WHAT IS THE CORRECT GEAR OIL

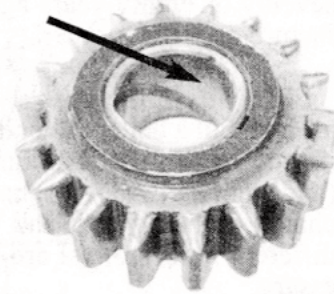
for your old car?

There has been a great deal of discussion as to which gear oils are suitable for our old cars and which are not. The discussion has very little to do with the viscosity (the 'thickness' or the 'flowability' of the material) but rather with the chemical contents and its effect on some metals in the transmission or rear end/differential/transaxle assemblies.

Gear oil is a special lubricant designed to provide the necessary anti-friction material in the differential, transmission and free-wheeling gear assemblies. Since these units do not contain oil pumps, the lubricant has to be carried by the gears as they move through the oil at the bottom of the unit, and throw it or splash it over the entire moving assembly. Most lubricants for manual gearboxes and differentials contain extreme pressure (EP) additives and antiwear additives to cope with the sliding action of hypoid bevel gears. It is these EP additives of which we are most concerned with our old cars.

We do not care too much about the effect on steel or cast iron. There is no negative effect with those metals. But we are concerned with transmissions and rear end assemblies that contain 'yellow metal.' For purposes of this article, we will group all copper-based metals together as yellow metal. Brass is an alloy consisting primarily of copper and zinc. Depending on the intended use of the brass, the zinc content can very from a low of about 20% to a high of 50%. But most brass contains between 30% - 40% zinc. In some cases lead is added to the alloy, generally at about 2%. The lead softens the brass and makes it more machinable. Bronze is an alloy of copper and tin. Although the alloy can vary, typically bronze contains about 12% tin and 88% copper. Bronze is less brittle than iron, is an excellent conductor of heat and electricity, and is reasonably easy to machine (compared to steel). Bronze is softer than steel or iron and so is often a choice for a surface exposed to the constant friction of iron or steel. The coefficient of friction for like metals is much greater than that of dissimilar metals. That is why bronze is often a choice for bushings. And that brings us back to the transmissions and rear end assemblies.

Bronze and, to a much lesser extent, brass have been used as bushings in many early cars and light trucks in the differentials and sometimes as bushings or syncros in the transmissions. They work well and efficiently. BUT, they are susceptible to damage caused by sulfur and phosphorous. Check your parts book for your vehicle. If you find a bronze or brass component in the tranny or rear end, check the jug of gear oil that you have been using. If it contains sulfur and phosphorous, plan on draining the old oil and replacing it with a lubricant that doesn't contain sulfur and phosphorous.



The bronze insert bushing in this gear (arrow) is susceptible to damage by sulfur and phosphorous.

I haven't been able to determine an exact date that the American Petroleum Institute (API) began applying 'GL' ratings to gear oil. It is not as easily defined as the 'S-' ratings used for gasoline motor oil. From what I can gather though, GL ratings likely began during or just after WWII. (More than likely it was a designation used to replace the old MIL rating.)

If you look through your old car manual - say through the 1930s - you will not find a 'GL' rating listed. You may find an SAE rating (often quite high: a 110 or a 90 for winter use). You may find that the car's manufacturer doesn't call out a specific weight of gear oil, but instead recommends that you use their own product available directly from their dealers - difficult today for marques like Hupmobile, Lafayette, or Pierce-Arrow. Or you may find another gear oil rating altogether: Saybolt is one. Without an equivalence chart it is almost impossible to cross reference the various grades or weights. For example, an SAE grade 50 motor oil has approximately the same viscosity (but not the same chemical contents) as a SAE 90 grade gear oil. And that same oil is about 1000 Saybolt (at 100°F) or Saybolt 90 (at 210°F). The temperatures listed are for rating purposes and have little to do with the correct selection of gear oil at a retail store. We have included a conversion chart on page 19 so that you can determine which modern, readily available gear oils are similar to what was called for seventy or eighty years ago by auto/truck manufacturers.

We blithely toss the term 'viscosity' around, but a better understanding of what viscosity means will help us understand how gear oil (and engine oil, too, for that matter) works, how it changes when warm, and why different grades of oil are necessary.

