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SAVANT LABS

On the Horizon

A World of Lubrication Understanding®

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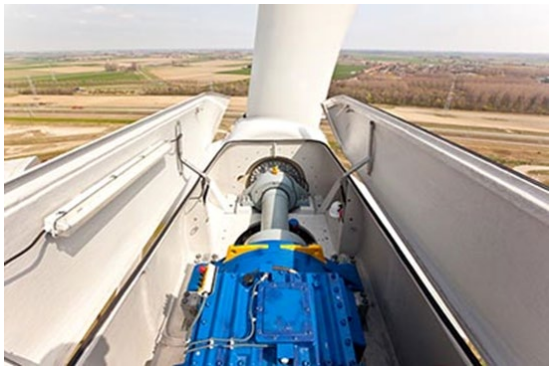
Today's Topics:

- **Industrial Lubricant/Gear Oil Testing Capabilities**
- **Understanding the Different Test Methods for Measuring PSSI**
- **Rob Gordon Named Savant Group Director of Sales**

Status of the Gear Oil Industry

It should come as no surprise that gear oil is a huge industry. Gears are among the most ubiquitous mechanical components of our commercial manufacturing and distribution systems, and every gear needs lubrication. According to Infineum's estimation in 2018, the global demand for all gear lubrication came to about 2,400 kT/yr, with about 40% of that demand for industrial gear oil and the rest for automotive gear oil. Of the 15% of demand in the North American market, about 60% was for industrial gear oil. [1] DataM Intelligence estimates a 2.6% annual growth rate in the gear oil market [2], so current demand may be as high as 2,700 kT/yr. Gear oil is big business, and lubricant manufacturers must keep up with end users' needs to be competitive.

Applications of Gear Oils

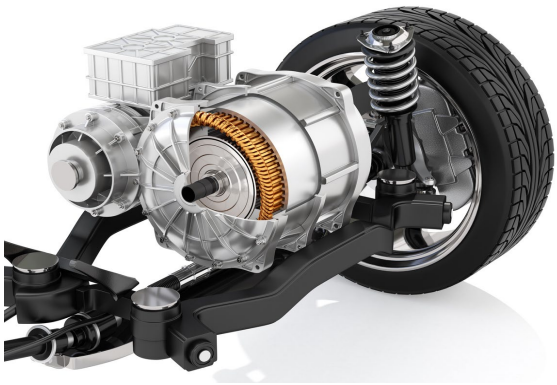


The differences between industrial and automotive gear oils and specific gear oils within either category depend on the particular application. [1,3] Savant Labs' customers cover a wide range of applications. Gears requiring lubrication are ubiquitous in warehouses and logistic centers focusing on product distribution. Industrial manufacturing also uses gear-driven equipment, from automotive assembly lines to automated manufacturing. Gears are also present in energy generation systems. The most significant use

of gear oils in energy generation may be the myriad of wind turbines providing sustainable electricity. Finally, automotive gear oils form a large portion of the industry. Every vehicle with a manual transmission, whether a passenger car or a heavy-duty commercial truck, uses automotive gear oil. Many early electric vehicles also used gear oils for lubrication until it became evident that EVs have special lubrication needs. Nonetheless, EV lubricants still share a number of properties with automotive gear oils.

Application-Specific Functions

To understand why many needs are application-specific, consider oxidation resistance. This property is most important in applications that generate heat, such as high-speed gears, gears with high friction or sliding, or automotive applications near a heat-generating internal combustion engine. The need for viscosity stability across different temperature ranges and cold-temperature operation also depends on the application. Therefore, in contrast to an indoor application, wind, and automotive applications usually require multi-grade oils and good low-temperature performance.



Changing Needs for Gear Oils

The need for protection has become more challenging as gearbox designs have continued to advance. Smaller gearboxes with increased power and less sump volume require lubricants with improved anti-wear or extreme pressure protection, better oxidation resistance, and better resistance to foaming. As new materials are used to make gears, some base oils or additives may react with these new materials, and it becomes critical to verify compatibility. Finally, as users seek to reduce costs and improve environmental sustainability, longer drain intervals become desirable, and certain additives, such as those containing zinc, phosphorous, and sulfur, become less desirable. Extended use requires lubricants with excellent oxidative, thermal, and viscosity stability as well as the ability to reject contaminants such as water. [3]

Whether it be anti-wear, extreme pressure protection, oxidation resistance, resistance to foaming, thermal or viscosity stability, and more, a complete listing of gear lubricant testing services is available at Savant Lab.com.

