



SURFACE VEHICLE STANDARD

J183™

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Superseding J183 AUG2017

(R) Engine Oil Performance and Engine Service Classification
(Other than “Energy Conserving” or “Resource Conserving”)

RATIONALE

This revision of SAE J183 had four objectives: First, to incorporate the SN PLUS Classification requirements. Second, to introduce ILSAC GF-6A, GF-6B specifications and the corresponding API SP Category. Third, to update various Categories in light of the activities of the Category Life Oversight Group (CLOG) as well as the ASTM D4485 Surveillance Panel. CLOG reviews the applicability of newer tests to support the ongoing licensing of older Categories (for example, using Sequence IIH in lieu of Sequence IIIG to support API SN licensing). The ASTM D4485 Surveillance Panel aims to provide prompt updates to ASTM D4485 using Information Letters. Finally, the title of the document had to be updated, since API no longer introduces “Energy Conserving” Categories; rather, the most recent gasoline engine oils displaying the right performance levels are referred to as “Resource Conserving.”

1. SCOPE

This SAE Standard outlines the engine oil performance categories and classifications developed through the efforts of the Alliance of Automobile Manufacturers (Alliance), American Petroleum Institute (API), the American Society for Testing and Materials (ASTM), the Engine Manufacturers Association (EMA), the International Lubricant Specification Advisory Committee (ILSAC), and SAE. The verbal descriptions by API and ASTM, along with prescribed test methods and limits, are shown for active categories in Table 1 and obsolete categories in Table A1. Appendix A is thus a historical documentation of the obsolete categories.

For purposes of this document, active categories are defined as those (a) for which the required test equipment and test support materials, including reference engine oils and reference fuels, are readily available, or for which the Category Life Oversight Group has established equivalencies between unavailable tests and newer, available tests; (b) which ASTM or the test developer monitors precision for all tests; and (c) which are available for licensing by API EOLCS at time of writing.

The current processes for initiating new classifications were developed through the cooperative efforts of the Alliance, API, ASTM, EMA, ILSAC, and SAE. New ILSAC classifications are developed using the procedure defined in API 1509 Annex C. New API “C” categories are added using the procedure defined in API 1509 Annex D. New API “S” categories are added by the API Lubricants Group.

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Documents

Document Sharing Hub

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J300	Engine Oil Viscosity Classification
SAE J304	Engine Oil Tests
SAE J312	Automotive Gasoline
SAE J313	Diesel Fuels
SAE J357	Physical and Chemical Properties of Engine Oils
SAE J1297	Alternative Automotive Fuels
SAE J1423	Classification of Energy Conserving Engine Oil and Resource Conserving Engine Oil for Passenger Cars, Vans, Sport Utility Vehicles, and Light-Duty Trucks
SAE J2227	Global Tests and Specifications for Automotive Engine Oils

2.1.2 API Publications

Available from API, 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001-5571, USA, Tel: 202-682-8000, www.api.org.

API Publication 1509 Engine Oil Licensing and Certification System

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D93	Standard Test Methods for Flash-Point by Pensky-Martens Closed Cup Tester
ASTM D130	Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test
ASTM D892	Standard Test Method for Foaming Characteristics of Lubricating Oils
ASTM D2887	Standard Test for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
ASTM D4485	Standard Performance Specification for Performance of Engine Oils
ASTM D4683	Standard Test Method for Measuring Viscosity at High Shear Rate and High Temperature by Tapered Bearing Simulator
ASTM D4684	Standard Test Method for Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature

ASTM D4741	Standard Test Method for Measuring Viscosity at High Temperature and High Shear Rate by Tapered-Plug Viscometer
ASTM D4814	Standard Specification for Automotive Spark-Ignition Engine Fuel
ASTM D4951	Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry
ASTM D5133	Test Method for Low Temperature, Low Shear Rate, Viscosity/Temperature Dependence of Lubricating Oils Using a Temperature-Scanning Technique
ASTM D5185	Standard Test Method for Determination of Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry
ASTM D5293	Standard Test Method for Apparent Viscosity of Engine Oils Between -5 and -35 °C Using the Cold-Cranking Simulator
ASTM D5302	Standard Test Method for Evaluation of Automotive Engine Oils for Inhibition of Deposit Formation and Wear in a Spark-Ignition Internal Combustion Engine Fueled with Gasoline and Operated at Low-Temperature, Light-Duty Conditions
ASTM D5480	Test Method for Motor Oil Volatility by Gas Chromatography (Method was withdrawn in 2003)
ASTM D5481	Standard Test Method for Measuring Apparent Viscosity at High-Temperature and High-Shear Rate by Multicell Capillary Viscometer
ASTM D5533	Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIE, Spark Ignition Engine
ASTM D5800	Standard Test Method for Evaporation Loss of Lubricating Oils by the Noack Method
ASTM D5844	Test Method for Evaluation of Automotive Engine Oils for Inhibition of Rusting (Sequence IID)
ASTM D5862	Standard Test Method for Evaluation of Engine Oils in Two-Stroke Cycle Turbo-Supercharged 6V92TA Diesel Engine
ASTM D5966	Standard Test Method for Evaluation of Engine Oils for Roller Follower Wear in Light-Duty Diesel Engine
ASTM D5967	Standard Test Method for Evaluation of Diesel Engine Oils in T-8 Diesel Engine
ASTM D5968	Standard Test Method for Evaluation of Corrosiveness of Diesel Engine Oil
ASTM D6082	Standard Test Method for High Temperature Foaming Characteristics of Lubricating Oils
ASTM D6202	Standard Test Method for Measurement of the Effects of Automotive Engine Oils on the Fuel Economy of Passenger Cars and Light-Duty Trucks in the Sequence VIA Spark Ignition Engine
ASTM D6278	Standard Test Method for Shear Stability of Polymer Containing Fluids Using a European Diesel Injector Apparatus
ASTM D6417	Standard Test Method for Estimation of Engine Oil Volatility by Capillary Gas Chromatography
ASTM D6483	Standard Test Method for Evaluation of Diesel Engine Oils in T-9 Diesel Engine
ASTM D6557	Standard Test Method for Evaluation of Rust Preventive Characteristics of Automotive Engine Oils

ASTM D6593	Standard Test Method for Evaluation of Automotive Engine Oils for Inhibition of Deposit Formation in a Spark-Ignition Internal Combustion Engine Fueled with Gasoline and Operated Under Low-Temperature, Light-Duty Conditions
ASTM D6594	Standard Test Method for Evaluation of Corrosiveness of Diesel Engine Oil at 135 °C
ASTM D6618	Standard Test Method for Evaluation of Engine Oils in Diesel Four-Stroke Cycle Supercharged 1M-PC Single Cylinder Oil Test Engine
ASTM D6681	Standard Test Method for Evaluation of Engine Oils in High Speed, Single-Cylinder Diesel Engine-Caterpillar IP Test Procedure
ASTM D6709	Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence VIII Spark-Ignition Engine (CLR Oil Test Engine)
ASTM D6750	Standard Test Method for Evaluation of Engine Oils in a High-Speed, Single-Cylinder Diesel Engine-1K Procedure (0.4% Fuel Sulfur), and 1N Procedure (0.04% Fuel Sulfur)
ASTM D6794	Standard Test Method for Measuring the Effect on Filterability of Engine Oils After Treatment with various Amounts of Water and a Long (6-h) Heating Time
ASTM D6795	Standard Test Method for Measuring the Effect on Filterability of Engine Oils After Treatment with various Amounts of Water and Dry Ice and a Short (30-min) Heating Time
ASTM D6837	Standard Test Method for Measurement of Effects of Automotive Engine Oils on Fuel Economy of Passenger Cars and Light-Duty Trucks in Sequence VIB Spark Ignition Engine
ASTM D6838	Standard Test Method for Cummins M11 High Soot Test
ASTM D6891	Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IVA Spark-Ignition Engine
ASTM D6896	Standard Test Method for Determination of Yield Stress and Apparent Viscosity of Used Engine Oils at Low Temperature
ASTM D6922	Standard Test Method for Determination of Homogeneity and Miscibility in Automotive Engine Oils
ASTM D6923	Standard Test Method for Evaluation of Engine Oils in a High Speed, Single-Cylinder Diesel Engine - Caterpillar 1R Test Procedure
ASTM D6975	Standard Test Method for Cummins M11 EGR Test
ASTM D6984	Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIF, Spark-Ignition Engine
ASTM D6987/D6987M	Standard Test Method for Evaluation of Diesel Engine Oils in T-10 Exhaust Gas Recirculation Diesel Engine
ASTM D7097	Standard Test Method for Determination of Moderately High Temperature Piston Deposits by Thermo-Oxidation Engine Oil Simulation Test-TEOST MHT
ASTM D7109	Standard Test Method for Shear Stability of Polymer Containing Fluids Using a European Diesel Injector Apparatus at 30 and 90 Cycles
ASTM D7156	Standard Test Method for Evaluation of Diesel Engine Oils in the T-11 Exhaust Gas Recirculation Diesel Engine
ASTM D7216	Standard Test Method for Determining Automotive Engine Oil Compatibility with Typical Seal Elastomers

ASTM D7320	Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIG, Spark-Ignition Engine
ASTM D7422	Standard Test Method for Evaluation of Diesel Engine Oils in the T-12 Exhaust Gas Recirculation Diesel Engine
ASTM D7468	Standard Test Method for Cummins ISM Test
ASTM D7484	Standard Test Method for Evaluation of Automotive Engine Oils for Valve-Train Wear Performance in Cummins ISB Medium-Duty Diesel Engine
ASTM D7528	Standard Test Method for Bench Oxidation of Engine Oils by ROBO Apparatus
ASTM D7549	Standard Test Method for Evaluation of Heavy-Duty Engine Oils under High Output Conditions - Caterpillar C13 Test Procedure
ASTM D7563	Standard Test Method for Emulsion Retention when Oil is mixed with 10% Water and 10% E85
ASTM D7589	Standard Test Method for Measurement of Effects of Automotive Engine Oils on Fuel Economy of Passenger Cars and Light-Duty Trucks in Sequence VID Spark Ignition Engine
ASTM D8047	Standard Test Method for Evaluation of Engine Oil Aeration Resistance in a Caterpillar C13 Direct-Injected Turbocharged Automotive Diesel Engine
ASTM D8048	Standard Test Method for Evaluation of Diesel Engine Oils in T-13 Diesel Engine
ASTM D8111	Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIG, Spark-Ignition Engine
ASTM D8114	Standard Test Method for Measurement of Effects of Automotive Engine Oils on Fuel Economy of Passenger Cars and Light-Duty Trucks in Sequence VIE Spark Ignition
ASTM D8226	Standard Test Method for Measurement of Effects of Automotive Engine Oils on Fuel Economy of Passenger Cars and Light-Duty Trucks in Sequence VIF Spark Ignition Engine
ASTM D8256	Standard Test Method for Evaluation of Automotive Engine Oils for Inhibition of Deposit Formation in the Sequence VH Spark-Ignition Engine Fueled with Gasoline and Operated Under Low-Temperature, Light-Duty Conditions
ASTM D8279	New Test Method for Determination of Timing-Chain Wear in a Turbocharged, Direct Injection, Spark-Ignition, Four-Cylinder Engine
ASTM WK50202	Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IVB Spark-Ignition Engine
ASTM 8291	New Test Method for Evaluation of Performance of Automotive Engine Oils in the Mitigation of Low-Speed, Preignition in the Sequence IX Gasoline Turbocharged Direct-Injection, Spark-Ignition Engine
ASTM E178	Recommended Practice for Dealing with Outlying Observations
ASTM STP 315	Multicylinder Test Sequences for Evaluating Automotive Engine Oils
ASTM STP 509	Single Cylinder Engine Tests for Evaluating Performance of Crankcase Lubricants

2.1.3.1 Significance and Use of More Recent ASTM Tests

Generally, tests identified in this section were introduced as part of the two most recent S-category or C-category introductions. For the current edition, these consist of SN/SN PLUS and SP, as well as CJ-4 and CK-4/FA-4. Exceptions may be made for tests introduced (or re-introduced) by ballot.

