

“GEAR LUBRICATION 101” BY CHRIS REAL CERTIFIED LUBRICATION SPECIALIST

In this issue I have elected to discuss Automotive Gear oils & lubrication for our vehicles. Gear oils are a very important issue when we are dealing with increased horsepower vehicles, and coupling the power to the ground.

To enter this discussion it is important to start with some basic fundamentals about lubrication. Lubrication of mechanical components is generally accomplished by maintaining two primary types of lubrication, Hydrodynamic Lubrication & Boundary Lubrication.

Hydrodynamic Lubrication or “Full Fluid Film” lubrication is accomplished from mechanically engineering oil pressure, or by using high viscosity fluids to maintain a fluid wedge to float the bearing surfaces upon. In this type of lubrication, the parts “surf” upon a cushion of oil and do not make excessive contact with the other surface, and the surfaces in theory do not come into severe contact with one another.

Boundary Lubrication is accomplished by having a thin, strong film, which provides chemical friction reduction & load wear protection. This method of providing lubrication generally relies upon the chemical structure of the lubricant to maintain a very thin chemical barrier to prevent wear and damage to the load bearing surfaces.

In gear lubrication, *both* methods of maintaining lubrication are important considerations. The viscosity of the lubricant must be correct to provide a fluid cushion to protect the surfaces from very high shock

loads, and the chemistry of the product must be correct to protect the surfaces during contact & sliding motion.

Automotive Gear oil chemistry differs considerably from motor oil chemistry in the types of anti-wear additives that are used in the formulations.

Motor oils rely upon a Zinc-Calcium anti-wear structure, and Gear oils generally rely upon a Sulfur-Phosphorus anti-wear structure. *(Considerable other differences exist in each of the types of fluids as well).*

Temperature and pressure activate the chemical EP (Extreme Pressure) components in gear oils. This chemical reaction provides slippage & protection to the gear face. Gear lubricants have a very distinctive odor associated with them, and this is generally due to their additive structure.

The performance and application of Gear oils are identified by their viscosity expressed in an SAE viscosity grade, and by an API (American Petroleum Institute) GL specification number.

The API - GL specification number is an indication of the intended gear type, load, and material for the application. The numbering scale progresses upward for load carrying ability with GL 3&4 products being primarily intended for low load automotive gearbox & manual transmissions, and Hypoid / GL 5 & 6* rated products being intended for higher load applications such as in differentials and rear-ends.

*The API Severe duty GL6 standard has been removed from warranty service specifications for new light duty passenger cars, but some oil manufacturers maintain the more severe capability oil performance specification for extreme applications.

For the enthusiast wanting maximum protection, it is my opinion that the additional protection that is offered by a "GL-6" rated product is a worthwhile investment.

