Factors That Influence Gear Oil Selection

Gears are the most common way to transmit power from one revolving shaft to another. Gear sets are responsible for increasing and decreasing speed and changing the direction of the shaft. Gears are extremely sensitive pieces of equipment and can experience problems for a number of reasons, most of which can be linked to improper lubricant type or lubrication techniques. To avoid premature gear wear or failure, consider these factors when specifying a gear lubricant:

Different **gear types** *have different lubrication needs. Spiral bevel, helical and herringbone gears utilize sliding action, which tends to "wipe away" the gear lubricant. For these gears, a slightly higher viscosity fluid with good film strength may be needed. Worm gears also employ sliding motion, which typically requires special compounded lubricants. Hypoid gears require lubricants with high levels of EP additives to combat changing boundary and film conditions.*

Gear speed *affects the weight of the gear lubricant. High-speed gear operations can use a lower viscosity fluid because speed reduces metal-to-metal contact and assists in forming fluid films. Low speed, highly loaded gear assemblies call for higher viscosity oils because they need thicker films. The inverse relationship between gear speed and oil viscosity also holds true for multiple reduction gear sets. Multiple gear reducers can be lubricated in the following two ways: (1) with a dual viscosity oil system, and (2) by circulating cooled oil to the low speed gears and then transferring it to the higher speed gears after its temperature is increased and viscosity reduced.*

Operating temperature *of a gear set is a critical piece of information when specifying a gear lubricant. To determine the true operating temperature of the gear set, take the rise in operating temperature and add it to the ambient temperature. Check manufacturers' recommendations for the appropriate lubricant grade for the calculated temperature range.*

Transmitted power *is based on the amount of load and power the gear set is expected to handle. Gear sets that transmit more power tend to run hotter. If operating temperature was properly calculated and the gear lubricant was chosen based on that temperature, the gear oil should be able to withstand the increased temperature.*

The **surface finish** *of the gear can play a role in choosing the lubricant's viscosity. Rough surfaces need a heavier viscosity lubricant to maintain film strength. But it is sometimes recommended to consider the average smoothing that can take place during the gear's operation and then choose the viscosity.*

Extreme and **high shock loading** *on gears require (EP) extreme pressure lubricants to prevent metal-to-metal contact. Gear lubricants must have specially balanced additive packages because EP additives can stain yellow metal components and cause failure.*

The gear **lubrication method** *influences the viscosity of the gear lubricant. Splash-lubricated units require a higher viscosity fluid to maintain film thickness and keep the lubricant in the gear set. Pressure-applied gear oils tend to distribute the lubricant more evenly and do not require a high viscosity fluid.*

Water contamination *is a very real threat to gear life. In gear sets where water contamination is present, a gear oil that can separate oil and water or demulsify is necessary. A quality gear oil has good water separation properties. It is critical that the lubricant can continue to demulsify after it has been in service. Water that is allowed to remain in dirty oil can cause excessive bearing and gear wear and rust. To prevent rust and corrosion in the presence of water, look for a lubricant with good rust and corrosion inhibitors.*

One of the best ways to determine lubricant quality is to review service specifications and mechanical test results for the given fluid. The American Petroleum Institute (API) has three industry standards that are widely used in North America. These specifications are API GL-4, API GL-5 and API MT-1. As described below, each API service designation takes into account the specific needs for different types of gears.

API GL-4 is generally equivalent to military specification MIL-L-2105 for manual transmissions and spiral bevel gears engaged in moderate service. API GL-4 rates a gear lubricant's performance in several areas including: high shock and high speed conditions, high torque and low speed conditions, corrosion in the presence of water, anti-foam tendency, copper corrosion, lubricant and seal compatibility and solubility.

API GL-5 is similar to the specification MIL-L-2105E for manual transmissions, hypoid and other types of gears in moderate or severe duty. API GL-5 is the primary field service recommendation for many passenger car and truck manufacturers. This specification has all the same test requirements as API GL-4 with added thermal and oxidative stability and cleanliness tests.

Both API GL-4 and GL-5 are valid industry specifications, but the needs of many equipment manufacturers exceed these specifications. This situation prompted a new API category, API MT-1, which has updated performance requirements for nonsynchronized manual transmissions, such as those found in buses and heavy-duty trucks. API MT-1 fluids are thermally stable and contain EP additives. In addition, this specification tests for antiwear characteristics, high temperature lubricant stability, oil seal and lubricant compatibility, anti-foam tendencies, copper corrosion and solubility. API MT-1 does not cover lubricants for synchronized manual transmissions in cars and heavy-duty vehicles.

For more information on gear lubricants, contact a Castrol Account Manager at (800) 777-1466.