

Grade 8 Science – Viscosity and Motor Oil



Name: _____ Class: _____ Date: _____

Ever wonder where the rating on oil for your car comes from? Does your car engine take 5W-30? Even if you didn't know that your engine takes oil, the following article will explain about engine oil – that essential ingredient that maximizes the efficiency of your car and extends the life of it too.

Viscosity means a fluid's resistance to flow. In motor oil, it's rated at zero degrees Fahrenheit (represented by the number preceding the "W" [for winter]) and at 212 degrees (represented by the second number in the viscosity designation). Motor oil thins as it heats and thickens as it cools. So, with the right additives to help it resist thinning too much, an oil can be rated for one viscosity when cold, another when hot. The more resistant it is to thinning, the higher the second number (10W-40 versus 10W-30, for example), and that's good. Within reason, thicker oil generally seals better and maintains a better film of lubrication between moving parts.

At the low-temperature end, oil has to be resistant to thickening so that it flows more easily to all the moving parts in your engine. Also, if the oil is too thick, the engine requires more energy to turn the crankshaft, which is partly submerged in a bath of oil. Excessive thickness can make it harder to start the engine, which reduces fuel economy. A 5W oil is typically what's recommended for winter use. However, synthetic oils can be formulated to flow even more easily when cold, so they are able to pass tests that meet the 0W rating.

Once the engine is running, the oil heats up. The second number in the viscosity rating—the "40" in 10W-40, for example—tells you that the oil will stay thicker at high temperatures than one with a lower second number—the "30" in 10W-30, for example. What's really important is that you use the oil viscosity your car's owner's manual recommends.

How to Choose Between Synthetic and Conventional Motor Oil

Premium Conventional Oil: This is the standard new-car oil. All leading brands have one for service level SL, available in several viscosities. The carmakers usually specify a 5W-20 or 5W-30 oil, particularly for lower temperatures, with a 10W-30 oil as optional, particularly for higher ambient temperatures. These three ratings cover just about every light-duty vehicle on the road. Even more important, though, is changing the oil and filter regularly. A 4000 miles/four months interval is good practice. The absolute minimum is twice a year. If your car has an electronic oil-change indicator on the instrument cluster, don't exceed its warning.



Full Synthetic Oil: The oils made for high-tech engines, whether in a Chevy Corvette or Mercedes-Benz, are full of synthetics. If these oils pass stringent special tests (indicated by their labeling), it means they have superior, longer-lasting performance in all the critical areas, from viscosity index to protection against deposits. They flow better at low temperatures and maintain peak lubricity at high temperatures. So why shouldn't everyone use them? Answer: These oils are expensive and not every engine needs them. In fact, there may be some features that your car's engine needs that the synthetics don't have. Again, follow your owner's manual.

Synthetic Blend Oil: These have a dose of synthetic oil mixed with organic oil, and overall are formulated to provide protection for somewhat heavier loads and high temperatures. This generally means they're less volatile, so they evaporate far less, which reduces oil loss (and increases fuel economy). They're popular with drivers of pickups/SUVs who want the high-load protection. And they're a lot less expensive than full synthetics, maybe just pennies more than a premium conventional oil.

Higher-Mileage Oil: Today's vehicles last longer, and if you like the idea of paying off the car and running the mileage well into six figures, you have another oil choice, those formulated for higher-mileage vehicles. Almost two-thirds of the vehicles on the road have more than 75,000 miles on the odometer. So, the oil refiners have identified this as an area of customer interest and have new oils they're recommending for these vehicles.

When your car or light truck/SUV is somewhat older and has considerably more mileage, you may notice a few oil stains on the garage floor. It's about this time that you need to add a quart more often than when the vehicle was new. Crankshaft seals may have hardened and lost their flexibility, so they leak (particularly at low temperatures) and may crack. The higher-mileage oils are formulated with seal conditioners that flow into the pores of the seals to restore their shape and increase their flexibility. In most cases, rubber seals are designed to swell just enough to stop leaks. But the oil refiners pick their "reswelling" ingredients carefully. Valvoline showed us the performance data of one good seal conditioner that swelled most seal materials, but actually reduced the swelling of one type that tended to swell excessively from the ingredients found in some other engine oils.

You also may have noticed some loss of performance and engine smoothness as a result of engine wear on your higher-mileage vehicle. These higher-mileage oils also have somewhat higher viscosities. (Even if the numbers on the container don't indicate it, there's a fairly wide range for each viscosity rating and the higher-mileage oils sit at the top of each range.) They also may have more viscosity-index improvers in them. The result? They seal piston-to-cylinder clearances better and won't squeeze out as readily from the larger engine bearing clearances. They also may have a higher dose of anti-wear additives to try to slow the wear process.



Oil Additives

Use of additives is another approach to improving and maintaining oil performance. High engine temperatures combine with moisture, combustion by-products (including unburned gasoline), rust, corrosion, engine-wear particles, and oxygen to produce sludge and varnish. The additives not only assist oil in maintaining good lubrication, they also help minimize sludge and varnish, and any damage from their formation. Here are the categories of key additive ingredients and why they're important:

- **Viscosity-index improvers:** Reduce the oil's tendency to thin with increasing temperature.
- **Detergents:** Unlike the household type, they don't scrub engine surfaces. They do remove some deposits, primarily solids. But their main purpose is to keep the surfaces clean by inhibiting the formation of high-temperature deposits, rust, and corrosion.
- **Dispersants:** Disperse solid particles, keeping them in solution, so they don't come together to form sludge, varnish, and acids. Some additives work both as detergents and dispersants.
- **Antiwear agents:** There are times when the lubricating film breaks down, so the antiwear agents have to protect the metal surfaces. A zinc and phosphorus compound called ZDDP is a long-used favorite, along with other phosphorus (and sulphur) compounds. If you must know, ZDDP stand for zinc dialkyl dithiophosphate.
- **Friction modifiers:** These aren't the same as antiwear agents. They reduce engine friction and, so, can improve fuel economy. Graphite, molybdenum, and other compounds are used.
- **Pour-point depressants:** Just because the 0° F viscosity rating is low doesn't mean the oil will flow readily at low temperatures. Oil contains wax particles that can congeal and reduce flow, so these additives are used to prevent it.
- **Antioxidants:** With engine temperatures being pushed up for better emissions control, the antioxidants are needed to prevent oxidation (and, therefore, thickening) of oil. Some of the additives that perform other functions also serve this purpose, such as the antiwear agents.
- **Foam inhibitors:** The crankshaft whipping through the oil in the pan causes foaming. Oil foam is not as effective a lubricant as a full-liquid stream, so the inhibitors are used to cause the foam bubbles to collapse.
- **Rust/corrosion inhibitors:** Protect metal parts from acids and moisture.

Questions on the article

Why do engines need oil?



What does the 'W' mean in the oil rating (i.e., 10W30)? Explain

Why are there two numbers in the rating? (i.e., 10W30)? Explain

What happens to the engine oil as the engine heats up?

What is the difference between Conventional and Synthetic Oil?

If synthetic oil is better, why doesn't everyone use it?

What three things do oil additives help with?

Name 3 or 4 oil additives that you found interesting and why (what they do).