D4683 Standard Test Method for Measuring Viscosity at High Shear Rate and High Temperature by Tapered Bearing Simulator

Viscosity at the shear rate and temperature of this test method is thought to be representative of the condition encountered in the bearings of automotive engines in severe service.

The importance of viscosity at these conditions to engine lubrication has been addressed in many publications.¹

Methods ASTM D4741 and ASTM D5481 have been shown in interlaboratory studies to yield identical results.

NOTE: Introduced to this section of the document by ballot in 2016.

D7216 Standard Test Method for Determining Automotive Engine Oil Compatibility with Typical Seal Elastomers

Some engine oil formulations have been shown to lack compatibility with certain elastomers used for seals in automotive engines. These deleterious effects on the elastomer are greatest with new engine oils (that is, oils that have not been exposed to an engine's operating environment) and when the exposure is at elevated temperatures.

This test method requires that non-reference oil(s) be tested in parallel with a reference oil, TMC 1006, known to be aggressive for some parameters under service conditions. This relative compatibility permits decisions on the anticipated or predicted performance of the non-reference oil in service.

Elastomer materials can show significant variation in physical properties, not only from batch-to-batch, but also within a sheet and from sheet-to-sheet. Results obtained with the reference oil are submitted by the test laboratories to the TMC to allow it to update continually the total and within-laboratory standard deviation estimates. These estimates, therefore, incorporate effects of variations in the properties of the reference elastomers on the test variability.

This test method is suitable for specification compliance testing, quality control, referee testing, and research and development.

The reference elastomers, reference oil and the physical properties involved in this test method address the specific requirements of engine oils. Although other tests exist for compatibility of elastomers with liquids, these are considered too generalized for engine oils.

D7528 Standard Test Method for Bench Oxidation of Engine Oils by ROBO Apparatus

This bench test method is intended to produce comparable oil aging characteristics to those obtained with ASTM TMC Sequence IIIGA matrix reference oils 434, 435, and 438 after aging in the Sequence IIIGA engine test.

To the extent that the method generates aged oils comparable to those from the Sequence IIIG engine test, the measured increases in kinematic and MRV viscosity indicate the tendency of an oil to thicken because of volatilization and oxidation, as in the Sequence IIIG and IIIGA (refer to Appendix X1 in Test Method D7320) engine tests, respectively.

¹ For a comprehensive review, refer to "The Relationship Between High-Temperature Oil Rheology and Engine Oil Ratings," ASTM Data Series Publication 62.

This bench test procedure has potential use in specifications and classifications of engine lubricating oils, such as Specification ASTM D4485.

D7549 Standard Test Method for Evaluation of Heavy-Duty Engine Oils under High Output Conditions - Caterpillar C13 Test Procedure

This test method assesses the performance of an engine oil with respect to control of piston deposits and maintenance of oil consumption under heavy-duty operating conditions selected to accelerate deposit formation in a turbocharged, intercooled four-stroke-cycle diesel engine equipped with a combustion system that minimizes federally controlled exhaust gas emissions.

The results from this test method may be compared against specification requirements to ascertain acceptance.

The design of the test engine used in this test method is representative of many, but not all, diesel engines. This factor, along with the accelerated operating conditions, needs to be considered when comparing test results against specification requirements.

D7563 Standard Test Method for Emulsion Retention when Oil is Mixed with 10% Water and 10% E85

During engine operation, engine oil can become contaminated by water and fuel. In the case of Ed85 fuels, this contamination can result in a non-emulsified aqueous bottom layer in the oil that can affect the lubrication and detergency of the engine oil. To avoid field problems, engine oil should be capable of emulsifying water contamination to the extent that no aqueous layer appears.

The test described in this method is designed to evaluate the ability of an engine oil, contaminated with a specified amount of water (volume fraction of 10% of the original oil sample) and simulated E85 fuel (also a volume fraction of 10% of the original oil sample), to emulsify the water after agitation in a blender and to maintain this emulsion at temperatures of 20 to 25 °C and -5 to 0 °C for at least 24 hours.

D7589 Standard Test Method for Measurement of Effects of Automotive Engine Oils on Fuel Economy of Passenger Cars and Light-Duty Trucks in Sequence VID Spark Ignition Engine

The data obtained from the use of this test method provide a comparative index of the fuel-saving capabilities of automotive engine oils under repeatable laboratory conditions. A baseline (BL) has been established for this test to provide a standard against which all other oils can be compared. The BL oil is an SAE 20W-30 grade fully formulated lubricant. The test procedure was not designed to give a precise estimate of the difference between two test oils without adequate replication. The test method was developed to compare the test oil to the BL oil. Companion test methods used to evaluate engine oil performance for specification requirements are discussed in the latest revision of Specification ASTM D4485.

The Sequence VID test method is useful for engine oil fuel economy specification acceptance. It is used in specifications and classifications of engine lubricating oils.

D8047 Standard Test Method for Evaluation of Engine Oil Aeration Resistance in a Caterpillar C13 Direct-Injected Turbocharged Automotive Diesel Engine

The tendency of engine oils to aerate in direct injection, turbocharged diesel engines is influenced by a variety of factors, including engine oil formulation, oil temperature, sump design and capacity, residence time of the oil in the sump, and the design of the pressurized oil systems. In some engine-oil-activated systems, the residence time of the oil in the sump is insufficient to allow dissipation of aeration from the oil. As a consequence, aerated oil can be circulated to hydraulically activated components, adversely affecting the engine timing characteristics and engine operation.

The results from this test method may be compared against specification requirements such as Specification ASTM D4485 to ascertain acceptance.

D8048 Standard Test Method for Evaluation of Diesel Engine Oils in T-13 Diesel Engine

This test method was developed to evaluate the oxidation resistance performance of engine oils in turbocharged and intercooled four-cycle diesel engines equipped with EGR and running on ultra-low sulfur diesel fuel. Obtain results from used oil analysis and component measurements before and after test.

The test method may be used for engine oil specification acceptance when all details of the procedure are followed.

D8111 Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IIH, Spark-Ignition Engine

This test method was developed to evaluate automotive engine oils for protection against oil thickening and piston deposits during moderately high-speed, high temperature service.

The increase in kinematic viscosity of the oil indicates the tendency of an oil to thicken because of oxidation. In automotive service, such thickening can cause oil pump starvation and resultant catastrophic engine failures.

The deposit ratings for an oil indicate the tendency for the formation of deposits throughout the engine, including those that can cause sticking of the piston rings in their grooves. In automotive service, such ring sticking can cause a loss of compression pressures in the engine.

The test method was developed to correlate with oils of known good and poor protection against oil thickening and piston deposits. Specially formulated oils that produce less than desirable results with unleaded fuels were also used during the development of this test.

The Sequence IIH engine oil test has been recommended as a replacement for the Sequence IIG test and is expected to be used in specifications and classifications of engine lubricating oils, such as the following: Specification ASTM D4485, Military Specification MIL-PRF-2104, or SAE Classification J183.

D8114 Standard Test Method for Measurement of Effects of Automotive Engine Oils on Fuel Economy of Passenger Cars and Light-Duty Trucks in Sequence VIE Spark Ignition

Test Method—The data obtained from the use of this test method provide a comparative index of the fuel-saving capabilities of automotive engine oils under repeatable laboratory conditions. A BL has been established for this test to provide a standard against which all other oils can be compared. The BL oil is an SAE 20W-30 grade fully formulated lubricant. The test procedure was not designed to give a precise estimate of the difference between two test oils without adequate replication. The test method was developed to compare the test oil to the BL oil. Companion test methods used to evaluate engine oil performance for specification requirements are discussed in the latest revision of Specification ASTM D4485.

Use—The Sequence VIE test method is useful for engine oil fuel economy specification acceptance. It is used in specifications and classifications of engine lubricating oils, such as the following: Specification ASTM D4485, API 1509, SAE Classification J304, SAE Classification J1423.

D8226 Standard Test Method for Measurement of Effects of Automotive Engine Oils on Fuel Economy of Passenger Cars and Light-Duty Trucks in Sequence VIF Spark Ignition Engine

Test Method—The data obtained from the use of this test method provide a comparative index of the fuel-saving capabilities of automotive engine oils under repeatable laboratory conditions. A BL has been established for this test to provide a standard against which all other oils can be compared. The BL oil is an SAE 20W-30 grade fully formulated lubricant. The test procedure was not designed to give a precise estimate of the difference between two test oils without adequate replication. The test method was developed to compare the test oil to the BL oil. Companion test methods used to evaluate engine oil performance for specification requirements are discussed in the latest revision of Specification ASTM D4485.

Use—The Sequence VIF test method is useful for engine oil fuel economy specification acceptance. It is used in specifications and classifications of engine lubricating oils, such as the following: Specification ASTM D4485, API 1509, SAE Classification J304, SAE Classification J1423.

D8256 Standard Test Method for Evaluation of Automotive Engine Oils for Inhibition of Deposit Formation in the Sequence VH Spark-Ignition Engine Fueled with Gasoline and Operated Under Low-Temperature, Light-Duty Conditions

This test method is used to evaluate an automotive engine oil's control of engine deposits under operating conditions deliberately selected to accelerate deposit formation. This VH test method was correlated with the previous VG test method, which was correlated with field service data, determined from side-by-side comparisons of two or more oils in police, taxi fleets, and delivery van services.

This test method, along with other test methods are used to define an engine oils minimum performance level necessary to meet certification requirements for API Category Specifications as outlined in Specification ASTM D4485. This test method may also be incorporated in automobile manufacturers' factory-fill specifications.

The basic engine used in this test method is representative of many that are in modern automobiles. This factor, along with the accelerated operating conditions, should be considered when interpreting test results.

D8279 New Test Method for Determination of Timing-Chain Wear in a Turbocharged, Direct Injection, Spark-Ignition, Four-Cylinder Engine²

This test method evaluates an automotive engine oil's lubricating efficiency in inhibiting timing-chain lengthening under operating conditions selected to accelerate timing-chain wear. Varying quality reference oils of known wear performance were used in developing the operating conditions of the test procedure.

The test method can be used to screen lubricants for satisfactory lubrication of an engine timing chain and has application in gasoline, automotive, engine-oil specifications. It is expected to be used in specifications and classifications of engine lubricating oils, such as the following: ILSAC GF-6, Specification ASTM D4485, SAE Classification J183.

WK50202 Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IVB Spark-Ignition Engine³

This test method was developed to evaluate automotive lubricant's effect on controlling valve-train wear and overall engine wear for overhead camshaft engines with direct acting bucket lifters. Average intake lifter volume loss is used as a measure of an oil's ability to prevent valve-train wear. End-of-test oil iron concentration is used as a measure of an oil's ability to prevent overall engine wear.

D8291 Standard Test Method for Evaluation of Performance of Automotive Engine Oils in the Mitigation of Low-Speed, Preignition in the Sequence IX Gasoline Turbocharged Direct-Injection, Spark-Ignition Engine

This test method evaluates the ability of an automotive engine to mitigate preignition in the combustion chambers in turbocharged, direct injection, gasoline engines under low-speed and high-load operating conditions. Varying quality reference oils, with known preignition tendencies, were used in developing the operating conditions of the test procedure.

The test method has applicability in gasoline-engine-oil specifications and is expected to be used in specifications and classifications of engine lubricating oils, such as the following: Specification ASTM D4485, ILSAC GF-6, and SAE Classification J183.

