Engine Oil Licensing and Certification System

Downstream Segment

API 1509
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FOREWORD

This publication describes the voluntary API Engine Oil Licensing and Certification System (EOLCS) and is intended to explain to marketers how different API Marks are licensed and displayed for the consumer. The publication describes methods for developing new engine oil performance requirements and provides the marketer with a description of the API Marks and their use, licensing requirements, aftermarket conformance, and enforcement procedures. It also explains the interaction and roles of the various independent organizations that are part of the API EOLCS.

Suggested revisions are invited and should be submitted to the Standardization Director, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

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SECTION 1—General

1.1 Introduction

This publication describes the API Engine Oil Licensing and Certification System (EOLCS), a voluntary licensing and certification program designed to define, certify, and monitor engine oil performance deemed necessary for satisfactory equipment life and performance by vehicle and engine manufacturers. Engine oil marketers that meet EOLCS requirements may be licensed to display two Marks, the API Service Symbol and the API Certification Mark.

Sections 2 through 6 of this publication define the current API engine oil service categories and explain the EOLCS licensing requirements, the API Marks and their use, and the EOLCS Aftermarket Audit Program. Appendices A through S provide a brief history of engine oil classifications, describe methods for developing new engine oil performance requirements, and explain the interaction and roles of the various independent organizations that are part of the API EOLCS.

1.2 EOLCS Overview

1.2.1 The API EOLCS is designed to define, certify, and monitor engine oil performance that vehicle and engine manufacturers and the oil and additive industries deem necessary for satisfactory equipment life and performance. The system includes a formal license agreement executed by the marketer with API. The program's Marks are intended to help the consumer identify products that have satisfied the requirements for licensing and certification. The system includes an audit process to verify that licensed products in the marketplace comply with the terms of the API Licensing Agreement.

1.2.2 API issues a license to an oil marketer after the marketer confirms it has met all the requirements spelled out in this publication and the EOLCS Application Package. The marketer must execute the API Licensing Agreement as a condition of licensure.

Note: An oil marketer is defined as the marketing organization responsible for the integrity of the brand name and the representation of the branded product in the marketplace.

1.2.3 Performance requirements, test methods, and limits are cooperatively established by vehicle and/or engine manufacturers [namely, Ford, General Motors, and DaimlerChrysler; Japan Automobile Manufacturers Association (JAMA); and Engine Manufacturers Association (EMA)] and technical societies such as ASTM and SAE.

1.2.4 API licenses two types of Marks: the API Service Symbol and the API Certification Mark. The Service Symbol denotes a licensed oil's performance properties through the use of the API Service Categories and, if applicable, the Energy Conserving and CI-4 PLUS designations; the API Certification Mark identifies oils meeting International Lubricant Standardization and Approval Committee (ILSAC) minimum performance standards.

1.2.5 API uses an alphanumeric system known collectively as API Service Categories to define specific engine oil performance levels. These categories are commonly used by vehicle and equipment manufacturers to identify the engine oil performance levels required by gasoline and diesel engines. The API Service Symbol displays current API Service Categories. The process for developing API "C" categories is explained in Appendix D.

The API Certification Mark does not change. Annual licenses for the API Certification Mark are issued only for engine oils that meet the current ILSAC performance requirements specified in Appendix Q. The process for developing new engine oil performance standards for the API Certification Mark is explained in Appendix C. At any time during this process, API's Lubricants Committee may ask ASTM or other bodies to recommend specifications for passenger car motor oils not addressed by the ILSAC minimum performance specification. This may include the API Lubricants Committee itself formulating specifications for a separate engine oil quality category that will be described under the API S performance category based on deviations/exceptions from the specifications being considered during the Appendix C process.

1.2.6 Engine oils licensed to use API Service Categories SM, SL, SJ, SH (when preceded by a C category), CF, CF-2, CF-4, CG-4, CH-4, CI-4, CJ-4 (beginning October 15, 2006), Energy Conserving, CI-4 PLUS, and/or the API Certification Mark, or both must be engine tested using the latest edition of the American Chemistry Council (ACC) Petroleum Additives Panel Product Approval Code of Practice (ACC Code). The ACC Code requires advance registration of all engine tests, along with criteria for handling results from multiple tests on an oil formulation to improve the measurement of the oil's performance (see Appendix N). Material updates to the ACC Code will be distributed to ILSAC, EMA, and API sufficiently in advance of formal publication to permit consideration of any comments the three stakeholders may have. Adherence to the ACC Code as a requirement for the API EOLCS will be periodically reviewed for continued suitability and enhancement.

1.2.7 The ACC Code currently includes only certain engine tests. For engine oils that use the API S and C Service Categories and/or the Energy Conserving designation, the engine tests covered by the ACC Code shall be conducted in accordance with the ACC Code.

1.2.8 The test data that support product claims are the responsibility of the individual marketer. The API Lubricants Committee through its Base Oil Interchange (BOI)/Viscosity Grade Read Across (VGRA) Task Force develops Base Oil Interchange and SAE Viscosity-Grade Engine Testing Guidelines. The API Lubricants Committee and BOI/VGRA Task Force will determine if the matrix testing described in Appendix C is to be conducted for the new engine tests so that sufficient data is available to allow the establishment of appropriate Base Oil Interchangeability and Viscosity-Grade Engine Testing Guidelines simultaneous with the establishment of the category performance criteria. Marketers may choose to use the API Base Oil Interchangeability Guidelines, the API Guidelines for SAE Viscosity-Grade Engine Testing, or both in lieu of specified engine testing. However, the decision to use such guidelines does not absolve the marketer of the responsibility to ensure that each licensed engine oil satisfies all engine and bench testing performance requirements.

1.2.9 All engine oils licensed to use the API Marks are subject to conformance audits. Conformance is determined by comparing measured physical and chemical properties of the oil with licensing data on file at API. In addition, a limited number of products will be randomly selected for engine and bench testing.

1.2.10 An Administrative Guidance Panel (AGP) has been established in accordance with the terms of a Memorandum of Understanding between API and Ford, General Motors, and DaimlerChrysler for the purpose of providing guidance to the EOLCS. An Interindustry Advisory Group (IAG; see Appendix B) consisting of representatives from organizations such as API, ASTM, ACC, EMA, Independent Lubricant Manufacturers Association (ILMA), Ford, General Motors, DaimlerChrysler, SAE, and the U.S. Army has been formed to advise the AGP on enhancements and improvements to the API EOLCS. Recommendations by the IAG will be considered for inclusion in the program.

SECTION 2—Description of API Marks

2.1 General

2.1.1 API licenses two types of Marks: the API Certification Mark "Starburst" and the API Service Symbol "Donut." Certain oils may meet the technical and licensing requirements of both (a) the API Certification Mark, and (b) API Service Category SM and Energy Conserving (as defined in 2.3.2.5.2). If properly licensed, these engine oils may be labeled with either or both API Marks. Examples of these two types of Marks are shown in Figures 1 and 2.

2.1.2 API's licensing of an engine oil does not imply that oils with the API Marks are appropriate for all vehicles or engines in the field. The consumer must refer to the owner's or operator's manual for specific vehicle or engine manufacturer's engine oil recommendations.

2.2 API Certification Mark

2.2.1 Each API Certification Mark is designed for the identification of engine oils recommended for a general application (for example, gasoline, fuel-flexible, light-duty diesel). The API Certification Mark may be licensed only if an oil satisfies the requirements of the most recent and applicable ILSAC minimum performance standards specified in Appendix Q. The API Certification Mark remains the same for a given application even if a new minimum engine oil performance standard is developed for the application (see Appendix C). Engine oils that meet the criteria of ILSAC GF-4 currently meet this requirement for gasoline-powered vehicles.

Figure 1 - API Certification Mark

2.2.2 The ILSAC GF-4 minimum performance standard for passenger car motor oils (see Appendix Q, paragraph Q.4) provides the current basis for issuance of a license to use the API Certification Mark. (See 2.4 for a list of viscosity grades eligible to obtain a license to use the API Certification Mark.). Licensing of ILSAC GF-4 as the only ILSAC gasoline engine oil minimum performance standard is planned through July 2009. If warranted, this date may change upon agreement by API and ILSAC (e.g., due to new or unanticipated performance requirements).

2.3 API Service Symbol

2.3.1 General

Service Categories are used in the upper portion of the API Service Symbol to identify specific engine oil performance levels. The API Service Symbol may be licensed for use with passenger car motor oils, diesel engine oils, or both as long as the oils meet the performance requirements of an appropriate API Service Category or Categories. Currently, the API Service Categories that may be included in the API Service Symbol are SM, SL, SJ, SH (when preceded by a C category), CF, CF-2, CF-4, CG-4, CH-4, CI-4, and CJ-4 beginning October 15, 2006. Oils that meet CH-4 licensing requirements are also authorized to display CF-4 and/or CG-4 in the API Service Symbol. Oils that meet API CI-4 licensing requirements are also authorized to display CH-4, CG-4, and/or CF-4 in the API Service Symbol. Oils that meet API CJ-4 licensing requirements are also authorized to display CI-4 with CI-4 PLUS, CI-4, CH-4, CG-4, and CF-4 in the API Service Symbol.

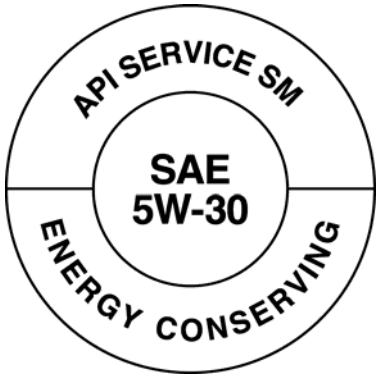

Figure 2—API Service Symbol

Note: The letters “SI” and “SK” have been omitted from the sequence of letter designators for API Service Categories because of their common association with other organizations or systems.

Use of more than one API S Service Category at a time in the API Service Symbol is prohibited. Service Category SH can be displayed in the API Service Symbol only when preceded by CF and/or CF-2 and/or CF-4 and/or CG-4 and/or CH-4 and/or CI-4, and/or CJ-4 beginning October 15, 2006. These alphanumeric Service Categories may change as new oil performance standards are developed and approved for use (see Appendices C and D).

For an oil that is formulated for diesel engine applications and meets both C and S Categories, it is suggested that the C Category be put first so that the consumer can recognize that the oil is primarily a diesel engine oil but also meets S Category requirements. For an oil that is formulated for passenger car motor oil applications and meets both S and C Categories, it is suggested that the S Category be put first so that the consumer can recognize that the oil is primarily a passenger car motor oil but also meets C Category requirements.

2.3.2 Service Categories for Passenger Car Motor Oils

2.3.2.1 SM—2005 Gasoline Engine Warranty Maintenance Service

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 current and earlier passenger cars, sport utility vehicles,

vans, and light-duty trucks operating under vehicle manufacturers' recommended maintenance procedures.

Engine oils that meet the API Service Category SM designation (see Appendix G) may be used where API Service Category SL and earlier S Categories have been recommended.

Engine oils that meet the API Service Category SM 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 (see Appendices E and F).

Starting November 30, 2004, engine oils that meet these requirements may display API Service Category SM in the upper portion of the API Service Symbol. Before the November 30, 2004, introduction date, oil marketers may license API SM oils as API SL.

2.3.2.2 SL—2001 Gasoline Engine Warranty Maintenance Service

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 current and earlier passenger cars, sport utility vehicles, vans, and light-duty trucks operating under vehicle manufacturers' recommended maintenance procedures.

Engine oils that meet the API Service Category SL designation (see Appendix G) may be used where API Service Category SJ and earlier S Categories have been recommended.

Engine oils that meet the API Service Category SL 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 (see Appendices E and F).

Engine oils that meet these requirements may display API Service Category SL in the upper portion of the API Service Symbol.

2.3.2.3 SJ—1997 Gasoline Engine Warranty Maintenance Service

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 passenger cars, sport utility vehicles, vans, and light-duty trucks operating under vehicle manufacturers' recommended maintenance procedures.

Engine oils that meet the API Service Category SJ designation (see Appendix G) 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 and may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing (see Appendices E and F).

Engine oils that meet these requirements may display API Service Category SJ in the upper portion of the API Service Symbol.

2.3.2.4 SH—1994 Gasoline Engine Warranty Maintenance Service

API Service Category SH was adopted in 1992 for use in describing engine oils available in 1993. These oils are for use in service typical of gasoline engines in passenger cars, vans, and light-duty trucks operating under vehicle manufacturers' recommended maintenance procedures.

Engine oils developed for this Service Category provide performance exceeding the minimum requirements for API Service Category SG, which Service Category SH was intended to replace, in the areas of controlling deposits, oil oxidation, wear, rust, and corrosion and must meet the engine-protection sequence test requirements of DOD CID-A-A-52039A (document obsolete) and ILSAC GF-1. In addition, all viscosity grades designated in DOD CID A-A-52039A (SAE 5W-30, 10W-30, and 15W-40) must meet the bench test requirements described in DOD CID A-A-52039A and ILSAC GF-1. (SAE 15W-40 does not have a phosphorus limitation and does not have to meet the GM filterability test.)

Engine oils that meet the API Service Category SH designation (see Appendix G) 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 (see Appendices E and F), and may be used where API Service Category SG and earlier S Categories have been recommended.

Engine oils that meet these requirements may not display API Service Category SH in the upper portion of the API Service Symbol unless SH is preceded by a C Category.

2.3.2.5 Energy Conserving Oil Classification for Gasoline-Powered Passenger Cars, Sport Utility Vehicles, Vans, and Light-Duty Trucks

2.3.2.5.1 General

The Energy Conserving oil classification for gasoline-powered passenger cars, sport utility vehicles, vans, and light-duty trucks is a supplementary classification for engine oils that have energy conserving properties and is displayed—when used—in the lower portion of the API Service Symbol. The performance requirements for this supplementary classification are described technically in SAE J1423 and ASTM D 4485 (latest version). Testing for conformance to these Categories must be in accordance with the ACC Code. The API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing (see Appendices E and F) may be used.

2.3.2.5.2 Energy Conserving in Conjunction with API Service Category SM

API Service SM engine oils designated as Energy Conserving are formulated to improve the fuel economy of passenger cars, sport utility vehicles, vans, and light-duty trucks powered by gasoline engines. These oils have produced a fuel economy improvement (FEI) both at the start and end of the Sequence VIB test at the percentages listed in Table 1, when compared with the standard reference oil (ASTM Reference Oil BC) used in the Sequence VIB test.

Starting November 30, 2004, oils that meet the Sequence VIB requirement and are properly licensed may display "Energy Conserving" in the lower portion of the API Service Symbol in conjunction with API Service Category SM in the upper portion. The fuel economy obtained by individual vehicle operators using engine oils labeled Energy 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.

Table 1—Sequence VIB Primary Performance Criteria with API Service Category SM

Viscosity Grade	FEI1 relative to BC, min	FEI2 relative to BC, min
0W-20 and 5W-20	2.3%	2.0%
0W-30 and 5W-30	1.8%	1.5%
10W-30 and all other viscosity grades not listed above	1.1%	0.8%

2.3.2.5.2 Energy Conserving in Conjunction with API Service Category SL

API Service Category SL engine oils categorized as Energy Conserving are formulated to improve the fuel economy of passenger cars, sport utility vehicles, vans, and light-duty trucks powered by gasoline engines. These oils have produced a fuel economy improvement (FEI) both at the start and end of the Sequence VIB test at the percentages listed in Table 2, when compared with the standard reference oil (ASTM Reference Oil BC) used in the Sequence VIB test.

Oils that meet the Sequence VIB requirement and are properly licensed may display “Energy Conserving” in the lower portion of the API Service Symbol in conjunction with API Service Category SL in the upper portion. The fuel economy obtained by individual vehicle operators using engine oils labeled Energy 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.

Table 2—Sequence VIB Primary Performance Criteria with API Service Category SL

Viscosity Grade	FEI1 relative to BC, min	FEI2 relative to BC, min	Sum of FEI1 + FEI2, min
0W-20 and 5W-20	2.0%	1.7%	—
0W-30 and 5W-30	1.6%	1.3%	3.0%
10W-30 and all other viscosity grades not listed above	0.9%	0.6%	1.6%

2.3.2.5.3 Energy Conserving in Conjunction with API Service Category SJ and SH

Energy Conserving claims are not permitted with API Service Categories SJ and SH.

2.3.3 Service Categories for Diesel Engine Oils

2.3.3.1 CJ-4—For 2007 Severe-Duty Diesel Engine Service

API Service Category CJ-4 describes oils for use in high-speed four-stroke cycle diesel engines designed to meet 2007 model year on-highway exhaust emission standards as well as for previous model years. These oils are compounded for use in all applications with diesel fuels ranging in sulfur content up to 500 ppm (0.05% by weight). However, the use of these oils with greater than 15 ppm (0.0015% by weight) sulfur fuel may impact exhaust aftertreatment system durability and/or oil drain interval.

These oils are especially effective at sustaining emission control system durability where particulate filters and other advanced aftertreatment systems are used. Optimum protection is provided for control of catalyst poisoning, particulate filter blocking, engine wear, piston deposits, low- and high-temperature stability, soot handling properties, oxidative thickening, foaming, and viscosity loss due to shear.

Engine oils that meet the API Service Category CJ-4 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.

API CJ-4 oils exceed the performance criteria of API CI-4 with CI-4 PLUS, CI-4, CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories. When using CJ-4 oil with higher than 15 ppm sulfur fuel, consult the engine manufacturer for service interval.

The first license date for API CJ-4 is October 15, 2006. Effective May 1, 2006, marketers may license products meeting API CJ-4 requirements as API CI-4 with CI-4 PLUS, CI-4, CH-4, CG-4, and CF-4.

2.3.3.2 CI-4—For 2004 Severe-Duty Diesel Engine Service

API Service Category CI-4 describes oils for use in high-speed four-stroke cycle diesel engines designed to meet 2004 exhaust emission standards implemented in 2002. These oils are intended for use in all applications with diesel fuels ranging in sulfur content up to 0.5% weight.

These oils are specifically formulated to sustain engine durability where Exhaust Gas Recirculation (EGR) is used and the impact of these oils on other supplemental exhaust emission devices has not been determined. Optimum protection is provided against corrosive and soot-related wear tendencies, piston deposits, degradation of low- and high-temperature viscometric properties due to soot accumulation, oxidative thickening, loss of oil consumption control, foaming, degradation of seal materials, and viscosity loss due to shear.

Engine oils that meet the API Service Category CI-4 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.

API CI-4 oils are superior in performance to those meeting API CH-4, CG-4, and CF-4 and may be used in engines calling for those API Service Categories. Marketers may license products meeting API CI-4 requirements as API CH-4, CG-4, and CF-4.

2.3.3.3 CH-4—For 1998 Severe-Duty Diesel Engine Service

API Service Category CH-4 describes oils for use in high-speed four-stroke diesel engines designed to meet 1998 exhaust emissions standards as well as for previous model years. CH-4 oils are specifically compounded for use with diesel fuels ranging in sulfur content up to 0.5% weight.

These oils are especially effective to sustain engine durability even under adverse applications that may stress wear control, high temperature stability, and soot handling properties. In addition, optimum protection is provided against non-ferrous corrosion, oxidative and insoluble thickening, foaming, and viscosity loss due to shear.

These oils also have the performance capability to afford a more flexible approach to oil drain intervals in accordance with the recommendations of the individual engine builders for their specific engines.

Engine oils that meet the API Service Category CH-4 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 (see Appendices E and F).

CH-4 oils are superior in performance to those meeting API CF-4 and API CG-4 and can effectively lubricate engines calling for those API Service Categories.

2.3.3.4 CG-4—For Severe-Duty Diesel Engine Service

API Service Category CG-4 describes oils for use in high-speed four-stroke cycle diesel engines used in highway and off-road applications where the fuel sulfur content may vary from less than 0.05% wt. up to 0.5% wt. CG-4 oils provide effective control over high temperature piston deposits, wear, corrosion, foaming, oxidation, and soot accumulation. These oils are especially effective in engines designed to meet 1994 exhaust emission standards and may also be used in engines requiring API Service Category CD, CE or CF-4. Oils designated for API Service Category CG-4 have been in existence since 1995. Engine oils that meet the API Service Category CG-4 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 (see Appendices E and F).

2.3.3.5 CF—For Off-Road Indirect-Injected Diesel Engine Service

API Service Category CF denotes service typical of off-road indirect-injected diesel engines and other diesel engines that use a broad range of fuel types including those using fuel with higher sulfur content, for example over 0.5% wt. Effective control of piston deposits, wear, and corrosion of copper-containing bearings is essential for these engines, which may be naturally-aspirated, turbocharged, or supercharged. Oils designated for this service have been in existence since 1994. Oils designated for this service may also be used when API Service Category CD is recommended. Engine oils that meet the API Service Category CF 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 (see Appendices E and F).

2.3.3.6 CF-2—For Two-Stroke Cycle Diesel Engine Service

API Service Category CF-2 denotes service typical of two-stroke cycle engines requiring highly effective control over cylinder and ring-face scuffing and deposits. Oils designated for this service have been in existence since 1994 and may also be used when API Service Category CD-II is recommended. These oils do not necessarily meet the requirements of CF or CF-4 unless the oils have specifically met the performance requirements of these Service Categories.