Gear Oil Specifications

With so many general and specific requirements, gear oil standards play an important role in ensuring that a given lubricant can meet the consumer's needs. Typically, industrial gear oils meet a baseline standard dependent on region. For instance, AGMA 9005 is specific to North America, DIN 51517-3 to Europe, and SEBI 181 226 to Germany. [1, 3, 4] These regional standards include testing for corrosiveness, flash point, viscosity index, water content, foaming, water separation, load capacity, bearing wear, oxidation, and low-temperature viscosity, as shown in Table 1. OEMs often supplement these specifications with additional requirements. [1,4] Automotive gear oils have their own viscosity classification and performance standards, SAE J306 and SAE J2360. These include many

of the same tests as the North American AGMA specification as well as shear stability, seal compatibility, and some specialized tests for oxidation stability, thermal stability, and performance with gears. [1]

Table *1. Tests required to meet AGMA 9005 [5,1]*

ASTM Test Method	Description
ASTM D130	Copper Strip Corrosion
ASTM D92	Flash Point, Cleveland Open Cup
ASTM D2270	Viscosity Index
ASTM D445	Kinematic Viscosity
ASTM D2422	ISO Viscosity Classification
ASTM D943	Oxidation Characteristics (2.0 TAN or 1000 Hrs)
ASTM D892	Foaming, Sequence I - III
ASTM D665	Rust Prevention 4 and 24 Hours (Method A or B)
ASTM D6304	Determination of Water Content by Karl Fischer Reagent
ASTM D5182	FZG Gear Test
ASTM D2711	Demulsibility - Procedures A and B
ASTM 2893	Oxidation Characteristics Extreme Pressure
ASTM D2983	Brookfield Viscosity, +20°C to -60°C
DIN 51819-3	Bearing Wear by FE8 Apparatus

Condition Monitoring of Gear Oils

In addition to testing to meet specifications, condition monitoring of in-service lubricants can be an excellent preventative maintenance and drain-interval extension technique. Periodically testing the fluid can give important indicators about the state of the gears. Changes in lubricant viscosity and makeup can indicate critical changes in the system. For instance, viscosity is known to increase as oil oxidizes. A reduction in viscosity could indicate permanent shear loss or contamination in the system that could cause serious damage if left unaddressed. A change in the metallic components found by elemental analysis (ASTM D5185) could indicate depletion of additives, particles of wear metals in the sample, or corrosion. In addition, it is also useful to monitor water content (ASTM D6304) and acid number through “oxidation lifetime" (ASTM D943). Increases in water content can drive corrosion and increases in acid number can indicate excessive oxidation products in the fluid. It is important to note that a successful condition monitoring program begins by testing the fresh oil to establish a baseline. [6]

Savant’s Gear Oil Testing Capabilities

Savant offers the tests included in the AGMA 9005 specification as well as additional specialized application- or manufacturer-specific tests. We can also:

- Perform the tests necessary for a successful condition monitoring program. Sometimes, there may be a specific problem with a gear-driven system or questions about whether a particular lubricant will be adequate.

- Develop custom testing and provide problem-solving efforts that can help identify lubricant-based root causes.
- Determine an array of tests that will best address a particular challenge.
- Provide expertise in new test development. We can assist in developing tests for emerging challenges faced by both manufacturers of novel gears and novel gear lubricants.

Contact Savant Labs for a quote on standard gear oil testing or to learn more about how our custom testing capabilities could address your needs.

Request Quote

References:

[1] Infineum. “Gear Lubricants.” Infineum Insight. 2008. https://www.infineuminsight.com/media/1821/10-gear-lubricants-na.pdf, accessed July 2023.

[2] Data Intelligence. “Gear Oil Market Size, Share, Trends, Outlook, Growth Opportunities, and Forecast 2023 – 2030.” May 24, 2023. https://www.datamintelligence.com/research-report/gear-oil-market, accessed July, 2023.

[3] Rob Profilet. “Trends in Industrial Gear Oil,” Machinery Lubrication. Jan. 2008. https://www.machinerylubrication.com/Read/1292/industrial-gear-oils

[4] Van Rensselar, Jean. “Gear Oils,” Tribology and Lubrication Technology: 28 - 33. Feb., 2013 https://www.stle.org/images/pdf/STLE_ORG/BOK/OM_OA/Additives/Trends%20in%20Industrial%20Gear%20Oils_tlt%20article_Feb13.pdf

[5] American National Standard. “Industrial Gear Lubrication,” ANSI/AGMA Standard 9005-E02, Rev. Dec 2002.

