Low Speed Pre-Ignition (LSPI)

Reading about the new and proposed engine oil performance classifications GM dexos1™ Gen 2, American Petroleum Institute’s (API) SP and International Lubricant Standardization and Approval Committee (ILSAC) GF-6, one has likely encountered the term LSPI or Low Speed Pre-Ignition. What is LSPI and how does it concern you and your customer’s vehicles? In this technical bulletin, I will discuss what LSPI is, what roll the engine oil has in LSPI and what you need to do as a customer or installer to prevent LSPI in your customer’s or your own vehicles.

**What is LSPI?**

First, what is LSPI? Low Speed Pre-Ignition (LSPI) is an “abnormal combustion event” where the air and fuel mixture ignites in the combustion chamber before the spark plug fires. When the air and fuel mixture ignite prior to the spark, excessive pressure builds up inside the combustion chamber resulting in an engine noise called “knock”. In severe cases engine damage or an engine failure can occur.

It has been a while since I’ve heard anyone talking about engine knock. Before knock sensors, when one experienced knock or ping, one would have to take their car in for service to have the engine timing adjusted. In modern engines, knock can be detected and engine timing adjusted by the vehicle’s computer.

Unlike this type of engine knock, LSPI cannot be predicted and corrected by adjusting the engine timing. The only way known to avoid LSPI is to alter the design of the engine or change the formulation of the lubricant used inside the engine.

**Why is LSPI occurring now and what vehicles are susceptible to LSPI?**

LSPI is directly connected to turbocharged, direct-injected gasoline engines (TGDI). These engines provide equivalent power as a conventional gasoline engine in a smaller more fuel-efficient package. The fuel economy provided by direct injection gasoline (GDI) engines is very attractive to automobile manufacturers trying to meet CAFÉ (Corporate Average Fuel Economy) fuel economy requirements mandated by the government. Turbocharging these (GDI) engines likewise provides additional fuel economy which is even more attractive to manufacturers. Most vehicle manufactures have incorporated one or both of these technologies to improve the fuel efficiency of their fleet. Unfortunately, one of the unintended consequences of these fuel savings is LSPI.

**Theories concerning LSPI**

The nature of LSPI is not fully understood. However, we know that certain conditions can increase the likelihood of LSPI events occurring. One theory suspects that small droplets of oil entering the

combustion chamber past the compression ring initiates the spontaneous combustion of the air and fuel mixture. Another surmises that deposit formation inside the combustion chamber or piston ring land area is the culprit. Much research will continue to be done in this area. What is known about LSPI is that the motor oil formulation used can affect the potential for LSPI events occurring inside a direct-injection gasoline engine. It is known that high levels of calcium detergents promote LSPI while magnesium detergents and molybdenum disulfide friction modifiers tend to reduce the occurrence of LSPI. One will undoubtedly hear more marketing references to “low calcium”, “magnesium detergents”, “enriched with moly” to signify oils intended to reduce the incidence of LSPI in the field.

**What is being done to address LSPI in the field?**

Engine damage to vehicles experiencing LSPI can be severe and expensive. Naturally, it is in the vehicle manufacturers’ best interest to address this issue as quickly as possible. General Motors introduced an LSPI engine sequence test as part of their “dexos1™ Gen 2” licensing program. Products licensed “Dexos1™ Gen 2” are allowed to be sold as of August 1, 2017. They will continue to be labeled “dexos1™” on the motor oil label but will add “Gen 2” which stands for the second generation of dexos1™. These new formulations have tested performance in TGDI engines run under simulated conditions where LSPI is known to occur. The API and International Lubricant Standardization and Approval Committee (ILSAC) are working on API SP and ILSAC GF-6 categories and will incorporate an LSPI engine sequence test as part of their requirements as well. Unfortunately, API SP and ILSAC GF-6 have been delayed and will not be available for licensing until 2019. API is considering “API SN-Plus” as a category that could be introduced as early as January 1, 2018.

**What can be done until 2018 or 2019?**

For GM vehicle owners, the answer is relatively easy-- be sure to use dexos1™ or dexos1 Gen 2 qualified engine oils such as Silver State® dexos1™ Synthetic Motor Oil and dexos1™ Gen 2 when it becomes available in the field. For GM and all other vehicles, it is imperative to perform required maintenance such as engine oil changes using the manufacturer’s specified viscosity and API service category. Regular maintenance is needed to reduce the chance of engine deposit formation that could lead to LSPI. Also, performing required maintenance is important to keep the vehicle manufacturer’s warranty in effect should LSPI occur.

**Summary**

In summary, Low Speed Pre-Ignition (LSPI) is a real phenomenon that has the potential to harm turbocharged, direct-injection gasoline engines. If you own or service one of these vehicles, it is imperative to use the proper lubricants and perform the required maintenance to minimize the risk of encountering LSPI. Using quality lubricants such as Rugged and Silver State Motor Oils and performing regular scheduled maintenance is the best defense against LSPI occurring in your turbocharged, direct-injection gasoline engines.

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