

Worldwide



Volatility of engine oils

By R. David Whitby

Oil change intervals for gasoline and diesel engines have been increasing gradually in many countries around the world. AMSOIL has been marketing long drain oils in the U.S. for many years and has now been joined by ExxonMobil Corp. in offering oil drain intervals up to 15,000 miles (24,100 km) for gasoline engines.

In Europe, for cars built in 2000 and later, Volkswagen has introduced oil drain interval specifications of 30,000 km or two years (whichever comes first) for gasoline engines and 50,000 km or two years for light-duty diesel engines. Many European specifications for heavy-duty diesel engines now have oil drain intervals of between 80,000 and 120,000 km.

One of the main factors that allow engine oils to function satisfactorily for such long periods is oil volatility. The less oil that volatilizes out of an engine, past the piston rings and into the exhaust gases, the more oil stays in the engine, and the longer the oil retains its initial viscosity. Of course, oxidation and thermal stability of the oil is also very important.

All the new European and U.S. specifications for engine oils now include limits for oil volatility, most usually using the NOACK test (CEC L-40-A-93, ASTM D5800). In this test, a sample of oil is heated for one hour at 250 C, and a controlled stream of air carries away the volatile components. The test conditions are intended to replicate the conditions around the pistons and cylinder

walls in an engine.

Another test used to measure volatility of oils is gas chromatographic (GC) simulated distillation (ASTM D6417). This test estimates the volatility of an engine oil from the percentage of the oil's simulated boiling range below a specified temperature. In the case of the latest API SM specification, the temperature is 371 C, and the percentage of oil that boils below this temperature must be a maximum of 10%. Additionally, the same specification requires the oil's Noack volatility to be less than 15%. In the latest European ACEA A3/B3, A3/B4 and A5/B5 specifications, an engine oil's Noack volatility must be less than 13%.

Although these volatility tests were originally intended for engine oils, they are now also being used to measure the volatility of base oils. This, however, presents a dilemma to manufacturers of base oils, because the volatility of an engine oil is likely to be lower than that of the base oil(s) from which it is made, whichever test is used to measure the volatility.

In the case of the Noack test, part of the oil's volatility is the result of oxidation and thermal cracking, so the use of oxidation inhibitors in the engine oil will lower the measured volatility. In the case of the GC test, the use of additives in the engine oil will lower the percentage that boils

below the specified temperature by between 10% and 20%.

Two problems that arise for base oil manufacturers are which volatility test to use and what volatility limit to aim for with each viscosity grade. Although there is a general correlation between Noack and GC test results, the correlation is not linear because the GC test does not have an oxidation and thermal stability component.

For example, oils that give an 8% volatility at 371 C in the GC test can have Noack volatilities ranging from 16% to 20%. Most manufacturers of base oils in Europe use the Noack test in preference to the GC test, reflecting the use of only the Noack test in European engine oil specifications.

Current industry practice in Europe suggests that the Noack volatility of a base oil can be around 2% higher than the specification for the engine oil to ensure meeting a formulator's requirements. But are base oil manufacturers giving away too much quality to engine oil marketers? There does not appear to be much published evidence to tell one way or another. <<

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