² Although approved as ASTM D8279, the Sequence X text was not fully published when this version of SAE J183 was being prepared. The text offered here is from ASTM WK67330.

³ The Sequence IVB test procedure had not completed the ballot process when this version of SAE J183 was being prepared, although Sequence IVB testing was taking place in terms of API SP licensing.

2.1.4 CRC Publications

CRC publications are available from Coordinating Research Council, 3650 Mansell Road, Suite 140, Alpharetta, GA 30022, Tel: 678-795-0506, www.crcao.com.

CRC Modified Supplemental Diesel Engine Rating Manual No. 15

2.1.5 ILSAC Publications

ILSAC publications are available from Alliance, 1401 Eye Street, N.W., Suite 900, Washington, DC 20005, Tel: 202-326-5500, www.autoalliance.org.

ILSAC GF-1	The ILSAC Minimum Performance Standard for Passenger Car Engine Oils
ILSAC GF-2	Minimum Performance Standard for Passenger Car Engine Oils
ILSAC GF-3	Minimum Performance Standard for Passenger Car Engine Oils
ILSAC GF-4	Standard for Passenger Car Engine Oils
ILSAC GF-5	Minimum Performance Standard for Passenger Car Engine Oils
ILSAC GF-6A	Recommendations for Passenger Car Engine Oils
ILSAC GF-6B	Recommendations for Passenger Car Engine Oils

2.1.6 American Chemistry Council

Petroleum Additives Panel Publications are available from American Chemistry Council, (ACC) 700 Second St., NE Washington, DC 20002, Tel: (202) 249-7000, www.americanchemistry.com.

ACC Publication: Product Approval Code of Practice

3. API ENGINE OIL LICENSING AND CERTIFICATION SYSTEM

3.1 Description and Purpose

The API Engine Oil Licensing and Certification System (EOLCS) as described by the 18th Edition to API 1509 Engine Oil Licensing and Certification System, dated June 2019, provides a communications tool for both engine manufacturers and oil marketers to describe a complex series of performance specifications to the user through a simple designation of several letters or symbols. This simplifies the oil marketer's job of communicating the applications for which his/her oil is suitable by using the same designations on his containers. More importantly, the consumer can easily link the engine manufacturer's recommendation with the information on the oil marketer's label to assist him/her in selecting the proper oil for his/her engine.

3.1.1 API Category Obsolescence

Under some circumstances, a category may be rendered obsolete in spite of the existence of engines calling for that category's performance attributes. This is frequently caused when one of the engine tests required by the category becomes permanently unavailable, especially when parts consumed in the test can no longer be secured. API licensing operates on the principle that any new licensee can enter the market by qualifying a formulation against all applicable performance tests. This requirement cannot be met if one or more tests become unavailable. Under such circumstances, the category must then be declared obsolete and licensing against that category must cease, unless equivalency to at least one available test has been established by the Category Life Oversight Group. Where licensing is interrupted, a phase-out period is usually provided.

3.2 Background

The API Engine Oil Licensing and Certification System was developed through the cooperative efforts of the Alliance of Automobile Manufacturers (Alliance) and API to assist engine manufacturers and oil marketers to specify and market engine oils, and permit consumers to purchase engine oils, using simple designations that describe the minimum performance standards for these engine oils. The system embodies several different types of classifications including the API "S" series which describes engine oil standards primarily for gasoline engine service, the API "C" series which defines standards for diesel engines, and the ILSAC GF Series Performance Standards for Passenger Car Engine Oils.

3.2.1 Application to Newer and Older Engines

The following tables, beginning with Table 1A, summarizing the active Engine Oil Performance and Engine Service Categories, were prepared from information developed by API, ILSAC, Alliance, EMA, and ASTM. These categories include API Classifications SJ, SL, SM, SN/SN PLUS, SP, and ILSAC GF-6A/6B, and API categories CH-4, CI-4 and CI-4 PLUS, CJ-4, CK-4, and FA-4. In some instances, an engine manufacturer may specify an engine oil that meets more than one engine service category, such as CJ-4/SN. Oils which can support the performance claims for more than one API service category may be so designated. API licensed oils may display the appropriately licensed symbol(s).

3.2.2 Additional Individual Engine Manufacturer Test Requirements

Engine oils with newer classifications may not always provide satisfactory performance where older classifications are recommended. The ASTM Engine Oil Description and the API Engine Service Description provide some guidance for substituting products with newer classifications where older ones are recommended. If there is any doubt, the equipment manufacturer should be consulted.

Some engine manufacturers may specify an Engine Service Category as the basis for their recommendation, but also have additional requirements. These requirements may include certain physical or chemical properties, or supplemental engine tests. Efforts should be made to determine the complete set of requirements for an application before selecting or recommending a lubricant.

3.2.3 Additional Individual Engine Manufacturer Test Requirements

Engine oils with newer classifications may not always provide satisfactory performance where older classifications are recommended. The ASTM Engine Oil Description and the API Engine Service Description provide some guidance for substituting products with newer classifications where older ones are recommended. If there is any doubt, the equipment manufacturer should be consulted.

Some engine manufacturers may specify an Engine Service Category as the basis for their recommendation, but also have additional requirements. These requirements may include certain physical or chemical properties, or supplemental engine tests. Efforts should be made to determine the complete set of requirements for an application before selecting or recommending a lubricant.

3.2.4 Sources of Information on Test Techniques

Details regarding many of these test techniques, including descriptions of their objectives or significance may be found in SAE J304, ASTM STP 315, and STP 509. Some service categories have required test protocols where applicable as test results are considered valid only if the tests are run in calibrated engine stands monitored by the ASTM Test Monitoring Center, and the test protocol meets all requirements of the ACC Product Approval Code of Practice.

3.2.5 Phosphorus Control

ILSAC GF-3 and some API SL service category oils have phosphorus levels (largely from the anti-wear, anti-oxidation additive family of zinc-dithio-diorgano-phosphates, ZDDP) restricted to 0.10% by mass maximum. Later ILSAC and API "S" categories have further restricted phosphorus to 0.08% mass maximum. CJ-4, CK-4, and FA-4 service category oils for diesel engines have phosphorus levels restricted to 0.12% mass maximum.

Notwithstanding the valuable contribution that ZDDPs contribute to engine wear resistance, concerns with phosphorus levels have grown. There are much data indicating phosphorus can significantly reduce the performance and life of three way catalysts used to control emissions. The data also demonstrate this effect can be modified by the detergent package.

More recent studies, reported to a committee called ILSAC/Oil (formed of automotive manufacturers and engine oil producers) in preparation for the introduction of ILSAC GF-5, have shown in bench studies, field studies, and later IIIG engine tests that, at the same phosphorus concentrations, different phosphorus chemistries combined with different additive packages will vary in phosphorus emission and catalyst effects leading to the possibility that phosphorus emission from the engine oil rather than phosphorus concentration in the oil may be a better criterion for reducing catalyst effects.

3.2.6 Energy Conserving and Resource Conserving Standards

In 1983, a standard was established to define the Energy Conserving features of motor oils. This characteristic is described in SAE J1423. However, following the declaration by ASTM that Sequence VIB was no longer available, API discontinued licensing of the “Energy Conserving” designation on December 31, 2016. Starting on October 1, 2010, oils that have passed all test requirements for API SN resource conserving may display “Resource Conserving” as part of the API Service Symbol.

Table 1A - Active API classification SJ

API Engine Service Description
API Service Category SJ was adopted for use in describing engine oils available in 1996. These oils are for use in service typical of gasoline engines in 1996 to 2000 passenger-car, sport utility vehicle, van, and light truck operations under vehicle manufacturers' recommended maintenance procedures.
Engine oils that meet the API Service Category SJ designation may be used where API Service Category SH and earlier categories have been recommended.
Engine oils that meet the API Service Category SJ designation have been tested in accordance with the ACC Code, may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing.
Engine oils that meet these requirements may display API Service Category SJ in the upper portion of the API Service Symbol.
Oil meeting the performance requirements measured in the following gasoline engine tests and bench tests.
Test Method ASTM D5844 , the Sequence IID , gasoline engine test has been correlated with vehicles used in short trip service prior to 1978, particularly with regard to rusting.
Test Method ASTM D6557 , the Ball Rust Test , is a laboratory test that has been found to correlate with the Sequence IID engine test.
Test Method ASTM D5533 , the Sequence IIIE gasoline engine test, has been correlated with vehicles used in high temperature service prior to 1988, particularly with regard to oil thickening and valve train wear.
Test Methods ASTM D6894, ASTM D7320, and ASTM D8111 , the Sequence IIIF, Sequence IIIG, and Sequence IIHG gasoline engine tests, respectively, have been correlated with vehicles used in high temperature service, particularly with regard to oil thickening and valve train wear.
Test Method ASTM D5302 , the Sequence VE gasoline engine test, has been correlated with vehicles used in stop-and-go service prior to 1988, particularly with regard to sludge and valve train wear.
Test Methods ASTM D6593 and ASTM D8256 , the Sequence VG and Sequence VH gasoline engine tests are designed to evaluate an automotive engine oil's control of engine deposits under operating conditions deliberately selected to accelerate deposit formations.
Test Method ASTM D6891 , the Sequence IVA gasoline engine test, measures the ability of engine oil to control camshaft lobe wear for spark-ignition engines equipped with an overhead valve-train and sliding cam followers.
Test Method ASTM D5119 , the L-38 gasoline engine test, is used to measure copper-lead bearing weight loss under high-temperature operating conditions. This test also indicates the ability of an oil to resist permanent viscosity loss due to shearing in an engine.

Test Method ASTM D6709, the **Sequence VIII** engine test, is used to measure copper-lead bearing weight loss under high-temperature operating conditions. This test also indicates the ability of an oil to resist permanent viscosity loss due to shearing in an engine.

Test Methods ASTM D4951 and ASTM D5185 are used to quantitatively determine the presence of various elements in a formulated engine oil, including Phosphorus content.

Test Method ASTM D5480; withdrawn in 2003, this method allowed determination of the amount of oil volatilized between 238 °C and 371 °C.

Test Method ASTM D5800, Noack Volatility, is used to measure engine oil volatility loss under high temperature operating conditions.

Test Method ASTM D6795, the Engine Oil Filterability Test, screens for the formation of precipitates and gels which can cause oil filter plugging.

Test Method ASTM D6794, the Water Tolerance Test, brings in the presence of water to assess whether precipitates will form that can lead to filter plugging.

Test Method ASTM D892, the Foaming Characteristics of Lubricating Oils Test, indicates an oil's foaming tendency at temperatures of 24 °C and 94 °C. Excessive foaming in engine oil can cause valve lifter collapse and a loss of lubrication due to the presence of air in the oil.

Test Method ASTM D6082, the High Temperature Foaming Characteristics of Lubricating Oils Test, allows the determining of any foaming tendency under high temperature conditions of 150 °C. Excessive foaming in engine oil can cause valve lifter collapse and a loss of lubrication due to the presence of air in the oil.

Test Method ASTM D6922, the Homogeneity and Miscibility Test, indicates the compatibility of an oil with standard test oils.

Test Method ASTM D6335, the TEOST 33 Test, may be useful in determining the deposit control of oils recommended for these engines.

Test Method ASTM D5133, the Gelation Index, provides an indication of whether the flow improver is suitable for the formulation.

Test Method ASTM D6417 allows an estimation of the amount of engine oil volatilized at any temperature between 126 °C and 371 °C using Capillary Gas Chromatography.

Test Methods ASTM D4683, ASTM D4741, and ASTM D5481 all allow determination of the high temperature, high-shear viscosity of an engine oil.

Category SJ requires that candidate oils meet the performance requirements in this specification, and that the oils be tested in accordance with the protocols described in the American Chemistry Council Petroleum Additives Product Approval Code of Practice. The ACC Code requires advance registration of all engine tests, along with a test methodology (Multiple Test Acceptance Criteria) to get a more precise estimate of the oil's true performance.