Engine oils evaluated in the two-stroke cycle DD 6V 92TA engine test since January 1, 1992, may be considered for this Service Category provided the tests were conducted in accordance with the test procedure as published in ASTM Research Report RR:D02-1319 or as revised by the ASTM Test Monitoring Center. All testing conducted since January 1, 1994, must be done in accordance with the most current test procedures. Engine oils that meet the API Service Category CF-2 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 (see Appendices E and F).

2.3.3.7 CF-4—For Diesel Engine Service

API Service Category CF-4 describes oils for use in high-speed four-stroke cycle diesel engines. CF-4 oils exceed the requirements of Service Category CE, are designed to replace CE oils, and provide improved control of oil consumption and piston deposits. CF-4 oils may be used in place of CC and CD oils. They are particularly suited for on-highway, heavy-duty truck applications. Oils designated for this service have been in existence since 1990.

2.3.4 CI-4 PLUS Classification in Conjunction with API Service Category CI-4 and CJ-4

API Service Category CI-4 and CJ-4 engine oils that also carry the classification CI-4 PLUS are formulated to provide a higher level of protection against soot-related viscosity increase and viscosity loss due to shear in vehicles powered by diesel engines.

Oils that meet the requirements for CI-4 PLUS as defined in Appendix S and are properly licensed may display “CI-4 PLUS” in the lower portion of the API Service Symbol in conjunction with API CI-4 and/or CJ-4 in the upper portion (see Figure 3).

Oils that satisfy CI-4 PLUS are superior in performance to those meeting API CI-4, CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories.

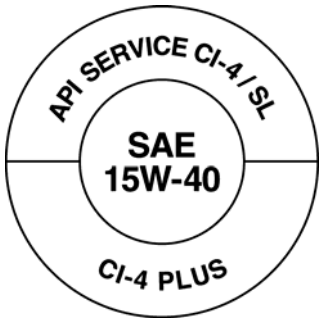

Figure 3—CI-4 PLUS Designation

2.4 SAE Viscosity Grades Eligible for Use with API Marks

The SAE viscosity grades eligible for use with the API Marks are specified in Table 3. Refer to SAE J300 for the most current SAE Viscosity Classification requirements.

Table 3—SAE Viscosity Grades Eligible for Use of API Marks

Low-Temperature Viscosity Grade	High-Temperature Viscosity Grade					
	—	20	30	40	50	60
—		Y	Y	Y	Y	Y
0W	XY	XY	XY	XY	XY	XY
5W	XY	XY	XY	XY	XY	XY
10W	XY	XY	XY	XY	XY	XY
15W	Y	Y	Y	Y	Y	Y
20W	Y	Y	Y	Y	Y	Y
25W	Y	NA	Y	Y	Y	Y

Note: X = eligible for the API Certification Mark, provided the oil meets all license requirements outlined in this publication for the API Certification Mark; Y = eligible for the API Service Symbol, provided the oil meets all license requirements outlined in this publication for the API Service Symbol; NA = not applicable.

SECTION 3—License System for API Marks

3.1 General

3.1.1 The API EOLCS is a voluntary licensing and certification program designed to define, certify, and monitor engine oil performance deemed necessary for satisfactory equipment life and performance by vehicle and engine manufacturers. Its purpose is to ensure that engine oils meeting the minimum performance standards of vehicle and engine manufacturers are easily identified by consumers.

3.1.2 To use either of the two API Marks, an engine oil marketer must obtain a license from API. Upon request, API will supply information to the marketer that describes reporting requirements for physical and chemical properties, documentation and verification of engine and bench test performance, conformance and enforcement procedures, fees, trace codes, application procedures, and licensing requirements. The procedures the marketer must follow and the licensing forms the marketer must complete and submit to API to secure the right to use the API Marks are described in the Application for Licensure (see Appendix H). A marketer desiring to apply for a license should contact API for the most recent version of the Application for Licensure. Licenses are valid for one year as long as all program requirements continue to be met. Annual renewals are issued when all renewal steps are completed.

3.2 Royalty Fees

3.2.1 Licensees pay API royalty fees to support EOLCS. These fees are reviewed annually. The current fee structure is available on-line at www.api.org/eolcs.

3.2.2 Licensees pay an annual minimum royalty fee and a royalty fee for each gallon of API-licensed oil sold after the first million gallons.

3.2.2.1 The minimum royalty fee is charged to all licensees upon initial licensing and upon annual renewal.

3.2.2.2 New licensees are only assessed the minimum royalty fee in their initial year of licensing. The royalty fee based on a licensee's volume of API-licensed oil sold is charged to the licensee at time of license renewal. To renew an API license, the licensee must report the volume of all API-licensed oils (packaged and bulk) sold in the prior year. Volume-of-sales figures will be held in strict confidence by API.

3.3 Responsibility of Marketers

3.3.1 Only engine oil marketers may apply for and be awarded a license to display an API Mark. (See the glossary [Appendix I] for a definition of marketer.)

3.3.2 As noted in the licensing agreement, the marketer is solely responsible for ensuring that the performance characteristics of the oil product displaying an API Mark or Marks meet all requirements for the Mark or Marks. If multiple Service Categories are used, the marketer must ensure that the oil meets the minimum performance requirements for each of the Service Categories designated. If, in obtaining a license for use of an API Mark, a marketer chooses to use either the API Base Oil Interchangeability Guidelines or API Guidelines for SAE Viscosity-Grade Engine Testing, that marketer is also responsible

for correctly applying those guidelines. The most recent version of the guidelines and license application forms can be obtained from the API EOLCS Coordinator.

3.4 Licensing Procedures

3.4.1 A valid API license permits the marketer to use the API Marks on its licensed oils and is that marketer's warranty that its licensed oils comply with licensing requirements. The license application requires applicants to certify that licensed oils meet EOLCS requirements and to abide by all the requirements of the program and the licensing agreement.

3.4.2 The license application (see Appendix H) specifies which certified information is required to qualify for a license for specific Service Categories and one or both of the API Marks. This includes written certification by the marketer that each brand and viscosity grade of the engine oil for which licensing is requested meets the most recent version of prescribed technical criteria as set forth in the following standards:

a. ASTM D 4485.
b. SAE J300.
c. SAE J183 for oils not designated Energy Conserving.
d. ILSAC GF-2 (see Appendix Q, item Q.2).
e. ILSAC GF-3 (see Appendix Q, item Q.3).
f. ILSAC GF-4 (see Appendix Q, item Q.4).

The API Application for Licensure will specifically note any additions, deletions, or other modifications to the standards listed above.

3.4.3 The license application includes but is not limited to the following certification statements:

a. Any engine tests covered by the ACC Code and in the API licensing program must be conducted in accordance with the latest edition of the ACC Code (see Appendix J).
b. Any Base Oil Interchangeability or Viscosity-Grade Engine Test Guidelines must be applied in accordance with Appendix E or F.

The license application clearly states that the use of API Base Oil Interchangeability Guidelines and API Guidelines for SAE Viscosity-Grade Engine Testing does not absolve the marketer of the responsibility to meet minimum performance standards for the licensed oils.

3.4.4 The applicant is required to submit the following information (based on the final engine oil formulation) for each viscosity grade:

a. Bench test data.
b. Physical and chemical properties.
c. Product traceability code information.

The license application specifies that all licensed oils are subject to monitoring and enforcement procedures, including audits.

3.4.5 After the marketer has completed the application process, paid the fee, and been granted the license, the marketer may display the API Marks on licensed products in accordance with Section 4.

3.4.6 API maintains strict confidentiality of all proprietary data provided by license applicants. Information submitted is used only as specified in the license agreement.

3.5 Renewals

A license may be renewed annually by mutual agreement of the parties, provided the licensee reports the volume of licensed product sold the previous year, pays the annual fee, and agrees to comply with any amendments to the license agreement and any modifications or additional specifications of the license requirements.

3.6 System Monitoring and Enforcement

The integrity of the API EOLCS is maintained by means of a formal monitoring and enforcement program, as defined in Section 5.

3.7 Provisional License

3.7.1 On rare occasions, a test specified under API licensing requirements (API S or C Service Categories or ILSAC minimum performance standards) may be declared "out of control" by ASTM Subcommittee D02.B0. When this occurs, API may grant a provisional license to a license applicant if the candidate engine oil meets all API licensing requirements except for the one test that has been declared "out of control." API cannot invoke provisional licensing unless it has received appropriate notification from ASTM.

3.7.2 API will notify all API licensees of the date on which any test required for an API license is declared "out of control" and the date on which the test is declared "no longer out of control" by ASTM.

3.7.3 All applications for a provisional API license shall include data that support the performance of the candidate engine oil in the test not conducted. These data shall conform to Level 2 Support, as described in the ACC Code (see Appendix J).

3.7.4 A request for provisional licensing of an oil is made by completing the relevant sections of Part B of the license application (see Appendix H).

3.7.5 When the API Guidelines for SAE Viscosity-Grade Engine Testing are used to "read across" from a provisionally licensed engine oil, the licensee must indicate provisional status on Part B of the license application for that engine oil.

3.7.6 After ASTM has notified API that the test is "no longer out of control" and API has forwarded this information to each licensee holding a provisional license, the licensee holding the provisional license must obtain a passing result on that test within 6 months.

3.7.6.1 Upon passing the test, the licensee will request full licensing of the oil by completing a revised Part B for the provisionally licensed oil. The Part B form requires the licensee to confirm that an oil is fully tested. After receiving the revised Part B, API will respond with a notification that the oil is fully licensed.

3.7.6.2 If a revised Part B for the provisionally licensed oil is not received by API within 6 months of API notifying the holder of the provisional license that the test is again available for testing, API will cancel the provisional license for that oil and notify the licensee that the API S or C Service Category in the API Service Symbol and/or the API Certification Mark shall no longer be displayed on the label of that engine oil or any engine oil that was provisionally licensed based on that engine oil.

3.7.7 Engine oils granted an API provisional license will be listed in API's Directory of Licensees on API's website in the same manner as API-licensed oils, without any special designation. The licensee is still responsible for the satisfactory performance of all engine oils granted an API provisional license.

3.7.8 An API provisional license will not be granted for any candidate oil if two or more required tests have not been conducted on the candidate engine oil. This criterion also applies to candidate oils for which the licensee is seeking multiple Service Category approval (for example, API CI-4/SL).

3.7.9 In the event that two or more tests used to support the API licensing process are declared "out of control" by ASTM Subcommittee D02.B0 and API has received appropriate notification by ASTM or if any EOLCS test becomes unavailable (because of a shortage of test materials, equipment, or similar industry-wide test-related emergency), a joint task force will immediately be formed and will be composed of (a) API and automotive representatives from API's Administrative Guidance Panel (AGP) (for the API Certification Mark or an API Service Category S test); (b) API and EMA (for an API Service Category C test); or (c) API, AGP automotive representatives, and EMA (for multiple Service Category tests). The joint task force will recommend the appropriate action to maintain the stability of the API EOLCS.

3.8 Emergency Provisional Licensing

3.8.1 If a supply of base oil or additives utilized by a number of licensees is disrupted, licensees may apply for short-term Emergency Provisional Licenses. A disruption is defined as a significant industry-wide limitation on the supply of a base oil or additive that makes it impossible for multiple licensees to market sufficient quantities of engine oil without violating the API licensing agreement. The disruption must be caused by an unforeseeable event involving, but not limited to, an explosion, fire, legal action, natural disaster or act of terrorism that is beyond the control of individual licensees.

3.8.2 The licensee's application for an Emergency Provisional License must include a detailed description of the event that created the need for the Emergency Provisional License; the steps that have been taken by the licensee to find other sources of licensable materials, including both raw materials and finished products; an estimate of the duration of the shortage; and other supporting information required by API. The licensee must also submit technical information that supports, to the satisfaction of API, that the use of the substitute component will not adversely affect the claimed performance categories of the licensed product.

3.8.3 The initial term of the Emergency Provisional License will be granted for up to 90 days. At the discretion of API, this license period may be extended beyond the 90-day term. The Emergency Provisional License is intended to last only until the licensee obtains alternative supplies of materials, completes additional requirements as defined by API or the disruption ends, whichever is earlier. The Emergency Provisional License will be conditioned upon the licensee fully complying with requirements and other conditions imposed by API to protect consumers and the integrity of the program.

3.8.4 Relief under this section will rarely be granted by API. The burden is on the licensee to establish clearly that there are exigent circumstances that justify the use of this type of remedy and that the failure of the licensee to obtain supplies of base oil, additives or finished products was not caused by the licensee's negligence or failure to utilize good business practices.

SECTION 4—Use and Labeling Requirements for API Marks

4.1 API Engine Oil Quality Marks

4.1.1 Two types of Marks are licensed by API: the API Certification Mark "Starburst" and the API Service Symbol "Donut." The marketer may display an API Mark, as described in this section, only after obtaining a license to use the specific API Mark. Under the terms of the License Agreement, marketers may use the Marks in a number of ways: for example, on containers of licensed products (bottles, cans, jugs, kegs, and drums), in advertisements of licensed products, and in materials describing licensed products.

4.1.2 API will provide API licensees with "camera-ready" quality images or electronic versions (TIF, EPS, JPG, BMP) of the API Marks, on request, for use in producing final artwork.

4.1.3 Both the API Certification Mark and the API Service Symbol may be used if the marketer meets all licensing requirements for both API Marks for that viscosity grade of engine oil. Note that a difference in viscosity grade, Service Category, or brand name denotes a separate engine oil. The API Marks shall be located and displayed as described in 4.2 and 4.3.

4.2 API Certification Mark

4.2.1 If the API Certification Mark is used, it shall be clearly displayed on the front of the container of those engine oils that have been properly licensed by API. Note that this does not prevent the licensed marketer from displaying the API Certification Mark again on the back of the container.

4.2.2 The outside diameter of the API Certification Mark "Starburst" (measured from the outside tips) shall be at least 2.1 centimeters and shall be 1.5 (±0.1) times the inside diameter. The background of the outer band (containing the words AMERICAN PETROLEUM INSTITUTE and CERTIFIED) shall be a color that contrasts with the label background. (For example, if the label background is white, the outside band could be black, with the words in white.)

Figure 4—API Certification Mark "Starburst"

The background of the inner circle shall be a color that contrasts with the outer band. The words AMERICAN PETROLEUM INSTITUTE and CERTIFIED in the outer band of the API Certification Mark and the words FOR GASOLINE ENGINES in the center shall be all capital letters. The relationship of the letter size to the allocated space within the API Certification Mark must be consistent for all users

of the API Certification Mark. All lettering used for words in the API Certification Mark must be identical for all licensees.

4.2.3 API has registered the API Certification Mark only in the English language, and it can be displayed only as registered (see Figure 4). However, the purpose of the API Certification Mark is to assist consumers, so API encourages licensed marketers to translate the words CERTIFIED and FOR GASOLINE ENGINES into any appropriate language outside of the API Certification Mark. The translation must be literal and provided to API as part of the licensing agreement. The location of the translations can be anywhere on the front of the label but not within a mark or symbol of any kind. AMERICAN PETROLEUM INSTITUTE is also a licensed mark and cannot be translated without permission of API.

4.3 API Service Symbol

4.3.1 The API Service Symbol "Donut" may be located anywhere on the outside of the container. The outside diameter of the API Service Symbol shall be 1.9 times the inside diameter. The Service Category is located in the upper part of the Donut, the SAE viscosity grade is in the center, and the optional Energy Conserving notation is in the lower part. The API Service Symbol shall be large enough for the lettering to be legible and shall strictly conform to the design (including the required information and its placement) shown in Figure 5.

Figure 5—API Service Symbol "Donut"

4.3.2 Use of the API Service Symbol is restricted to current API Service Categories [namely, SM, SL, SJ, SH (when used as described in 4.3.3), CF, CF-2, CF-4, CG-4, CH-4, CI-4, and CJ-4 beginning October 15, 2006]. Except as prohibited in 4.3.3, these may appear alone or in combination with other current Service Categories. The API Service Categories must appear in the upper part of the API Service Symbol, but such placement does not preclude their use elsewhere on the container. Use of API Service Categories SA, SB, SC, SD, SE, SF, SG, CA, CB, CC, CD, CD-II, or CE within the API Service Symbol is prohibited (see Appendix A).

4.3.3 Use of more than one API S Service Category in the API Service Symbol is prohibited. Service Category SH cannot be used in the API Service Symbol unless preceded by CF and/or CF-2 and/or CF-4 and/or CG-4 and/or CH-4 and/or CI-4 and/or CJ-4 beginning October 15, 2006.

If API C Service Category oils are licensed for more than one current Service Category, these oils may display the Service Categories in the upper part of the API Service Symbol. Except as specified above, if the engine oil marketer chooses to include API C Service Categories with a current API S Category, a virgule (/) must be placed between the API S Service Category and the API C Service Categories, which are separated by commas. Licensees of Service Category C oils may use the C Categories first. Examples of acceptable notations are "API Service SM"; "API Service SL/CF"; "API Service CI-4, CH-4/SL";

"API Service CJ-4/SM"; "API Service CF"; "API Service CF, CF-2"; and "API Service CF-4." Figure 5 shows examples of notations for various Service Categories used within the API Service Symbol.

For an oil that is formulated for diesel engine applications and meets both C and S Categories, it is suggested that the C Category be put first so that the consumer can recognize that the oil is primarily a diesel engine oil but also meets S Category requirements. Conversely, for an oil that is formulated for passenger car motor oil applications and meets both S and C Categories, it is suggested that the S Category be put first so that the consumer can recognize that the oil is primarily a passenger car motor oil but also meets C Category requirements.

4.4 Product Traceability Coding

4.4.1 For purposes of conformance audits, the marketer shall ensure that product traceability codes appear on each container and that these codes are legible and durable. Each container shall be coded to permit traceability of samples in the marketplace by formulation, date of packaging, and source of manufacture.

4.4.2 The marketer may use whatever coding system is appropriate or convenient. Disclosure of coding systems to API is required in the license application (see Appendix H). No change in coding is permitted without prior notification of API. Coding information provided to API is considered confidential and will be used only as described in the API license agreement.

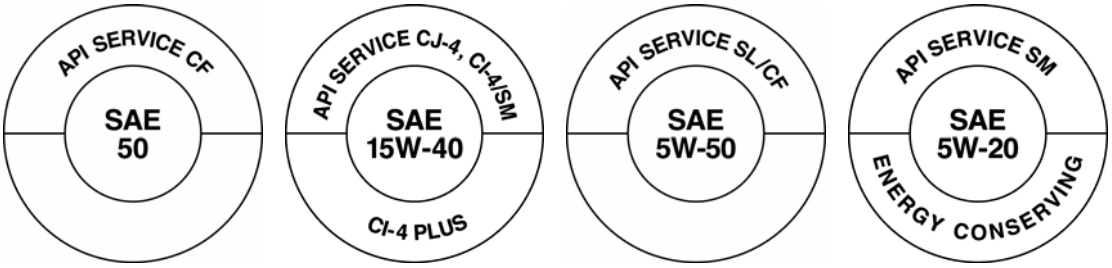

Figure 5—Representative Examples of the API Service Symbol

SECTION 5—System Monitoring, Enforcement, and Conformance

5.1 General

5.1.1 API's Aftermarket Audit Program (AMAP) is a monitoring and enforcement program designed to ensure compliance with the API EOLCS. The integrity of this voluntary system depends on adherence by marketers (licensees) to industry technical specifications and compliance with the terms of the marketers' licensing agreements. Monitoring and enforcement efforts are directed to ensure that licensed oils meet industry technical specifications and that the API Marks are properly displayed on containers and convey accurate information to consumers about the contents.

5.1.2 An attempt will be made annually to secure samples of brands and viscosity grades of oils currently licensed by API. Each of the oils sampled will be analyzed according to a standard audit (see Appendix K) to determine compliance with technical specifications (physical, chemical, and bench tests). Of the oils found to meet the technical specifications, some will be randomly chosen for engine testing to determine compliance with engine performance specifications (see Appendix L).

5.1.3 Physical and chemical audit data are compared with the information submitted through the API licensing process. Test results must meet the physical and chemical tolerances described in Appendix K. Engine test results are evaluated using specified methodology (see Appendix M) to determine whether an oil meets minimum performance standards.

5.1.4 Engine oils will be chosen for engine test audits based on a randomly generated list of API licensees, weighted by volume (see Appendix L).

5.1.5 API will contract with independent organizations to collect samples from the field and conduct all physical and chemical analyses, bench tests, and engine tests.

5.1.6 Data obtained through the Aftermarket Audit Program are considered confidential, are available only to the appropriate API staff and the licensee, and are used only for the purposes stated in the inquiry. Specific data derived from the Aftermarket Audit Program will not be used for any reason other than the monitoring process without written permission from the licensee. When summary data are issued by API, they will not be company specific.

5.2 Violations

5.2.1 General

Violations of the EOLCS are divided into two categories: (a) noncompliance with technical specifications and (b) improper use of the API Marks.