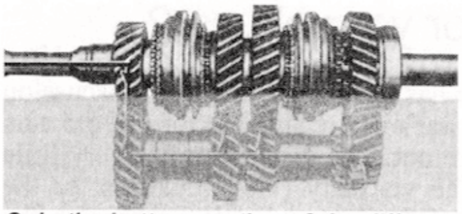
Viscosity describes a fluid's resistance to flow. It can be described as fluid friction. A high viscosity is a denser liquid. It moves more slowly. A lower viscosity is less dense and has less internal friction and therefore moves more readily. Water has a relatively low viscosity. Molasses is thick. It has a higher viscosity. It is evident that when you pour water it seems to have little or no resistance, yet when you pour molasses it pours very slowly. Its internal resistance keeps it from flowing.

The viscosity of a fluid is subject to change. Temperature, for example, will alter the viscosity. Take a bottle of cooking oil, and place it in the refrigerator. As it gets colder it gets thicker, almost to the point of becoming a solid. Yet at room temperature it flows readily. Heat it, and it becomes even less viscose.

Viscosity can be described in comparative terms. For example, a 20 weight engine oil is less viscose - more able to flow - than a 50 weight engine oil. But the criteria for comparing the viscosity must be the same. A heated 50 weight oil will flow more freely than a near-frozen 20 weight. Multi-weight oils are chemically engineered so that they perform well over a wide temperature range. More on multi-weights in a moment.

Engine oil has to be 'thin' enough to be pumped through the oil galleries and into all of the niches and crevices that require lubrication. The oil pump is primarily responsible for distributing the oil to the upper parts of the engine, but then the oil flows and is splashed into less accessible areas.

In a differential or transmission, the oil is much thicker. The lubricant sits in the bottom of the unit, covering perhaps half of the gears. As the gears rotate through the gear oil, the heavier (less viscose) matter is 'scooped' up by the gears and 'carried' up to the top of the unit and then it slowly flows back to the sump. If the gear oil is too thin, it runs off the gear surfaces and never makes it up to the top to lubricate. It can also allow the gears to spin too quickly and not slow down adequately for a clean gear change. Too thick and it cannot flow or be splashed or thrown to the areas of the gear train that require lubrication. It might also retard the rotation of gears requiring too much power from the engine to spin them properly. Viscosity is a measure of a fluid's resistance to flow. It describes the internal friction of a moving fluid. A fluid with high viscosity resists motion. Using a straight grade of gear oil might be satisfactory in constantly warm situations, but if the ambient temperature, or the temperature of the component, is cold, it will not be properly lubricated until the oil warms up to its 'flowable' state. That's why virtually all gear oils are multi-weight. They provide lubrication when cold and maintain that lubrication as the unit and the oil warms up.



Only the bottom section of the differential or transmission is bathed in oil.

Let's get back to your old car. If you know, or suspect, that yellow metal is used in your gear train, we suggest that you find a GL-1 gear oil. There are a number of specialty oils on the market, often touted for use in our old cars, but their prices tend to be rather high. That's fine, if you don't know of options. GL-1 is essentially pure mineral oil. It does not contain sulfur or phosphorous and is not harmful to yellow metal. GL-1 does not contain extreme pressure additives or friction modifiers, but it may contain additives intended to inhibit rust and oxidation or defoamers. GL-1 is not

Straight mineral oil.

readily available in your local auto parts store, but many national chains do carry it, albeit in five-gallon buckets. That's a lot of differentials! Another option is to locate a commercial oil-supplier. They can often offer you straight mineral oil (in various SAE weights) or GL-1.

GL-2 (obsolete) and GL-3 (obsolete) were designed with additives to improve friction resistance and protect the metal against extreme pressure. Both GL-2 and GL-3 have been superseded by GL-4 and GL-5 gear oils. GL-4 is designed for spiral bevel gears operating under moderate to severe conditions of speed and load or axles with gears operating under moderate speeds and loads. GL-5 is similar to GL-4 but it is designed to withstand rougher treatment - combinations of high-shock load or high speed varied with low speed-high torque conditions.

GL-4 is available in most auto parts stores.