Engine Test Requirements ^(a) - All Viscosity Grades		
Sequence IID or ASTM D6557 ^(b)	Pass	
Sequence IIIE or IIIF or IIIG or IIIH	Pass	
Sequence VE or (IVA plus VG ^(b) or IVA plus VH)	Pass	
L-38 or Sequence VIII	Pass	
Bench Test and Measured Parameter ^(a)	Viscosity Grade Performance Criteria	
	SAE 0W-20, SAE 5W-20, SAE 5W-30, SAE 10W-30	All Others ^(k)
ASTM D5800 volatility loss, %, max ^(c)	22	20 ^(d)
ASTM D6417 volatility loss at 371 °C (700 °F), %, max ^(c)	17	15 ^(d)
ASTM D5480 volatility loss at 371 °C (700 °F), %, max ^(c)	17	15 ^(d)
ASTM D6795, % flow reduction, max	50	50
ASTM D6794, % flow reduction, max	Report	Report
With 0.6% H ₂ O	Report	Report
With 1.0 % H ₂ O	Report	Report
With 2.0% H ₂ O	Report	Report
With 3.0% H ₂ O	Report	Report
ASTM D4951 or D5185 phosphorus % mass, max	0.10 ^(e)	NR
ASTM D92 flash point, °C, min ^(f)	200	NR
ASTM D93 flash point, °C, min ^(f)	185	NR
ASTM D892 foaming tendency (Option A)		
Sequence I, max, foaming/settling ^(g)	10/0	10/0
Sequence II, max, foaming/settling ^(g)	50/0	50/0
Sequence III, max, foaming/settling ^(g)	10/0	10/0
ASTM D6082 (optional blending required), static foam max, tendency/stability	200/50 ^(h)	200/50 ^(h)
ASTM D6922, homogeneity and miscibility	(i)	(i)
L-38 or Sequence VIII shear stability	(j)	(j)
ASTM D6335 high temperature deposits (TEOST), deposit wt, mg, max	60	60
ASTM D5133 gelation index, max ^(b)	12	NR
ASTM D4683, ASTM D4741, or ASTM D5481, high temp/high shear viscosity at 150 °C, mPa·s, min	NR	2.6

NOTE: All oils must meet the requirements of the most recent edition of SAE J300; NR = not required.

(a) Tests and limits are per ASTM D4485.

(b) If CI-4 and/or CJ-4 categories precede the "S" category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.

(c) Volatility requirement shall be met in either Test Method D5800, Test Method D5480, or Test Method D6417. A passing result in only one of these procedures is required.

(d) Passing volatility loss performance only required for SAE 15W-40 oils.

(e) This is a non-critical specification as described in ASTM D3244.

(f) Either Test Method D92 or Test Method D93 flash point requirement shall be met.

(g) Settling volume determined at 10 minutes.

(h) Settling volume determined at 1 minute.

(i) Homogeneous with SAE reference oils.

(j) 10-hour stripped kinematic viscosity must remain in original SAE viscosity grade, except XW-20, which must remain ≥5.6 mm²/s.

(k) Does not include 0W-16 and 5W-16.

Appendix to Table 1A

API staff may cease maintaining a listing of limits for engine tests within Annex G of API 1509. The following entries reflect the limits required to achieve a “pass” for each engine test required for the SJ performance category.

Test Methods	Rated or Measured Parameter	Primary Performance Criteria
ASTM D5844 ^{(1),(2)} Sequence IID Or ASTM D6557 ⁽¹⁾ Ball Rust Test	Average engine rust rating ⁽³⁾ , min	8.5
	Number stuck lifters	None
	Average gray value, min	100
ASTM D5533 ^{(2),(4)} Sequence IIIE <		

ASTM D5302 ^{(2),(14)} Sequence VE	Average engine sludge rating ⁽⁵⁾ , min	9.0
	Rocker arm cover sludge rating ⁽⁵⁾ , min	7.0
	Average piston skirt varnish rating ⁽⁶⁾ , min	6.5
	Average engine varnish rating ⁽⁶⁾ , min	5.0
	Oil ring clogging, %	Report
	Oil screen clogging, %, max	20.0
	Compression ring sticking (hot stuck)	None
	Cam wear, μm	
	Average, max	127
	Maximum, max	380
Or		
Combination of ASTM D6891 ⁽¹⁴⁾ Sequence IVA PLUS	Average cam wear, μm ⁽¹⁵⁾	120
ASTM D6593 ⁽¹⁴⁾ Sequence VG	Average engine sludge rating ⁽⁵⁾ , min	7.8
	Rocker arm cover sludge rating ⁽⁵⁾ , min	8.0
	Average piston skirt varnish rating ⁽⁶⁾ , min	7.5
	Average engine varnish rating ⁽⁶⁾ , min	8.9
	Oil ring clogging, %, max	2.0
	Hot stuck compression rings	None
	Average cam wear, μm ⁽¹⁵⁾	120
Or		
Combination of ASTM D6891 ⁽¹⁴⁾ Sequence IVA PLUS		
ASTM D8256 Sequence VH	Average engine sludge, merits, min	7.4
	Average Rocker cover sludge, merits, min	7.4
	Average engine varnish, merits, min	8.6
	Average piston skirt varnish, merits, min	7.4
	Oil Screen Clogging, % area	Rate & report
	Hot stuck compression rings	None
ASTM D5119 (L-38)	Bearing weight loss, mg, max	40
	Shear stability	⁽¹⁶⁾
Or		
ASTM D6709 Sequence VIII	Bearing weight loss, mg, max	26.4
	Shear stability	⁽¹⁶⁾

(1) Demonstrate passing performance in either Test Method D5844 or D6557.

(2) Monitoring of this test method was discontinued on June 20, 2001. Valid test results shall predate the end of the last calibration period for the test stand in which this test method was conducted.

(3) CRC Rust Rating Manual No. 7, available from Coordinating Research Council, 219 Perimeter Center Pkwy., Atlanta, GA 30346.

(4) Demonstrate passing performance in either Test Method D5533 or D6984. However, an oil passing Test Method D6984 and containing less than 0.08% mass phosphorus in the form of ZDDP shall also pass the wear limits in Test Method D5302 (see also footnote 17).

(5) CRC Sludge Rating Manual No. 12, available from Coordinating Research Council, 219 Perimeter Center Pkwy., Atlanta, GA 30346.

(6) CRC Varnish Rating Manual No. 14, available from Coordinating Research Council, 219 Perimeter Center Pkwy., Atlanta, GA 30346.

(7) An oil-related stuck ring occurs on a piston with an individual oil ring land deposit rating ≤ 2.6

- (8) Determine at 60 hours.
- (9) Determine at 80 hours.
- (10) Determine weighted piston deposits by rating the following piston areas: undercrown, 10%; second land, 15%; third land, 30%; piston skirt, 10%; first groove, 5%; second groove, 10%; and third groove, 20%. Use CRC Varnish Rating Manual No. 14 for all ratings.
- (11) Calculate by eliminating the highest and lowest cam-plus-lifter wear results and then calculating an average based on the remaining ten rating positions.
- (12) For oils containing at least 0.06% mass phosphorus in the form of ZDDP, demonstrating passing performance in the Sequence IIIG test obviates the need to conduct Test Method D5302 (Sequence VE), which was previously required for oils with less than 0.08% mass phosphorus.
- (13) Unlike the Sequence IIIF test, piston skirt varnish rating is not required in the Sequence IIIG test.
- (14) Demonstrate passing performance in Test Method D5302, or alternatively, in both Test Methods D6891 and Test Method D6593.
- (15) Determine cam wear according to Test Method D6891. Seven wear measurements are made on each cam lobe and the seven measured values are added to obtain an individual cam lobe wear result. The overall cam wear value is the average of the 12 individual cam lobe wear results.
- (16) 10-hour stripped kinematic viscosity (oil shall remain in original viscosity grade).

Table 1B - Active API classification SL

ASTM Engine Oil Description
API Service Category SL was adopted for use in describing engine oils available in 2001. These oils are for use in service typical of gasoline engines in 2001 to 2003 passenger-car, sport utility vehicle, van, and light truck operations under vehicle manufacturers' recommended maintenance procedures. Engine oils that meet the API Service Category SL designation may be used where API Service Category SJ and earlier categories have been recommended. Engine oils that meet the API Service Category SL designation have been tested in accordance with the ACC Code, may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing. Engine oils that meet these requirements may display API Service Category SL in the upper portion of the API Service Symbol. Oil meeting the performance requirements is measured in the following gasoline engine tests and bench tests. Test Methods ASTM D6894, ASTM D7320, and ASTM D8111, the Sequence IIIF, Sequence IIIG, and Sequence IIH gasoline engine tests respectively, have been correlated with vehicles used in high temperature service, particularly with regard to oil thickening and valve train wear. Test Methods ASTM D6593 and ASTM D8256, the Sequence VG and Sequence VH gasoline engine tests are designed to evaluate an automotive engine oil's control of engine deposits under operating conditions deliberately selected to accelerate deposit formations. Test Method ASTM D5302, the Sequence VE gasoline engine test, has been correlated with vehicles used in stop-and-go service prior to 1988, particularly with regard to sludge and valve train wear. Test Method ASTM D6891, the Sequence IVA gasoline engine test, is used to measure valve train wear. In addition to passing performance in the engine tests, specific viscosity grades shall also meet bench test requirements. The volatility of engine oils is one of several factors which relates to engine oil consumption. Test Methods ASTM D6794 and ASTM D6795 on filterability of engine oil, screen for the formation of precipitates and gels which can cause oil filter plugging.

Test Method ASTM D6557, the Ball Rust Test, is a laboratory test that has been found to correlate with the Sequence IID engine test.

Test Method ASTM D5800, Noack Volatility, is used to measure engine oil volatility loss under high temperature operating conditions.

Test Method ASTM D6417 allows an estimation of the amount of engine oil volatilized at any temperature between 126 °C and 371 °C using Capillary Gas Chromatography.

Test Method ASTM D892, the Foam Test, indicates an oil's foaming tendency.

Test Method ASTM D6082, the High Temperature Foam Test, allows the determining of any foaming tendency under high temperature conditions.

Test Method ASTM D6922, the Homogeneity and Miscibility Test, indicates the compatibility of an oil with standard test oils.

Test Method ASTM D6709, the Sequence VIII engine test, is used to measure copper-lead bearing weight loss under high-temperature operating conditions. This test also indicates the ability of an oil to resist permanent viscosity loss due to shearing in an engine.

Test Method ASTM D7097, the TEOST MHT-4, may be useful in determining the deposit control of oils recommended for these engines.

Test Method ASTM D5133, the Gelation Index, provides an indication of whether the flow improver is suitable for the formulation.

Test Methods ASTM D4951 and ASTM D5185 are used to determine the amount of phosphorus present in an engine oil sample, using Inductively Coupled Plasma Atomic Emission Spectroscopy. Each method is also suitable to determine several other elements.

Test Methods ASTM D4683, ASTM D4741, and ASTM D5481 all allow determination of the high temperature, high-shear viscosity of an engine oil. The **Category SL** requires that candidate oils meet the performance requirements in this specification, and that the oils be tested in accordance with the protocols described in the American Chemistry Council Petroleum Additives Product Approval Code of Practice. The ACC Code requires advance registration of all engine tests, along with a test methodology (Multiple Test Acceptance Criteria) to get a more precise estimate of the oil's true performance.