5.2.1.1 Noncompliance with Technical Specifications

If an API-licensed oil does not meet technical specifications, API will attempt to work directly with the marketer to evaluate the nonconformity and take additional corrective action as appropriate on a voluntary basis. In the event that the matter cannot be satisfactorily resolved, API will take or initiate the actions listed below, singly or in combination, to maintain the credibility of the API Mark and protect the consumer. Enforcement action will be related to the severity of the alleged offense, the period of time that

the violating product has been in the marketplace, the efforts made by the marketer to correct the violation, and the possible harmful impact on the consumer. These actions include the following:

a. Temporary suspension of the authority of the licensee to use the API Mark on a product until corrective action has been taken.
b. Termination of the authority of the licensee to use the API Mark on an individual product.
c. Termination of the authority of the licensee to use the API Mark on all API-licensed products marketed by the licensee.
d. Requirement for the licensee to remove noncomplying products that display API Marks from the marketplace.

Note: All monitoring and enforcement actions must be resolved to API's satisfaction before an existing license will be renewed or a new license issued.

5.2.1.2 Improper Use of API Marks

If licensed or unlicensed oils display an improper label or unauthorized labeling data, API will require the marketer to cease and desist from committing the violation and will request verification that the violation has been corrected.

5.2.2 Verification of Compliance with API Enforcement Action

API will take steps to verify that required corrective action has been executed. Actions requested to verify compliance will depend on the seriousness of the violation. The cost of these verification procedures will be borne by the marketer, as specified in the license agreement. Verification procedures include the following:

a. Submission of copies of labels. The marketer will be required to provide a copy of all labels reflecting the correction of the API Mark violation.
b. Attestations. The marketer will be required to furnish an affidavit from a third party (a law firm or an accounting firm) that the specified remedial action has been completed.
c. Retesting. The marketer will agree to undertake any agreed-upon retesting.
d. Other evidence of compliance. API can make other reasonable requests to verify compliance.

5.2.3 Appeals

When API suspends or revokes a license, the former licensee may appeal the decision. Appeals must be submitted in writing to the Director, Certification Programs. The appeal shall include a statement of the basis for the objection. The appeal must be filed with API within 45 days of the date of notification of the suspension or revocation of the license. The API Director shall investigate the objections raised and respond to them in writing within 45 days of receipt. If the objections cannot be resolved by the Director, a hearing by a designated appeals board shall be convened in accordance with API Policy 104.

SECTION 6—Referenced Publications

The following standards and specifications are cited in this publication. In each case, the most recent version is applicable.

ACC

American Chemistry Council Petroleum Additives Panel Product Approval Code of Practice

ASTM

D 92	*Standard Test Method for Flash and Fire Points by Cleveland Open Cup*
D 93	*Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester*
D 445	*Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)*
D 892	*Standard Test Method for Foaming Characteristics of Lubricating Oils*
D1552	*Standard Test Method for Sulfur in Petroleum Products (High-Temperature Method)*
D 2007	*Standard Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum Derived Oils by the Clay-Gel Absorption Chromatographic Method*
D 2270	*Standard Practice for Calculating Viscosity Index From Kinematic Viscosity at 40 and 100°C*
D 2622	*Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry*
D 2887	*Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography*
D 3120	*Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry*
D 3244	*Standard Practice for Utilization of Test Data to Determine Conformance with Specifications*
D 4057	*Standard Practice for Manual Sampling of Petroleum and Petroleum Products*
D 4294	*Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy*
D 4485	*Standard Specification for Performance of Engine Oils*
D 4628	*Standard Test Method for Analysis of Barium, Calcium, Magnesium, and Zinc in Unused Lubricating Oils by Atomic Absorption Spectrometry*
D 4629	*Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection*
D 4683	*Standard Test Method for Measuring Viscosity at High Shear Rate and High Temperature by Tapered Bearing Simulator*

D 4684 *Standard Test Method for Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature*

D 4741 *Standard Test Method for Measuring Viscosity at High Temperature and High Shear Rate by Tapered-Plug Viscometer*

D 4927 *Standard Test Method for Elemental Analysis of Lubricant and Additive Components, Barium, Calcium, Phosphorus, Sulfur, and Zinc, by Wavelength-Dispersive X-Ray Fluorescence Spectroscopy*

D 4951 *Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry*

D 5119 *Standard Test Method for Evaluation of Automotive Engine Oils in CRC L-38 Spark Ignition Engine*

D 5133 *Standard Test Method for Low Temperature, Low Shear Rate, Viscosity/Temperature Dependence of Lubricating Oils Using a Temperature-Scanning Technique*

D 5185 *Standard Test Method for Determination of Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)*

D 5293 *Standard Test Method for Apparent Viscosity of Engine Oils Between –5 and –30˚C Using the Cold-Cranking Simulator*

D 5302 *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 Under Low-Temperature Light-Duty Conditions*

D 5480 *Standard Test Method for Motor Oil Volatility by Gas Chromatography*

D 5481 *Standard Test Method for Measuring Apparent Viscosity at High-Temperature and High-Shear Rate by Multicell Capillary Viscometer*

D 5533 *Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIE Spark Ignition Engine*

D 5800 *Standard Test Method for Evaporation Loss of Lubricating Oils by the NOACK Method*

D 5844 *Standard Test Method for Evaluation of Automotive Engine Oils for Inhibition of Rusting (Sequence IID)*

D 5862 *Standard Test Method for Evaluation of Engine Oils in Two-Stroke Cycle Turbo-Supercharged 6V92TA Diesel Engine*

D 6082 *Standard Test Method for High Temperature Foaming Characteristics of Lubricating Oils*

D 6202 *Standard Test Method for Automotive Engine Oils on the Fuel Economy of Passenger Cars and Light-Duty Trucks in the Sequence VIA Spark Ignition Engine*

D 6335 *Standard Test Method for Determination of High Temperature Deposits by Thermo-Oxidation Engine Oil Simulation Test*

D 6417 *Standard Test Method for Estimation of Engine Oil Volatility by Capillary Gas Chromatography*

D 6557 *Standard Test Method For Evaluation of Rust Preventative Characteristics of Automotive Engine Oils*

D 6593 *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*

D 6922 *Standard Test Method for Determination of Homogeneity and Miscibility in Automotive Engine Oils*

RR:D02:1204 *Fuel Efficient Engine Oil Dynamometer Test Development Activities, Part II (Sequence VI Test)*

RR:D02:1649 *Sequence VIB*

RR:D02:1473 *Sequence IVA*

RR:D02:1491 *Sequence IIIF*

Under Development by ASTM D02.B TEOST MHT-4

Under Development by ASTM D02.06 EOFT

Under Development by ASTM D02.06 EOWTT

CEC

L-36-A-90 *High Temperature/High Shear Viscosity*

L-40-A-93 *Evaporative Loss of Lubricating Oils*

DOD

CID A-A-52039A *Lubricating Oil, Automotive Engine, API Service SG*

MIL-L-2104 *Lubricating Oil, Internal Combustion Engine, Tactical Service*

GM

9099P *Engine Oil Filterability Test (EOFT)*

9099P *Engine Oil Filterability Test (EOFT) (Modified), May 1980*

ILSAC

GF-1 *Minimum Performance Standard for Passenger Car Engine Oils*

GF-2 *Minimum Performance Standard for Passenger Car Engine Oils*

GF-3 *Minimum Performance Standard for Passenger Car Engine Oils*

JPI

5S-41-93 *Evaporative Loss*

SAE

J183 *Engine Oil Performance and Engine Service Classification (Other Than "Energy-Conserving")*

J300 *Engine Oil Viscosity Classification*

J357 *Physical and Chemical Properties of Engine Oils*

J1423 *Classification of Energy-Conserving Engine Oil for Passenger Cars, Vans, and Light-Duty Trucks*

APPENDIX A—Evolution of Engine Oil Classifications

In 1911, SAE developed a system that classified engine oils by viscosity. This engine oil classification system remained in place until 1947, when API designated three types of engine oils: regular, premium, and heavy duty. Generally, the regular oils were straight mineral oils, the premium oils contained oxidation inhibitors, and the heavy-duty oils contained both oxidation inhibitors and detergent-dispersant additives.

Recognizing the inadequacy of this designation system, in 1952 API's Lubricants Committee, in cooperation with ASTM, developed the Engine Service Classification System (ESCS). API and ASTM revised ESCS in 1955 and again in 1960. ESCS separated gasoline and diesel engine performance with Service Categories ML, MM, and MS and DG, DM, and DS, respectively.

In 1969 and 1970, API, ASTM, and SAE established an entirely new classification system that would satisfy the changing warranty, maintenance, and lubrication requirements of the automotive industry. SAE initially determined that there were eight separate Service Categories of passenger car engine oils of current substantial commercial interest to be considered. ASTM established the test methods and performance characteristics and technically described each of the Service Categories. API prepared a user language, including new letter designations for each of the eight Service Categories. These eight engine Service Categories were tied to the ASTM technical description and primary performance criteria. SAE then published results of the entire project and the methodology as SAE J183.

Over the years, API, ASTM, and SAE have established new Service Categories and declared old Service Categories technically obsolete: The three organizations declared Gasoline Engine Service Category SA technically obsolete; Service Categories SB, SC, SD, SE, SF, and SG became technically obsolete when test methods were no longer available to verify performance; and Diesel Engine Service Categories CA, CB, CC, CD, CD-II, and CE also became technically obsolete when test methods were no longer available to verify performance. Table A-1 lists all technically obsolete Service Categories.

In 1992 and 1993, API, ASTM, and U.S. and Japanese automotive manufacturers introduced improvements in the licensing process for engine oils to ensure the quality of products being marketed and to enhance consumer awareness of the recommended lubricants for new vehicles. This improved process is known today as the API Engine Oil Licensing and Certification System (EOLCS).

Table A-1—Summary of Obsolete Service Categories and Related Military and Industrial Designations

Technically Obsolete API Service Categories	Previous API Service Categories	Related Military and Industrial Designations
Automotive Gasoline Engines (Passenger Car Engine Oils)		
SA	ML	Straight mineral oil
SB	MM	Inhibited oil, minimum duty
SC	MS (1964)	1964 MS warranty approved, M2C101-A
SD	MS (1968)	1968 MS warranty approved, M2C101-B, 6041-M (before July 1970)
SE	None	1972 warranty approved, M2C101-C, 6136-M (previously 6041-M Rev.), MIL-L-46152A
SF	None	1980 warranty approved, M2C153-D, MIL-L-46152B/C, 6048-M, 6049-M
SG	None	1989 warranty approved, MIL-L-46152D
Commercial Diesel Engines (Diesel Engine Oils)		
CA	DG	MIL-L-2104A
CB	DM	Supplement 1
CC	DM	MIL-L-2104B, MIL-L-46152B
CD	DS	MIL-L-45199B, Series 3, MIL-L-2104C/D/E
CD-II	None	MIL-L-2104D/E
CE	None	None

APPENDIX B—Interindustry Advisory Group to the API/Automotive Manufacturers Administrative Guidance Panel on the API EOLCS

B.1 Scope

The Interindustry Advisory Group (IAG) will provide recommendations to the API/Automotive Manufacturers Administrative Guidance Panel (AGP) on proposed modifications to the API EOLCS.

B.2 Function

The group will review, evaluate, and make recommendations on EOLCS matters, including tolerance limits, the Aftermarket Audit Program, the ACC Code, and any other issues relevant to the licensing program.

B.3 Organization

Each of the following organizations will be invited to provide one representative to the group: ACC, API, ASTM, Automotive Manufacturers, EMA, ILMA, JAMA, PAJ, SAE, and the U.S. Army. Representatives from other organizations may be added to the group as deemed necessary by the AGP. A group member serves at the discretion of the sponsoring organization and is charged with addressing improvements and concerns from his or her organization's perspective. Therefore, there will be no fixed term of membership for the group members.

B.4 Officers

The chair of the IAG is the API representative. The chair calls the meetings, sets the agenda, and presides.

The vice chair of the IAG is rotated annually between an Automotive Manufacturer and an EMA representative. The vice chair assists the chair and presides when the chair is absent.

The secretary of the IAG is the API EOLCS Coordinator. The secretary assists the chair, arranges meetings, drafts minutes, and handles the group's correspondence.

B.5 Meetings

The intent is to meet at the call of the chair, not to exceed two meetings per year. Where possible, group meetings will be held in conjunction with other scheduled meetings that are widely attended by industry. Meetings will be held in accordance with API policy.

B.6 Decision Making

The chair will attempt to achieve group consensus on issues before a formal vote. Lacking consensus, standard voting procedures will be followed, with a simple majority of voting members present at the meeting required to carry any motion. Each organization will have a single ballot in each formal vote. The chair will allow dissenting voters to present their views when forwarding the outcome of votes.

APPENDIX C—Developing New Engine Oil Performance Standards for the API Certification Mark

C.1 GENERAL

One of the objectives of API's voluntary Engine Oil Licensing and Certification System (EOLCS) is to help consumers identify engine oils recommended by vehicle and engine manufacturers. To accomplish this objective, the International Lubricant Standardization and Approval Committee (ILSAC) and API created the API Certification Mark, "Starburst" for short, a Registered Mark that clearly identifies passenger car engine oils meeting the latest engine oil performance specification adopted by ILSAC and API. Vehicle and engine manufacturers, technical societies, trade associations, lubricant and additive marketers, independent testing laboratories, and consumers play essential roles in defining and developing new minimum performance specifications for engine oils.

This appendix outlines the primary process that ILSAC uses to set specifications for certain passenger car engine oils and describes the procedures that API will use to determine whether these specifications become the criteria against which engine oil marketers are licensed to use the API Certification Mark.

C.2 ILSAC/OIL COMMITTEE

ILSAC specifications are developed through a committee known as the ILSAC/Oil Committee, which is composed of representatives from ILSAC member companies and the API Lubricants Committee. The ILSAC/Oil Committee guides and facilitates the development and introduction of ILSAC performance specifications for passenger car engine oils. In addition to these members, liaison representatives from allied organizations—for example ASTM, ILMA, and the U.S. Army— may also be asked to participate.

C.2.1 Membership

Membership of the ILSAC/Oil Committee shall consist of 50 percent representation from ILSAC and 50 percent from API. ILSAC and the API Lubricants Committee will establish the number of representatives. ILSAC shall designate one of its members as the ILSAC/Oil Committee chair. ILSAC members and API members will jointly fund most of the ILSAC/Oil Committee meeting expenses. API will provide administrative support such as meeting announcements, minutes, and mailings of meeting information.

C.2.2 Voting

The ILSAC/Oil Committee shall attempt to reach consensus on issues related to needs and the issuance and finalization of a draft specification. Consensus is defined as approval by two thirds of the ILSAC representatives and two thirds of the Oil representatives. If the ILSAC/Oil Committee cannot achieve consensus on the draft specification, then ILSAC may issue a draft for industry comment pursuant to C.3.2.4. If the ILSAC/Oil Committee cannot achieve consensus on the final specification, then ILSAC may issue an ILSAC specification pursuant to item b of C.3.3.2. If the ILSAC/Oil Committee cannot achieve consensus on needs, the Administrative Guidance Panel will convene pursuant to C.4.3.

A quorum of two thirds of both industries is required for the ILSAC/Oil Committee to conduct official business.

C.2.3 Procedures

The ILSAC/Oil Committee shall provide an adequate level of due process by ensuring that:

a. All meetings of the ILSAC/Oil Committee where the proposed standards are discussed, decisions made or votes taken are open to all interested parties.
b. Interested parties are given a meaningful opportunity to comment on draft specifications. Comments received by the ILSAC/Oil Committee shall be reviewed and evaluated pursuant to the consensus criteria specified in C.2.2. The ILSAC/Oil Committee shall respond in writing to comments received on the draft specifications.
c. Any party having a material interest in the process has the right to bring a timely appeal of an ILSAC/Oil Committee action or decision. Appeals must be submitted in writing to the Chair of the ILSAC/Oil Committee. If the objections cannot be resolved by the Chair, the appeal will be transmitted to an ILSAC appeals board for resolution.

C.3 ILSAC/Oil Development Process

The ILSAC/Oil performance category development process is designed to accomplish the following:

a. Validate the need for a new category.
b. Achieve stakeholder consensus early in the process.
c. Optimize the process for developing and approving new categories.

A new category is developed in steps, some of which are conducted in parallel and provide input to subsequent steps, as summarized in Figure C-1.

C.3.1 Determination of Need

C.3.1.1 Request for a New Category

Any individual, company or association may request a new definition of oil performance that may eventually result in a new category. To invoke the evaluation process, the new category request must be submitted to the Chair of the ILSAC/Oil Committee and to the Chair of the API Lubricants Committee.

The request for a new category must include adequate data and justification for the proposed category. The request must demonstrate a need for significant oil performance changes to meet requirements not met by existing categories. Justification should include, but is not limited to, one or more of the following:

a. Impending government regulations.
b. Consumer-driven needs.
c. New hardware design or service requirements.
d. Field problems encountered with current oils.

Following the receipt of the new category request, the Chairs will notify ILSAC and the API Lubricants Committee of the proposed category and request that the associations either confirm the existing ILSAC/Oil Committee representatives or designate new representatives to serve on the ILSAC/Oil Committee, as appropriate.

C.3.1.2 Evaluation Criteria

The ILSAC/Oil Committee will work to reach a consensus position on the need and timing for the new category by considering the following questions:

a. What is the proposed change and why is it required?
b. Does data presented support the request?
c. When is it needed in the marketplace?
d. What are the potential impacts on engines?
e. What are the potential impacts on consumers?
f. What are the potential impacts on the environment?
g. How could the change affect existing API categories? Could an existing API category satisfy the need expressed?
h. What performance and field tests are needed to properly evaluate the performance needs requested?
i. Are the tests available now? If not, in what timeframe can the performance and field tests be developed?

The ILSAC/Oil Committee may solicit additional industry input and data at any time to assist it in reaching a decision. Other industry groups [for example, SAE, API Detroit Advisory Panel (DAP), and EMA] may be asked to provide supplemental information.

C.3.1.3 Decision on Need

The ILSAC/Oil Committee shall evaluate the request pursuant to the consensus process outlined in C.2.2 and make one of the decisions below:

a. Support the request for the new ILSAC category and proceed with development. This recommendation shall document the basis for determining that there is a need for the new category.
b. Deny the request.
c. Determine that it cannot reach consensus.

The sponsor has the option of resubmitting the request with additional information if the ILSAC/Oil Committee denies the request or is unable to reach consensus. If the ILSAC/Oil Committee cannot achieve consensus on needs after reviewing the additional information, the Administrative Guidance Panel will convene pursuant to C.4.3.

C.3.2 Category Development

When the ILSAC/Oil Committee approves the request for the development of a new category, the ILSAC/Oil Committee will proceed with development. Parties such as ACC, ASTM, SAE, ILMA, and independent test laboratories may be requested to provide assistance in the development process. Other national, regional or international bodies—for example, JASO and Conseil Europeen de Coordination pour les Dévelopments des Essais de Performance des Lubrifiants et des Combustibles pour Moteurs (Coordinating European Council) (CEC)—may also be asked for input during this process.

C.3.2.1 Timing

The ILSAC/Oil Committee will draft a timetable for the development of a new category to enable the issuance of the ILSAC specification and licensing of products with the API Starburst at the earliest practicable date. That timetable will indicate the dates at which specific development milestones should be reached and the date first allowable licensing of the Starburst should occur for the new category. This date of first licensing shall allow oil marketers a reasonable opportunity to perform the testing required.

C.3.2.2 Identification of Test Development Needs and Alternatives

If an appropriate test method is not available, a new test method must be developed. Test procedures may be developed or modified by ASTM, CEC, JASO, or other technical societies or trade associations, an OEM, or a third party contractor.

The ILSAC/Oil Committee will monitor the category development process to ensure adherence to the approved timeline. The ILSAC/Oil Committee will also develop alternative methods of satisfying the category needs in the specified timeline to ensure that unanticipated problems or situations will not have the potential to unduly delay category development. If a test or a performance measurement is not ready by the scheduled time, a replacement shall be developed or the requirement dropped.

C.3.2.3 Development of ILSAC Draft

C.3.2.3.1 Review of Proposed ILSAC Draft Specifications

After agreement has been reached on the need, tests and alternatives have been identified, and timing has been established, the ILSAC/Oil Committee is charged with developing a draft specification. Performance-based rather than composition-based standards should be used to the maximum extent feasible. The ILSAC/Oil Committee may consider proposed requirements submitted by any stakeholder in the engine oil category development process (ILSAC, API, ACC, a company, an individual, or another association). After considering these inputs, the ILSAC/Oil Committee may send its proposed draft to the ASTM Passenger Car Engine Oil Classification Panel (PCEOCP) for review within a specified timeframe. If appropriate, the ILSAC/Oil Committee may also send the proposed draft to JASO and CEC.

As necessary, the ASTM PCEOCP, JASO and/or CEC will be asked to review the proposed draft, and within a specified timeframe, prepare an informal report for the ILSAC/Oil Committee to consider. The following inputs will be requested from the ASTM PCEOCP, and if necessary JASO and CEC, during this review:

a. The groups will evaluate the proposed draft specification and limits and provide comments on whether the proposed test methods will evaluate the needs defined by the ILSAC/Oil Committee.
b. Each group will be requested to issue a report to the ILSAC/Oil Committee that contains a summary of comments and data received during the group’s proceedings.