[6] Dagnino, Jesus Teran. “Oil Analysis Interpretation for Gearboxes,” Machinery Lubrication, Aug. 2021. https://www.machinerylubrication.com/Read/32068/oil-analysis-interpretation-gearboxes

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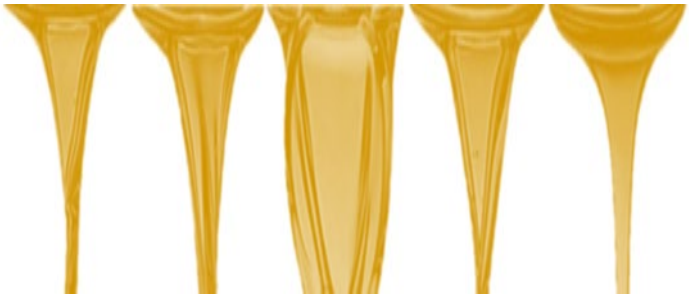
Understanding the Different Test Methods for Measuring PSSI



The performance of a lubricant is dependent on various factors such as viscosity, anti-wear capabilities, and stability under severe conditions. One of the key parameters used to evaluate a lubricant's performance is the PSSI or the Permanent Shear Stability Index. This parameter is an indicator of the lubricant's ability to maintain its viscosity and provide optimal protection to the machinery after prolonged use. However, measuring PSSI is not a straightforward process as different ASTM methods exist for conducting the test. We'll explore the different ASTM methods for measuring PSSI, and why understanding the test method used is crucial when comparing results.

There are several ASTM test methods used for measuring PSSI, each with its unique approach. One of the most common types of methods is the procedure that involves passing oil through a fuel injector (FISST and/or Kurt Orbahn). These methods measure the mechanical shear stability of the lubricant and are carried out by three

commonly requested methods: ASTM D5275, D6278, and D7109. These tests require passing the oil through the injector at a specified pressure and number of passes, with the viscosity of the oil measured before and after the test. The results of the test are then used to calculate the PSSI of the lubricant.

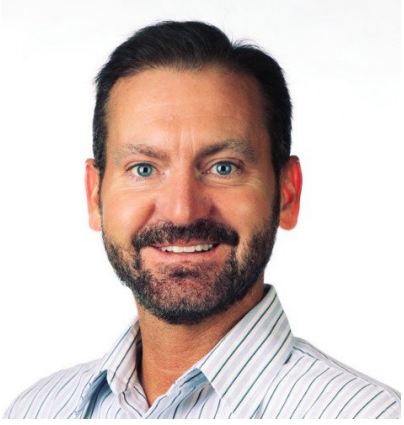
Another ASTM test method that measures PSSI is the sonic shear method, which uses a sonic oscillator to cavitate the oil, thereby inducing shearing. There are two such sonicating methods with different timing specifics. One is more directed at hydraulic fluids ASTM D5621 while the other is for polymer-containing fluids ASTM D2603.

The KRL Test, CEC L-45-99, is another severe shear test that measures PSSI. This test involves placing steel rollers in a tapered roller bearing, which is then installed in a test machine. The machine subjects the bearing to a specified load, rpm, and duration, with the oil's viscosity measured before and after the test. The results are then used to calculate the lubricant's PSSI. The KRL test is considered a more severe test method compared to the sonic and fuel injector methods since it involves actual bearing testing and subjecting the lubricant to high loads.

In conclusion, PSSI is an essential parameter that is used to evaluate the performance of finished lubricants. However, when comparing PSSIs of different lubricants, it is crucial to know the ASTM method used for conducting the test. This is because different methods measure PSSI under different conditions, thereby affecting the results. Understanding the test method used can help ensure accurate comparisons of lubricants' performance and make informed decisions. Contact Savant Labs to learn more about measuring PSSI.

People on the Move

Exciting News: Rob Gordon has recently been appointed Savant Group's Director of Sales! In this role, Rob will oversee strategic planning, monitor industry trends, and strengthen customer relationships to drive growth for the Savant Group companies — Savant Labs, IOM, Tannas & King, and Excell Manufacturing.



Rob's extensive experience as a seasoned sales manager with sister company Tannas & King brings immense value to Savant Labs. Over the past decade, he has successfully collaborated with global industry partners, catering not only to their precision testing equipment needs but also now fulfilling laboratory testing requirements through Savant Labs. With Rob on board, we are poised for remarkable growth and continued success across all Savant Group companies.

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