TECHNI/TIPS

A Publication of the Lubrication Engineers Technical Department

LEADERS IN LUBRICANTS NUMBER 110

GEARS AND GEAR LUBRICATION

Modern gears are performing heavier work and carrying greater loads than ever before. Gear manufacturers are redesigning, modernizing and using finer steels to produce precision gears that will give better performance.

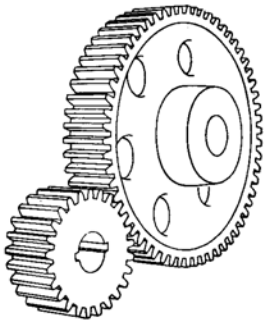
Production demands are forcing the user to raise production above rated machine capacity. Many times this is done deliberately, with the knowledge that gear life will be reduced, but that the increased cost will be offset by the increased production.

In the automotive, aviation and marine areas, as well as in industry, there is an increasing demand for more power in smaller packages. Gears are used to transmit this power and the same squeeze is on the gearbox, so a means must be found for increasing the load capacity of gears.

Lubricant manufacturers have helped in addressing this need by developing better gear oils to help carry these increased loads safely. Lubrication Engineers, Inc. continues, with extensive research and testing programs, to produce tougher lubricants to stay ahead of the increasing demands of industry.

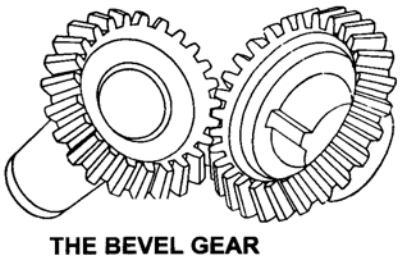
TYPES OF GEARS

The SPUR GEAR is a cylinder. The teeth are cut parallel with the axis on the surface of the cylinder. Spur gears are most commonly found on industrial machinery working under ordinary conditions at moderate speeds and tooth pressures.

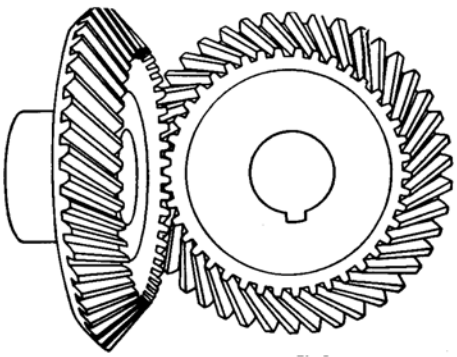


THE SPUR GEAR

The BEVEL GEAR has teeth cut on an angular surface, like a section of a cone. Bevel gears are used for the transmission of motion between shafts with intersecting center lines. This is usually 90 degrees.



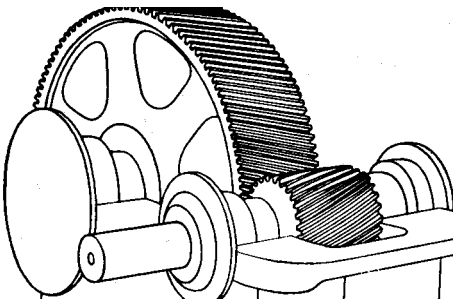
THE BEVEL GEAR



THE SPIRAL BEVEL GEAR

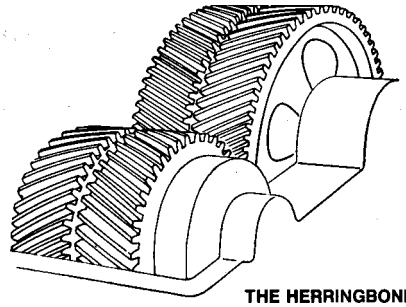
The SPIRAL BEVEL GEAR represents cone surfaces, as does the bevel, but with the teeth spiraling around the cone. It is also applicable to nonparallel shafting, where it is usually termed an angle drive.

The HERRINGBONE GEAR is similar to two helical gears having reversed directions of spiral. They are placed side by side so that the teeth come together to form a chevron pattern. Spiraling the teeth in both directions neutralizes end thrust.



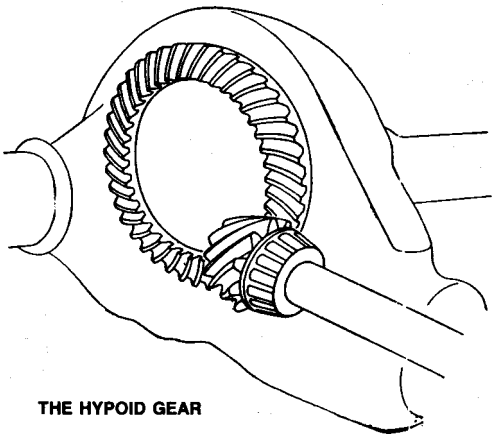
THE HELICAL GEAR

The HELICAL GEAR resembles the spur gear in that the teeth are cut on a cylinder. The teeth on the helical gear, however, spiral around the cylinder rather than being cut parallel to the gear axis. The helix provides smoothness of operation.



