

Abstract

With the continued modernization and improvements being made in the automotive industry, a new level of performance is required for engine oils. Engines are being built to be more durable, while also being designed for better fuel economy and to meet higher emission standards. The current GF-5 engine oil standard does not meet all the new requirements, specifically those of the USA Corporate Average Fuel Economy (CAFE) which will require the average fuel economy to be 54.5 MPG by the year 2025. While oils with lower viscosities can meet these fuel economy requirements, the oil must also maintain the engine durability, hence the need for the GF-6 performance levels.

Along with performance needs, the engine testing needs have also undergone a lot of recent changes. Older engine tests have been replaced with updated versions and brand new tests have been developed that will all need to be accounted for in the ILSAC GF-6 specification. Because of the significant number of new tests and requirements the GF-6 standard has seen numerous delays and is not expected to be finalized until Q2 of 2020. This poster will go deeper into the needs for the new GF-6 specifications along with the reasons why it has taken so long to achieve.

Introduction

- ILSAC defines lubrication specifications and licensing standards to meet the needs and requirements of the automotive industry and legislative bodies.
- ILSAC GF-6 is the upcoming engine oil standard for passenger vehicles and light trucks in the United States.
- ILSAC GF-6 has been pushed back several times, but first acceptable usage is expected to be in 2020.



History of ILSAC

- Prior to ILSAC's formation in 1992, engine oil standards were issued under the Tripartite System headed by the following organizations: API, SAE, and ASTM2.
- The AAMA and the JASO founded the ILSAC in 1992 to meet industry needs in a timely manner.
- Tripartite System and ILSAC merged to form the Engine Oil Licensing and Certification System (EOCLS).
- Each member of EOCLS has different functions
- ILSAC sets minimum performance standards
- SAE determines the needs of engine oil specifications based on automaker inputs and market trends
- ASTM develops tests and parameters for each specification provided by SAE
- API licenses and certifies the engine oil.

History of ILSAC

ILSAC GF-1

The ILSAC GF-1 standard indicates the oil meets both API SH and the Energy Conserving II (EC-II) requirements. It was created in 1990 and upgraded in 1992 and became the minimum requirement for oil used in American and Japanese automobiles.

ILSAC GF-2

ILSAC GF-2 replaced GF-1 in 1996. The oil must meet both API SJ and EC-II requirements. The GF-2 standards require 0W-30, 0W-40, 5W-20, 5W-30, 5W-40, 5W-50, 10W-30, 10W-40 and 10W-50 motor oils to meet stringent requirements for phosphorus content, low temperature operation, high temperature deposits and foam control.

ILSAC GF-3

An ILSAC GF-3 oil must meet both API SL and the EC-II requirements. The GF-3 standard has more stringent parameters regarding long-term effects of the oil on the vehicle emission system, improved fuel economy and improved volatility, deposit control and viscosity performance. The standard also requires less additive degradation and reduced oil consumption rates over the service life of the oil.

ILSAC GF-4

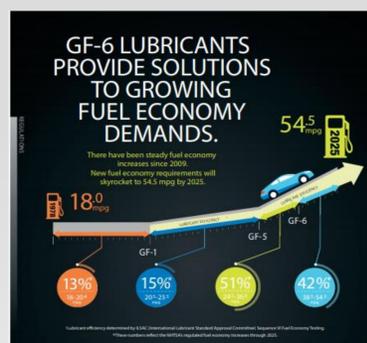
ILSAC GF-4 is similar to the API SM service category, but it requires an additional sequence VIB Fuel Economy Test (ASTM D6837).

ILSAC GF-5

Introduced in October 2010 for 2011 and older vehicles, designed to provide improved high temperature deposit protection for pistons and turbochargers, more stringent sludge control, improved fuel economy, enhanced emission control system compatibility, seal compatibility, and protection of engines operating on ethanol-containing fuels up to E85.

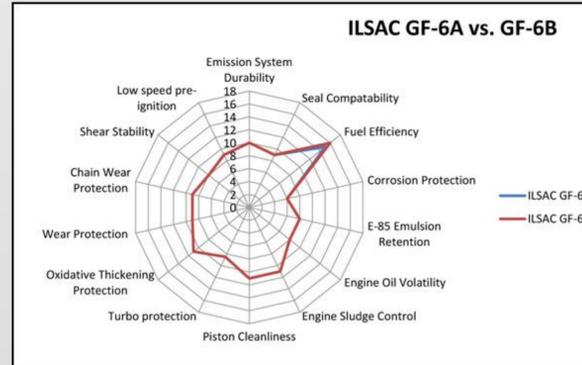
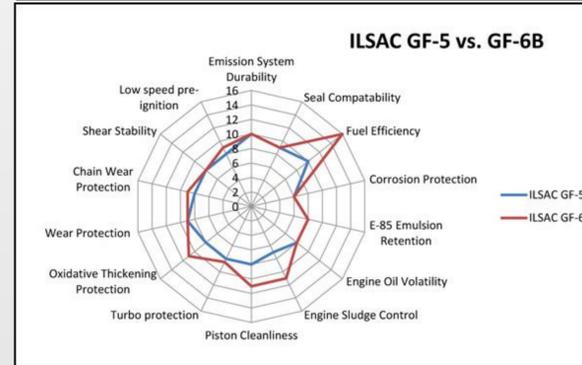
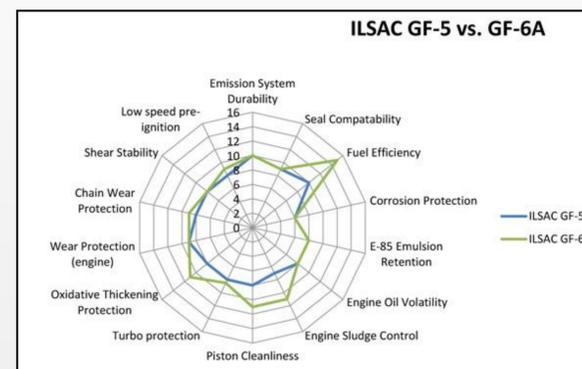
The Need for ILSAC GF-6

