Teamwork brings ROBO test to completion
New bench test to replace engine test in GF-5

The latest upgrade for passenger car engine oils is expected to be licensable next year, in time for 2011 model year vehicles, and that means lubricant and additive companies once again will have to conduct costly, complex and time-consuming tests to meet this new international specification called ILSAC GF-5.

One of the most expensive tests on the current list is the Sequence IIIGA, which costs about US$40,000, takes 100 hours to complete and requires the use of a real engine to condition oil for low-temperature viscosity measurement. The goal is to detect oil thickening at cold temperatures where thickening, if it has occurred, may be less noticeable.

The Sequence IIIGA is part of the Sequence IIIG. The “A” version uses the same engine, conditions and duration but it differs by specifying only cold-temperature viscosity. The Sequence IIIG itself is a fired engine test designed to evaluate the candidate oil’s performance in four areas: viscosity increase at warm temperature, high-temperature piston deposits, valve train wear and hot stuck rings. The test uses a GM 3.8L V-6 engine. For GF-5, the rated performance parameters proposed are the same as its predecessor, GF-4, but with improved piston deposits.

Thanks to the efforts of three researchers, the pricey Sequence IIIGA test is about to be replaced by a laboratory test that can simulate engine conditions while delivering the same accurate results for a fraction of the time and cost—40 hours and about US$1,500.

“That’s great news for additive manufacturers and lube companies who will spend hundreds of thousands of dollars to develop, test and qualify their products about every five years. “Developing oil formulations is an expensive proposition... [With the new test] we all benefit in the sense we’re all saving a little bit of money.”

That’s great news for additive manufacturers and lube companies who will spend hundreds of thousands of dollars to develop, test and qualify their products about every five years. “Developing oil formulations is an expensive proposition,” said Bernard Kinker, one of three researchers who helped develop the new test, known as ROBO, for RohMax Oil Additives, a globally operating business line, and part of the.

Photos courtesy of Evonik Rohmax USA, Inc.
as original equipment manufacturers (OEMs), additive companies, oil companies and oil marketers. It’s rare to replace one of these engine tests, which are long, involved complex procedures, with something that is a bench test rather than an engine test,” said Kinker.

The ROBO procedure

The test oil is combined with a small amount of iron ferrocene, a soluble iron catalyst, to aid oil thickening. This mixture is then placed in the reaction vessel and is heated to 170°C with vigorous stirring for 40 hours. During this time, a measured amount of nitrogen dioxide, simulating blowby gas and itself a powerful oxidant, is introduced over 12 hours to further catalyze the oxidation, or thickening, reaction. A subsurface feed of air is introduced to supply oxygen. Another extremely important parameter—application of a vacuum—mimics the volatilization of the Sequence IIIGA and lends to further thickening as light base oil ends are removed.

Iron ferrocene is added to the test oil to simulate the catalytic effect of iron found in used oils from wearing of engine parts. Iron has a catalytic (accelerating) effect on oxidation (oil thickening). So, iron ferrocene is added to ROBO test oil to simulate this. Why iron ferrocene? This form of iron is soluble in oil which is important so it can be available to participate in the oxidation (thickening reactions).
“I think the overall trend is toward more laboratory tests, replacing some of the more expensive engine tests. I don’t know if we would ever get away completely from engine tests, but certainly we are going in that direction,” said Linden.

There are 27 tests that have been proposed for GF-5. Eight of the tests are engine tests; 19 are bench tests. All eight of the new tests are bench tests.

ILSAC members include not only the three American OEMs, but also Japanese OEMs collectively under the Japan Automobile Manufacturers Association. But the GF-5 specification is expected to have an impact well beyond American and Japanese shores. Countries, such as Canada, South Korea, Singapore as well as other Asian countries, are expected to adopt the specification.

For motorists, GF-5 will mean improved fuel economy, better engine performance and lesser negative environmental impact. “They get overall better quality of oil,” Linden said. “They may be able to extend drain intervals longer, they’re more assured the oil meets the requirements that engine manufacturers have come up with so they know the oil works well in the vehicle they’ve purchased.”

Research for the ROBO test began in 2003 and was presented to ILSAC two years later. “We worked with colleagues in the industry to develop this test,” said Kinker.

In June 2006, RohMax submitted the test to ASTM for consideration. ASTM has almost taken the last step to making it official, said Kinker, who retired in 2006 and now works as a consultant for RohMax. “I truly expect formal adoption very shortly,” he says.

It was the cost that first motivated the researchers to look at an alternative to the Sequence IIIGA.

“At the time we said hey, we don’t want to be spending US$40,000 to qualify a product every time we do something. We said we can do something in the lab. “There was no breakthrough moment, no ‘aha!’ moment. There were some dead ends,” Kinker recalls.

Kinker believes that the ROBO test “was an excellent example of teamwork and hard work and knowledge to take the fundamentals of chemistry and for our industry to work as a team.”

The objective, he said, was “to have a good less expensive test method available to show that low-temperature viscosity of used oils is okay and RohMax products and associated additive packages are working well.”
The ROBO (Romaszewski Oil Bench Oxidation) test is under development as an ASTM test with the potential to replace the costly Sequence IIIGA test. The ROBO test is used to evaluate the used oil low temperature viscosity performance of engine oils and was developed by RohMax to help save time and money in GF-5 formulation development. Take full advantage of our expertise, industry-leading service and products. Join the many customers who have already started development of their GF-5 formulations with us. For more information, visit www.rohmax.com.