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Bridging the Gap from ILSAC GF-5 to GF-6
Preparing for New Engine Oil Industry Standards with Innovative Solutions
The development of an engine oil specification is a complex process that requires seamless coordination among several industry partners. Member companies that constitute original equipment manufacturers (OEMs), oil marketers, additive companies, test laboratories and associated trade groups play a major role in such developments. Because of the ever-increasing complexity of new specifications, such as ILSAC GF-6, which comprises a multitude of engine tests, the first license date has been delayed to 2019, further widening the gap between GF-5 and GF-6.

To put this into perspective, decades ago engine oil industry standards were mainly focused on a singular objective: certain tailpipe emissions reductions. Then, during the 1970s and 1980s, the concept of fuel economy was developed and defined as the now well-known corporate average fuel economy, or CAFE, standards. Today we take a broader and more holistic view. When it comes to both passenger car and heavy-duty engine oil standards, we think in terms of total cost of ownership (TCO). This approach allows us to focus on specific issues such as fuel economy and extended service (or durability), while keeping the needs of the consumer in focus.

Fuel economy is gaining greater attention again because of global concerns over carbon dioxide and its effect as a greenhouse gas. Another reason is that the U.S. lags most other countries in this area. Why? Fuel prices and fuel taxes are relatively low in the U.S., which means consumers don’t have as much incentive to buy more fuel-efficient vehicles. Even though CAFE regulations naturally cause OEMs to produce more fuel-efficient vehicles, the demand for even more fuel efficiency is still relatively low in the U.S.
Fuel Economy Will Drive Technology

Fuel economy will continue to drive technology developments. To meet the target of 56.2 miles per gallon by 2025, OEMs need to improve CAFE by 4 percent per year from now through 2025. The target gets progressively more difficult as the “low-hanging fruit” is captured and more sophisticated and expensive technologies get adopted. Engine oil will play an important role in this, both by directly affecting fuel economy and by helping enable new engine technologies.

Engine lubricant is a cost-effective tool to help improve fuel economy. Weighing the impact of various technologies on the magnitudes of potential fuel consumption reduction versus cost effectiveness, it becomes clearer that many options are available.

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Engine lubricant is a cost-effective tool to help improve fuel economy. Weighing the impact of various technologies on the magnitudes of potential fuel consumption reduction versus cost effectiveness, it becomes clearer that many options are available. Low-friction lubricants act as an outlier; they provide a relatively small reduction in fuel consumption but are very cost-effective compared to other options. In addition to being cost effective, switching to low-friction lubricants can be accomplished with little effort and can be implemented across a fleet of vehicles quickly without having to introduce new hardware or wait for new technologies.

There are various ways in which fuel economy requirements drive new technologies into the market. First, one must consider what conditions are used to measure fuel economy and whether those conditions are truly representative of the market. Changes in what I refer to as the “operating environment” have an impact on engine technology, which in turn has an impact on the oil formulations. Some of these relationships are not always obvious or even predictable.

Looking at the penetration of many of the technologies highlighted on the previous chart, we see that OEMs are using various means to improve fuel economy. Of course, those with the highest penetration were in many cases the easiest or most cost effective to use — the “low-hanging fruit.”

Virtually all the technologies shown have a direct or indirect impact on the engine oil. Changes in engine oil have been required to enable many of these technologies.

To provide optimal fuel economy performance, many OEMs are offering turbocharged gasoline direct injection (GDI) engines coupled with six-, seven-, or eight-speed transmissions, or even continuous variable transmission (CVT). We see a rapid growth of products incorporating these technologies in the marketplace. To enable these technologies, passenger car motor oils (PCMO) must provide protection against low speed pre-ignition (LSPI), oxidation/deposits and soot/particulate emissions.

OEMs all over the world are evaluating various aspects of LSPI to better understand how it is affected by fuels, lubricants and operating conditions. LSPI results in formulation of the flame front (deactivation mode) resulting from an unknown initiator that leads to knock. Unlike standard knock, the initiator can’t be described with bulk gas properties. LSPI has been found to occur pre-ignition or post-ignition (similar to surface ignition). Besides making an audible noise which is detectable by vehicle operators, LSPI can result in pressure spikes of 1.0 bar or higher. Passenger car gasoline engines are not designed to operate at those pressures, and engine damage can result. Most often pistons will crack or break because of these pressure spikes.