API Gear Oil Service Designations

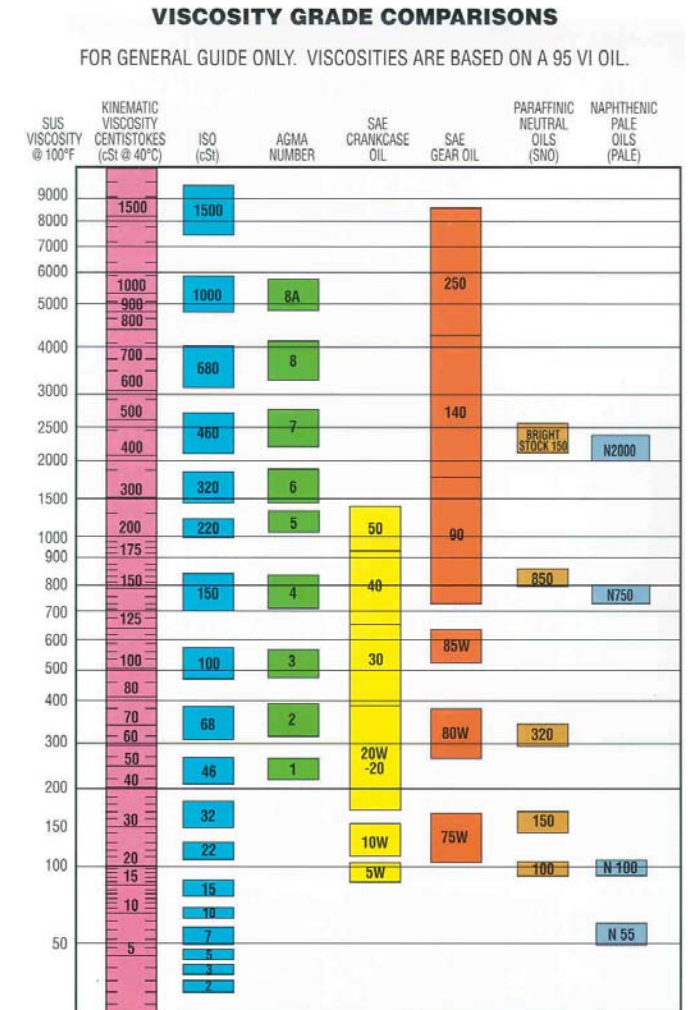
API Classification	Type of Chemistry	Typical Application
GL-1	Straight mineral oil.	Truck manual transmissions.
GL-2	Usually contains fatty materials.	Manual transmissions and spiral bevel final drives.
GL-3	Contains mild EP additives. Variety of chemistries varying from motor oils Zinc / Calcium components to special fluids containing mild EP chemistry such as Sulphur / Phosphorus.	Manual transmissions, and spiral bevel and final drives.
GL-4	Equivalent to obsolete MIL-L-2105 usually satisfied service with 50% GL-5 additive level.	Manual transmissions, and spiral bevel and hypoid gears in moderate load service.
GL-5	Virtually equivalent to present MIL-L-21 050; primary field service recommendation of most passenger car and truck builders worldwide.	Moderate and severe service in hypoid and other types of gears. Is typically used in most passenger cars and light truck manual transmissions.
GL-6	Obsolete - Severe Duty API Specification.	Severe service involving high-offset hypoid gears operating at high loads, high shock loads and sustained high speeds.

Many gear oils maintain chemistry to reduce chemical attack of soft metals, and when the consumer selects a product, they should always be aware of what type & specification of lubricant the equipment manufacturer recommends for the application.

One important thing to point out with gear lubricants is that they are not classified on the same viscosity scale as crankcase motor oils, and their viscosity relationship (not Load Carrying Ability or application read-across)

may be approximately summarized as follows, 75w90 gear oil = 10w40 motor oil, 85w gear oil = SAE 30 motor oil, 90w gear oil = SAE 40 motor oil.

The chart gives an accurate visual relationship of viscosities of different oils that are typically used for gear lubrication.



In the high performance & specialty applications the consumer needs to take into consideration how they will be using their equipment and what other variables exist. For example, in some applications where a rear end or transmission has been custom built or modified, the rebuilding engineer may have set the gear contact area & clearances for street, drag racing, or road racing. With or without limited slip, or with numerous other variables.

The re-builder may have set the clearances for a light viscosity product such as a 75w90 for road racing, where the loads are constant and the speeds are high. Or have set the clearances to withstand severe shock loads such as in drag racing, where a higher viscosity product such as a 90w140 or higher viscosity may be necessary.

In performance street applications the equipment manufacturer or re-builder may specify a mid-viscosity product such as a 90w to provide gear protection and to limit gear noise. And in some cases an additional additive may be necessary for different applications with limited slip or posi-traction.

Tips For Sport Enthusiasts

Synthetic gear oils will generally evacuate foam faster than petroleum oils, and will take more temperature prior to degrading. Synthetic products usually have less fluid drag and have a more positive feel for shifting.

Petroleum oils will usually be the factory-fill oils, particularly in old vehicles. These oils may have degraded with use & time and should be checked. Top up with a similar viscosity & type of product if the system is low. In the case of very old vehicles, synthetic oils may not be the ideal products because of worn seals & looser tolerances may promote leakage.

Change out gear & differential oil occasionally because as gears wear, they generally shed metal, and it is good to keep "random" metal flakes out of the gears.

➤ Always use the correct "API GL" service specification for the gear type and application!

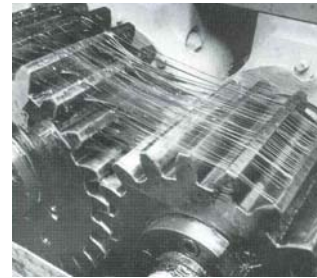
➤ Never use Gear Oils for engine lubrication!