THE HERRINGBONE GEAR

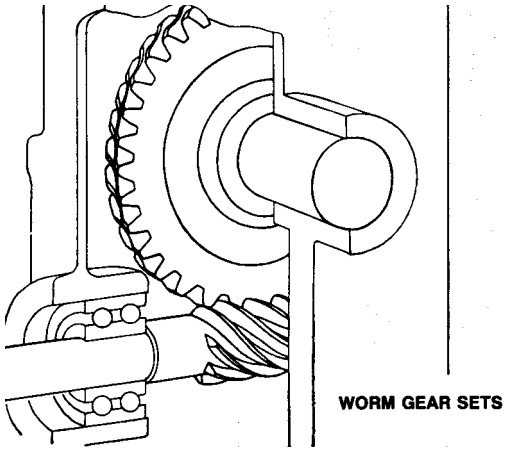
The HYPOID GEAR is a spiral bevel with the pin-ion lowered below the center line of the driven gear. It is this design feature that led to its early use in automobile rear axles, because by lowering the propeller shaft it was possible to lower the car. The hypoid gear develops a longitudinal sliding motion between the teeth of the gears in contrast to the conventional spiral bevel gear where motion is predominately rolling. This greater sliding action between the teeth creates a wiping effect, along with high tooth pressures. The hypoid gear is being used more and more in trucks because the pinion is larger and stronger than a corresponding bevel pinion. So far, industrial applications have been limited.



THE HYPOID GEAR

The two members of a WORM GEAR set are known as the worm and worm wheel or gear. The worm resembles a screw, although it is really a special form of helical gear and its teeth are referred to as threads. The worm is usually made of a hard wear- resistant steel. The worm wheel, which resembles a helical gear, should be of a good bearing bronze. The worm wheel is throated or curved on the face to partially envelop the driver and its action in the worm gear is similar to the action of a screw on a nut. Due to the wedge-like action of the worm thread on the gear tooth, the set is relatively quiet in operation. It also provides a very

These sketches and descriptions cover the basic types of gearing. There are a number of patented gear designs by various manufacturers which are quite unusual. Most of these are variations on the basic types. Usually they are for a specific purpose, such as limited space for extremely heavy loads, ultra-precision power transfer, very high reductions, etc. Care should be taken in lubrication recommendations for these unusual units.



WORM GEAR SETS

Most of the gears pictured can be lubricated with a reasonable amount of care and intelligence, but two of them are quite difficult to lubricate. These are the hypoid gears and the worm gears.

Galling removes metal from tooth surfaces. Initially it may be referred to as scoring. Galling is due to the failure of the oil film to carry the load, because operating conditions are abnormally severe or because the incorrect oil was used. Metal-to-metal contact occurs and tooth surfaces are worn or torn. Excessive wear results and usually the surfaces are very rough. Occasionally metal is dragged over the tooth edges, creating a feathery appearance. Because of the metal wiping action, a ridge may develop at the pitch line of the driven gear and a groove at the pitch line of the driving gear.

Spalling is the abnormal loading of tooth surfaces. This overstresses the subsurface metal until large chips or flakes break way from the teeth. This condition starts at the base of the tooth: Small flat flakes of metal may be visible in the oil.

Through years, of building and servicing truck axles, Eaton Manufacturing Company has come to the conclusion that lubrication, loads, operation (terrain) and the driver are the four major operating requirements that must be considered to assure satisfactory rear axle performance. Eaton makes the following suggestions:

Lubrication. Using proper gear oil helps to lengthen axle life. Gear and bearing life is always improved by the use of extreme pressure lubricants containing the proper additives. These lubricants are designed to carry heavier loads than straight mineral oils. Also, correct viscosity is important, particularly in extremely hot or cold weather because of the heavy loading on rear axles.

Dirt and debris in the housing is a serious problem in lubrication. More dirt accumulates during break-in and this is one of the most critical periods in the life of an axle. The factory lubricant should be changed at low mileage or hours and then a periodic check of the lubricant level on a regular, frequent basis should be made. Lubricants can be run fairly long under normal or average conditions, but the drain period should be reduced under high speed and/or heavy operating conditions.

Loads. Loading has a definite effect on axle life. Loads will affect both the housing and the differential assembly. An axle housing can take some bending and still spring back to its original shape. Shock loading, hitting a stump or rock, and other similar abuse can bend a housing past the yield point and cause extensive damage to axle components. Overloading will also reduce axle life.

