More Than You Ever Wanted to Know About Motor Oil

By Ed Hackett
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Choosing the best motor oil is a topic that comes up frequently in discussions between motoheads, whether they are talking about motorcycles or cars. The following article is intended to help you make a choice based on more than the advertizing hype.

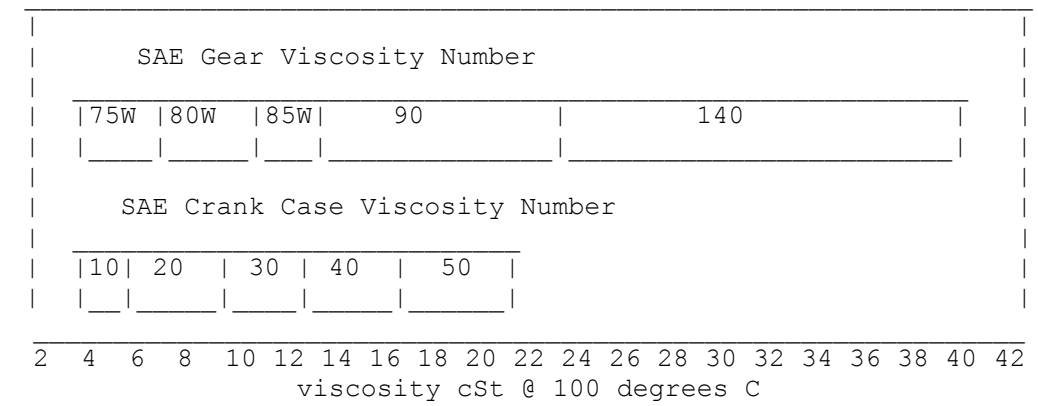
Oil companies provide data on their oils most often refer to as "typical inspection data". This is an average of the actual physical and a few common chemical properties of their oils. This information is available to the public through their distributors or by writing or calling the company directly. I have compiled a list of the most popular, premium oils so that a ready comparison can be made. If your favorite oil is not on the list get the data from the distributor and use what I have as a data base.

This article is going to look at six of the most important properties of a motor oil readily available to the public: viscosity, viscosity index (VI), flash point, pour point, % sulfated ash, and % zinc.

Viscosity is a measure of the "flowability" of an oil. More specifically, it is the property of an oil to develop and maintain a certain amount of sheering stress dependent on flow and then to offer continued resistance to flow. Thicker oils generally have a higher viscosity, and thinner oils a lower viscosity. This is the most important property for an engine. An oil with too low a viscosity can shear and loose film strength at high temperatures. An oil with too high a viscosity may not pump to the proper parts at low temperatures and the film may tear at high rpm.

The weights given on oils are arbitrary numbers assigned by the S.A.E. (Society of Automotive Engineers). These numbers correspond to "real" viscosity, as measured by several accepted techniques. These measurements are taken at specific temperatures. Oils that fall into a certain range are designated 5, 10, 20, 30, 40, 50 by the S.A.E. The W means the oil meets specifications for viscosity at various low temperatures depending on weight, and is therefore suitable for winter use. 5W is tested at -25C, 10W at -20C, 15W at -15C, and 20W at -10C.

The following chart shows the relationship of "real" viscosity to their S.A.E. assigned numbers. The relationship of gear oils to engine oils is also shown.



Multi viscosity oils work like this: Polymers are added to a light base (5W, 10W, 20W), which prevent the oil from thinning as much as it warms up. At cold temperatures the polymers are coiled up and allow the oil to flow as their low numbers indicate. As the oil warms up the polymers begin to unwind into long chains that prevent the oil from thinning as much as it normally would. The result is that at 100 degrees C the oil has thinned only as much as the higher viscosity number indicates. Another way of looking at multi-vis oils is to think of a 20W-50 as a 20 weight oil that will not thin more than a 50 weight would when hot.

Multi viscosity oils are one of the great improvements in oils, but they should be chosen wisely. Always use a multi grade with the narrowest span of viscosity that is appropriate for the temperatures you are going to encounter. In the winter base your decision on the lowest temperature you will encounter, in the summer, the highest temperature you expect. The polymers can shear and burn forming deposits that can cause ring sticking and other problems. 10W-40 and 5W-30 require a lot of polymers (synthetics excluded) to achieve that range. This has caused problems in diesel engines, but fewer polymers are better for all engines. The wide viscosity range oils, in general, are more prone to viscosity and thermal breakdown due to the high polymer content. It is the oil that lubricates, not the additives. Oils that can do their job with the fewest additives are the best.