Timing chain wear is also an issue. Turbo GDI engines are more severe on timing chain wear because of the higher soot/particulate level and faster oil degradation. The rate of chain wear depends on engine operation, chain design, chain materials, type of lubrication and engine oil. With direct injection, passenger car engine oils are tasked with helping manage soot or particulate matter for the first time. Previously, soot or particulate matter in the oil has been limited to diesel engines, which also inject fuel directly into the combustion chamber. With GDI, passenger car oils now must be able to provide wear control with soot or particulate matter in the oil. As a part of the upcoming ILSAC GF-6 category change, Ford is developing a timing chain wear test using a 2.0-liter turbocharged GDI engine. The test uses a silent chain and will measure the percentage of chain stretch (i.e., a function of wear between the link pin and plate).

ILSAC GF-6: What to Expect

Oil specifications are regularly upgraded to reflect concerns raised by OEMs and to incorporate the latest engine hardware and its needs. Each new specification has either new tests or replacement tests. In fact, the specifications are not licitable or creditable without standardized and monitored tests. For the consumer, the stardard and donuts are API licensing symbols that help them identify the correct oil to use in their vehicles.

While fuel economy continues to be the driving factor for today’s OEMs, the challenges presented by new engine technologies will also need to be addressed. Here’s where manufacturers will be focusing: (1) measured fuel economy benefits in the Sequence VIE/F, which will include fresh and used oil requirements; (2) GF-6 oils minimizing LSPI, allowing for an indirect fuel economy benefit from GF-6; and (3) oil robustness. Engine cleanliness can benefit fuel economy performance, and GF-6 will continue requirements to minimize deposits, sludge and varnish. Wear protection will also remain an important focus, demonstrated by the Sequence IVB and chain wear tests. The key viscosity grades for GF-6 would be:

- CF-6A: SAE 0W-20, 0W-30, 5W-20, 5W-30, 10W-30
- CF-6B: SAE 0W-16 and lower

(Note that future grades below 0W-16 will require additional review by the Auto-Oil Advisory Panel)

The basic function of additives will remain the same under GF-6. Namely: (1) altering the frictional properties
To meet your dexos1®:2015 additive package needs

Formulating for the next-generation categories is a mixture of science and art that requires commitment, creativity, precision and lots of experience.

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Building on our legacy of strong PCMO technology, the OLOA® 55516 platform delivers dexos1®:2015 performance requirements while also meeting ILSAC GF-5 and API SN standards. General Motors’ updated specification requires additional performance upgrades that will help provide enhanced fuel economy, improved turbocharger performance, and reduced low speed pre-ignition (LSPI) events in direct injected small displacement engines. Since receiving the first-in-the-industry dexos1:2015 approval, Chevron Oronite has been assisting our customers with their product upgrades using a broad array of OLOA 55516 technology. To learn more, please contact your local Oronite representative or visit www.oroniteaddups.com.

Formulating for LSPI is not reliant on simply adjusting the detergent system. A matrix approach was taken to understand the trade-off impacts of key components (e.g., detergent, antioxidants) in the formulation.

Chevron Oronite has developed a formulating space that can help induce LSPI while meeting other key performance objectives for wear, cleanliness, fuel economy and more.

As the need for LSPI performance proliferates around the world, it is important to understand the fundamental similarities and differences between key tests defining various global specifications (e.g., dexos, GF-6 and others). For more details, refer to the Society of Automotive Engineers (SAE) paper 2015-01-2028, which was also discussed at Society of Automotive Engineers of Japan (JSAE) 2015 and the 2016 F+L Asia meeting.

Engine oil plays the dual role of directly increasing fuel economy using lower-viscosity oils while also helping to enable new hardware technologies to be introduced. The move toward lower-viscosity, higher-quality engine oils is also likely to continue and accelerate. Technologies such as turbo-charging, GDI and engine down-sizing are placing greater demands on engine oil formulations. Engine life and durability cannot be sacrificed for fuel economy gains. The life expectancy of engines and vehicles is increasing thanks to improved hardware quality alongside better fuels and lubricants.

While the industry waits on the development of GF-6 specification, there is a more immediate need to upgrade products to meet the second-generation dexos™ specification (dexos® Gen 2) developed to protect GM’s new turbocharged GDI and legacy engine platforms before the expiration of dexos™ Gen 1 licenses on Aug. 31, 2017. That is why Chevron Oronite and others are working closely with OEMs to make sure additive packages meet current and future technology needs for the global PCMO market.

Summary — Delivering Performance within New Challenges

Total cost of ownership, including fuel economy and extended drain, are the likely focus area for engine oil development over the next decade. Demands for increased vehicle fuel economy are leading to new downstream technologies entering the market.

“The life expectancy of engines and vehicles is increasing thanks to improved hardware quality alongside better fuels and lubricants.”

Add OLOA® 55516.

“Formulating for the next-generation categories is a mixture of science and art that requires commitment, creativity, precision and lots of experience.”

Add PCFlex ADDvantage.