While the ILSAC/Oil Committee may seek input from the ASTM PCEOCP, JASO, and CEC, the ILSAC/Oil Committee may proceed with category development if the results of these reviews are not delivered within a specified timeframe. Pursuant to the consensus process specified in C.2.2, the ILSAC/Oil Committee will issue a draft ILSAC specification for review and comment by all interested parties (see C.3.2.4).

C.3.2.3.2 Formalization of Tests

In parallel with C.3.2.3.1, the Administrative Guidance Panel is responsible for forming a group to develop the funding basis for conducting industry precision matrix testing, if necessary. This group should include representatives from the principal stakeholders in the process: ILSAC, API, ACC, independent test laboratories, and other parties deemed appropriate.

Once a new test becomes available (e.g., shows satisfactory discrimination of oil performance) pursuant to C.3.2.2, the appropriate industry group (ASTM, CEC, JASO) will determine test precision.

For example, if an engine test is being developed by ASTM, the ILSAC/Oil Committee will provide a specified timeframe to ASTM. It is ASTM's responsibility to have a functioning task force or surveillance panel in place to coordinate activities and analyze test data including determining when a test is ready for matrix testing. For bench tests, ASTM must provide a method for referencing and/or calibrating each bench test that does not have an assigned surveillance panel. Based on the ILSAC/Oil Committee's agreed upon timeline, ASTM will also develop a timetable that contains, among other things, planned dates for reference oil selection, bench and engine test selection, and test method completion. The objective is to formalize the tests and establish criteria to demonstrate that the tests are precise, are reproducible, and have the ability to discriminate. All applicable engine and bench tests shall be monitored by the TMC (or equivalent) prior to incorporation into the final specification (see C.3.3).

If ASTM fails to discharge these responsibilities in a timely manner, the ILSAC/Oil Committee shall take appropriate actions to ensure that the timing identified in C.3.2.1 for implementing the specification will be met. This may include developing an ILSAC specification containing alternative test methods.

C.3.2.4 Industry Review of ILSAC Draft Specification

The draft ILSAC specification developed in C.3.2.3 will be circulated to all interested parties for comment. The ILSAC/Oil Committee will solicit comments in writing and will hold public forums as deemed appropriate. The ILSAC/Oil Committee will review the comments and data from the industry received in C.3.2.3 before determining the requirements and limits for the final specification. If there are significant changes in the requirements between the draft and the final specification, the ILSAC/Oil Committee will conduct another comment period on the revised specification. All comment periods will be for a period of at least 30 days. A longer review period may be allowed for comments on an initial draft.

In parallel with industry review of the draft ILSAC specification, API will solicit data on category demonstration oils (see item b of C.3.3.1) in such a manner as to maintain confidentiality of individual company data.

C.3.3 Category Finalization

C.3.3.1 Review of Development Process

At or near the end of the development of the new category (e.g., prior to C.3.3.2), the ILSAC/Oil Committee shall confirm that the following items have been addressed:

a. (1) The tests developed satisfy the needs agreed to by the ILSAC/Oil Committee, (2) the performance descriptions contained in the proposed consumer language are met by the tests

proposed for the category, (3) the timetable is acceptable, (4) and the test methods chosen to define the new standard represent the best means of establishing the new performance level.

b. Available data on demonstration oils have been reviewed. A demonstration oil shows the technical and commercial viability of the proposed new engine oil category. This is an oil formulated with base stock and additive components expected to be commercially available when licensing of the new category begins. The oil shall have been tested in and passed, at the proposed limits, all engine, chemical, physical and bench tests required in the draft specification, according to the ACC Code of Practice[1] in effect at the time the tests are run (for engine tests). Registration is not needed, but stand calibration is required.
c. If sufficient information on a demonstration oil is not available, ILSAC/Oil will re-evaluate the draft specification for technical and commercial viability. While information on a demonstration oil is useful as input to the limit-setting process and may help achieve consensus, the demonstration oil is not required prior to achieving the ILSAC/Oil Committee consensus pursuant to item a of C.3.3.2.
d. All industry comments on the proposed specification have been reviewed to ensure that they have been considered and addressed by the ILSAC/Oil Committee in sufficient detail.

C.3.3.2 Approval of the Final ILSAC Specification

When the ILSAC/Oil Committee agrees that its original goals and objectives appear to have been met, the ILSAC/Oil Committee will promptly convene to vote on acceptance of the final ILSAC specification. The specification may be issued by ILSAC under the following conditions:

a. Two thirds of the ILSAC representatives and 2/3 of the Oil representatives vote in favor of the specification.
b. If the ILSAC/Oil Committee is unable to reach a consensus position on the final specification, then ILSAC may, after providing notice to all interested parties, unilaterally issue the specification. ILSAC shall document the rationale for unilaterally issuing the specification.

When the specification has been approved pursuant to item a or b above, ILSAC shall publish the final specification and send copies to all interested parties. A copy of the final specification shall be transmitted by the Chair of the ILSAC/Oil Committee to the Chair of the API Lubricants Committee for further action pursuant to C.4.

C.4 API LUBRICANTS COMMITTEE APPROVAL OF LICENSING AND CRITERIA

C.4.1 A meeting of the API Lubricants Committee will be scheduled as soon as possible after API has received the final ILSAC specification. The Lubricants Committee will vote whether to accept the ILSAC specification as the basis for licensing of the API Starburst via letter ballot pursuant to API standardization policies.

In resolving negative ballots, the Chair of the Lubricants Committee will consider whether the issue that was raised in the negative ballot was (1) adequately addressed in the ILSAC/Oil process and (2) raised in a timely manner.

[1] Provided the ILSAC/Oil Committee has accepted the Code of Practice as a basis for engine testing.

C.4.2 When submitting an ILSAC specification that has been approved pursuant to item b of C.3.3.2, ILSAC must provide documentation that the following criteria have been satisfied:

a. Complied with due process requirements.
b. Provided justification for overriding any technical objections raised during the ILSAC/Oil process.
c. Provided data on at least one demonstration oil meeting all of the requirements defined in item b of C.3.3.1 at the time the specification is delivered.
d. Showed that the ILSAC specification oil will be reasonably achievable and will likely be widely available to consumers within the specified timeframe (e.g., recommended additional time for compliance).
e. Based on data from items c and d above, showed that the ILSAC specification provides significantly more needed benefits to consumers (as identified in C.3.1) than any other specification proposal the ILSAC/Oil Committee considered.

C.4.3 If the API Lubricants Committee does not adopt the ILSAC specification or if the ILSAC/Oil Committee cannot achieve consensus on needs, the Administrative Guidance Panel will convene to consider dissolution of the Starburst system.

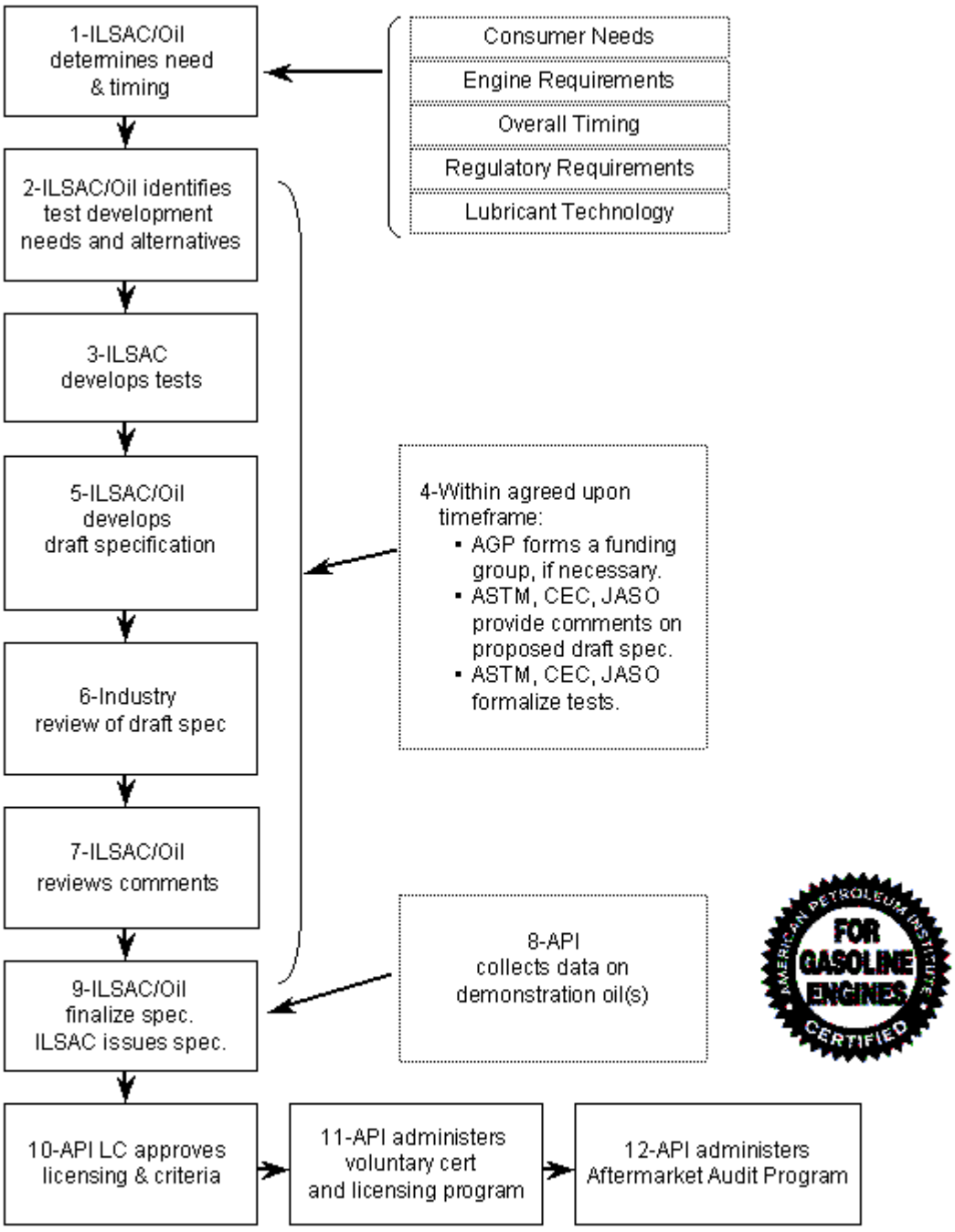

Figure C-1—Process for Developing New Engine Oil Performance Standards for the API Certification Mark

APPENDIX D—Developing New Diesel Oil Performance Standards for API C Service Categories

D.1 General

One of the objectives of API's voluntary Engine Oil Licensing and Certification System (EOLCS) is to help consumers identify lubricants that meet the needs of their vehicles. This is accomplished through the use of category designations within the API Service Symbol. These categories are based on engine oil performance specifications that require close coordination and consensus among the affected parties. Technical societies, trade associations, lubricant and additive marketers, vehicle and engine manufacturers, independent testing laboratories, and consumers play essential roles in defining and developing new minimum lubricant performance standards. This appendix outlines the roles and responsibilities of each organization in the heavy-duty diesel oil specification development process for API licensing.

API is responsible for licensing engine oil marketers against and enforcement of lubricant performance standards adopted for use in EOLCS. The API Lubricants Committee must grant final approval to any new category and recommend its inclusion in EOLCS.

D.2 API C Service Categories for Diesel Oils

The C Service Category Development Process for diesel oils is designed to accomplish the following:

a. Justify and validate the need for a new category.
b. Achieve stakeholder consensus early in the process.
c. Establish funding sources for all necessary category components.
d. Optimize the process for developing and approving new categories.

A new C category is developed in three phases, as summarized in Figure D-1.

D.3 Category Development Phases

D.3.1 PHASE 1: CATEGORY REQUEST/EVALUATION

D.3.1.1 Sponsor

A new definition of oil performance that may eventually result in a new category can be requested by any individual, company, or association (see Figure D-2). This party is referred to as the sponsor of the request.

D.3.1.2 Evaluation Process

The purpose of the evaluation process is to determine whether there is a need for the proposed category. To invoke the evaluation process, a sponsor must submit a new category request to the Chairpersons of the Joint API/EMA Diesel Engine Oil Advisory Panel (DEOAP).

The DEOAP is a formally constituted committee composed of representatives from API and EMA member companies who deal with heavy-duty lubricant matters affecting the two trade associations. The

DEOAP will guide and facilitate the introduction of proposed heavy-duty performance categories. In addition to DEOAP members, liaison representatives from allied organizations—for example, ACC, SAE, ASTM, ILMA, and the U.S. Army—may also participate.

The Chairpersons of the DEOAP will acknowledge the receipt of the new category request and will work with the category sponsor to furnish the DEOAP with the information necessary to make a decision. The DEOAP has 6 months from the date that all the requested information has been presented to make a decision to either accept or reject the request for a new category. If no decision on the request is made within 6 months, it is automatically forwarded to the API Lubricants Committee for its members' information and disposition.

The sponsor must provide adequate data and justification for the proposed category. The request must demonstrate a need for significant oil performance changes to meet requirements not met by existing categories. Justification should include, but is not limited to, one or more of the following:

a. Likely or impending government regulations.
b. Consumer-driven needs.
c. New hardware design or service requirements.

D.3.1.3 New Category Evaluation Team (NCET)

The Chairpersons of the DEOAP will ask API, EMA, and ACC to appoint representatives to serve on an ad hoc review team that will formally evaluate each request for a new category—a New Category Evaluation Team (NCET).

NCET membership will be limited to the minimum number needed to accomplish the work while remaining consistent with full technical representation. This number may vary depending on the requested category. API, EMA, and ACC may each have up to three representatives on the NCET. At the first meeting the NCET will develop working rules, elect a chairperson, decide who to invite as liaison representatives, and request a meeting with the sponsor. The API, EMA, and ACC representatives are equal participants and decision making by consensus will be strongly encouraged. However, if that is not possible, decision making will be assumed by API and EMA representatives through majority vote. In the case of a tie vote, the request will be addressed by the DEOAP. All NCET meetings will be open to API, EMA, and ACC member company representatives and others.

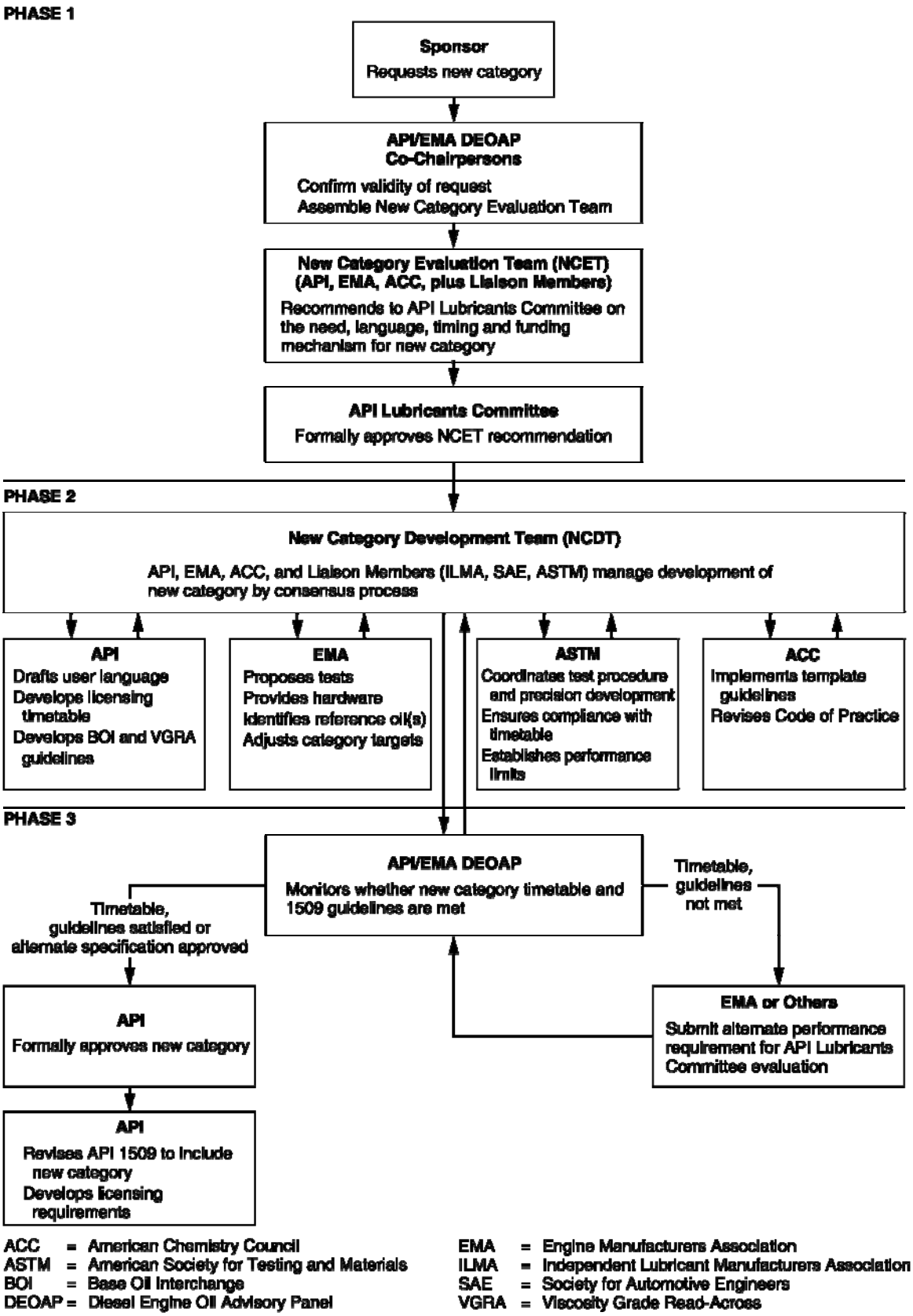

Figure D-1—Heavy Duty Category Request/Approval Process

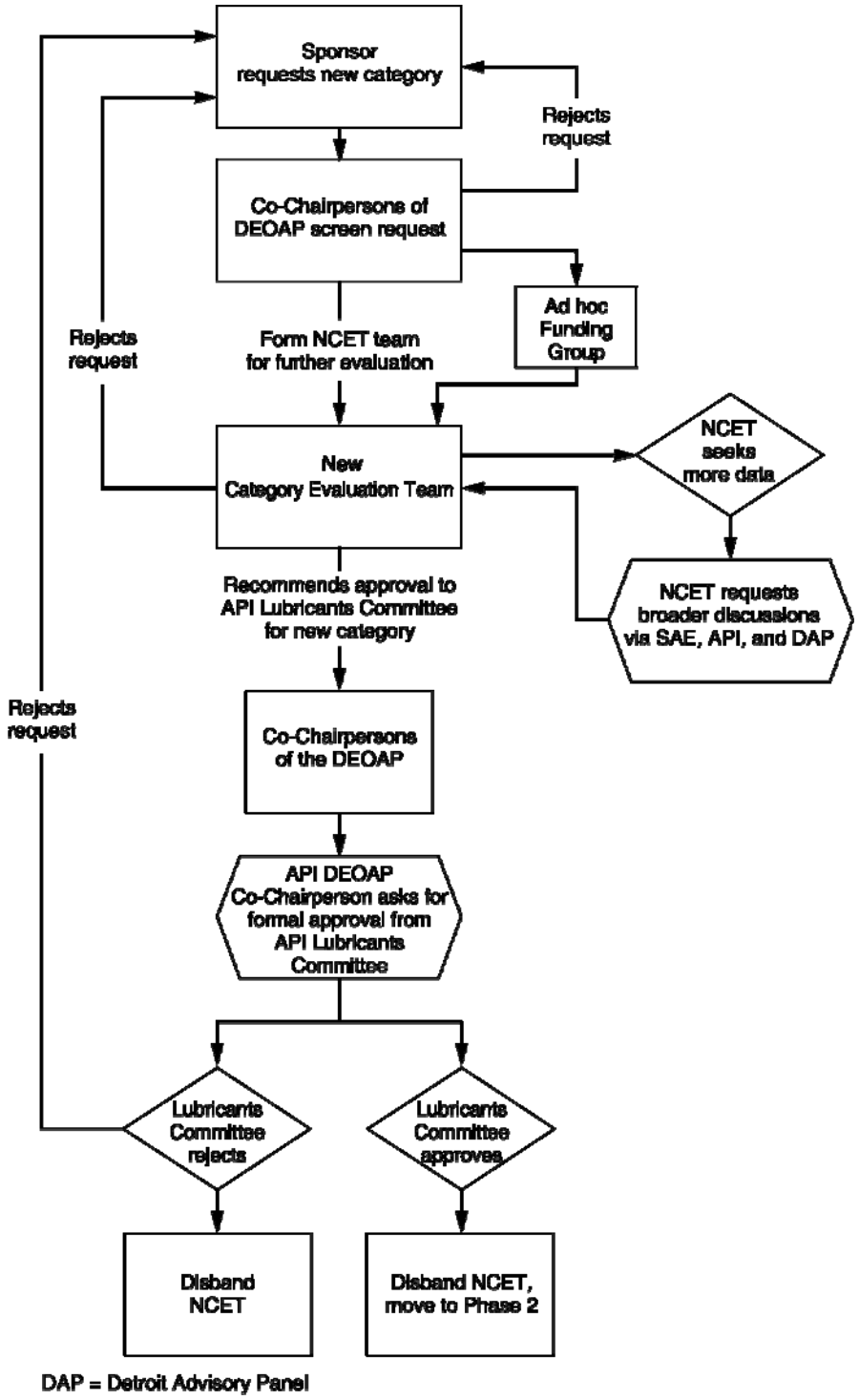

Figure D-2—Phase 1: Category Request/Evaluation

D.3.1.3.1 NCET Evaluation Responsibilities

The NCET will work to reach consensus positions on the following questions:

a. What is the proposed change and why is it required?
b. Does data presented support the request?

c. When is it needed in the marketplace?
d. What are the potential impacts on engines?
e. What are the potential impacts on consumers?
f. What are the potential impacts on the environment?
g. How could the change affect existing API categories?
h. Are performance tests available that properly evaluate the performance needs requested?
i. Do the perceived benefits outweigh the projected costs?
    1. How much will it cost to develop test procedures and determine precision and define, if necessary, Base Oil Interchange (BOI) and Viscosity-Grade Read-Across (VGRA) Guidelines for the proposed category?
    2. What is the estimated total cost to carry out projected work for the new category if the need is approved?