Very few manufacturers recommend 10W-40 any more, and some threaten to void warranties if it is used. It was not included in this article for that reason. 20W-50 is the same 30 point spread, but because it starts with a heavier base it requires less viscosity index improvers (polymers) to do the job. AMSOIL can formulate their 10W-30 and 15W-40 with no viscosity index improvers but uses some in the 10W-40 and 5W-30. Other multigrade synthetics may not use VI improvers either. The full literature available from the oil company should include this information. Follow your manufacturer's recommendations as to which weights are appropriate for your vehicle.

Viscosity Index is an empirical number indicating the rate of change in viscosity of an oil within a given temperature range. Higher numbers indicate a low change, lower numbers indicate a relatively large change. The higher the number the better. This is one major property of an oil that keeps your bearings happy. These numbers can only be compared within a viscosity range. It is not an indication of how well the oil resists thermal breakdown.

Flash point is the temperature at which an oil gives off vapors that can be ignited with a flame held over the oil. The lower the flash point the greater tendency for the oil to suffer vaporization loss at high temperatures and to burn off on hot cylinder walls and pistons. The flash point can be an indicator of the quality of the base stock used. The higher the flash point the better. 400 F is the minimum to prevent possible high consumption. Flash point is in degrees F.

Pour point is 5 degrees F above the point at which a chilled oil shows no movement at the surface for 5 seconds when inclined. This measurement is especially important for oils used in the winter. A borderline pumping temperature is given by some manufacturers. This is the temperature at which the oil will pump and maintain adequate oil pressure. This was not given by a lot of the manufacturers, but seems to be about 20 degrees F above the pour point. The lower the pour point the better. Pour point is in degrees F.

% sulfated ash is how much solid material is left when the oil is reacted with sulfuric acid and burned. This is used to quantify the amount of metallic antiwear and detergent additives in the oil. Zinc dithiophosphate is a common detergent and antiwear additive that is reflected in this test.

% zinc is the amount of zinc used as an extreme pressure, anti- wear additive. The zinc is only used when there is actual metal to metal contact in the engine. Hopefully the oil will do

its job and this will rarely occur, but if it does, the zinc compounds react with the metal to prevent scuffing and wear. A level of .11% is enough to protect an automobile engine for the extended oil drain interval, under normal use. Those of you with high reving, air cooled motorcycles or turbo charged cars or bikes might want to look at the oils with the higher zinc content. More doesn't give you better protection, it gives you longer protection if the rate of metal to metal contact is abnormally high.

The Data: (Note: this data is mostly from 1991 and is for SG rated oils. Some of the data is current, and I am working on collecting the most recent data. I have found over the years that the "better" oils remain the "better" oils. It is still valid as a place to start in your own search. The formulation of oils is constantly being updated and subject to change by the manufacturer at any time. The best thing to do is collect data on the oils you are interested in directly from the oil company.)

The synthetics offer the only truly significant differences, due to their superior high temperature oxidation resistance, high film strength, very low tendency to form deposits, stable viscosity base, and low temperature flow characteristics. Synthetics are superior lubricants compared to traditional petroleum oils. You will have to decide if their high cost is justified in your application.

The extended oil drain intervals given by the vehicle manufacturers (typically 7500 miles) and synthetic oil companies (up to 25,000 miles) are for what is called normal service. Normal service is defined as the engine at normal operating temperature, at highway speeds, and in a dust free environment. Stop and go city driving, trips of less than 10 miles, or extreme heat or cold puts the oil change interval into the severe service category, which is 3000 miles for most vehicles. Synthetics can be run two to three times the mileage of petroleum oils with no problems. They do not react to combustion and combustion by-products to the extent that the dead dinosaur juice does. The longer drain intervals possible help take the bite out of the higher cost of the synthetics. If your car or bike is still under warranty you will have to stick to the recommended drain intervals. These are set for petroleum oils and the manufacturers make no official allowance for the use of synthetics. Some oil companies, AMSOIL being an example, offer their own engine warranties. If the oils are used in compliance with the company's recommendations (including extended drain intervals) and a problem is caused by the engine oil, the company will pay for the repairs. Check with the company for specifics of any warranties offered.

Oil additives should not be used. The oil companies have gone to great lengths to develop an additive package that meets the vehicle's requirements. Some of these additives are synergistic, that is the effect of two additives together is greater than the effect of each acting separately. If you add anything to the oil you may upset this balance and prevent the oil from performing to specification.

The numbers above are not, by any means, all there is to determining what makes top quality oil. The exact base stock used, the type, quality, and quantity of additives used is very important. The given data combined with the manufacturer's claims, your personal experience, and the reputation of the oil among others who use it should help you make an informed choice.