Engine Test Requirements ^(a) - All Viscosity Grades	
Sequence IIIF or IIIG or IIIH	Pass
Sequence IVA	Pass
Sequence VE	Pass Wear Only Or a minimum 0.08% phosphorus in the form of ZDDP
Sequence VG ^(b) or VH	Pass
Sequence VIII	Pass

Bench Test and Measured Parameter ^(a)	Viscosity Grade Performance Criteria	
	SAE 0W-20, SAE 5W-20, SAE 0W-30, SAE 5W-30, SAE 10W-30	All Others ^(j)
ASTM D6557 (Ball Rust Test), avg gray value, min ^(b)	100	100
ASTM D5800 volatility loss, %, max	15	15
ASTM D6417 volatility loss at 371 °C (700 °F), %, max	10	10
ASTM D6795, % flow reduction, max	50	50
ASTM D6794, % flow reduction, max		
With 0.6% H ₂ O	50	50
With 1.0% H ₂ O	50	50
With 2.0% H ₂ O	50	50
With 3.0% H ₂ O	50	50
ASTM D4951 or D5185 phosphorus % mass, max ^(c)	0.10 ^(d)	NR
ASTM D892 foaming tendency (Option A)		
Sequence I, max, foaming/settling ^(e)	10/0	10/0
Sequence II, max, foaming/settling ^(e)	50/0	50/0
Sequence III, max, foaming/settling ^(e)	10/0	10/0
ASTM D6082 (optional blending required), static foam max, tendency/stability ^(f)	100/0	100/0
ASTM D6922, homogeneity and miscibility	(g)	(g)
Sequence VIII shear stability	(h)	(h)
ASTM D7097, high temperature deposits (TEOST MHT), deposit wt, mg, max	45	45
ASTM D5133 gelation index, max ^(b)	12 ⁽ⁱ⁾	NR
ASTM D4683, ASTM D4741, or ASTM D5481, high temp/high shear viscosity at 150 °C, mPa·s, min	NR	2.6

NOTE: All oils must meet the requirements of the most recent edition of SAE J300; NR = not required.

(a) Tests and limits are per ASTM D4485.

(b) If CI-4, CJ-4, CK-4, and/or FA-4 categories precede the "S" category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.

(c) For all viscosity grades: If CH-4, CI-4, and/or CJ-4 categories precede the "S" category and there is no API Certification Mark, the "S" category limits for phosphorus do not apply. However, the CJ-4 limits for phosphorus and sulfur do apply for CJ-4 oils. This footnote cannot be applied if CK-4 or FA-4 is also claimed. Note that these "C" category oils have been formulated primarily for diesel engines and may not provide all of the performance requirements consistent with vehicle manufacturers' recommendations for gasoline-fueled engines.

(d) This is a non-critical specification as described in ASTM D3244.

(e) Settling volume determined at 10 minutes.

(f) Settling volume determined at 1 minute.

(g) Homogeneous with SAE reference oils.

(h) 10-hour stripped kinematic viscosity must remain in original SAE viscosity grade except XW-20 which must remain $\geq 5.6 \text{ mm}^2/\text{s}$.

(i) For gelation temperatures at or above the W-grade pumpability temperatures as defined in SAE J300.

(j) Does not include 0W-16 and 5W-16.

Appendix to Table 1B

API staff may cease maintaining a listing of limits for engine tests within Annex G of API 1509. The following entries reflect the limits required to achieve a “pass” for each engine test required for the SL performance category.

Test Methods	Rated or Measured Parameter	Primary Performance Criteria
ASTM D6984 Sequence IIIF Or ASTM D7320 ⁽⁶⁾ Sequence IIIG Or ASTM D8111 Sequence IIIF	Kinematic viscosity, % increase at 40 °C, max	275
	Average piston skirt varnish rating ⁽²⁾ , min	9.0
	Weighted piston deposit rating ⁽³⁾ , min	4.0
	Screened average cam-plus-lifter wear, µm, max	20 ⁽⁴⁾
	Hot stuck rings	None
	Low temperature viscosity performance ⁽¹⁾	Report
	Kinematic viscosity, % increase at 40 C, max	150
	Weighted piston deposit rating ⁽⁷⁾ , min	3.5
	Cam plus lifter wear average, µm, max	60
	Hot stuck rings	None
	Low temperature viscosity performance ⁽⁵⁾	Report
	70-hour kinematic viscosity, % increase at 40 °C, max	181
	70-hour average weighted piston deposits, merits, min	3.3
	70-hour average piston skirt varnish, merits, min	7.9
ASTM D6891 Sequence IVA	Cam wear average, µm ⁽⁸⁾ , max	120
ASTM D5302 ⁽⁹⁾ Sequence VE ⁽¹⁰⁾ Or ASTM D6593 Sequence VG	Cam wear average, µm, max	127
	Cam wear max, µm, max	380
	Average engine sludge rating ⁽¹¹⁾ , min	7.8
	Rocker arm cover sludge rating ⁽¹¹⁾ , min	8.0
	Average piston skirt varnish rating ⁽²⁾ , min	7.5
	Average engine varnish rating ⁽¹²⁾ , min	8.9
	Oil ring clogging, %	Report
	Oil screen clogging, % max	20
	Hot stuck compression rings	None
	Cold stuck rings	Report
	Oil screen debris, %	Report

Or ASTM D8256 Sequence VH		
	Average engine sludge, merits, min	7.4
	Average rocker cover sludge, merits, min	7.4
	Average engine varnish, merits, min	8.6
	Average piston skirt varnish, merits, min	7.4
	Oil screen clogging, % area	Rate & report
	Hot stuck compression rings	None
ASTM D6709 Sequence VIII	Bearing weight loss, mg, max	26.4
	Shear Stability	(13)

- (1) Evaluate the 80 hour test oil sample by Test Method D4684 at the temperature indicated by the low temperature grade of oil as determined on the 80 hour sample by Test Method D5293.
- (2) CRC Varnish Rating Manual No. 14, available from Coordinating Research Council, 219 Perimeter Center Pkwy., Atlanta, GA 30346.
- (3) Determine weighted piston deposits by rating the following piston areas and applying the corresponding weightings: undercrown, 10%; second land, 15%; third land, 30%; piston skirt, 10%; first groove, 5%; second groove, 10%; and third groove, 20%. Use CRC Varnish Rating Manual No. 14 for all ratings.
- (4) Calculate by eliminating the highest and lowest cam-plus-lifter wear results, and then calculating an average based upon the remaining 10 rating positions.
- (5) Measure the viscosity of the EOT oil sample by Test Method D4684. The measured viscosity shall meet the requirements of the original grade or next higher grade. The EOT sample can be either from a Sequence IIIG or a Sequence IIIGA test. (A Sequence IIIGA test is identical to a Sequence IIIG except only low temperature viscosity performance is measured.) Additional details are provided in the Sequence IIIG Test Method in 13.6.
- (6) For oils containing at least 0.06% mass phosphorus in the form of ZDDP, demonstrating passing performance in the Sequence IIIG test obviates the need to also conduct Test Method D5302 (Sequence VE), which was previously required for oils with less than 0.08% mass phosphorus.
- (7) Unlike the Sequence IIIF test, piston skirt varnish is not required in the Sequence IIIG test.
- (8) Determine cam wear according to Test Method D6891. Seven wear measurements are made on each cam lobe, and the seven measured values are added to obtain an individual cam lobe wear result. The overall cam wear value is the average of the 12 individual cam lobe wear results.
- (9) Monitoring of this test method was discontinued in June 20, 2001. Valid test results shall predate the end of the last calibration period for the test stand in which this test method was conducted.
- (10) Not required for oils containing a minimum of 0.08% mass phosphorus in the form of ZDDP.
- (11) CRC Sludge Rating Manual No. 12, available from Coordinating Research Council, 219 Perimeter Center Pkwy., Atlanta, GA 30346.
- (12) Determine the average engine varnish rating by averaging the piston skirt, right rocker arm cover, and left rocker arm cover varnish ratings. Use the CRC Varnish Rating Manual No. 14 for all ratings.
- (13) 10-hour stripped kinematic viscosity (oil shall remain in original viscosity grade).

Table 1C - Active API classification SM

ASTM Engine Oil Description
API Service Category SM was adopted for use in describing engine oils available in 2004. These oils are for use in service typical of gasoline engines in 2004 to 2010 passenger-car, sport utility vehicle, van, and light truck operations under vehicle manufacturers' recommended maintenance procedures. Engine oils that meet the API Service Category SM designation may be used where API Service Category SL and earlier categories have been recommended. Engine oils that meet the API Service Category SM designation have been tested in accordance with the ACC Code, may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing. Engine oils that meet these requirements may display API Service Category SM in the upper portion of the API Service Symbol. Oil meeting the performance requirements is measured in the following gasoline engine tests and bench tests: Test Method ASTM D7320, the Sequence IIIG and the Sequence IIIGA, as well as ASTM D8111 the Sequence IIH and the Sequence IIHA gasoline engine tests, have been correlated with vehicles used in high temperature service, particularly with regard to oil thickening and valve train wear. Test Method ASTM D7528, The ROBO test, has been correlated to Sequence IIIG and Sequence IIH with respect to engine oil aging and its impacts on low-temperature performance. Test Method ASTM D6593, the Sequence VG and Test Method ASTM D8256, the Sequence VH gasoline engine test, have been correlated with vehicles used in stop-and-go service, particularly with regard to sludge and varnish. Test Method ASTM D6891, the Sequence IVA gasoline engine test, is used to measure valve train wear. Test Method ASTM D6709, the Sequence VIII gasoline engine test, is used to measure copper-lead bearing weight loss under high-temperature operating conditions. This test also indicates the ability of an oil to resist permanent viscosity loss due to shearing in an engine. Test Method ASTM D6557, the Ball Rust Test, is a laboratory test that has been found to correlate with the Sequence IID engine test. Test Method ASTM D5800, Noack Volatility, is used to measure engine oil volatility loss under high temperature operating conditions. Test Method ASTM D6417 allows an estimation of the amount of engine oil volatilized at any temperature between 126 °C and 371 °C using Capillary Gas Chromatography. Test Methods ASTM D6794 and ASTM D6795 on Filterability of Engine Oil, screen for the formation of precipitates and gels which can cause oil filter plugging. Test Methods ASTM D4951 and ASTM D5185 are used to determine the amount of phosphorus present in an engine oil sample, using Inductively Coupled Plasma Atomic Emission Spectroscopy. The methods are also suitable to determine several other elements, including sulfur. Test Method ASTM D2622 may be used to determine the amount of sulfur present in an engine oil sample using Wavelength Dispersive X-Ray Fluorescence Spectroscopy.. The Foam Tests, Test Methods ASTM D892 and ASTM D6082, indicate an oil's foaming tendency. Excessive foaming in engine oil can cause valve lifter collapse and a loss of lubrication due to the presence of air in the oil. Test Method ASTM D6922, the Homogeneity and Miscibility Test, indicates the compatibility of an oil with standard test oils.

Test Method ASTM D7097, the **TEOST-MHT**, may be useful in determining the deposit control of oils recommended for these engines.

Test Method ASTM D5133, the **Gelation Index**, provides an indication of whether the flow improver is suitable for the formulation.

Test Methods ASTM D4683, ASTM D4741, and ASTM D5481 all allow determination of the high temperature, high-shear viscosity of an engine oil.

The **Category SM** requires that candidate oils meet the performance requirements in this specification, and that the oils be tested in accordance with the protocols described in the American Chemistry Council Petroleum Additives Product Approval Code of Practice. The ACC Code requires advance registration of all engine tests, along with a test methodology (Multiple Test Acceptance Criteria) to get a more precise estimate of the oil's true performance.