Operation--Terrain. Misapplication of the vehicle generally reduces the axle life. Continuous operation in mountains causes axles to operate at or near maximum torque loads for long periods of time and reduces the axle life. Off-highway applications such as logging and mining are strenuous operations for any axle. To insure economical operation it may be advisable to select an axle one size larger than standard.

Driver. The driver of the vehicle is as important a factor in the life of an axle as any other. Correct operation of the axle, as well as other components, are the direct result of driver performance. Trained drivers will improve any operation.

Lubrication Engineers, Inc. supplies seven types of mineral oil gear lubes and two types of synthetic gear oils to more closely meet the requirements for various applications. The seven mineral based oils are 604-609 ALMASOL Vari-Purpose Gear Lubricant, 401 ALMASOL Pure Mineral Gear Lubricant, 680 ALMASOL Worm Gear Lubricant, 5250 ALMAGEAR EP Gear Lubricant, 4090-4140 QUINPLEX White Gear Lubricants, 300 MONOLEC Industrial Gear Lubricant and 703-704 MONOLEC Gear Lubricants. The synthetic gear oils are 9920 SYNOLEC Gear Lubricant 75W-140 and 9320-9460 MONOLEC Synthetic Industrial Lubricant.

The first four contain ALMASOL, which is LE's exclusive wear-reducing additive. ALMASOL is an inert lubricating material which has an affinity for metal and a unique laminar-lattice construction that adds to the lubricating ability of the gear oil. LE's 703-704, LE's 300, LE's 9920 and LE's 9320-9460 contain MONOLEC, another LE exclusive wear-reducing additive. Very often both MONOLEC and ALMASOL contribute to reducing gearbox temperatures. Essentially they improve film strength and reduce friction.

LE's 401 ALMASOL Pure Mineral Gear Lubricant is designed to be used where the manufacturer calls for a straight mineral, pure mineral or non-EP oil. This product does contain ALMASOL and special rust and oxidation inhibitors for long life and excellent lubrication.

LE's 604-609 ALMASOL Vari-Purpose Gear Lubricants are designed to meet the various automotive gear lubricants (SAE and API) and industrial gear lubricant (AGMA) requirements. Both contain the necessary load carrying and friction modifying characteristics required for today's wide range of differing gear trains, including certain worm or screw types.

LE's 680 ALMASOL Worm Gear Lubricant is designed to protect worm gears and bronze parts. Gives excellent lubricity and film strength along with high load carrying ability. Use where AGMA 8C lubricant is required.

LE's 5250 ALMAGEAR EP Gear Lubricant is a heavy duty, high viscosity gear lubricant. It is recommended for applications specifying an AGMA 8A EP lubricant.

LE's 703-704 MONOLEC Gear Lubricants are versatile, multiviscosity EP gears oils which exceed the demanding requirements of all types of differentials and transmissions. They are recommended for both Rockwell and Eaton axles in over-the-road and stop-and-go fleets, as well as off-highway equipment and industrial gearboxes.

LE's 9920 SYNOLEC Gear Lubricant is a 100% synthetic base fluid formulated with MONOLEC, LE's exclusive wear-reducing additive. It is blended to achieve true multigrade SAE 75W-140 characteristics with-out the use of viscosity improvers, to allow excellent low and high temperature performance in over-the-road and off-highway automotive equipment as well as industrial gear applications.

LE'S 9320-9460 MONOLEC Synthetic Industrial Lubricants are 100% synthetic base fluids formulated with MONOLEC, LE's exclusive wear-reducing additive. These lubricants meet ISO 320 and ISO 460 (AGMA 6EP & AGMA 7EP) viscosity ranges. They meet all requirements for AGMA 9005-D94 R&O and AGMA 9005-D94 EP.

LE's 300 MONOLEC Industrial Lubricant, also formulated with MONOLEC, is an exceptionally adhesive, nonfoaming, extreme pressure (EP) industrial oil with good water separation characteristics. It is recommended for applications specifying an AGMA 2EP lubricant.

LE's 4090-4140 QUINPLEX White Gear Lubricants are USDA Hl lubricants for the food processing industry. They have excellent load carrying, wear-reducing and nonfoaming properties. LE's QUINPLEX White Gear Lubricants are recommended for use in gearboxes where incidental food contact can occur or where a clean, nonstaining lubricant is desired.

LE's quality and durability in high performance gear lubricants will mean greater productivity for you and lower maintenance costs for your budget. You will realize extended equipment life, less downtime and fewer repairs. Place your confidence in LE lubricants.

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