Note: The DEOAP is responsible for calculating an estimated total cost for developing the proposed category and ensuring that an agreement in principle is reached on category development funding before submitting the request to the API Lubricants Committee. To that end, the DEOAP Co-Chairpersons will establish an ad hoc Task Force for that specific purpose. This group should include representatives from the principal stakeholders in the process: API, EMA, ACC, independent test laboratories, and other parties deemed appropriate.

The NCET may solicit additional industry input and data at any time to assist it in reaching a decision. Any industry group (e.g., SAE, API Detroit Advisory Panel [DAP], and EMA) can be asked to provide supplemental information.

The NCET's specific charge is to evaluate the request and to make one of the decisions below:

a. Support the request for the new category and recommend to DEOAP that the request be forwarded to the API Lubricants Committee for consideration to proceed with category development. This recommendation shall identify the need for the category, recognize its feasibility, provide a timetable for category development, suggest draft language for the category, and identify the proposed method for funding development of the new category. The API Co-Chairperson of the DEOAP shall present the DEOAP recommendation, along with appropriate documentation, to the API Lubricants Committee for consideration at its next meeting.

or

b. Deny the request, explaining to the sponsor in writing the reasons for the denial. The sponsor has the option of resubmitting the request with additional information.

or

c. Not reach consensus. If the NCET cannot reach consensus on the request for a new performance category, the API Co-Chairperson shall provide the API Lubricants Committee with the vote outcome and a summary of the reasons for the action.

D.3.1.3.2 API Lubricants Committee

The API Lubricants Committee must approve or deny the recommendation by formal vote. If denied, the API DEOAP Co-Chairperson will provide the sponsor with a written explanation outlining the Lubricants Committee's reasons for disapproval. The sponsor may then make a new request with modifications based on the Lubricants Committee actions.

If the API Lubricants Committee approves the NCET recommendation for the new category, the API DEOAP Co-Chairpersons will move the process forward, and development of the new category will commence. Independent of whether the Lubricants Committee approves or denies the request, the ad hoc NCET disbands at this point in the process.

D.3.2 PHASE 2: CATEGORY DEVELOPMENT

D.3.2.1 New Category Development Team (NCDT) Responsibilities

When the API Lubricants Committee approves the request for new category development, the API DEOAP Co-Chairpersons will convene an ad hoc New Category Development Team (NCDT) (see Figure D-3).

The NCDT will function under the same guidelines as the NCET (see D.3.1.3). However, the API, EMA, and ACC representatives need not be the same as those on the NCET. The NCDT will decide on working rules, select a chairperson or facilitator, and, as with the NCET, invite liaison representatives from other groups or affected parties: ASTM, SAE, ILMA, independent test laboratories, or others as required. Other national, regional or international bodies—for example, JAMA—may also be asked for input during category implementation.

The DEOAP Co-Chairpersons will explain to the NCDT any conditions established by the Lubricants Committee, including, but not limited to, the following:

a. The proposed draft language for the category.
b. The proposed timetable.

The DEOAP Co-Chairpersons are responsible for ensuring that funding sources are established to cover the specific costs for all necessary category components. These components, which may include development of new engine and bench tests and precision matrix testing, are identified and confirmed during Phase 2 by the functional work groups: for example, ASTM and the NCDT, respectively. The DEOAP Co-Chairpersons will establish a new ad hoc funding Task Force or reconvene the Task Force used to arrive at the agreement in principle on funding (see D.3.1.3.1). The composition of this Task Force will be constituted in the same manner as the original one and function in a similar way.

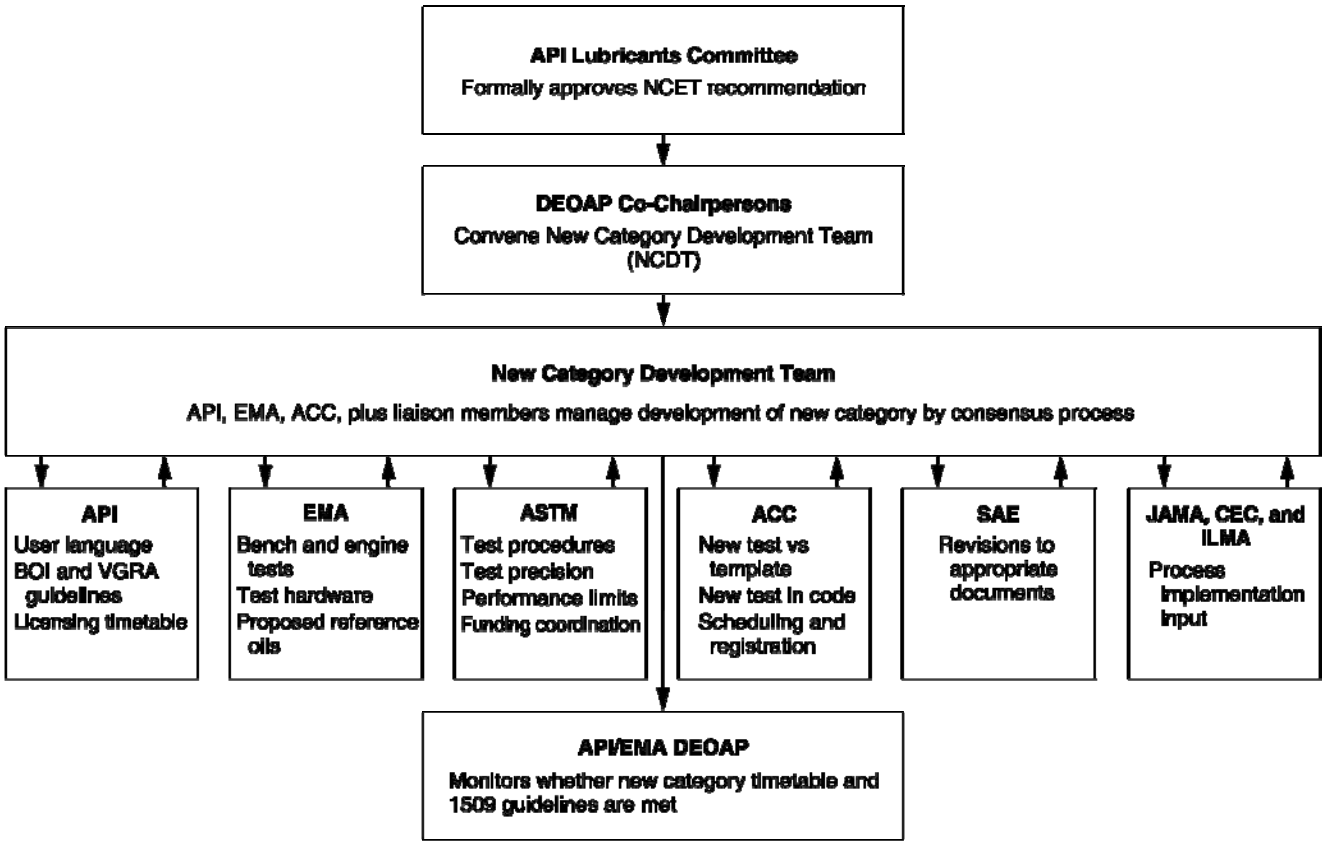

Figure D-3—Phase 2: Category Development

The NCDT will manage and coordinate the new process working toward final approval within the timetable and budget. The Co-Chairpersons will monitor the process on behalf of the EMA and API Lubricants Committees and periodically report on progress to them. In addition, the Co-Chairpersons will carry out any other liaison functions that are not covered by the responsibilities of the NCDT.

D.3.2.2 Specific Duties of NCDT

The NCDT will manage all phases of category development through four functional work groups chaired by NCDT members: an API member will manage the API function, an EMA member the EMA function, an ACC member the ACC function, and another NCDT member the ASTM and SAE functions.

D.3.2.2.1 API Function

a. Ensure that no conflicts develop between existing categories and the one proposed.
b. Coordinate with the API BOI/VGRA Task Force on its development of base oil interchange and viscosity-grade read-across guidelines based on data (including ASTM matrix testing), engineering judgment, and field experience.
    1. Ensure that matrix testing is conducted for the new engine tests in accordance with the plan developed by the NCET (see D.3.1.3.1) so that sufficient data is available to allow the establishment of appropriate BOI and VGRA Guidelines simultaneous with the establishment of the category performance criteria.

2. Review proposed BOI/VGRA Guidelines with the NCDT before formal approval. These guidelines will be embodied in the new category request when it is forwarded to the API Lubricants Committee to consider for inclusion in API 1509, Engine Oil Licensing and Certification System.

c. Draft a timetable to enable licensing at the earliest practicable date. That timetable will indicate the dates at which first allowable licensing can occur for the new category. Normally, the first allowable licensing date for a new category is 1 year after ASTM Subcommittee B formally approves the new performance standard used to define the category. This delay allows all oil marketers equal opportunity to meet the category requirements.
d. Develop draft Consumer User Language. The final version of that language will be approved by the API and EMA Lubricants Committees.
e. Ensure that emergent marketing or consumer issues that arise during category development are brought to the attention of responsible groups for resolution.

D.3.2.2.2 EMA Function

a. Guide the selection process for appropriate reference oils as well as low and high discrimination oils. At least one reference oil must be identified that meets all the bench and engine tests contained in the new category. The oil shall be used in test development and reformulated as necessary to ensure the best measure of performance. Before any new minimum performance category can be established by ASTM, at least one reference oil must be able to meet all category requirements. This reference oil shall have been engine tested in accordance with the *ACC Code of Practice*.

   The new category sponsors or their designee will have the primary responsibility for recommending oil selections. The DEOAP will provide feedback and formally approve the selections, and the selections will be reviewed with ASTM.

Note: “Discrimination” oils should be available for each test. It is highly desirable that the minimum performance reference oil represent the performance level of the oil category being superseded and the high performance reference oil meet the expected performance level of the new category.

b. Recommend and/or provide relevant engine tests and hardware, with or without a test procedure.
c. Stay abreast of changes that may occur (government-, industry-, or consumer-generated) and, when necessary, suggest modifications to the new category to ensure that it will meet the predetermined target (see D.3.1.3.1). Coordinate any necessary modifications in language and tests with the NCDT.

D.3.2.2.3 ACC Function

a. Assess the new tests against the criteria of the ACC Code of Practice Template with the objective of optimizing cost-effective engine testing quality. Test precision and discrimination are examples of qualities to be assessed. Provide analysis of these assessments to the DEOAP and NCDT.
b. Incorporate the new engine tests that meet the Template into the ACC Code together with accompanying test scheduling and registration procedures.

D.3.2.2.4 ASTM and SAE Function

a. Work through ASTM Section D02.B0.02 Heavy-Duty Engine Oil Classification Panel to select or develop test methods that evaluate the needs defined by the NCET.

b. Ensure that the bench and/or engine tests selected for the new category will satisfy the requirements of the draft consumer language approved by the API Lubricants Committee. The NCDT and ASTM will also develop a timetable that contains, among other things, planned dates for reference oil selection, bench and engine test selection, and test method completion. Dates must agree with those approved by the Lubricants Committee (see D.3.2.1). Tests should correlate with field experience.
c. Provide input, as requested, to the new category sponsors in the selection of appropriate discrimination reference oils for the individual tests in the new proposed category (see D.3.2.2.2).
    1. Coordinate with other appropriate technical societies, such as SAE, to develop and approve written test procedures and limits for tests not within the ASTM system that will be published as standards and specifications.
    2. Once a test shows satisfactory discrimination of oil performance, conduct matrix testing to determine test precision and assess base oil and viscosity-grade effects. If, for example, an engine test is being developed by ASTM, it is ASTM's responsibility to have a functioning task force or surveillance panel in place to coordinate activities and analyze test data. For bench tests, ASTM must provide a method for referencing and/or calibrating each bench test that does not have an assigned surveillance panel.
d. Implement and coordinate through the appropriate ASTM group the funding mechanism recommended by the NCET and approved by the API Lubricants Committee for the development of tests, precision, and base oil interchange. Also establish the high reference/"passing" category oil for the Test Monitoring Center.
e. Establish pass/fail limits for each test and the entire category.
f. Update SAE "J" documents as appropriate.

D.3.2.3 Category Completion

At or near the end of the development of the new category, the NCDT must undertake a number of actions to bring the process to a successful conclusion. In general, these actions are to review the output of the four functional groups and advise as necessary to ensure completion as well as harmony among the discrete parts. Specific actions are as follows:

a. For the ASTM functional group, review the appropriateness of the test data developed for discrimination and precision. Agree on the final description for each new performance test and that the optimum test methods and performance limits have been chosen. (At least one "demonstration" reference oil capable of meeting all minimum performance criteria is required.)
b. For the ACC functional group, ensure that the ACC Code includes each of the new engine performance tests.
c. Obtain from SAE and other cooperating agencies any standards, codes, and publications that are necessary parts of the new category.

When the NCDT is in agreement that all of its original goals and objectives have been met, the team will forward all procedures, facts, data, and information that is pertinent to the new category to the DEOAP. The DEOAP will promptly convene and together with the NCDT ensure that (1) the tests developed under NCDT guidance satisfy the need expressed by the original sponsor, (2) the performance targets contained in the proposed consumer language are met by the tests proposed for the category, (3) the timetable is acceptable, (4) and the test methods chosen to define the new standard represent the most cost-effective means of establishing the new performance level. All input is evaluated, including API BOI and VGRA Guidelines. The complete package is then presented by the DEOAP Co-Chairpersons, with a recommendation for formal approval, to the API Lubricants Committee. API must approve the complete package including the final consumer language.

D.3.3 PHASE 3: CATEGORY IMPLEMENTATION

D.3.3.1 Alternate Category Development Process

As stated in D.3.2.1, the Co-Chairpersons will monitor the category development process to ensure adherence to the timeline as well as other applicable API1509 new category guidelines (see Figure D-4).

If unanticipated problems or situations arise that cannot be overcome and that unduly delay category development or prevent original plans from meeting expectations, EMA may choose to develop minimum performance requirements or a new category for API consideration through a process of their own choosing outside of the processes herein described. However, before this or any new minimum API performance category is adopted, it must be approved by the API Lubricants Committee at which time it may be incorporated into API1509.

D.3.3.2 Normal Category Development Process

Upon agreement between the NCDT and DEOAP that all parameters of the new category that were approved by the API Lubricants Committee during the evaluation phase have been met (see D.3.2.3), the final approval procedure is implemented. However, if for some reason, full, complete approvals have not been obtained, the DEOAP will carry out the necessary negotiations to resolve differences.

When all differences are resolved, the final specification will include its API Category Designation, a description of performance parameters, pass/fail limits, BOI and VGRA Guidelines, ACC Code requirements, and consumer language. Timelines for licensing will also be designated by API.

After final approval is obtained, API staff will be responsible for issuing revisions to API 1509 and advising oil marketers and other affected parties of the new licensing standard.

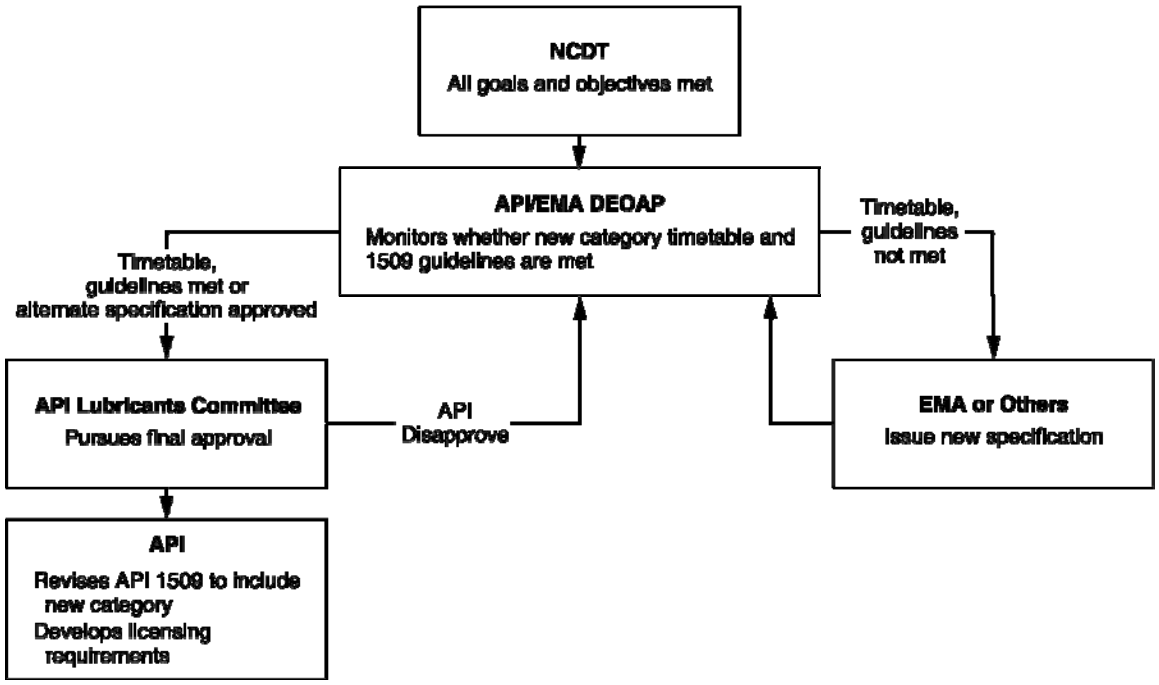

Figure D-4—Phase 3: Category Implementation

D.4 Supplement to Existing C Category

An individual, company, or association may propose to the DEOAP that a Supplement to an existing C Category be developed to meet an urgent field performance need. If developed and approved, this Supplement would be incorporated into API 1509 as a separate, licensable classification in the lower portion of the API Service Symbol "Donut." The Supplement would not replace the existing C Category; however, it would establish additional performance requirements beyond those originally approved for the Category. Oils licensed against the existing C Category specification would remain licensed.

Since the request for the Supplement results from an urgent field performance need, the development process is designed to move more quickly than the traditional C Category development process. This "fast track" process is managed by the DEOAP and is intended to minimize retesting and oil qualification time.

D.4.1 SUPPLEMENT EVALUATION

The DEOAP will formally evaluate each request for a Supplement to an existing C Category. Decision-making by consensus will be strongly encouraged. However, if that is not possible, decision-making will be assumed by API and EMA representatives through majority vote. In the case of a tie vote, DEOAP will continue to work to achieve a consensus but, if unable to do so, will refer the request to the API Lubricants Committee for resolution.

For a proposed C Category Supplement to move forward, DEOAP should consider the following items:

a. Tests must be developed and be ASTM-approved or have made significant progress toward ASTM approval.
b. Oils are being marketed that meet the proposed Supplement.
c. Multiple technologies have been shown to meet the proposed Supplement.
d. There is no previous Supplement for this category (one Supplement per Category).

The DEOAP will work to reach consensus positions on the following questions:

a. What is the proposed change and why is it required?
b. What field performance issues support the need for a Supplement?
c. Does data presented support the request?
d. When is it needed in the marketplace?
e. What are the potential impacts on engines and aftertreatment devices?
f. What are the potential impacts on consumers?
g. What are the potential impacts on the environment?
h. Can the tests requested for the Supplement be used for the next full, new C Category?
i. Are the requested performance tests available, or will they be available within the requested time frame, that properly evaluate the requested performance needs?
j. Do the perceived benefits outweigh the projected costs?

Note: Since a Supplement will rely heavily on engine manufacturer tests and/or performance specifications, EMA members will be responsible for determining and justifying the economics for development.

The DEOAP may solicit further industry input and data at any time to assist it in reaching a decision. Any industry group [e.g., SAE, API Detroit Advisory Panel (DAP), ACC and EMA] can be asked to provide additional information.