Engine Test Requirements ^(a)	Viscosity Grade Performance Requirements	
	SAE 0W-20, SAE 5W-20 SAE 0W-30, SAE 5W-30, SAE 10W-30	All Others ^(k)
ASTM D7320 (Sequence IIIG) or ASTM D8111 (Sequence IIH)	Pass	Pass
ASTM D4684 (Sequence IIIGA) or ASTM D8111 (Sequence IIHA) or ASTM D7528 (ROBO) with ASTM D4684	Pass	NR
ASTM D6891 (Sequence IVA)	Pass	Pass
ASTM D6593 (Sequence VG) ^(b) or ASTM D8256 (Sequence VH)	Pass	Pass
ASTM D6709 (Sequence VIII)	Pass	Pass
Bench Test and Measured Parameter ^(a)	Viscosity Grade Performance Requirements	
	SAE 0W-20, SAE 5W-20, SAE 0W-30, SAE 5W-30, SAE 10W-30	All Others ^(k)
ASTM D6557 (Ball Rust Test), avg gray value, min ^(b)	100	100
ASTM D5800, evaporation loss, 1 hour at 250 °C, %, max ^(c)	15	15
ASTM D6417, simulated distillation at 371 °C, %, max	10	10
ASTM D6795, EOFT, % flow reduction, max	50	50
ASTM D6794, EOWTT, % flow reduction, max		
with 0.6% H ₂ O	50	50
with 1.0% H ₂ O	50	50
with 2.0% H ₂ O	50	50
with 3.0% H ₂ O	50	50
ASTM D4951, phosphorus % mass, max ^(d)	0.08 ^(e)	NR
ASTM D4951, phosphorus % mass, min ^(d)	0.06 ^(e)	0.06 ^(e)
ASTM D4951, or D2622, sulfur % mass, max ^(d)		
SAE 0W-20, 0W-30, 5W-20, and 5W-30	0.5 ^(e)	NR
SAE 10W-30	0.7 ^(e)	NR

ASTM D892 (Option A), foaming tendency		
Sequence I, mL, max, tendency/stability ^(f)	10/0	10/0
Sequence II, mL, max, tendency/stability ^(f)	50/0	50/0
Sequence III, mL, max, tendency/stability ^(f)	10/0	10/0
ASTM D6082 (Option A), high-temperature foaming, mL, max, tendency/stability ^(g)	100/0	100/0
ASTM D6922, homogeneity and miscibility	(h)	(h)
ASTM D6709, (Sequence VIII) shear stability	(i)	(i)
ASTM D7097, TEOST MHT, high temperature deposits, deposit wt, mg, max ^(d)	35	45
ASTM D5133, gelation index, max ^(b)	12 ^(j)	NR
ASTM D4683, ASTM D4741, or ASTM D5481, high temp/high shear viscosity at 150 °C, mPa·s, min	NR	2.6

NOTE: All oils must meet the requirements of the most recent edition of SAE J300; NR = not required.

- (a) The “pass” limits for the Sequence IIIG, IIIGA, IVA, VG and VIII are the engine sequence test limits published in the ILSAC GF-4 Passenger Car Engine Oil Minimum Performance Standard (see Table A1L in this document, or Table Q-4 in API 1509).
- (b) If CI-4, CJ-4, CK-4 and/or FA-4 categories precede the “S” category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.
- (c) Calculated conversions specified in ASTM D5800 are allowed.
- (d) For all viscosity grades: If CH-4, CI-4, and/or CJ-4 categories precede the “S” category and there is no API Certification Mark, the “S” category limits for phosphorus, sulfur, and the TEOST MHT do not apply. However, the CJ-4 limits for phosphorus and sulfur do apply for CJ-4 oils. This footnote cannot be applied if CK-4 or FA-4 is also claimed. Note that these “C” category oils have been formulated primarily for diesel engines and may not provide all of the performance requirements consistent with vehicle manufacturers’ recommendations for gasoline-fueled engines.
- (e) This is a non-critical specification as described in ASTM D3244.
- (f) After 10-minute settling period.
- (g) After 1-minute settling period.
- (h) Shall remain homogenous and, when mixed with ASTM reference oils, shall remain miscible.
- (i) 10-hour stripped kinematic viscosity must remain in original SAE viscosity grade except XW-20 which must remain $\geq 5.6 \text{ mm}^2/\text{s}$.
- (j) To be evaluated from -5 °C to temperature at which 40000 cP is attained or -40 °C, or 2 °C below the appropriate MRV TP-1 temperature (defined by SAE J300), whichever occurs first.
- (k) Does not include 0W-16 and 5W-16.

Appendix to Table 1C

API staff may cease maintaining a listing of limits for engine tests within Annex G of API 1509. The following entries reflect the limits required to achieve a “pass” for each engine test required for the SM performance category.

ASTM Method	Rated or Measured Parameter	Performance Requirements	
		Viscosity Grade	All others
		SAE 0W-20, SAE 5W-20, SAE 0W-30, SAE 5W-30, SAE 10W-30	All Others ^(b)
ASTM D7320 (Sequence IIIG) Or ASTM D8111 (Sequence IIH)	Kinematic viscosity increase at 40°C, %	150 (max)	150 (max)
	Average weighted piston deposits, merits	3.5 (min)	3.5 (min)
	Hot stuck rings	None	None
	Average cam plus lifter wear, µm	60 (max)	60 (max)
	Kinematic viscosity increase at 40 °C, %	150 (max)	150 (max)
	Average weighted piston deposits, merits	3.2 (min)	3.2 (min)
	Hot stuck rings	None	None
ASTM D4684 (Sequence IIIGA) Or ASTM D8111 (Sequence IIIHA) Or ASTM D7528 (ROBO)			
	Evaluate EOT oil from ASTM Sequence IIIGA, Sequence IIIHA, or ROBO test with ASTM D4684 (MRV TP-1)	ASTM D4684 viscosity of EOT sample must meet requirements of original grade or next higher grade	NR
ASTM D6891 (Sequence IVA)	Average Cam Wear (seven position avg), µm	90 (max)	90 (max)
ASTM D6593 (Sequence VG)	Average engine sludge, merits	7.8 (min)	7.8 (min)
	Average rocker cover sludge, merits	8.0 (min)	8.0 (min)
	Average engine varnish, merits	8.9 (min)	8.9 (min)
	Average piston skirt varnish, merits	7.5 (min)	7.5 (min)
	Oil screen sludge, % area	20 (max)	20 (max)
	Oil screen debris, % area	Rate & report	Rate & report
	Hot-stuck compression rings	None	None
	Cold stuck rings	Rate & report	Rate & report
	Oil ring clogging, % area	Rate & report	Rate & report
	Follower pin wear, cyl #8, avg, µm	Rate & report ^(d)	Rate & report ^(d)
	Ring gap increase, cyl #1 and #8, µm	Rate & report ^(d)	Rate & report ^(d)

Or ASTM D8256 (Sequence VH)	Average engine sludge, merits	7.4	7.4
	Average rocker cover sludge, merits	7.4	7.4
	Average engine varnish, merits	8.6	8.6
	Average piston skirt varnish, merits	7.6	7.6
	Oil screen clogging, % area	Rate & report	Rate & report
	Hot stuck compression rings	None	None
ASTM D6709 (Sequence VIII)	Bearing weight loss, mg	26 (max)	26 (max)

(a) Tests and limits are per ASTM D4485.

(b) Does not include SAE 0W-16 and 5W-16.

(c) If CI-4, CJ-4, CK-4 and/or FA-4 categories precede the “S” category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.

(d) ASTM Surveillance Panel will review statistics annually.

Table 1D - Active API service category SN and SN PLUS

ASTM Engine Oil Description
API Service Category SN was adopted for use indesccribing engine oils available in 2011. These oils are for use in service typical of gasoline engines in current and earlier passenger cars, sport utility vehicles, vans, and light-duty trucks operating under vehicle manufacturers' recommended maintenance procedures. Vehicle owners and operators should follow their vehicle manufacturer's recommendations on engine oil viscosity and performance standard. Engine oils that meet the API Service Category SN designation may be used where API Service Category SM and earlier “S” categories have been recommended. Engine oils that meet the API Service Category SN designation have been tested in accordance with the ACC Code and may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing. Starting October 1, 2010, oils that have passed the tests for API Service Category SN at the limits shown in the table below and are properly licensed by API may display API Service SN in the upper portion of the API Service Symbol. Before the October 1, 2010, introduction date, oil marketers may license API SN oils as API SM. After May 1st, 2018, some Category SN oils may also qualify for the SN PLUS designation⁽ⁿ⁾. Resource Conserving in Conjunction with API Service Category SN: API Service SN engine oils designated as Resource Conserving are formulated to help improve fuel economy and protect vehicle emission system components in passenger cars, sport utility vehicles, vans, and light-duty trucks powered by gasoline engines. These oils have demonstrated a fuel economy improvement (FEI) in the Sequence VID test at the percentages listed in the table when compared with a baseline oil (BL) used in the Sequence VID test. Additionally, these oils have demonstrated in the tests listed in table below that they provide greater emission system and turbocharger protection and help protect engines when operating on ethanol-containing fuels up to E85. Many previous S-categories made reference to “Energy Conserving,” but this reflected an emphasis on fuel-economy performance alone. Resource Conserving in conjunction with API SN focuses on fuel economy, emission system and turbocharger protection, and compatibility with ethanol-containing fuel up to E85.

Starting October 1, 2010, oils that have passed the tests at the limits shown in the table below and are properly licensed by API may display "Resource Conserving" in the lower portion of the API Service Symbol in conjunction with API Service SN in the upper portion. The fuel economy and other Resource Conserving benefits obtained by individual vehicle operators using engine oils labeled Resource Conserving may differ because of many factors, including the type of vehicle and engine, engine manufacturing variables, the mechanical condition and maintenance of the engine, oil that has been previously used, operating conditions, and driving habits. Before the October 1, 2010, introduction date, oil marketers may license oils meeting Resource Conserving in conjunction with API Service SN as Energy Conserving in conjunction with API Service SM.

Oil meeting the performance requirements is measured in the following gasoline engine tests and bench tests:

Test Methods ASTM D7589, ASTM D8114, and ASTM D8226 the **Sequence VID, Sequence VIE, and Sequence VIF** respectively are gasoline engine tests, used to provide a comparative index of the fuel-saving capabilities of automotive engine oils under repeatable laboratory conditions.

Test Methods ASTM D7320 and ASTM D8111 the **Sequence IIIG and Sequence IIH** gasoline engine tests, have been correlated with vehicles used in high temperature service, particularly with regard to oil thickening and valve train wear.

Test Method ASTM D7528 describes a bench procedure to simulate the oil aging encountered in Test Methods D7320 and D8111, the Sequence IIIG and Sequence IIH engine test methods, respectively. These aged oils are then tested for kinematic viscosity and for low-temperature pumpability properties as described in the Sequence IIIGA or IIHA engine tests, per appendixes in their test methods.

Test Methods ASTM D6593 and ASTM D8256, the **Sequence VG and Sequence VH** gasoline engine tests respectively, have been correlated with vehicles used in stop-and-go service, particularly with regard to sludge and varnish.

Test Method ASTM D6891, the **Sequence IVA** gasoline engine test, is used to measure valve train wear.

Test Method ASTM D6709, the **Sequence VIII** gasoline engine test, is used to measure copper-lead bearing weight loss under high-temperature operating conditions. In addition to passing performance in the engine tests, specific viscosity grades shall also meet bench test requirements. The volatility of engine oils is one of several factors which relates to engine oil consumption.

Test Method ASTM D6557, the **Ball Rust Test**, is a laboratory test that has been found to correlate with the Sequence IID engine test.

Test Method ASTM D5800, Noack Volatility, is used to measure engine oil volatility loss under high temperature operating conditions.

Test Method ASTM D6417 allows an estimation of the amount of engine oil volatilized at any temperature between 126 °C and 371 °C using Capillary Gas Chromatography.