You will find that GL-2, GL-3, GL-4 and GL-5 generally contain sulfur and phosphorous. Applications calling for GL-3 or GL-4 can safely use GL-5. GL-5 has reduced copper corrosion properties than its predecessors, but still too much for our older cars containing yellow metal. (*Editor's note: We have been advised that cars/light trucks with bronze or brass bearings avoid GL-4 or GL-5, but those with bronze bushings will not suffer the same detrimental wear from sulfur and phosphorous. Bearing surface pitting is less critical. Your judgement call.*)

If your car or light truck does not have brass or bronze in the rear end assembly or in the transmission, you will probably find that GL-5 provides a much better level of metal-wear protection, reduced friction and extreme pressure tolerance than GL-1. But, I repeat, if there is a possibility that yellow metal is used in your car's tranny or diff, stick with the mineral oil.

Next, multi-weight gear oils. Like motor oil, multi-weight gear oils are not merely a blend of lighter gear oil and heavier gear oil. The oil has been modified to react to both heat and cold, changing the composition and providing protection for the full range of operating temperatures. When cold, the multi-weight gear oil flows better, protecting metal parts. As the temperature (of the transmission or rear end) increases with use, the oil modifies so that it doesn't flow as quickly and remains on the metal to give the necessary protection and lubrication. A multi-weight oil will carry a viscosity designation like 80W-90, or 80W-120. The first number, the one followed by the 'W' indicates that the oil has been tested and approved for cold ('W' = winter) operation, but the second number means the oil has been tested at 212°F (100°C) and will retain its viscosity at the higher temperatures.

Most cars and trucks use a distinct motor oil and completely separate transmission grease or gear oil. One notable exception, though, is the Ford Model 'T'. The 'T' shares the lubrication of its engine along with the transmission. It's a splash system that distributes oil over the moving engine parts and flows back to the transmission where the gears throw the oil over the moving parts. Instead of using transmission gear oil, the same engine oil lubricates both components. But, and this is a big 'but', it is highly recommended that the oil in a Model 'T' Ford be a single weight, non-detergent oil. Normally we do not recommend non-detergent oil. The popular notion that the detergent will loosen and break-down built up sludge and deposits in the engine causing blockages is not the issue. Since the Model 'T' uses bands in the transmission for forward, reverse and even for the service brakes, the bands are submerged in and lubricated by the oil. The detergent in the oil will lead to the premature degradation of the leather bands. (The Model 'T' does use a separate gear oil in the rear end.)

We cannot tell you if your particular car uses 'yellow metal' - bronze or brass - in the rear end or transmission. We suggest that someone in your car club is experienced in rebuilding these components and can best advise whether or not bronze or brass bushings and synchros were normally used. If so, be safe and use GL-1 or pure mineral oil (of the correct viscosity). If not, you may use GL-1 with the additives, and that includes the sulfur and phosphorous, that will provide a better lubrication and protection for the mating gear surfaces.

S.K.

VISCOSITY CLASSIFICATION EQUIVALENTS

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Kinemactic Viscosities						***Saybolt Viscosities***	
cSt/ 40° C	*cSt/ 100° C*	*ISO VG*	*AGMA Grade*	*SAE Grade Crankcase Oils*	*SAE Grades Gear Oils*	*SUS/ 210° F*	*SUS/ 100° F*
2000							10000
1800	70					350	8000
1500	60	1500				300	6000
1200							5000
1000	50	1000	8A		250		4000
800	40					200	3000
600		680	8				2500
500	30					150	2000
400		460	7		140		1800
350						125	1500
300		320	6	60			1250
250	20					100	1000
200	16	220	5	50	90	90	800
150	14	150	4	40		80	600
100	12	100	3		85W	70	500
80	10			30		60	400
60	8	68	2			55	300
50	7			20	80W	50	250
40	6	46	1			45	200
30	5	32			75W		150
20	4	22		10W		40	100
15		15		5W			80
10		10					50

Note:
Viscosities can be related horizontally. Viscosities based on 96 VI single grade oils.
ISO are specified at 40° C. AGMA are specified at 40° C.
SAE 75W, 80W 85W and 5W & 10W specified at low temperature. Equivalent viscosities for 100° and 210° F are shown.
SAE 90 to 250 and 20 to 50 specified at 100° C.