What Has Changed with PCMO and What It Means to You

PCMO (Passenger Car Motor Oil) has been through a series of ongoing changes to address challenges with newer engine technologies, driven by regulations to reduce emissions and improve fuel economy.

Original Equipment Manufacturers (OEMs) have been tasked with implementing hardware changes to meet these requirements. A few of these newer technologies include gasoline direct injection (GDI), turbocharged GDI engines, start/stop technologies, timing chain advancements, and variable valve timing. However, with these newer technologies, issues have arisen that have required changes in engine oil formulations.

Additionally, trends requiring lower-viscosity engine oils continue to grow as lighter-viscosity oils offer less viscous drag in an engine, improving efficiency without sacrificing engine protection. Equipment manufacturers found that a higher-performing oil was necessary to protect hardware against the concerns of lighter viscosities. These advancements and trends have been addressed in new oil requirements included in the latest PCMO specification from the American Petroleum Institute, API SP, and the latest International Lubricant Standardization and Approval Committee certification, ILSAC GF-6.

Challenges with Turbocharged Gasoline Direct Injection Engines

One advancement in gasoline engine technology includes equipping engines with gasoline direct injection. GDI engines are becoming more popular due to their many advantages, including increased fuel efficiency, higher power output, lower emissions, and faster acceleration. This is accomplished by directly injecting the gasoline into the combustion chamber rather than directing the fuel into an intake port. In a GDI engine, the gasoline is highly pressurized, and combustion is more efficient and complete, leading to the boost in fuel economy and reduction in emissions.

OEMs have taken the challenge further and, in some cases, have downsized the engine, equipped it with GDI, and added a turbocharger, offering a great balance in power and efficiency. Ultimately, these changes have led to a more severe combustion environment that can lead to a phenomenon known as low-speed pre-ignition (LSPI). LSPI can potentially generate a very severe knock, leading to catastrophic results up to and including engine failure. The mechanisms that cause LSPI are continuously being studied, and while it is not fully understood what causes LSPI, there are engine tests that can measure LSPI, assisting our ability to understand and prevent the phenomenon.

Many factors can affect LSPI:

- Engine hardware design (injection system, piston rings, etc.)
- Engine operating conditions (temperature, pressure, mixture composition, etc.)
- Gasoline fuel properties
- Engine deposits
- Lubricant and its additives

Oil additive companies have done extensive research on the lubricant's role and have found that achieving a proper balance of metallic detergents adequately minimizes LSPI events. Through these efforts, PCMO formulations have evolved to minimize the occurrence and negative effects of LSPI. This was a key driver in the industry's transition to the current API SP oil specification / ILSAC GF-6 certification that went into effect May 1, 2020.

The addition of the turbocharger adds another layer of complexity that the oil needs to address. Turbochargers, which contain a turbine and compressor, operate at extremely high temperatures and spin at incredibly high speeds. In fact, small turbochargers have rotating assemblies that record speeds from 150,000 to 300,000 rpm. They are designed to compress the air going into the engine, optimizing the air-to-fuel ratio, resulting in improved power output. Inadequate and poor lubrication are the most frequent causes of turbocharger failure. Excellent oxidation stability and the ability to resist oil degradation, deposit buildup, and contamination become even more important in newer engines equipped with turbochargers. This is another area of improvement in oil technology addressed with API SP and ILSAC GF-6.

Challenges with Start/Stop Technologies

Vehicles equipped with start/stop technology (also known as idle-stop systems) are designed to improve fuel economy and reduce emissions by stopping the engine when the car is not moving. However, the most wear in an engine occurs upon startup, especially within components that are exposed to boundary lubrication regimens (like the crankshaft resting on the main bearings). New oils that meet API SP and ILSAC GF-6 are optimized to offer better wear protection than prior generation oils. Formulating with a higher-quality base oil, a tougher viscosity modifier, and a better-performing anti-wear additive better protects newer cars built with a start/stop system, leading to longer engine life.

Challenges with Timing Chain Wear

In a four-stroke internal combustion engine (ICE), the camshaft, rotating at half the speed of the crankshaft, is connected to the crankshaft via a timing chain or belt. Proper synchronization of both components is critical in control of the movement of the valves and pistons. Without the proper timing associated with these components, the engine will experience reduced efficiency, potentially leading to catastrophic failure of the belt or chain. Many modern engines are now engineered with timing chains. Over time, if not properly lubricated, the chain (and its tensioner) can start to wear and elongate, leading to poor synchronization of these critical engine components. Low oil pressure or deposit buildup can lead to timing chain wear. Therefore, another formulation improvement included in API SP / ILSAC GF-6 is better protection against timing chain wear. This is accomplished by using a higher-quality oil that does not shear (fall out of grade) as readily, is equipped with a robust anti-wear additive, and contains a high-performing detergent/dispersant.

Challenges with Variable Valve Timing

One additional engine technology that has been introduced to improve engine efficiency is variable valve timing (VVT). The intake and exhaust valves activate the breathing of the engine and can influence how efficient the engine is based on the timing of these valves. Most VVT systems utilize the engine oil (hydraulic) pressure and an electronic solenoid to initiate the changes in valve lifting, duration, and timing.

Common factors in diagnosing ~~a~~ VVT system issue are low oil pressure or a low engine oil level. A higher-quality engine oil that will remain in grade longer and an oil with excellent aeration properties (part of the upgrade to API SP and ILSAC GF-6) become even more critical in cars that are built with VVT systems.

The Solution

Consumers should be excited about new engine technologies on the market today, especially since improved fuel economy is better for our wallets and reduced emissions will provide for a better future. Yet it is apparent that the various hardware advancements have led to challenges that the lubricant industry has been tasked to address. Fortunately, the lubricants industry has taken a proactive approach to these challenges by quickly identifying solutions through evolvement in oil formulations. These formulation improvements can be found in oils marketed to meet API SP and ILSAC GF-6.

The FS Lubricants brand continues to remain ahead of the curve by offering oils that not only meet current specification requirements but, in many cases, exceed them. FS chooses to blend its lubricants to this quality level to offer longer-lasting protection and peace of mind. Its PCMO lineup, known as FS Engine Guard, has been transitioning to meet API SP and ILSAC GF-6. Rest assured these oils are not only designed to protect new engines but are also fully backward compatible to protect older engines.

Contact your local FS to learn more.

Looking for more information on the API or ILSAC? Visit: https://www.oilspecifications.org/ilsac.php | https://www.api.org/