The DEOAP must decide to:

a. Support the request for the Supplement and forward it to the API Lubricants Committee for consideration to proceed with development. This recommendation shall identify the need for the Supplement to an existing Category, recognize its feasibility, provide a timetable for development, suggest draft language for the Supplement, and verify funding of the development. The API Co-Chairperson of the DEOAP shall present the DEOAP recommendation, along with appropriate documentation, to the API Lubricants Committee for consideration at its next meeting.

or

b. Deny the request, explaining to the sponsor in writing the reasons for the denial. The sponsor has the option of resubmitting the request with additional information. The API Co-Chairperson of the DEOAP shall report this denial to the API Lubricants Committee.

or

c. Not reach consensus. If the DEOAP cannot reach consensus on the request for a Supplement, the API Co-Chairperson shall provide the API Lubricants Committee with the vote outcome and a summary of the reasons for the action.

D.4.2 API LUBRICANTS COMMITTEE

The API Lubricants Committee must approve or deny the recommendation for a Supplement by formal vote. If denied, the API DEOAP Co-Chairperson will provide the sponsor with a written explanation outlining the API Lubricants Committee's reasons for disapproval. The sponsor may then make a new request to the DEOAP with modifications based on the API Lubricants Committee actions.

If the API Lubricants Committee approves the DEOAP recommendation for the Supplement, the DEOAP Co-Chairpersons will proceed with development.

D.4.3 SUPPLEMENT DEVELOPMENT

When the API Lubricants Committee approves the request for development of a C Category Supplement, the DEOAP will follow the Fast-Track process outlined on Figure D-5. A comparison of the fast track supplement process and the normal C Category process is shown on Table D-1 for guidance.

The DEOAP Co-Chairpersons will explain any conditions established by the Lubricants Committee, including, but not limited to, the following:

a. The proposed draft language for the Supplement.
b. The proposed timetable.

Development of a Supplement will be fast-tracked by relying on the following principals:

a. Performance requirements will be based primarily on tests developed by Original Equipment Manufacturer (OEM) sponsors.
b. Oils meeting the Supplement must maintain the performance criteria of the corresponding C Category.
c. Oils licensed by API for the Supplement must also be licensed for the corresponding C Category.

d. The ASTM HDEOCP, or the appropriate Surveillance Panel or Test Development Task Force, must deem engine tests as suitable for use in the Supplement, and the tests must be monitored by TMC.
e. Engine tests must be run in ASTM calibrated stands and meet performance limits and read-across guidelines established by the OEM test sponsor OR applicable engine test results must be reviewed by the test sponsor and deemed acceptable (see Section D.5 regarding OEM review).

D.4.4 ASSOCIATION FUNCTIONS—CATEGORY SUPPLEMENT

D.4.4.1 OEM Test Sponsor

The OEM sponsoring each individual test shall fulfill the following requirements:

a. Justify the need for the test and performance limits.
b. Provide test hardware.
c. Provide a test procedure.
d. Provide discrimination and precision data.
e. Provide suggested initial BOI and VGRA Guidelines.
f. Provide suggested pass/fail limits.

D.4.4.2 API

API shall fulfill the following requirements:

a. Ensure that no conflicts develop between existing Categories and the proposed new Supplement.
b. For the Supplement, ensure that the test sponsor provides sufficient input to allow adoption of appropriate BOI and VGRA Guidelines simultaneous with the establishment of the Supplement performance criteria. Coordinate these activities with the API BOI/VGRA Task Force.
c. Draft a timetable to enable Supplement licensing at the earliest practicable date. This timetable will indicate the dates at which first allowable licensing can occur. Supplement requests will generally be approved based on a more urgent need for enhanced performance in the field. Therefore, every effort will be made to license use of a Supplement designation at the earliest possible date, after the performance tests are accepted for use and limits are defined.
d. Develop draft Consumer User Language. The final version of that language will be approved by the API and EMA Lubricants Committees.
e. Ensure that emergent marketing or consumer issues that arise during development of a Category Supplement are brought to the attention of responsible groups for resolution.

D.4.4.3 EMA

EMA shall fulfill the following requirements:

a. Recommend the combination of engine and bench tests to define the Supplement.
b. Establish the engine and bench test limits.
c. Guide the selection process for appropriate reference oils as well as low and high discrimination oils.
    1. Since a Supplement incorporates new tests from engine builder specifications, the sponsor of the test must identify reference oils that demonstrate that performance differentiation can be achieved. The sponsor should also provide information illustrating that passing a

new test is sufficient to meet the performance criteria of the existing C Category upon which the Supplement is based.

2. The new Supplement sponsors or their designees will have the primary responsibility for recommending oil selections. The DEOAP will provide feedback and formally approve the selections, and the selections will be reviewed with ASTM.

Note: "Discrimination" oils should be available for each test. It is mandatory that the minimum performance discrimination oil meet the performance level of the oil Category being superseded and the high performance discrimination oil meet the expected performance level of the new Supplement.

d. Recommend and/or provide relevant engine tests and hardware, with or without a test procedure.

Note: Test procedures must be provided for fast-tracking development of a new Supplement.

D.4.4.4 ACC

ACC shall fulfill the following requirements:

a. Assess any new tests against the criteria of the ACC Code of Practice Template with the objective of optimizing cost-effective engine testing quality. Test precision and discrimination are examples of qualities to be assessed. Provide analysis of these assessments to the DEOAP.
b. Consider incorporating the new engine tests that meet the Template into the ACC Code together with accompanying test scheduling and registration procedures.

D.4.4.5 ASTM and SAE

ASTM and SAE shall fulfill the following requirements:

a. Ensure that the engine and/or bench tests selected for the new Supplement will satisfy the requirements of the draft consumer language approved by the API Lubricants Committee. Dates indicated must agree with those approved by the API Lubricants Committee (see D.4.2). Tests should correlate with field experience.
b. Provide input, as requested, to the new Supplement sponsors in the selection of appropriate discrimination reference oils for the individual tests in the new proposed Supplement (see D.4.4.3).
    1. ASTM will coordinate with other appropriate technical societies, such as SAE, to develop and approve written test procedures and limits for tests not within the ASTM system that will be published as standards and specifications.
    2. It is ASTM's responsibility to have a functioning Development Task Force or Surveillance Panel in place to coordinate activities and analyze test data. For bench tests that do not have an assigned Surveillance Panel, ASTM must provide referencing and/or calibration methods
c. Update SAE "J" documents as appropriate.

D.4.5 SUPPLEMENT COMPLETION

D.4.5.1 Category Supplement

When the DEOAP is in agreement that all of its original goals and objectives have been met, the DEOAP will promptly convene to ensure that (1) the tests involved satisfy the needs expressed by the original sponsor, (2) the performance targets contained in the proposed consumer language are met by the tests

proposed for the Supplement, (3) the timetable is acceptable, (4) and the test methods chosen to define the new Supplement represent the most cost-effective means of establishing the new performance level. All input is evaluated, including API BOI and VGRA Guidelines. The DEOAP will carry out the above functions to the extent possible, considering the fast-track process used to develop the Supplement.

D.4.5.2 API Lubricants Committee Approval

The complete package describing a new C Category Supplement is then presented by the DEOAP Co-Chairpersons, with a recommendation for formal approval, to the API Lubricants Committee. The API Lubricants Committee must approve by letter ballot the complete package including the final consumer language. If the API Lubricants Committee does not approve the C Category Supplement package, they must send it back to the DEOAP indicating changes necessary for approval or reasons for an outright rejection.

D.4.6 CATEGORY SUPPLEMENT IMPLEMENTATION

Upon agreement between the DEOAP members that all parameters of the new Category Supplement that were approved by the API Lubricants Committee during the evaluation phase have been met, the final approval procedure is implemented. However, if for some reason, full, complete approvals have not been obtained, the DEOAP will carry out the necessary negotiations to resolve differences.

When all differences are resolved, the final specification will include its API Category Supplement Designation, a description of performance parameters, pass/fail limits, BOI and VGRA Guidelines, ACC Code requirements, and consumer language. Timelines for licensing will also be designated by API.

If, during this step, the DEOAP makes any changes to the package approved by the API Lubricants Committee, these changes must be presented by the DEOAP API Co-Chairperson to the API Lubricants Committee for final approval.

After final approval is obtained, API staff will be responsible for issuing revisions to API 1509 and advising oil marketers and other affected parties of the new licensing standard.

D.5 Supplement Performance Requirements and Documentation

It is expected that the performance tests and limits for a new Supplement will be listed in applicable industry documents, such as ASTM D 4485. However, since a Supplement is developed with a fast-track process to meet an urgent technical need and with an expedited time to first license, it is important that the performance needs and limits for an active Supplement are incorporated into API 1509 as soon as possible.

D.5.1 ACTIVE SUPPLEMENT REQUIREMENTS

The performance requirements and test limits for an approved Supplement are outlined in Appendix S of API 1509. CI-4 PLUS is the only active C Category Supplement for which an API license can be issued as of September 1, 2004.

D.5.2 SUPPLEMENT PERFORMANCE CERTIFICATION

A marketer that wants to license an oil against the Supplement requirements must attest in the API license application that the product meets the requirements of the Supplement and its associated C Category. For the C Category, this means following the traditional process for licensing the oil with API (i.e., the marketer attests that the product has been tested in accordance with and met all applicable requirements for the Category as defined in API 1509, the ACC Code, SAE J300, and ASTM D 4485).

For the Supplement, the marketer must meet the specific performance requirements approved by the DEOAP and the API Lubricants Committee. However, the fast-track process also allows marketers to apply technical judgment in lieu of candidate engine test results. If technical judgment is applied, it must be documented in one of two ways in cooperation with the OEM test sponsor:

a. Formal OEM approval (e.g., oil is listed on an OEM approval list or an OEM approval letter has been issued for the oil).
b. Confirmation of OEM review. If this method is used, the marketer must indicate in Part B of the EOLCS application that the OEM has reviewed the pertinent data and agreed the product meets the requirements of the Supplement. The marketer must submit a Part F signed by the OEM and marketer confirming the review occurred.

Note: The OEM approval or review process must involve a detailed summary and discussion of results from the specific engine test type in question. These data, which should be on similar and related oil formulations or from a Single Technology Matrix (STM), will be used to support the oil marketer's position that the oil being licensed is capable of meeting the performance requirements.

When requested by API, marketers that choose to use the Supplemental Performance certification process must provide copies of any approval letters to API along with the technical data and information that was used to justify the use of this process.

API may require marketers to provide additional technical data, engine test results, or documentation at any time if API believes that additional data is needed to establish the performance of specific oil formulations. Marketers remain responsible for ensuring and warranting that all products that are licensed and marketed pursuant to the streamlined process will satisfy and meet all of the specified performance criteria. If a marketer has reason to believe that a specific product or formulation does not satisfy all of the performance criteria, the marketer must immediately notify API.

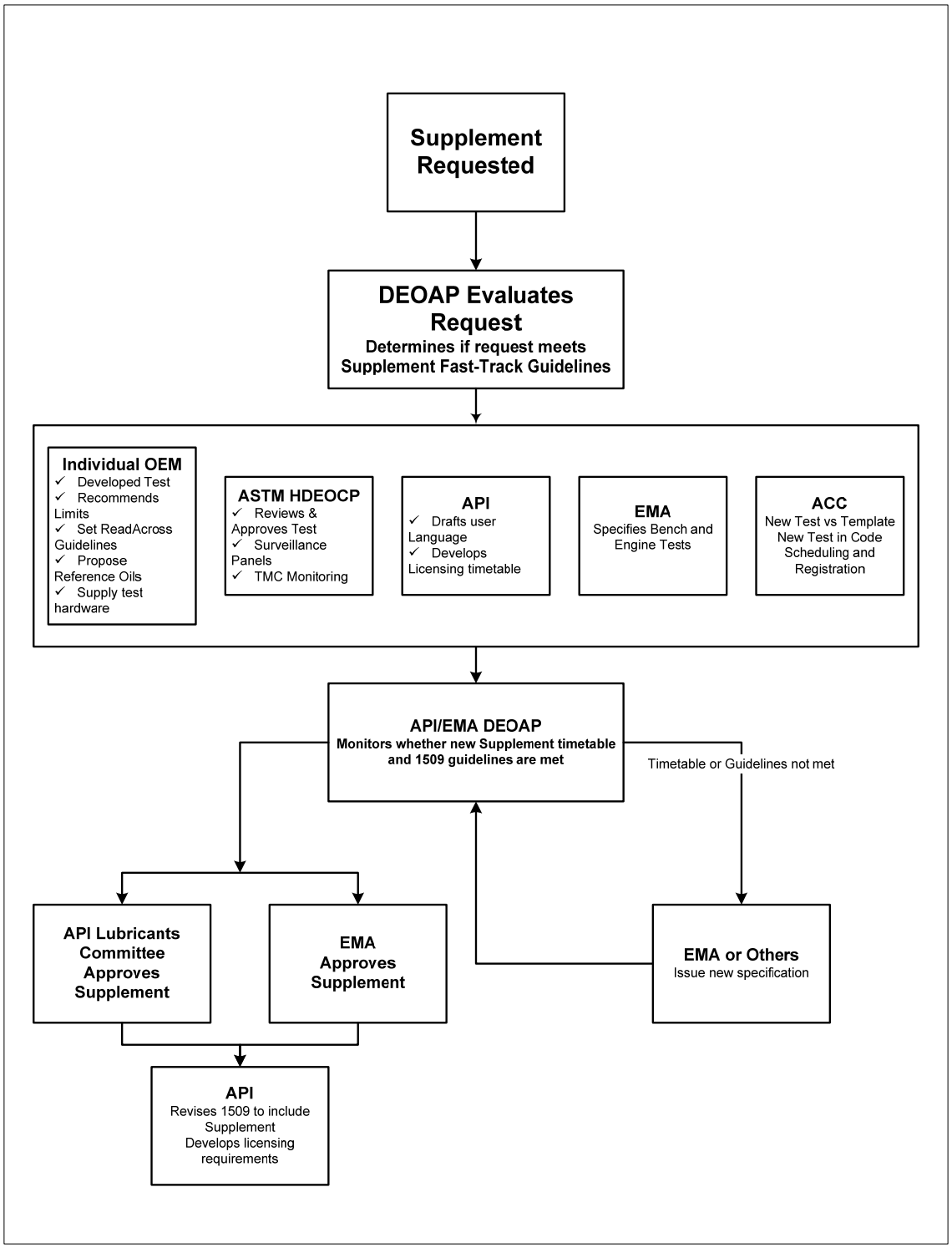

Figure D-5—Heavy Duty Category Supplement Request/Approval Process–Fast Track Approach

Table D-1—Comparison of Fast Track Supplement and Normal C Category Development Processes

Process/Subprocess	Category	Supplement
Specification		
Establish need	NCET	DEOAP
Tests	EMA	Individual OEMs
Timeline management	NCDT/ASTM	DEOAP
Test Development		
Hardware selection	OEMs	OEMs
Initial procedure	OEMs	OEMs
Final procedure	ASTM	OEMs
Precision data	ASTM	OEMs
Discrimination data	OEMs	OEMs
Research report	ASTM	ASTM
Template evaluation	ACC	ACC
Monitoring	ASTM	ASTM
Reference oils	OEMs	OEMs
Testing protocol	ACC	ASTM approved
Product Approval		
Testing required	ASTM	DEOAP
Limits	EMA/API	OEMs
BOI/VGRA	API	OEM/API
Latest pre-licensed C category		API
Accept test development data		API
Formulation modifications	ACC	ACC
Licensing	API	API
Aftermarket Auditing	API	API

APPENDIX E—API Base Oil Interchangeability Guidelines for Passenger Car Engine Oils and Diesel Engine Oils

The most recent version of Appendix E can be downloaded from API's website at www.api.org .

To receive a copy of Appendix E by mail, please contact:

EOLCS Program
American Petroleum Institute
1220 L Street, N.W.
Washington, D.C. 20005

Telephone: 202-682-8516 or
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Facsimile: 202-962-4739

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APPENDIX F—API Guidelines for SAE Viscosity-Grade Engine Testing

The most recent version of Appendix F can be downloaded from API's website at www.api.org.

To receive a copy of Appendix F by mail, please contact:

EOLCS Program
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1220 L Street, N.W.
Washington, D.C. 20005

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APPENDIX G—Requirements for API Service Categories SH, SJ, SL and SM by Viscosity Grade

Table G-1—Requirements for API Service Category SH by Viscosity Grade

Engine Test Requirements[a]—All Viscosity Grades	
Sequence IID	Pass
Sequence IIIE	Pass
Sequence VE	Pass
L-38	Pass

Bench Test and Measured Parameter	Viscosity Grade Performance Criteria[b]		
	SAE 5W-30	SAE 10W-30	SAE 15W-40
Test Method D 5800 volatility loss, % max[c]	25	20	18
Test Method D 2887 volatility loss at 371°C (700°F), % max[c]	20	17	15
EOFT[d], % flow reduction, max	50	50	NR
Test Method D 4951 or D 5185, phosphorus % mass, max	0.12	0.12	NR
Test Method D 92 flash point, °C, min[e]	200	205	215
Test Method D 93 flash point, °C, min[e]	185	190	200
Test Method D 892 foaming tendency (Option A)			
Sequence I, max, foaming/settling[f]	10/0	10/0	10/0
Sequence II, max, foaming/settling[f]	50/0	50/0	50/0
Sequence III, max, foaming/settling[f]	10/0	10/0	10/0
Test Method D 6082[g]	Report	Report	Report
ASTM D 6922, homogeneity and miscibility	h	h	h
L-38 shear stability	i	i	i

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 D 4485.
[b]There are no bench test and measured parameter requirements for other viscosity grades.
[c]A passing volatility result in only one of these procedures is required.
[d]Engine Oil Filterability Test (EOFT) Research Report is under development by ASTM Committee D02.06. The test procedure is available from the ASTM Test Monitoring Center, 6555 Penn Avenue, Pittsburgh, PA, 15206-4489.
[e]Either Test Method D 92 or Test Method D 93 flash point requirement shall be met.
[f]Settling volume determined at 5 min.
[g]Kinetic foam volume; mL/static foam volume and mL/collapse time in seconds.
[h]Homogeneous with SAE reference oils.
[i]10-hour stripped kinematic viscosity (oil shall remain in original viscosity grade).

Table G-2—Requirements for API Service Category SJ by Viscosity Grade

Engine Test Requirements[a]—All Viscosity Grades	
Sequence IID	Pass
Sequence IIIE	Pass
Sequence VE	Pass
L-38	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
Test Method D 5800 volatility loss, % max[b]	22	20[c]
Test Method D 6417 volatility loss at 371°C (700°F), % max[b]	17	15[c]
Test Method D 5480 volatility loss at 371°C (700°F), % max[b]	17	15[c]
EOFT[d], % flow reduction, max	50	50
EOWTT, % flow reduction, max	Report	Report
With 0.6% H_2O	Report	Report
With 1.0 % H_2O	Report	Report
With 2.0% H_2O	Report	Report
With 3.0% H_2O	Report	Report
Test Method D 4951 or D 5185 phosphorus %mass, max	0.10[e]	NR
Test Method D 92 flash point, °C min[f]	200	NR
Test Method D 93 flash point, °C min[f]	185	NR
Test Method D 892 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
Test Method D 6082 (optional blending required), static foam max, tendency/stability	200/50[h]	200/50[h]
ASTM D 6922, homogeneity and miscibility	[i]	[i]
L-38 shear stability	[j]	[j]
Test Method D 6335 high temperature deposits (TEOST), deposit wt, mg, max	60	60
Test Method D 5133 gelation index, max	12	NR

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 D 4485.
[b]Volatility requirement shall be met in either Test Method D 5800, Test Method D 5480, or Test Method D 6417. A passing result in only one of these procedures is required.
[c]Passing volatility loss performance only required for SAE 15W-40 oils.

[d]Engine Oil Filterability Test (EOFT) and Engine Oil Water Tolerance Test (EOWTT) Research Reports are under development by ASTM D02.06. Test procedures are available from the ASTM Test Monitoring Center, 6555 Penn Avenue, Pittsburgh, PA, 15206-4489.
[e]This is a non-critical specification as described in ASTM D 3244.
[f]Either Test Method D 92 or Test Method D 93 flash point requirement shall be met.
[g]Settling volume determined at 10 min.
[h]Settling volume determined at 1 min.
[i]Homogeneous with SAE Reference Oils.
[j]Ten-hour stripped kinematic viscosity (oil shall remain in original viscosity grade).