- Corporate Average Fuel Economy (CAFE) requires passenger cars and light trucks to attain an average fuel economy of 54.5 mpg.
- Reducing greenhouse gas (GHG) emissions is a primary concern for legislators and car manufacturers.
- Lubricants tend to improve fuel economy by only up to 3%, but with light-duty vehicles producing 60% of GHG emissions from the U.S. transportation sector, there is huge GHG emission reduction potential4.
- Turbocharged/gasoline direct injection (T/GDI) engines have grown in popularity.
- Low speed pre-ignition is very common in T/GDI engines
- Piston cleanliness and particulate matter reduction for overall longevity



ILSAC GF-6

First standard to have two subcategories

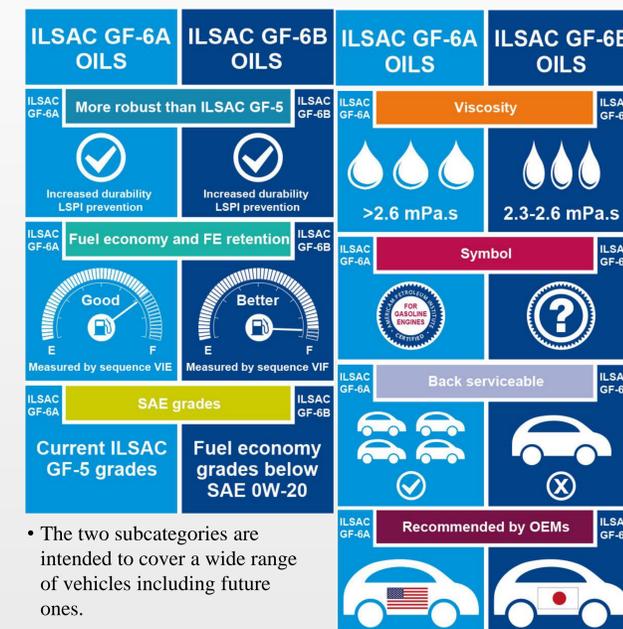


First standard to introduce seven new tests at once

Test	Test focus	Test engine	
Legacy test	Sequence VIII	Corrosion	CLR Test 0.7L
Replaces VID	Sequence VIE	Fuel Economy	2012 GM 3.6L PFI*
Replaces IIIG	Sequence IIIH	Oxidation & deposits	2012 FCA 3.6L PFI
Replaces IVA	Sequence IVB	Wear	2010 Toyota 1.5L PFI
Replaces VG	Sequence VH	Sludge & varnish	20xx Ford 4.6L PFI
New	Sequence VIF	Fuel Economy	2012 GM 3.6L PFI
New	LSPI	Pre-ignition	2016 Ford 2.0L GDI**
New	Chain Stretch	Wear	2016 Ford 2.0L GDI

*Port fuel injection
** Gasoline direct injection

ILSAC GF-6A vs. GF-6B



- The two subcategories are intended to cover a wide range of vehicles including future ones.

Future of Lubricants

First acceptable use of ILSAC GF-6 is expected in 2020
New lubricants are needed for changing engine technology
Solid-state lubricants may be an alternative to thinning engine oils

References

- "ILSAC GF-6." Lubrizol Additives 360 - Passenger, The Lubrizol Corporation, passenger.lubrizoladditives360.com/specifications/gf-6/#Timeline.
- Modern Technology of Petroleum, Greases, Lubricants & Petro Chemicals. 2nd ed., Publication Division, National Institute of Industrial Research, 2008.
- "ILSAC Oil Specifications." Oilspecifications.org, www.oilspecifications.org/ilsac.php.
- "Fast Facts on Transportation Greenhouse Gas Emissions." EPA, Environmental Protection Agency, 27 Aug. 2018, www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions.
- Canter, Neil. "GF-6, PC-11 and dexos1™: New Engine Oil Specifications Mean New Additive Challenges." Tribology & Lubrication Technology, Sept. 2015, pp. 10-24.
- Chabot, Bob. "A Well-Oil Edge." MOTOR, www.motor.com/newsletters/20131121/WebFiles/ID_AdvancedLubes.html.
- "ILSAC GF-6 Engine Tests." Insight, From Infineum International Limited, Infineum International Limited, 1 Jan. 2017, www.infineuminsight.com/trends/ilsac-gf-6/ilsac-gf-6-engine-tests.
- "Two Categories Explained." Insight, From Infineum International Limited, Infineum International Limited, www.infineuminsight.com/trends/ilsac-gf-6/two-categories-explained.

Acknowledgements

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