavy loads and slower speeds require heavier lubricants, but the quality level should remain high.

Fresh oil and grease will usually force out old lubricant. If the lubricant is badly oxidized or dirty, flush with a light oil, drain and add new lubricant. In some cases, a small amount of solvent may be added to the flush to aid in cleaning.

Overheating must be prevented in order to have long bearing life. Discoloration of the races, balls or rollers, or retainers is a sure sign of overheating. The color is usually a gunmetal blue or a bluish-black. LE lubricants are excellent for reducing operating temperatures and energy consumption.

Rubbing often causes overheating. Check the operating clearance of the bearing seal. If it rubs against the shaft shoulder, remachine the shoulder to allow proper clearance. Bent lock washer prongs can also cause overheating.

External heat conducted through the shaft can expand the clearance of the inner race of the bearing, or it can expand the shaft, preload the bearing and cause thrust loads. Special design bearings must be used where thermal expansion is excessive.

Overheating can be caused by improper lubrication. In pillow block bearings, if oil lubricated, the oil should only come to the center of the lowest ball or roller in the bearing. If grease lubricated, the spaces between rollers should be one-third full.

If the bearing housing is warped, or if the bore is distorted and out-of-round, this can cause overheating. Also inspect for any metal chips or foreign materials in the housing which could create high stress points on the bearing. Check to see whether the bore is pinching the bearing and relieve by remachining the bore. Also make sure that the pedestal surface is flat and that any shims cover the entire base area.

Dirt shortens bearing life. Look for a satin finish, clearly marked ball or roller paths in the bearings. It is a sure sign that fine abrasives are entering the bearing and are lapping parts. Larger dirt particles will cause scoring. Of course, this leads to failure.

Start with good housekeeping. Work with clean tools in a clean area, handle bearings carefully and clean them when replacing them.

Handle bearings as little as possible. Keep them wrapped until actually ready to install. Protect disassembled bearings from contamination.

Inspect your lubricants and lubricating equipment. Dirty oil and grease carry debris right into the bearing. See that all lubricants are well protected from contamination. Keep grease guns and oil cans under cover.

Standardize lubrication procedures and allow only experienced personnel to lubricate equipment.

If seals are broken, bent or worn, dust, dirt and other foreign matter can get into the bearing. If moisture or water is present, specially designed seals or fingers will help keep it out. Where dirt is a constant problem, try shrouding the bearing housing in a light metal box. It is inexpensive, easy to build and helps keep dust and dirt from the bearing area. Double tipped seals may also be used to help keep contamination out.

Use only the best quality lubricants. The difference in performance can mean large differences in wear, repairs and downtime.

Properly breaking in a new bearing will prevent damage, early failure and downtime. The first few hours of operation are the most critical in a bearing life. Watch each newly installed bearing carefully and learn its characteristic sounds and temperature. Breakin periods vary from a few hours to a few weeks, but 24 hours is usually sufficient.

Noise is a symptom. A soft purring sound and the slapping of grease are all you should hear from a bearing if it is operating correctly. Any other noise ultimately means trouble. Check a new bearing by using a screwdriver as a stethoscope. Squeaking indicates inadequate lubrication. Metallic tones indicate shaft or housing interference or improper adjustment. Smooth, clean tones tell of marks in the stationary race. Irregular noises indicate a damaged ball. Crunching means dirt.

Many bearings are too hot to touch. Learn to recognize a bearing's usual operating temperature. An increase in that temperature usually means trouble. This can come from axial or radial preloading, misalignment, tight fitting seals or rubbing.

Always check the bearing within a few days after the breakin period. Look at the lubricant. If it is dirty, change it.

Check the seals for damage or wear. A few minutes spent double checking now, eliminates damage and downtime later.

According to an industry representative, more than 95% of all antifriction bearing trouble comes from defective mounting, improper operating conditions and similar causes which can usually be detected by visual inspection of the bearing. However, many of these failures can be prevented or delayed by the use of better lubricants.

Properly operating bearings under radial loading can easily be seen. Bearings which are correctly mounted, operated under less than maximum load conditions and are kept clean and properly lubricated, show a ball path in the race as a slightly dulled surface. This is similar to a lapped surface wherein the very fine grinding scratches have been smoothed out. There is no appreciable wear on the surfaces.

Other indications that conditions are good, are uniform ball paths exactly parallel with the sides of the races and the track centered on the races. Normally an outer race should carry loads of less than one-half the circumference, but if the bearing creeps slightly in the housing, the ball contact will show around the entire circumference.