Gears "stir" air into the fluid. In the event that the system gets contaminated with water, change the fluid! In some instances when water has contaminated the gear lubrication

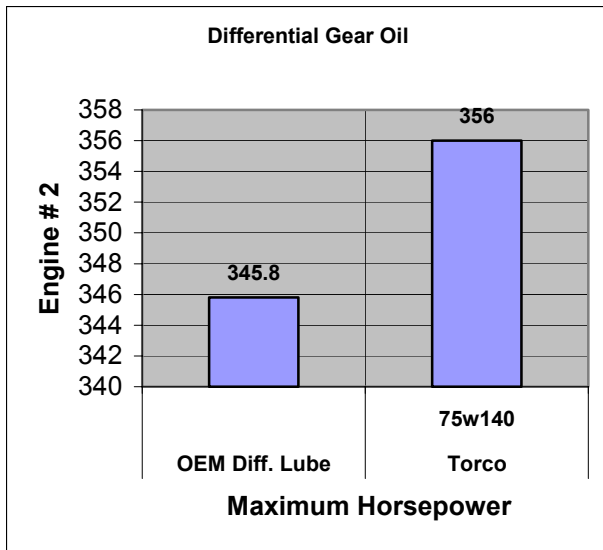
system, multiple oil changes may be necessary to get rid of the water traces that promote foam.

Water turns to steam, and as the lubricant is removed from the gear surface it promotes wear and no fluid cushion is available for shock load protection. Foam & steam pressurizes the gear case, and may blow the lubricant past a seal, and when water gets in, it usually brings abrasive dirt....

In some instances gears may not get much lubrication because of designs that exist. In cases such as these, an oil that webs may be beneficial, as the oil will be transfused to the gears at the top of the gear case. This is usually beneficial in low speed gear cases, and for gears that do not experience extreme loads, temperatures or speeds.



In applications where the gear speeds and loads are high, an oil that has a webbing tendency may in fact starve the gears, as the oil is carried away from the gear faces, and air is entrained in the webs of the fluid, and the oil in the sump becomes depleted. Also, when the high speed gearcase has high concentrations of an adhesive oil, considerable frictional drag is present.



This chart shows horsepower changes related *exclusively* to the paracitic losses in the differential from the oil. This data was measured on a Dynojet 248C Chassis Dynamometer. (Data courtesey of Dr. Joseph Donnelly.)

In many cases it is difficult to know which gear oil is the best for your application. The best way to select a gear oil is to understand the specifications and to know what type of service requirement your application requires.

For Your Information....

If your gear application requires extra protection, and minimal paracitic losses related to the gear oil, Torco manufacture’s a variety of Gear oils. The gear oils that Torco manufactures have an easy to understand identification system.

Synthetic ATF: This product is intended for heavy duty high heat applications where the fluid must remain ultra consistent.

MTF: Manual Transmission Fluid. These products are available in petroleum, synthethetic blend, and full synthetic formulations. A variety of viscosity grades are available, with formulations for specific applications.

Racing Gear Oil GL-6: These petroleum based oils are available in a variety of viscosity

grades ranging from 80w90 to 85w140. Also a very high viscosity top fuel version is available.

SGO - Synthetic Gear Oil GL-6: These high performance gear oils are available to withstand severe heat applications, and have minimal fluid drag chacteristics.

RTF – Racing Transaxle Fluid: This racing transmission fluid is designed for applications where minimal fluid resistance is required, and the gears run under constant high speed conditions.

For more complete information on the gear oils that are available, please refer to the product data sheets related to the specific Torco gear lubricant.

Application	Torco Gear Oil
Motorcycles with a wet clutch or primary drive gear cases.	MTF® Motorcycle Formulations (Manual Transmission Fluid)
Manual Transmissions in cars & light performance vehicles, some marine outdrives.	MTF® Automotive Formulations (Manual Transmission Fluid)
Street Rods , Off Road Vehicles, Trucks & Drag Racing. 4x4 Differentials, some high performance marine gearcases.	Racing Gear Oil GL-6 Or SGO (Synthetic Gear Oil)
Race Cars , road racing & oval racing applications, snowmobile chain cases.	SGO GL-6 (Synthetic Gear Oil)
Sport Compact Cars Front wheel drive, FWD	SGO GL-6 (Synthetic Gear Oil)
Formula Cars , FWD applications, performance manual transmissions & transaxles.	RTF (Synthetic Racing Transmission Fluid, GL-6)
Marine Outdrives , High performance gear cases & dry-sump applications.	RTF (Synthetic racing transmission Fluid GL-6)
Automatic Transmissions	Synthetic ATF

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