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Engine oil viscosity

Why it's important to look beyond the numbers.

WHILE I WAS RUNNING A LUBRICANTS TRAINING COURSE RECENTLY, one of the delegates asked me to explain what 0W-20 viscosity means exactly. The explanation and discussion took a bit longer than I had anticipated because the delegate wanted to understand whether a 0W-20 oil was better than a 20W-50 oil or a 10W-30 oil.

The Society of Automotive Engineers (SAE) publishes the viscosity specifications for automotive engine oils in SAE J300, which can be obtained at **www.sae.org**. The numbers 0W, 5W, 10W, 15W, 20W, 20, 30, 40, 50 or 60 refer to ranges of either dynamic or kinematic viscosities measured at defined temperatures. They are just numbers, not viscosities.

For example, all 0W engine oils (usually referred to as 0W-XX) must have a low-temperature cranking viscosity of less than 6,200 mPa-s (centipoise, cP) at -35 C, measured using ASTM D5293, a low-temperature pumping viscosity with no yield stress of less than 60,000 mPa-s at 40 C, measured using ASTM 4684, and a low shear rate kinematic viscosity of at least 3.8 mm^2/s (centistokes, cSt) at 100 C, measured using ASTM D445.

Conversely, all 20W-XX engine oils must have a low-temperature cranking viscosity of less than 9,500 mPa-s (centipoise, cP) at -15 C, a low-temperature pumping viscosity, with no yield stress, of less than 60,000 mPa-s at 20 C and a low shear rate kinematic viscosity of at least 5.6 mm^2/s (centistokes, cSt) at 100 C.

It is worth noting at this point that, not only are the low-temperature cranking viscosities of 0W-XX oils different from those of 20W-XX oils, but the temperatures at which both the cranking and pumping viscosities are measured also are different. It is also worth emphasizing that an oil with a cranking viscosity of 5,800 cP at -35 C and another oil with a cranking viscosity of 6,150 cP at -35 C are both 0W-XX oils.

For the other numbers, all XW-20 oils must have a low shear rate kinematic viscosity at 100 C between 4.0 and 6.1 mm2/s (cSt), measured using ASTM D445 and a high shear rate viscosity at 150 C of at least 2.6 mPa-s (cP), measured using either ASTM D4643, ASTM D4741, ASTM D5481 or CEC L-36-90.

Similarly, all XW-50 oils must have a low shear rate kinematic viscosity at 100 C between 16.3 and 21.9 mm2/s (cSt) and a high shear rate viscosity at 150 C of at least 3.7 mPa-s (cP). Thus, an oil with a low shear rate kinematic viscosity of 16.5 cSt at 100 C and a high shear rate viscosity of 3.8 cP at 150 C and another oil with a low shear rate kinematic viscosity of 19.5 cSt at 100 C and a high shear rate viscosity of 4.0 cP at 150 C are both XW-50 oils.

There are slight differences in the limits for high shear rate viscosities for XW-40 oils, as readers will observe when studying the J300 specification. The other viscosity grades have different limits from those few grades described above.

In practice, this means that not all 0W-20 oils are exactly the same, as are not all 10W-40 oils, 20W-50 oils or other similar viscosity grades.

Not all 0W-20 oils are exactly the same, nor are all 10W-40 oils, 20W-50 oils or other similar viscosity grades.

With the J300 classification, the lubricants industry aims to guide engine oil users about the flow properties of an oil when an engine starts from cold (the W is for winter) and the lubricating ability of the oil at the normal operating temperatures of an engine. Hence, a 0W-20 oil will have similar low-temperature flow properties to a 0W-40 oil and a 5W-50 oil will have similar lubricating properties to a 20W-50 oil.

The latest J300 specification contains the viscosity limits for 0W-16, 0W-12 and 0W-8 viscosity grades; I wrote about these in the May 2015 TLT.

Whether one oil is better than another one depends on what a user deems *better*. The J300 specification defines oils that have lower viscosities than other oils. Lower oil viscosity means less friction, which usually means better fuel efficiency.

Whether these oils are suitable for use in any specific engine depends on the characteristics and operation of that engine. There are many factors other than viscosity that affect the ability of an engine oil to meet all the test requirements in the API, ILSAC, ACEA or JASO specifications.

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 The arctic fox, arctic hare, ptarmigan, barren-ground caribou and ermine are among the animals that turn white for winter survival.