B. ANALYSIS OF FAILURES

Foreign Materials - Ball bearings are especially sensitive to dirt or foreign material which may be more or less abrasive because of the very high unit pressure between the balls or rollers and the race, and because the rolling motion tends to trap the debris, especially if it is small.

Dirt is the most common cause of damage to all bearings. It may get into the bearing during initial assembly, during repairs, by seepage from the atmosphere into the bearing housing or even though the use of dirty lubricants.

Fine or soft debris will have the effect of a fine abrasive or lapping compound. The races become worn in the ball paths, the balls or rollers wear and the bearing becomes loose and noisy.

Hard, coarse foreign material such as iron scale or other metal particles, make small depressions considerably different from those produced by overload failure, acid etching or corrosion. Jamming of the hard particles may cause the races to turn.

Water, acid or other corrosive materials cause a failure that is indicated by a reddish-brown coating and very small etched holes over the entire exposed surface of the races. Many times the etching does not show on the ball or roller path, because the rolling action pushes the lubricant away from the ball path. The corrosive oxides act as lapping agents that cause wear and produce a dull gray color on the balls or rollers and their paths, as contrasted with the reddish-brown color of the remainder of the surface.

Overload - Overloading causes fatigue failure of the metal and it is shown by breaking out the surface layer. This failure starts in a small area and spreads rapidly and will eventually spread over both the races and the ball or roller surfaces. Most frequently the failure starts on the inner race.

Misalignment & Off Square - Where the ball or roller path is not parallel to the bearing edges, there is obviously misalignment or combined radial and thrust load. In single row ball bearings, the failure is usually cracking or

wearing out of the retainers. Failure is caused by variations in ball speed, jamming the balls into the separator pockets. Misalignment will force a solid retainer to rub one or another of the races.

Brinelling - This is shown by regular depressions in the races, which coincide with the ball or roller spacing. It is usually caused where the force to install the bearing is applied through the balls or rollers, or the bearing is struck heavily. It can also happen from extremely high pressures which may not be properly centered.

False brinelling occurs when bearings do not rotate for a long time, but vibrate. It can, of course, be severely increased by abrasive foreign material. It can be controlled many times by either preloading the bearings and/or using a heavier lubricant. False brinelling can occur during bearing storage or shipment.

Heat - Heat failures generally occur at medium and high speed operations. The causes may include such things as: the failure because the lubricant source is cut off; lubricant deterioration; lubricant contamination; overlubrication; excessive loads or cramped bearings caused by expansion of one or the other of the races. In addition, the off square mounting can generate heat at the retainer. And, finally, heat from an external source.

The cause of this may be found by noting which parts show the initial heating, the most heating or by similar indications. Heat can oxidize the separators but may also soften the balls or rollers and the races, because heat cannot be conducted away from them as rapidly. Liberal lubrication may allow continued operation in spite of the deteriorated balls or races.

It is never simple to determine the reason for antifriction bearing failures. However, careful observations of the condition of the lubricant, the balls or rollers or the races and the condition of the shaft or housing, will many times give a true indication of the reason for antifriction bearing failures.

LE LUBRICANTS

Oils.

As indicated, the bearing type and function dictate the viscosity and type of oil used in a bearing application.

MONOLEC® Industrial Oils are excellent for bearing lubrication where a lighter oil is required. The MONOLEC® wear-reducing additive acts as a deterrent to sliding and scuffing wear. Superior base stocks combined with the finest antioxidation additives give unmatched protection against corrosion and corrosive wear.

ALMASOL® Gear Lubricants are proven as the very best in lubrication of bearings where a heavier oil is needed. Operating temperatures are normally reduced. Wear is cut to an absolute minimum. Finely prepared bearing surfaces are protected by the film of ALMASOL® wear-reducing additive.

Greases:

LE's 3751/3752 ALMAGARD® Vari-Purpose Lubricants are designed to give ultimate protection to heavy-duty bearings. A special additive enables this product to withstand heavy shock loads. It reduces the possibility of rust and corrosion in sensitive bearing areas. It has an unusual ability to form its own seal against outside contaminants such as dust and dirt. The ALMASOL® wear-reducing additive reduces friction, temperature and wear.

LE's 1274/1275 ALMAPLEX® Industrial Lubricant and 4700/4702 MONOLEC® Industrial Lubricant are designed primarily for implant industrial bearing applications. LE's ALMAPLEX® Industrial Lubricant is blended with an oil of the proper viscosity for low starting and running torques and with ALMASOL®, LE's wear-reducing additive to further reduce wear. LE's MONOLEC® Industrial Lubricants contain MONOLEC®, LE's exclusive wear-reducing additive and are formulated primarily for centralized lubrication systems.



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LI20067
Rev. 07-92