Test Methods ASTM D6794 and ASTM D6795, on **Filterability of Engine Oil**, screen for the formation of precipitates and gels which can cause oil filter plugging.

Test Methods ASTM D4951 or ASTM D5185 are used to determine the amount of phosphorus present in an engine oil sample, using Inductively Coupled Plasma Atomic Emission Spectroscopy. The method is also suitable to determine several other elements, including sulfur.

Test Methods ASTM D4951, ASTM D5185, or ASTM D2622 may be used to determine the amount of sulfur present in an engine oil sample. ASTM D4951 uses Inductively Coupled Plasma Atomic Emission Spectroscopy. The method is also suitable to determine several other elements, including phosphorus. ASTM D2622 determines sulfur content using Wavelength Dispersive X-Ray Fluorescence Spectroscopy.

Control of the phosphorus content using ASTM D7320 or ASTM D8111: Phosphorus compounds in excessive amounts can cause glazing of automotive catalysts and exhaust gas oxygen sensors, and thereby deactivate them. This method determines the ability of an engine oil to retain its phosphorus content.

The **Foam Tests, Test Methods ASTM D892 and ASTM D6082**, indicate an oil's foaming tendency. Excessive foaming in engine oil can cause valve lifter collapse and a loss of lubrication due to the presence of air in the oil.

Test Method ASTM D6922, the **Homogeneity and Miscibility Test**, indicates the compatibility of an oil with standard test oils.

Test Method ASTM D6709 also measures the ability of an oil to resist permanent viscosity loss due to shearing in an engine. Newer engines designed to provide increased horsepower, improved drivability, and meet future federal emissions and fuel economy requirements may be sensitive to internal deposits caused by elevated engine operating temperatures.

Test Method ASTM D6335, the **TEOST 33C**, indicates the tendency for an engine oil to form coke-like deposits in the oil passages of a turbocharger when used in conjunction with the automotive engine.

Test Method ASTM D7097, the **TEOST MHT**, has been correlated with piston deposits in engine tests and is considered useful in determining the piston-ring deposit tendencies of engine oils.

Test Method ASTM D5133, the **Gelation Index**, provides an indication of whether the flow improver is suitable for the formulation.

Test Method ASTM D7563 describes a qualitative procedure to measure the ability of a specific volume of engine oil to emulsify a specific added volume of combined water and simulated Ed85 fuel upon agitation in a high-speed blender and to retain this emulsified state for at least 24 hours at temperatures of both 20 to 25 °C and -5 to 0 °C.

Test Method ASTM D7216 covers quantitative procedures for the evaluation of the compatibility of automotive engine oils with several reference elastomers typical of those used in the sealing materials in contact with these oils. Compatibility is evaluated by determining the changes in volume, Durometer A hardness, and tensile properties when the elastomer specimens are immersed in the oil for a specified time and temperature.

API Category SN requires that candidate oils meet the performance requirements in this specification, and that the oils be tested in accordance with the protocols described in the American Chemistry Council Petroleum Additives Product Approval Code of Practice. The ACC Code requires advance registration of all engine tests, along with a test methodology (Multiple Test Acceptance Criteria) to get a more precise estimate of the oil's true performance.

		API SN	API SN	API SN with Resource Conserving
ASTM Method	Rated or Measured Parameter	SAE 0W-16, SAE 5W-16, SAE 0W-20, SAE 5W-20, SAE 0W-30, SAE 5W-30, SAE 10W-30	Other Viscosity Grades	All Viscosity Grades
ASTM D7320 (Sequence IIIG) OR ASTM D8111 (Sequence IIH)	Kinematic viscosity increase at 40 °C, %	150 (max)	150 (max)	150 (max)
	Average weighted piston deposits, merits	4.0 (min)	4.0 (min)	4.0 (min)
	Hot stuck rings	None	None	None
	Average cam plus lifter wear, µm	60 (max)	60 (max)	60 (max)
	Kinematic viscosity increase at 40 °C, %	150 (max)	150 (max)	150 (max)
	Average weighted piston deposits, merits	3.7 (min)	3.7 (min)	3.7 (min)
	Hot stuck rings	None	None	None

ASTM D6891 (Sequence IVA) ASTM D6593 (Sequence VG) ^(c) OR ASTM D8256 (Sequence VH) ^(c)	Average cam wear (seven position avg), μm	90 (max)	90 (max)	90 (max)
	Average engine sludge, merits	8.0 (min)	8.0 (min)	8.0 (min)
	Average rocker cover sludge, merits	8.3 (min)	8.3 (min)	8.3 (min)
	Average engine varnish, merits	8.9 (min)	8.9 (min)	8.9 (min)
	Average piston skirt varnish, merits	7.5 (min)	7.5 (min)	7.5 (min)
	Oil screen sludge, % area	15 (max)	15 (max)	15 (max)
	Oil screen debris, % area	Rate & report	Rate & report	Rate & report
	Hot-stuck compression rings	None	None	None
	Cold stuck rings	Rate & report	Rate & report	Rate & report
	Oil ring clogging, % area	Rate & report	Rate & report	Rate & report
	Average engine sludge, merits	7.6 (min)	7.6 (min)	7.6 (min)
	Average rocker cover sludge, merits	7.7 (min)	7.7 (min)	7.7 (min)
	Average engine varnish, merits	8.6 (min)	8.6 (min)	8.6 (min)
	Average piston skirt varnish, merits	7.6 (min)	7.6 (min)	7.6 (min)
	Oil screen clogging, % area	Rate & report	Rate & report	Rate & report
	Hot-stuck compression rings	None	None	None
ASTM D7589 (Sequence VID) ^(d)	SAE XW-16 viscosity <i>grade</i>			
	FEI SUM	NR	NR	2.8% min
	FEI 2			1.3% min after 100 hours aging
	SAE XW-20 viscosity <i>grade</i>			
	FEI SUM			2.6% min
	FEI 2			1.2% min after 100 hours aging
	SAE XW-30 viscosity <i>grade</i>			
	FEI SUM			1.9% min
	FEI 2			0.9% min after 100 hours aging
	SAE 10W-30 and all other viscosity grades not listed above			
	FEI SUM			1.5% min
	FEI 2			0.6% min after 100 hours aging

OR ASTM D8114 (Sequence VIE) ^(d)	SAE XW-20 viscosity grade			
	FEI SUM			3.2% min
	FEI 2			1.5% min after 100 hours aging
	SAE XW-30 viscosity grade			
	FEI SUM			2.5% min
	FEI 2			1.2% min after 100 hours aging
	SAE 10W-30 and all other viscosity grades not listed above			
	FEI SUM			2.2% min
	FEI 2			1.0% min after 100 hours aging
OR ASTM D8226 (Sequence VIF) ^(d)	SAE XW-16 viscosity grade			
	FEI SUM			3.7% min
	FEI 2			1.8% min after 100 hours aging
ASTM D6709 (Sequence VIII)	Bearing weight loss, mg	26 (max)	26 (max)	26 (max)
Bench Test and Measured Parameter^(a)				
ASTM D4684, (MRV TP-1)	Low-temperature viscosity of aged oil at EOT of Sequence IIIGA, ASTM D7320	a. If CCS viscosity measured is less than or equal to maximum CCS viscosity specified for original viscosity grade, run ASTM D4684 (MRV TP-1) at MRV temperature specified in SAE J300 for original viscosity grade. b. If CCS viscosity measured is higher than maximum viscosity specified for original viscosity grade in SAE J300, run ASTM D4684 (MRV TP-1) at 5 °C higher temperature (i.e., at MRV temperature specified in SAE J300 for next higher viscosity grade). c. EOT IIIGA sample must show no yield stress in ASTM D4684 test and its ASTM D4684 viscosity must be below maximum specified in SAE J300 for original viscosity grade or next higher viscosity grade, depending on CCS viscosity grade, as outlined in a. or b. above.		
OR ASTM D4684, (MRV TP-1)	Low-temperature viscosity of aged oil at EOT of ROBO Test, ASTM D7528	a. If CCS viscosity measured is less than or equal to maximum CCS viscosity specified for original viscosity grade, run ASTM D4684 (MRV TP-1) at the MRV temperature specified in SAE J300 for original viscosity grade. b. If CCS viscosity measured is higher than maximum viscosity specified for original viscosity grade in SAE J300, run ASTM D4684 (MRV TP-1) at 5 °C higher temperature (i.e., at MRV temperature specified in SAE J300 for next higher viscosity grade). c. EOT ROBO sample must show no yield stress in ASTM D4684 test and its ASTM D4684 viscosity must be below maximum specified in SAE J300 for original viscosity grade or next higher viscosity grade, depending on CCS viscosity grade, as outlined in a. or b. above.		
ASTM D7320, (Sequence IIIGB)	Phosphorus retention, %, min	NR	NR	79
ASTM D6557 (Ball Rust Test)	Average gray value, min ^(b)	100	100	100
ASTM D5800 (Noack Volatility)	Evaporation loss, 1 hour at 250°C, %, max ^(e)	15	15	15
ASTM D6417, (Simulated Distillation)	Simulated distillation at 371°C, %, max	10	10	10

ASTM D6795, (EOFT)	% flow reduction, max	50	50	50
ASTM D6794, (EOWTT)	% flow reduction, max			
	With 0.6% H ₂ O	50	50	50
	With 1.0% H ₂ O	50	50	50
	With 2.0% H ₂ O	50	50	50
	With 3.0% H ₂ O	50	50	50
ASTM D4951 or ASTM D5185 (Phosphorus Content)	Phosphorus % mass, max ^(f)	0.08 ^(g)	NR	0.08 ^(g)
ASTM D4951 or ASTM D5185 (Phosphorus Content)	Phosphorus % mass, min ^(f)	0.06 ^(g)	0.06 ^(g)	0.06 ^(g)
ASTM D4951, D5185, or D2622 (Sulfur Content)	Sulfur % mass, max ^(f)			
	<i>SAE 0W-16, 5W-16, 0W-20, 0W-30, 5W-20, and 5W-30</i>	0.5 ^(g)	NR	0.5 ^(g)
	<i>SAE 10W-30</i>	0.6 ^(g)	NR	0.6 ^(g)
	<i>All other viscosity grades</i>	NR	NR	0.6 ^(g)
ASTM D892 (Option A), (Foaming Tendency)	Sequence I, mL, max, tendency/stability	10/0 ^(h)	10/0 ⁽ⁱ⁾	10/0 ^(h)
	Sequence II, mL, max, tendency/stability	50/0 ^(h)	50/0 ⁽ⁱ⁾	50/0 ^(h)
	Sequence III, mL, max, tendency/stability	10/0 ^(h)	10/0 ⁽ⁱ⁾	10/0 ^(h)
ASTM D6082, (Option A), (High Temperature Foaming Tendency)	mL, max, tendency/stability ^(h)	100/0	100/0	100/0
ASTM D6922, (Homogeneity and Miscibility)		(j)	(j)	(j)
ASTM D6709, (Sequence VIII)	Shear stability	(k)	(k)	(k)
ASTM D7097, (TEOST MHT)	High-temperature deposits, deposit wt, mg, max ^(f)	35	45	35
ASTM D5133, (Gelation Index)	Gelation Index, max ^(b)	12 ^(l)	NR	12 ^(l)
ASTM D6335, (TEOST 33C)	High-temperature deposits, total deposit weight, mg, max			
	<i>SAE XW-16</i>	NR	NR	NR
	<i>SAE 0W-20</i>	NR	NR	NR
	<i>All other viscosity grades</i>	NR	NR	30

ASTM D7563, Emulsion Retention		NR	NR	No water separation
ASTM D7216 Annex A2, (Elastomer Compatibility)		Table 1D-B	Table 1D-B	Table 1D-B

NOTE: All oils must meet the requirements of the most recent edition of SAE J300; NR = not required.