Table G-3—Requirements for API Service Category SL by Viscosity Grade

Engine Test Requirements[a]—All Viscosity Grades	
Sequence IIIF	Pass
Sequence IVA	Pass
Sequence VE	Pass Wear Only Or a minimum 0.08% phosphorus in the form of ZDDP
Sequence VG	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
Test Method D 6557 (Ball Rust Test), avg. gray value, min	100	100
Test Method D 5800 volatility loss, % max	15	15
Test Method D 6417 volatility loss at 371°C (700°F), % max	10	10
EOFT[b], % flow reduction, max	50	50
EOWTT[b], % flow reduction, max		
With 0.6% H_2O	50	50
With 1.0 % H_2O	50	50
With 2.0% H_2O	50	50
With 3.0% H_2O	50	50
Test Method D 4951 or D 5185 phosphorus %mass, max[c]	0.10[d]	NR
Test Method D 892 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
Test Method D 6082 (optional blending required), static foam max, tendency/stability[f]	100/0	100/0
ASTM D 6922, homogeneity and miscibility	g	g
Sequence VIII shear stability	h	h
High temperature deposits (TEOST MHT-4), deposit wt, mg, max	45	45
Test Method D 5133 gelation index, max	12[i]	NR

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 D 4485.
[b]Engine Oil Filterability Test (EOFT) and Engine Oil Water Tolerance Test (EOWTT) Research Reports are under development by ASTM Committee D02.06. Test procedures are available from the ASTM Test Monitoring Center, 6555 Penn Avenue, Pittsburgh, PA, 15206-4489.

[c]For all viscosity grades: If CF-4, CG-4, CH-4, and/or CI-4 (beginning September 5, 2002) categories precede the “S” category and there is no API Certification Mark, the limit for phosphorus does not apply. Note that these 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 D 3244.
[e]Settling volume determined at 10 min.
[f]Settling volume determined at 1 min.
[g]Homogeneous with SAE Reference Oils.
[h]Ten-hour stripped kinematic viscosity (oil shall remain in original viscosity grade).
[i]For gelation temperatures at or above the W-grade pumpability temperatures as defined in SAE J300.

Table G-4—Requirements for API Service Category SM

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
Sequence IIIG	Pass	Pass
Sequence IIIGA	Pass	NR
Sequence IVA (ASTM D 6891)	Pass	Pass
Sequence VG (ASTM D 6593)	Pass	Pass
Sequence VIII (ASTM D 6709)	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
ASTM D 6557 (Ball Rust Test), avg. gray value, min	100	100
ASTM D 5800, evaporation loss, 1 hour at 250°C, % max[b]	15	15
ASTM D 6417, simulated distillation at 371°C, % max	10	10
ASTM D 6795, EOFT, % flow reduction, max	50	50
ASTM D 6794, EOWTT, % flow reduction, max		
with 0.6% H_2O	50	50
with 1.0% H_2O	50	50
with 2.0% H_2O	50	50
with 3.0% H_2O	50	50
ASTM D 4951, phosphorus % mass, max[c]	0.08[d]	NR
ASTM D 4951, phosphorus % mass, min[c]	0.06[d]	0.06[d]
ASTM D 4951, or D 2622, sulfur % mass, max[c]		
SAE 0W-20, 0W-30, 5W-20, and 5W-30	0.5[d]	NR
SAE 10W-30	0.7[d]	NR
ASTM D 892 (Option A), foaming tendency		
Sequence I, ml, max, tendency/stability[e]	10/0	10/0
Sequence II, ml, max, tendency/stability[e]	50/0	50/0
Sequence III, ml, max, tendency/stability[e]	10/0	10/0
ASTM D 6082 (Option A), high-temperature foaming ml, max, tendency/stability[f]	100/0	100/0
ASTM D 6922, homogeneity and miscibility	[g]	[g]
ASTM D 6709, (Sequence VIII) shear stability	[h]	[h]
TEOST MHT, high temperature deposits, deposit wt, mg, max[c]	35	45
ASTM D 5133, gelation index, max	12[i]	NR

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]Calculated conversions specified in ASTM D 5800 are allowed.

[c]For all viscosity grades: If CF-4, CG-4, CH-4 and/or CI-4 categories precede the "S" category and there is no API Certification Mark, the limits for phosphorus, sulfur, and the TEOST MHT do not apply. Note that these 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 D 3244.

[e]After 10-minute settling period.

[f]After 1-minute settling period.

[g]Shall remain homogenous and, when mixed with ASTM reference oils, shall remain miscible.

[h]Ten-hour stripped kinematic viscosity at 100°C. Kinematic viscosity must remain in original viscosity grade.

[i]To be evaluated from –5°C to temperature at which 40,000 cP is attained or –40°C, or 2 Celsius degrees below the appropriate MRV TP-1 temperature (defined by SAE J300), whichever occurs first.

APPENDIX H—American Petroleum Institute Application for Licensure

(Order Information)

The Application for Licensure consists of the following:

Part A—Company Data
Part B—Project Data Sheet
Part C—License Agreement
Part D—Product Traceability Code
Part E—Signature Authorization Form
Part F—Supplemental Category Documentation of Original Equipment Manufacturer Review and Certification of Engine Test Performance

The Application for Licensure can be downloaded from API's website at www.api.org.
To order an Application for Licensure, please contact:

EOLCS Program
American Petroleum Institute
1220 L Street, N.W.
Washington, D.C. 20005
Telephone: 202-682-8516 or
202-682-8233
Facsimile: 202-962-4739
e-mail: eolcs@api.org

APPENDIX I—Glossary

Note: This glossary defines terms for the purposes of this publication.

Administrative Guidance Panel (AGP): A balanced body, consisting of three API and three automotive manufacturer (Ford, General Motors, and DaimlerChrysler) members, that will meet at least annually to evaluate the operation of the EOLCS program.

Aftermarket Audit Program (AMAP): See Section 5 and monitoring, enforcement, and conformance below.

American Automobile Manufacturers Association (AAMA): A trade association that represented car manufacturers headquartered in the United States. AAMA disbanded on May 1, 1999.

Note: On December 16, 1992, the Motor Vehicle Manufacturers Association of the United States (MVMA) changed its name to the American Automobile Manufacturers Association.

American Chemistry Council (ACC): A trade association formerly known as the Chemical Manufacturers Association (CMA) responsible for the development and administration of the Petroleum Additives Panel Product Approval Code of Practice (ACC Code; see Appendix J).

American Petroleum Institute (API): A trade association that promotes U.S. petroleum interests, encourages development of petroleum technology, cooperates with the government in matters of national concern, and provides information on the petroleum industry to the government and the public.

American Society for Testing and Materials (ASTM): A professional society that is responsible for the publication of test methods and the development of test evaluation techniques.

API Base Oil Interchangeability Guidelines: A system that reduces testing costs by permitting the interchangeable use of certain base oils without requiring a full engine and bench test program for each of the base oils. This system is described in detail in Appendix E.

API Certification Mark: An API Mark that remains the same for a given application (for example, gasoline, fuel-flexible, light-duty diesel) even if a new minimum engine oil standard or standards are developed.

API Guidelines for SAE Viscosity-Grade Engine Testing: Guidelines established for different oil viscosity grades that allow certain engine and bench test results to be used in lieu of additional testing. These guidelines are described in detail in Appendix F.

API Mark: A mark licensed by API and used by oil marketers in connection with engine oil products to certify conformance with quality standards established under the API EOLCS.

API Service Symbol: An API Mark that identifies specific engine oil performance levels by means of alphanumeric Service Categories, SAE viscosity grades, and the Energy Conserving designation as appropriate.

ASTM Test Monitoring Center: An entity within ASTM that monitors the calibration of engine test stands and laboratories (see referenced laboratory).

base oil: A base stock or blend of base stocks used in an API-licensed oil.

Base Oil Interchangeability Guidelines: See API Base Oil Interchangeability Guidelines above.
base stock: A lubricant component that is produced by a single manufacturer (independent of crude source or manufacturing location), that meets the same manufacturer's specification, and that is identified by a unique formula, product identification number, or both.

Base Stock: A lubricant component that is produced by a single manufacturer to the same specifications (independent of feed source or manufacturer's location); that meets the same manufacturer's specification; and that is identified by a unique formula, product identification number, or both. Base stocks may be manufactured using a variety of different processes including but not limited to distillation, solvent refining, hydrogen processing, oligomerization, esterification, and rerefining. Rerefined stock shall be substantially free from materials introduced through manufacturing, contamination, or previous use

base stock slate: A product line of base stocks that have different viscosities but are in the same base stock grouping and from the same manufacturer.

bench test: A laboratory test that measures various performance parameters of an engine oil.
Chemical Manufacturers Association (CMA): See American Chemistry Council above.

engine oil: A lubricating agent that can be classified according to one or a combination of the viscosity grades identified in Table 1 of the most recent edition of SAE J300. Engine oils are also called motor oils. Engine oils include diesel engine oils and passenger car motor oils (PCMOs).

Engine Oil Licensing and Certification System (EOLCS): An administrative process and legally enforceable system by which API authorizes marketers of engine oil to display an API Mark or Marks on oils that meet specified industry standards, as prescribed in a formal licensing agreement.
engine test: (also called engine sequence test or sequence test) A test of an oil's performance using a full-scale engine operating under laboratory conditions.

formulation identifier: An alphanumeric designation that permits traceability of samples in the marketplace by formulation.

formulation number: As defined in the ACC Code, a unique identification number that is assigned before engine testing to each candidate oil tested and that identifies the candidate's formulation, sponsor, blend, blend modification, test type, run number, testing laboratory, and test stand.

Guidelines for SAE Viscosity-Grade Engine Testing: See API Guidelines for SAE Viscosity-Grade Engine Testing above.

Independent Lubricant Manufacturers Association (ILMA): A trade association of businesses engaged in compounding, blending, formulating, packaging, marketing, and distributing lubricants.
Interindustry Advisory Group (IAG): Provides advice to the API/Automotive Manufacturers Administrative Guidance Panel regarding the API EOLCS. The Interindustry Advisory Group consists of representatives from organizations such as Ford, General Motors, and DaimlerChrysler; ACC; API; ASTM; EMA; ILMA; JAMA; PAJ; SAE; and the U.S. Army.

International Lubricant Standardization and Approval Committee (ILSAC): A joint committee of Ford, General Motors, and DaimlerChrysler and JAMA members that assists in the development of new minimum oil performance standards.

Japan Automobile Manufacturers Association (JAMA): A trade association that represents automobile manufacturers headquartered in Japan.

license number: An identification number that is issued to a marketer upon successful completion of the licensing process and is used for audit purposes.

monitoring, enforcement, and conformance: Aftermarket monitoring and enforcement to ensure that representation in the marketplace of API Marks to consumers and compliance with technical specifications are being adhered to, as stated in the API license agreement.

Motor Vehicle Manufacturers Association (MVMA): See American Automobile Manufacturers Association above.

oil marketer: The marketing organization responsible for the integrity of a brand name and the representation of the branded product in the marketplace.

passenger car motor oils (PCMOs): Engine oils for passenger cars, light-duty trucks, and similar vehicles (see also engine oil).

Petroleum Additives Panel Product Approval Code of Practice (ACC Code): A system developed by ACC to register and account for engine tests to help ensure that a lubricant meets a given performance specification. This system is described in detail in Appendix J.

Petroleum Association of Japan (PAJ): A trade association that represents petroleum companies headquartered in Japan and promotes Japanese petroleum interests.

physical and chemical properties: The results from several analytical tests that measure various physical characteristics and ingredients (constituents) of an engine oil.

product traceability code: A code that permits oil samples in the marketplace to be traced by formulation, date of packaging, and source of manufacture.

provisional license: Authority granted by API to a marketer to permit the temporary licensing of a specific engine oil when one of the required engine tests has been declared “out of control” by ASTM. A provisional license may also be granted for an engine oil that is qualified by means of SAE viscosity-grade engine testing “read-across” from another provisionally licensed engine oil (see 3.7 for details).

referenced laboratory: An engine testing laboratory that is monitored by the ASTM Test Monitoring Center’s blind reference oil system.

Service Category: An alphanumeric code developed by API to specify a level of performance defined by ASTM D 4485 and SAE J183. As new Service Categories are developed, new alphanumeric codes may be assigned.

severity adjustments: Mathematically derived correction factors designed to minimize or eliminate laboratory biases. Severity adjustments are developed by the testing laboratory and confirmed by the ACC Monitoring Agency and the ASTM Test Monitoring Center.

Society of Automotive Engineers (SAE): An engineering society founded to develop, collect, and disseminate knowledge of mobility technology.

APPENDIX J—ACC Petroleum Additives Panel Product Approval Code of Practice

The American Chemistry Council (ACC) Petroleum Additives Panel has developed a Product Approval Code of Practice (the ACC Code) for passenger car motor oils (PCMOs) and diesel engine oils. The ACC Code defines practices to help ensure that a particular engine lubricant meets its performance specifications. This is accomplished through the use of specified engine tests, procedures, and record keeping. The ACC Code went into effect on March 30, 1992. ACC has contracted with Registration Systems, Inc., San Antonio, Texas, to serve as the monitoring agency for administration of the ACC Code.

Compliance with the ACC Code is mandatory to obtain a license to use the API Certification Mark or to use API Service Categories SL, SJ, SH, CF, CF-2, CF-4, CG-4, CH-4, or
CI-4 (beginning September 5, 2002) in the API Service Symbol.

Adherence to the ACC Code as a requirement for the EOLCS will be periodically reviewed for continued suitability and enhancement.

A copy of the ACC Code is not included in this publication. Since ACC has committed to continuous updates, a copy of the most recent edition of the ACC Code may be downloaded from the American Chemistry Council's website at www.americanchemistry.com. Navigate to the affiliates link "Petroleum Additives Product Approval Code of Practice."

The American Chemistry Council is located at 1300 Wilson Blvd., Arlington, VA 22209, USA [telephone (703) 741-5000].

APPENDIX K—Tolerance Limits for Physical and Chemical Properties (for Auditing)

Table K-1—Tolerance Limits for Standard Audit[a]

Parameter	Tolerance
Viscosity at 100°C (ASTM D 445)	As defined in SAE J300
Cranking viscosity (ASTM D 5293)	As defined in SAE J300
Pumping viscosity (ASTM D 4684)	As defined in SAE J300
Elements (ICP)[b]	
Values ≥100 parts per million	–10%, +15%
Values <100 parts per million	–15%, +20%
Phosphorus (ICP)	±10%

Note: ICP = inductively coupled plasma.
[a]ASTM analytical test method precision will be accounted for when applying the tolerance limits.
[b]The elements to be reported and audited are those shown in the ACC Candidate Data Package for the licensed formula. Included are Ca, Mg, Zn, Na, Cu, S, Mo, and any other element with a concentration of more than 50 parts per million, except C, H, and O.

Table K-2—Tolerance Limits for Expanded Audit[a]

Parameter	Tolerance
HTHS viscosity [ASTM D 4683, CEC L-36-A-90 (ASTM D 4741), or ASTM D 5481]	As defined in SAE J300
Volatility	
Noack (ASTM D 5800)	[b]
Sim. dis. (ASTM D 2887, D 5480, or D 6417)	[b]
Gelation index (ASTM D 5133)	12.0 (max)
Foaming (ASTM D 892, all sequences)[c]	Max +10 ml[d]
High temperature foaming (ASTM D 6082)	Max +10 ml[d]
Filterability (EOFT)	[b]
Modified filterability (EOWTT)	E
Flash point (ASTM D 92)	200°C (min)
Shear stability (100°C viscosity stripped)[f]	Stay in grade

Note: All percentages are measured against the original licensed value. HTHS = high temperature/high shear; sim. dis. = simulated distillation; EOFT = Engine Oil Filterability Test; EOWTT = Engine Oil Water Tolerance Test.
[a]ASTM analytical test method precision will be accounted for when applying the tolerance limits.
[b]Refer to API SH, API SJ, API SL, ILSAC GF-2, or ILSAC GF-3, as applicable.
[c]Use Option A for API SH, API SJ, API SL, ILSAC GF-2, and ILSAC GF-3. No Option A for API CG-4.
[d]Above API SH, API SJ, API SL, ILSAC GF-2, or ILSAC GF-3 requirement, as applicable.
[e]Refer to API SJ, API SL, ILSAC GF-2, or ILSAC GF-3, as applicable.
fUse only during L-38 or Sequence VIII engine test verification audit.

APPENDIX L—Guidelines for the Selection of Product and Engine Test Audits

L.1 General

As part of API's Aftermarket Audit Program, engine tests will be conducted on randomly selected licensed engine oils purchased from the aftermarket. The selection of products to be engine tested will be based on the total volume of engine oil licensed by each marketing company. Although the examples of random selection use "balls from a pot," the actual random selections will be computer assisted.

L.2 Selection of Marketing Company

A pot will contain one ball for each marketing company that holds an API license. This same pot will contain an additional ball for each 1 million gallons (or portion thereof) over 1 million gallons of API-licensed engine oils (see Table L-1).

L.3 Selection of Engine Test

A separate pot will contain one ball for each engine test to be conducted in a calendar year. The total number of engine tests for each particular engine test type will be determined before any engine testing is conducted (see Table L-2).

L.4 Selection of Viscosity Grade

A predetermined number of engine tests will be conducted on each viscosity grade of licensed oil each year. A pot will contain one ball for each viscosity grade to be tested each year (see Table L-3).

L.5 Selection Process

L.5.1 A ball will be selected from the pot containing the names of the engine tests.

L.5.2 A ball will be selected from the pot containing the names of the marketing companies.

L.5.3 A ball will be selected from the pot containing the viscosity grades to be tested. In the event that the marketing company does not have an API license for the viscosity grade selected, the ball will be returned to the pot, and another will be selected. This process will continue until a ball is selected that matches a viscosity grade marketed by the licensed company.

L.6 Other Selection Criteria

L.6.1 In the event that a selected marketing company markets two or more brand names of the selected viscosity grade, a ball for each brand name will be placed in a pot, and a brand name will be selected.

L.6.2 In the event that a selected marketing company does not market a viscosity grade remaining in the pot, a ball for each viscosity grade marketed by the selected marketing company will be placed in a pot, and a viscosity grade will be selected.

Table L-1—Marketing-Company Pot: Example

Company	Volume (millions of gallons)	Number of Balls	Chance of Selection (%)
A	0.9	1	0.11
B	1.5	2	0.22
.	.	.	.
.	.	.	.
.	.	.	.
M	4.4	5	0.55
N	9.2	10	1.09
.	.	.	.
.	.	.	.
X	50.2	51	5.59
Y	100.5	101	11.06
Z	200.0	200	21.9
Total	900.0	913	100

Table L-2—Sequence-Test Pot: Example

Sequence Test	Number of Balls	Percentage
IIIF	6	30
IVA	3	15
VG	6	30
VIII	5	25
Total	20	100

Table L-3—Viscosity-Grade Pot: Example

Viscosity Grade	Number of Balls	Percentage
SAE 5W-30	8	40
SAE 10W-30	9	45
SAE 10W-40	2	10
SAE 20W-50	1	5
Total	20	100

APPENDIX M—API Mark Conformance Audit: Engine Tests

M.1 General

The oil licensee does not need to prove that the oil meets or exceeds the required performance standards, only that the engine oil performance, as measured by an engine test conducted in accordance with the ACC Code, is not below the allowed performance band set at a 95-percent confidence level (one-tailed test). In other words, an oil is assumed to meet or exceed the required performance standard unless proved otherwise. If an aftermarket engine oil yields a test result that does not meet the testing criteria described in M.2, the licensee will be notified that the oil has been found to be out of conformance. The licensee must respond to API on the nonconformity within 30 days of notification. The licensee may elect to pay for additional engine testing, in which case the oil's conformance to the performance standards will be evaluated using the Multiple Test Evaluation Procedure (see Appendix N). Additional engine testing related to this conformance evaluation shall be scheduled within 60 days of the original notification and conducted in accordance with the ACC Code. If the additional results are to be included in the conformance evaluation, the specific product to be tested shall be approved by the API EOLCS Coordinator before the start of engine testing.

M.2 Confidence Level

When engine sequence tests are conducted as part of the Aftermarket Audit Program, conformance will be determined at the 95-percent confidence level using industry published standard deviation data. Non-conformance will be subject to enforcement action as described in paragraph M.1 and Section 5—System Monitoring, Enforcement, and Conformance.

M.3 Statistical Testing Criteria

The statistical testing criteria are as follows:

H_0: True oil performance meets or exceeds the performance limit,

H_1: True oil performance does not meet the performance limit.

The decision rules are as follows:
The oil fails the test (that is, H_0 is rejected) if the following is true:

$$\overline{X} < PL - Z_{0.05}\frac{s}{\sqrt{n}}$$

Equivalently, the oil passes the test (that is, H_0 is not rejected) if the following is true:

$$\overline{X} \geq PL - Z_{0.05}\frac{s}{\sqrt{n}}$$

where:

$\overline{X}$ = average performance of the oil,
s = industry published standard deviation based on reference oil testing conducted on ACC-participating test stands,

n = number of tests,
$Z_{0.05}$ = 95-percent (one-tailed) confidence coefficient from a standard normal table,
= 1.645,
PL = performance limit, as defined by the applicable performance standard.

M.4 Example

The performance limit for a test is defined as 6.5 on a 0–10 merit scale. The industry published standard deviation is 0.221. If a random aftermarket engine oil test yields a result of 6.0, the oil would be found to be out of conformance.

If additional testing is conducted, this parameter's performance must exceed the values listed in Table M-1.

Table M-1—Example

Number of Tests (n)	Minimum Average Needed to Pass Audit (X)[a]
1	6.14
2	6.24
3	6.29
5	6.34

[a]Confidence level at 95 percent.