- (a) Tests are per ASTM requirements.
- (b) If CI-4, CJ-4, CK-4, and/or FA-4 categories precede the "S" category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.
- (c) Viscosity grades are limited to 0W, 5W, and 10W multigrade oils.
- (d) Not required for monograde and 15W, 20W, and 25W multigrade oils.
- (e) Calculated conversions specified in ASTM D5800 are allowed.
- (f) For all viscosity grades: If CH-4, CI-4, and/or CJ-4 categories precede the "S" category and there is no API Certification Mark, the "S" category limits for phosphorus, sulfur, and the TEOST MHT do not apply. However, the CJ-4 limits for phosphorus and sulfur do apply for CJ-4 oils. This footnote cannot be applied if CK-4 or FA-4 is also claimed. Note that these "C" category oils have been formulated primarily for diesel engines and may not provide all of the performance requirements consistent with vehicle manufacturers' recommendations for gasoline-fuelled engines.
- (g) This is a non-critical specification as described in ASTM D3244.
- (h) After 1-minute settling period.
- (i) After 10-minute settling period.
- (j) Shall remain homogenous and, when mixed with ASTM reference oils, shall remain miscible.
- (k) 10-hour stripped kinematic viscosity must remain in original SAE viscosity grade except XW-20 which must remain $\geq 5.6 \text{ mm}^2/\text{s}$.
- (l) To be evaluated from -5°C to temperature at which 40000 cP is attained, or -40°C or 2°C below the appropriate MRV TP-1 temperature (defined by SAE J300), whichever occurs first.
- (m) Resource Conserving does not apply to 0W-16 and 5W-16.
- (n) The **SN PLUS** designation requires one additional engine test beyond all the laboratory and engine tests listed above, namely, Sequence IX, ASTM D8291, the Ford Low-Speed Preignition Test. The limits in Table 1D-A apply.

Table 1D-A - Requirements for SN PLUS classification

		API SN	API SN	API SN with Resource Conserving
ASTM Method	Rated or Measured Parameter	SAE 0W-16, SAE 5W-16, SAE 0W-20, SAE 5W-20, SAE 0W-30, SAE 5W-30, SAE 10W-30	Other Viscosity Grades	All Viscosity Grades
ASTM D8921 Sequence IX	Average number of events	5 (max)	5 (max)	5 (max)

Table 1D-B - Elastomer compatibility

Candidate oil testing for elastomer compatibility shall be performed using the five Standard Reference Elastomers (SREs) referenced herein and defined in SAE J2643. Candidate oil testing shall be performed according to ASTM D7216 Annex A2. The post-candidate-oil-immersion elastomers shall conform to the specification limits detailed herein.

Elastomer Material (SAE J2643)	Test Procedure	Material Property	Units	Limits
Polyacrylate Rubber (ACM-1)	ASTM D471	Volume	% Δ	-5, 9
	ASTM D2240	Hardness	pts.	-10, 10
	ASTM D412	Tensile Strength	% Δ	-40, 40
Hydrogenated Nitrile Rubber (HNBR-1)	ASTM D471	Volume	% Δ	-5, 10
	ASTM D2240	Hardness	pts.	-10, 5
	ASTM D412	Tensile Strength	% Δ	-20, 15
Silicone Rubber (VMQ-1)	ASTM D471	Volume	% Δ	-5, 40
	ASTM D2240	Hardness	pts.	-30, 10
	ASTM D412	Tensile Strength	% Δ	-50, 5
Fluorocarbon Rubber (FKM-1)	ASTM D471	Volume	% Δ	-2, 3
	ASTM D2240	Hardness	pts.	-6, 6
	ASTM D412	Tensile Strength	% Δ	-65, 10
Ethylene Acrylic Rubber (AEM-1)	ASTM D471	Volume	% Δ	-5, 30
	ASTM D2240	Hardness	pts.	-20, 10
	ASTM D412	Tensile Strength	% Δ	-30, 30

**Table 1E - Active API service category SP,
effective 01 May 2020**

ASTM Engine Oil Description
API Service Category SP was adopted for use in describing engine oils available in 2020. These oils are for use in service typical of gasoline engines in current and earlier passenger cars, sport utility vehicles, vans, and light-duty trucks operating under vehicle manufacturers' recommended maintenance procedures. Vehicle owners and operators should follow their vehicle manufacturer's recommendations on engine oil viscosity and performance standard. Engine oils that meet the API Service Category SP designation (refer to Annex G) may be used where API Service Category SN and earlier S categories have been recommended. Engine oils that meet the API Service Category SP designation have been tested in accordance with the ACC Code and may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing (refer to Annexes E and F). Engine oils that meet these requirements may display API Service Category SP in the upper portion of the API Service Symbol beginning May 1, 2020. Resource Conserving in Conjunction with API Service Category SP: API Service SP engine oils designated as Resource Conserving are formulated to help improve fuel economy and protect vehicle emission system components in passenger cars, sport utility vehicles, vans, and light-duty trucks powered by gasoline engines. These oils have demonstrated a fuel economy improvement (FEI) in a specific sequence test at the percentages listed in Table 1 when compared with a baseline oil (BL). Additionally, these oils have demonstrated in other tests listed in Table 1 that they provide greater emission system and turbocharger protection and help protect engines when operating on ethanol-containing fuels up to E85. Many previous S Categories made reference to "Energy Conserving," but this reflected an emphasis on fuel-economy performance alone. Resource Conserving in conjunction with API SP focuses on fuel economy, emission system and turbocharger protection, and compatibility with ethanol-containing fuel up to E85.

Starting May 1, 2020, oils that have passed the tests at the limits shown in Table 1 and are properly licensed by API may display “Resource Conserving” in the lower portion of the API Service Symbol in conjunction with API Service SP in the upper portion. The fuel economy and other Resource Conserving benefits obtained by individual vehicle operators using engine oils labeled Resource Conserving may differ because of many factors, including the type of vehicle and engine, engine manufacturing variables, the mechanical condition and maintenance of the engine, oil that has been previously used, operating conditions, and driving habits. Before the May 1, 2020, introduction date, oil marketers may license oils meeting Resource Conserving in conjunction with API Service SP as Resource Conserving in conjunction with API Service SN.

Oil meeting the performance requirements is measured in the following gasoline engine tests and bench tests:

Test Method D8111, the **Sequence IIH** gasoline engine tests, has been correlated with vehicles used in high temperature service, particularly with regard to oil thickening and valve train wear.

Test Method ASTM D7528 describes a bench procedure to simulate the oil aging encountered in Test Method D8111, the Sequence IIH engine test methods. These aged oils are then tested for kinematic viscosity and for low-temperature pumpability properties as described in the Sequence IIIHA engine tests, per Appendix X1 in test method ASTM D8111.

Test Method ASTM WK50202, the **Sequence IVB** gasoline engine test, is used to measure valve train wear.

Test Method ASTM D8256, the **Sequence VH** gasoline engine test, has been correlated with vehicles used in stop-and-go service, particularly with regard to sludge and varnish.

Test Methods ASTM D8114 and ASTM D8226, the **Sequence VIE** and **Sequence VIF** respectively are gasoline engine tests, used to provide a comparative index of the fuel-saving capabilities of automotive engine oils under repeatable laboratory conditions.

Test Method ASTM D6709, the **Sequence VIII** gasoline engine test, is used to measure copper-lead bearing weight loss under high-temperature operating conditions. In addition to passing performance in the engine tests, specific viscosity grades shall also meet bench test requirements. The volatility of engine oils is one of several factors which relates to engine oil consumption.

Test Method ASTM D8291, the **Sequence IX Low-Speed Pre-Ignition** test, is used to measure an engine oil's ability to suppress preignition events.

Test Method ASTM D8279, the **Sequence X** test, measures an engine oil's ability to prevent soot-induced wear by measuring the elongation in the timing chain of the test engine over the course of the test.

Test Method ASTM D6557, the **Ball Rust Test**, is a laboratory test that has been found to correlate with the Sequence IID engine test.

Test Method ASTM D5800, Noack Volatility, is used to measure engine oil volatility loss under high temperature operating conditions.

Test Methods ASTM D6794 and ASTM D6795, on **Filterability of Engine Oil**, screen for the formation of precipitates and gels which can cause oil filter plugging.

Test Methods ASTM D4951 or ASTM D5185 are used to determine the amount of phosphorus present in an engine oil sample, using Inductively Coupled Plasma Atomic Emission Spectroscopy. The method is also suitable to determine several other elements, including sulfur.

Test Methods ASTM D4951, ASTM D5185, or ASTM D2622 may be used to determine the amount of sulfur present in an engine oil sample. ASTM D4951 uses Inductively Coupled Plasma Atomic Emission Spectroscopy. The method is also suitable to determine several other elements, including phosphorus. ASTM D2622 determines sulfur content using Wavelength Dispersive X-Ray Fluorescence Spectroscopy.

Control of the phosphorus content using ASTM D8111: Phosphorus compounds in excessive amounts can cause glazing of automotive catalysts and exhaust gas oxygen sensors, and thereby deactivate them. This method determines the ability of an engine oil to retain its phosphorus content.

The **Foam Tests, Test Methods ASTM D892 and ASTM D6082**, indicate an oil's foaming tendency. Excessive foaming in engine oil can cause valve lifter collapse and a loss of lubrication due to the presence of air in the oil.

Test Method ASTM D6922, the Homogeneity and Miscibility Test, indicates the compatibility of an oil with standard test oils.

Test Methods ASTM D6709 and ASTM D6278 measure the ability of an oil to resist permanent viscosity loss due to shearing in an engine. Newer engines designed to provide increased horsepower, improved drivability, and meet future federal emissions and fuel economy requirements may be sensitive to internal deposits caused by elevated engine operating temperatures.

Test Method ASTM D6335, the TEOST 33C, indicates the tendency for an engine oil to form coke-like deposits in the oil passages of a turbocharger when used in conjunction with the automotive engine.

Test Method ASTM D5133, the Gelation Index, provides an indication of whether the flow improver is suitable for the formulation.

Test Method ASTM D7563 describes a qualitative procedure to measure the ability of a specific volume of engine oil to emulsify a specific added volume of combined water and simulated Ed85 fuel upon agitation in a high-speed blender and to retain this emulsified state for at least 24 hours at temperatures of both 20 to 25 °C and -5 to 0 °C.

Test method ASTM D7216 covers quantitative procedures for the evaluation of the compatibility of automotive engine oils with several reference elastomers typical of those used in the sealing materials in contact with these oils. Compatibility is evaluated by determining the changes in volume, Durometer A hardness, and tensile properties when the elastomer specimens are immersed in the oil for a specified time and temperature.

API Category SP requires that candidate oils meet the performance requirements in this specification, and that the oils be tested in accordance with the protocols described in the American Chemistry Council Petroleum Additives Product Approval Code of Practice. The ACC Code requires advance registration of all engine tests, along with a test methodology (Multiple Test Acceptance Criteria) to get a more precise estimate of the oil's true performance.

Engine Test Requirements	API SP	API SP	API SP with Resource Conserving
	SAE 0W-16, SAE 5W-16, SAE 0W-20, SAE 5W-20 SAE 0W-30, SAE 5W-30, SAE 10W-30	Other Viscosity Grades	All Viscosity Grades
ASTM D8111 (Sequence IIH)			
Kinematic viscosity increase at 40 °C, %	100 (max)	100 (max)	100 (max)
Average weighted piston deposits, merits	4.2 (min)	4.2 (min)	4.2 (min)
Hot stuck rings	None	None	None
ASTM WK50202 (Sequence IVB)			
Average intake lifter volume loss, eight position average, mm ³	2.7 (max)	2.7 (max)	2.7 (max)
End of test iron, ppm	400 (max)	400 (max)	400 (max)