APPENDIX N—Multiple Test Evaluation Procedure

N.1 General

The Multiple Test Evaluation Procedure (MTEP) is any databased approach for evaluation of the quality and performance of a formulation where more than one test has been run. The applicable tests and parameter values to be averaged are specified in Table N-1 for PCMOs and N-2 for diesel engine oils and listed in ASTM D 4485.

N.2 Passenger Car Motor Oils

For the API Certification Mark or for Service Category SM and/or SL and/or SJ and/or SH where specifications do not include a defined MTEP for those tests listed in Table N-1, the criteria expressed in the ACC Code, Appendix F, must be followed.

N.3 Diesel Engine Oils

For API Service Categories CF, CF-2, CG-4, CH-4, CI-4, and CJ-4, the limits of a specification have been expressed in terms of a defined MTEP technique. To determine the acceptability of a candidate oil formulation, the value of the parameters in each of the tests (appropriate to the respective specification) listed in Table N-2 must be treated in accordance with ASTM D 4485.

Table N-1—Parameter Values to Be Averaged for PCMO

Test Method	Rated Parameter
Sequence IIIF	Kinematic viscosity (% increase at 40°C)
	Average piston skirt varnish
	Weighted piston deposit
	Cam plus lifter wear
	Hot stuck rings[a]
Sequence IIIG	Kinematic viscosity (% increase at 40°C)
	Weighted piston deposit
	Cam plus lifter wear
	Hot stuck rings[a]
Sequence IVA	Cam wear
Sequence VG	Average engine sludge
	Rocker arm cover sludge
	Average piston skirt varnish
	Average engine varnish
	Oil screen clogging
	Hot stuck compression rings[b]
Sequence VIB	Fuel economy improvement (FEI 1, FEI 2, FEI 1+FEI 2)
Sequence VIII	Bearing weight loss

[a]The majority of retained tests must not have ring sticking (hot stuck).
[b]The majority of retained tests must not have compression ring sticking (hot stuck).

Table N-2—Parameter Values to be Averaged for Diesel Engine Oils

Engine Test	Parameter
Sequence VIII	Bearing weight loss
	Used oil viscosity[a]
Sequence IIIF	60-hour viscosity increase[b]
	Kinematic viscosity % increase
	Viscosity increase at end of test[c]
Sequence IIIG	60-hour viscosity increase[b]
	Kinematic viscosity % increase
1K	Weighted demerits (WDK)
	Top groove fill
	Top land heavy carbon
	Average oil consumption
	Final oil consumption
	Piston, ring, and liner scuffing
	Piston ring sticking
1M-PC	Top groove fill
	Weighted total demerits (WTD)[d]
	Piston ring sticking
	Piston, ring and liner scuffing
1N	Weighted demerits (WDN)
	Top groove fill
	Top land heavy carbon
	Oil consumption
	Piston, ring, and liner scuffing
	Piston ring sticking[e]
1P	Weighted demerits (WDP)
	Top groove carbon
	Top land carbon
	Average oil consumption
	Final oil consumption
	Piston, ring, and liner scuffing
1R	Weighted demerits
	Top groove carbon
	Top land carbon
	Initial oil consumption
	Final oil consumption
	Piston, ring, and liner distress
	Ring sticking
C13	Merits
	Hot stuck rings
ISB	Tappet wear
	Cam wear
	Crosshead weight loss
ISM	Crosshead wear
	Oil filter pressure
	Sludge rating
	Merits[f]
	Top ring weight loss[f]
M11	Rocker pad average weight loss
	Oil filter differential pressure
	Engine sludge
M11 EGR	Crosshead weight loss
	Top ring weight loss
	Oil filter differential pressure
	Engine sludge
6V 92TA	Cylinder liner scuffing
	Cylinder liner port plugging
	Piston rings face distress
T-8	Viscosity increase at 3.8% soot
	Filter plugging
	Oil consumption
T-8E	Relative viscosity at 4.8% soot
	Viscosity increase at 3.8% soot

T-9	Average liner wear Average top ring weight loss EOT used oil lead content
T-10	Liner wear Ring wear Lead content Merit rating[g]
T-11	Soot at 4, 12, and 15 cSt
T-12	Merits
Engine Oil Aeration Test	Aeration
Roller Follower Wear Test	Wear Average pin wear[h]

[a]Limit for API CG-4.
[b]If three or more operationally valid tests have been run, the majority of these tests shall not have scuffing. The scuffed tests are considered uninterpretable, and all data from these tests are eliminated from averaging.
[c]CJ-4 parameter.
[d]Two methods of calculating WTD are used, one for API Category CF and a different one for API Category CF-2. Both methods use MTAC for handling test results.
[e]CG-4 parameter.
[f]CJ-4 parameter.
[g]CI-4 parameter.
[h]CH-4 parameter.

APPENDIX O—Technical Interpretations of API 1509

API 1509 is an API Standard. API Policy and Procedure Number 104, Subject: Standardization, provides general guidance for API Standards activities. Policy Number 104 allows API to provide written "interpretations . . . on the meaning of a standard."

Note that the EOLCS License Agreement (Part C), Section 3, states in part "Licensee agrees to comply with . . . any interpretations of API 1509."

No. 1

Question: What is a definition of "complete engine testing" as found on the EOLCS application form?

Answer: "Complete engine testing" means that the oil has passed each engine test required for licensing of that oil (see Appendix G). Where applicable, (for all "S" Category oils) the oil must have been registered with the American Chemistry Council (ACC) monitoring agency (Registration Systems, Inc.) and have passed each test in full compliance with the ACC Product Approval Code of Practice. When a complete engine test program has been successfully completed on an oil, API Guidelines for SAE Viscosity-Grade Engine Testing, Appendix F, can be applied for licensing. The intent of "complete engine testing" is to distinguish between oils which have been fully tested and those that are licensed by reference to "read-across."

No. 2

Question: On the EOLCS application Product Traceability Code, is the day and time of manufacture actually required to be submitted as part of the EOLCS application for licensure?

Answer: The Introduction to Part D—Product Traceability Code states in part " . . . API is mandating, as a requirement of licensing, that each container of licensed oil marketed be legibly date stamped (bolding added) and that sufficient information be provided in licensing documents to allow API to interpret the date stamp and match the audited oil with the licensing data for that oil."

No. 3

Question: Is the API ILSAC mark design in Figure O-1 acceptable for display on containers?

Figure O-1—Incorrect API ILSAC Mark Design

Figure O-2—Correct API Mark Design

Answer: No. Figure 1 (reprinted in Figure O-2) of API 1509 shows how the mark must appear on labels; Section 4.2 specifies design requirements for the mark. Paragraph 4.2.2 states in part, "The background of the outer band (bold added) . . . shall be a color that contrasts with the label background." The specific error in Figure O-1 is that the outer band has been separated into two bands of different colors.

No. 4

Question: A marketer of motor oil, for example a car manufacturer, sells oil under its own name. The marketer purchases its branded oil from several different oil companies, each of which use a completely different format for its product traceability code. How should this be handled under EOLCS?

Answer: Each separate formulation supplied to the marketer must be filed with and accepted by API on a Part B form Product Data Sheet. Each Part B has space for four (4) separate formulations. If a marketer has more than 5 formulations an additional Part B form must be submitted in the licensing document.

API must be able to compare data obtained from oils analyzed under the aftermarket audit program with the data for that oil submitted to API as part of the licensing program. Therefore, an interpretation of the Formulation Code identifier required on Part B for each oil must be available to API. The marketer should submit a separate Part D form, Product Traceability Code, for each formulation and link the information in Part D with Part B.

Please refer to the Introduction to Part D—Product Traceability Code which states in part " . . . API is mandating, as a requirement of licensing, that each container of licensed oil marketed be **legibly date stamped** (bolding added) and that sufficient information be provided in the licensing documents to allow API to interpret the date stamp and match the audited oil with the licensing data for that oil."

No. 5

Question: With regard to the administration fee, does one fee cover the various oils listed on the Application Form? With regard to the volume fee, is this based on the total sales of the various oils on the Application Form? (It is assumed that the volume of each grade is not separately assessed.)

Answer: There are two fees as described in 3.2 of API 1509. The Administration fee is a flat fee payable by all licensees. It covers all licensed oils. The volume of sales fee covers the total sales of licensed oils, that is, the "oils listed on the Application Form." The volume of sales fee is not separately assessed.

No. 6

Question: On the EOLCS application Part D—Product Traceability Code, does the "date stamp" requirement refer to (a) the date of manufacture or packaging, and (b) is the actual day (italics added) of either manufacture or packaging required?

Answer: (a) You must use date of packaging for the date stamp and (b) the day of packaging is required.

No. 7, amended

Question: Assume there are two Group I base oils from different manufacturers, both of which have passed engine and bench tests with given (bolding added) additive and VI packages and both individual base oil/additive blends are licensed "SH."

Could a packager purchase these two different sourced base oils, mix them together (bolding added) with the given additive/VI package and have an API licensed motor oil? This assumes 1) the SAE viscosity grade of the theoretical blend was one licensed for each base oil, and 2) the additive/VI packages and treat levels of the two licensed formulations were consistent.

Answer: Refer to Section E.2.1.5: "Base stocks approved under the provisions of these guidelines may be commingled without further testing."

No. 8

Question: Appendix E, Section 2.2.2 is as follows:

Complete performance documentation is required for the original PCMOs. The detergent inhibitor (DI) and/or viscosity modifier (VM) remain unchanged when interchange base oils are tested, except as provided by **the ACC Code** (bolding added). A base oil interchange obtained under these guidelines applies to a single PCMO formulation. In the event of a change in the DI and/or VM outside of the ACC Code, these guidelines shall be **reapplied** (bolding added).

What part of **the ACC Code** is referred to?
How should the guidelines (BOIG) be **reapplied**?

Answer: In the ACC Code, proposed changes in the "core data set" are accomplished by applying Appendix H, Guidelines for Minor Formulation Modifications. Proposed changes in a "program" are accomplished by applying Appendix I, Program Guidelines.

The BOIG should be reapplied as follows. If the VM/DI concentration in the interchange base oil differs from the original PCMO oil by more than the variation authorized under the ACC Code (Appendix H or I), then complete performance documentation is required for the new PCMO with the interchange basestock.

No. 9

Question: On the EOLCS application Part D—*Product Traceability Code*, is it adequate to indicate only the month and year of manufacture?

Answer: No. The day of manufacture is also required. This response assumes that the date of "manufacture" and "packaging" is the same day.

The Introduction to Part D—Product Traceability Code states in part ". . . API is mandating, as a requirement of licensing, that each container of licensed oil marketed be **legibly date stamped** (bolding added) and that sufficient information be provided in the licensing documents to allow API to interpret the date stamp and match the audited oil with the licensing data for that oil."
The date that appears on the container that is selected for aftermarket auditing must be the date of packaging.

No. 10

Question: Part B of the EOLCS Application for Licensure specifies a test method for measuring sulfur and nitrogen which is not addressed in the text of API 1509. Are licensees bound by requirements specified in the Application for Licensure?

Answer: Yes, the API License Agreement requires licensees to comply with all requirements specified in API 1509 and the Application for Licensure.

Question: If test methods for measuring Physical and Chemical Properties are specified in API 1509, may marketers utilize alternate (but equivalent) test methods to measure these properties?

Answer: No. The properties must be measured by the methods specified in API 1509.

No. 11

Question: In Appendix G—Requirements for API Service Categories SH, SJ and SL by Viscosity Grade, the last column in Table G-1 titled "All Other Grades" has an NR for all Bench Tests and the L-38 shear stability test. NR means No Requirement. Following is a review of NR.

Answer: The technical language which describes API Service Category SH (Section 2.3.2.3 of API 1509) specifically mandates the application of specified parts of ILSAC GF-1 or DOD CID A-A-52039 specifications for all viscosity grades covered by these specifications. This includes the three oils specifically noted in Appendix G (SAE 5W-30, 10W-30 and 15W-40) and any other oils which are requested to be licensed under ILSAC GF-1. Also, the most recent edition of SAE J300 contains high temperature/high shear requirements for SH.

Appendix G, Table G-1, as it appears in API 1509, is correct with the addition of the SAE J300 requirements as noted above. If ASTM subsequently adopts requirements for SH, these requirements will be presented to the appropriate committees for consideration as an amendment to API 1509.

No. 12

Question: If an oil company sells its oil to another company and that company resells the oil under its own brand name does the reseller have to be licensed?

Answer: Yes. Section 1.2.1 of API 1509 includes the following statements. EOLCS is "…a licensing system that includes a formal license agreement executed by the marketer with API." An oil marketer " is defined as the marketing organization responsible for the integrity of the brand name and the representation of the branded product in the marketplace."

Section 9 of the EOLCS License Agreement is as follows:

> 9. Licensee agrees that it is the marketing organization responsible for the integrity of the brand name and the product's representation in the marketplace **and agrees to use the marks only on products bearing the Licensee's name** (bolding added).

The Licensee's name on the product is the key element. If the owner company's name appears on the container it may license the oil. If the subsidiary's name appears on the container, the subsidiary must be separately licensed.

No. 13

Question: Can a result of 2.69 on a Sequence VI candidate oil test be rounded to 2.70 so as to claim an EFEI of ECII on an EOLCS Application for Licensure?

Answer: Yes. Rounding of Sequence VI candidate test values is done in accord with ASTM E 29–89, Section 2.3 and 4. *Rounding-Off Method*.

References:

ASTM E 29–89 *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*.

> 2.3 Rounding Off Method—In other fields, specification limits of (for example), 2.5 inches max, 2.50 inches max, 2.500 inches max are taken to imply that, for purposes of determining conformance with specifications, an observed value or a calculated value should be rounded off to the nearest 0.1 inch, 0.01 inch, 0.001 inch, respectively, and then compared with the specification limit.

API 1509, *API Engine Oil Licensing and Certification System*, 12th Edition, January 1993. Table D-1, page 19.

Fuel Efficiency ASTM RR-D:2-1204 Sequence VI Test improvement (EFEI) 2.7% (min).

No. 14

Question: What is the difference between Table K-1 "Tolerance Limits for Standard Audit" and Table K-2 "Limits for Expanded Audit" in Appendix K? Are Tables K-1 and K-2 applied to API SH oils throughout the world? Is there any difference in their frequency?

Answer: Each oil selected for testing under the provisions of the Aftermarket Audit Program (AMAP) will be audited using the tests in Table K-1, as appropriate for the viscosity grade. Table G-1 should be consulted for guidance on tests that apply to different viscosity grades for SH oils. Oils for testing and the frequency of testing under Table K-2 will be selected by reference to an API protocol. Audit samples are selected worldwide.

No. 15

Question: A marketer has successfully completed an ACC-registered DDC 6V92TA test on an SAE 15W-40 engine oil. This engine oil has also been qualified against API CH-4 through the application of Base Oil Interchange (BOI) according to Table E-9 of API 1509. Because it is API CH-4 qualified, it also meets the requirements for API CF (i.e., Caterpillar 1M-PC testing is waived according to Table E-6 of API 1509).

Does the SAE 15W-40 described above qualify for licensing as API CF-2?

Answer: The SAE 15W-40 oil qualifies for API CF-2 because it passed the 6V92TA test, as required by API 1509. The question correctly notes that CAT 1M-PC testing is waived because the product meets CH-4 interchange requirements as noted in footnote c of Table E-6.

No. 16

Question: A company uses the solvent refining process to produce 150N Group I base stocks at separate refineries. Refined from different crude oil sources, the base stocks display unique properties when tested according to ASTM D 445, D 2270, D 4052, and D 2622.

Are these base stocks considered the same base stock slate per E.1.2.2 of API 1509, 14th Edition?

Answer: The two stocks as described above would not be considered as coming from the same base stock slate as defined in E.1.2.2 of API 1509. That definition refers to base stocks in the same grouping and from the same manufacturer but having different viscosities. The two stocks described above have the same viscosity. It would be more likely that they could be called the same base stock if they were produced to the same specifications, used the same formulation, and had the same product identifier (see API 1509, E.1.2.1).

If the company chooses to consider both 150N base stocks the same, there are some issues that need to be taken into account. Since the base stocks display some unique properties, the company needs to select the more severe of the two stocks to conduct performance testing or commit to proving equivalent performance by testing both. That responsibility is not removed by producing them under the same specification.

If the company chooses to identify the Group I base stocks separately, they would be subject to the applicable base oil interchange guidelines in Appendix E of API 1509.

No. 17

Question: A single base stock manufacturer makes Group I, Group II, and/or Group III base stocks by a variety of different processes. This includes manufacturing base stocks by mixing a Group I with a Group II (or Group III) or mixing a Group II with a Group III. This mixed base stock is associated with a manufacturer's specification and product identification number. According to API 1509, this mixed Group base stock should be marketed as a Group I, or Group II, or Group III base stock based on the saturates, sulfur and VI analysis of the product as sold. For example:

- If the saturates are < 90%, and sulfur is > 0.03%, and VI is > 80 and < 120, the base stock is a Group I.

- If the saturates are > 90%, and sulfur is < 0.03%, and VI is > 80 and < 120, the base stock is a Group II.
- If the saturates are > 90%, and sulfur is > 0.03%, and VI is > 80 and < 120, the base stock is a Group I.
- If the saturates are > 90%, and sulfur is < 0.03%, and VI is > 120, the base stock is a Group III.

There has been some debate on this issue, especially on the correct labeling of the third example listed above. Do the examples above correctly interpret the guidelines set forth in API 1509?

It is understood that the base stock manufacturer retains responsibility for supplying commercial product with performance capability at least equivalent to that tested in formulations. It is also understood that API 1509 does not limit base stocks by manufacturing process. According to E.1.2.1 of API 1509, "Base stocks may be manufactured using a variety of different processes including but not limited to distillation, solvent refining, hydrogen processing, oligomerization, esterification, and rerefining."

Answer: The four examples above do correctly interpret the base stock category guidelines set forth in E.1.3 of API 1509. In the third example, the high sulfur content makes the base stock a Group I. According to API 1509, "Group I base stocks contain less than 90 percent saturates and/or greater than 0.03 percent sulfur and have a viscosity index greater than or equal to 80 and less than 120 using the test methods specified in Table E-1."

No. 18

Question: A marketer of a fully qualified SAE 10W-40 API CH-4/SJ product wishes to substitute Group III/IV base oils for the Group I base oils used in the original formulation. The marketer believes this substitution is permitted based on a clause in Appendix I Section 5 of the ACC Code of Practice: "Following completion of a program according to the ACC Code of Practice, substitution of Group III or Group IV base stock for Group I and/or Group II base stock is allowed with Level 2 support." The marketer's Level 2 support is full engine test data on an SAE 0W-30 API CH-4/SJ oil using a mixture of Group III and Group IV base oils.

Can a marketer use Appendix I, Section 5 of the ACC Code of Practice to justify the substitution of Group III and Group IV base oils for Group I oils in a fully qualified SAE 10W-40 API CH-4/SJ product without further testing?

Answer: API 1509 contains the only authorized base oil interchange (BOI) and viscosity grade read across (VGRA) guidelines for API-licensed products. The ACC Code of Practice is not applicable in this situation.

Taking into account the base oil information provided above, a marketer could qualify the 10W-40 API CH-4/SJ formulation in at least two ways:

- Run complete engine testing for both the CH-4 and SJ categories as recommended in Appendix E of API 1509.
- Use the VGRA guidelines in Appendix F of API 1509. These recommend complete engine testing for CH-4 proof of performance but could offer some relief for SJ proof of performance.

The marketer of the formulations has the final responsibility for assuring that the products meet API requirements.

No. 19

Question: A marketer wants to qualify a new SJ engine oil formulation using SL/Energy Conserving tests and results from a double-length Sequence IIIE engine test in lieu of a Sequence IIIE test. The API Lubricants Committee approved the use of SL/Energy Conserving tests to qualify SJ oils as of May 1, 2000. The committee also instituted Provisional Licensing on that date to address a shortage of parts limiting the availability of Sequence IIIE tests.

Can a double-length Sequence IIIE be used to qualify a formulation for full SJ licensing?

Answer: No, the formulation cannot qualify for full licensing using the double-length Sequence IIIE results. To qualify for SJ, an oil must meet the most recent technical criteria set forth in ASTM D 4485 (see 3.4.2 of API 1509). Currently, D 4485 does not include performance criteria for double-length IIIE's.

Assuming the marketer cannot run a standard IIIE, his only recourse for licensing the SJ formulation at this time is to apply for Provisional Licensing. The procedures for Provisional Licensing require the marketer to submit Level 2 support data as described in the ACC Code of Practice. Although the double-length IIIE could not be used to qualify the formulation for full licensing, its results can be used as Level 2 support for Provisional Licensing.

No. 20

Question: On Page 3 of 3 of Part B of the API Application for Licensure, a note states the following: "Additionally, I attest that all engine and bench test data submitted or referred to on this form has been generated using ASTM/ACC calibrated instruments when applicable."

In the statement above, what does the phrase "when applicable" mean. The hypothetical question below should help to illustrate the question:

At the start of GF-2, if a marketer ran a D 5133 Gelation Index test one day prior to the start of TMC surveillance, would this data have been acceptable? One argument would state that since TMC calibration did not apply at the time of the test, the data should be acceptable. Another argument would state that since ASTM intended to calibrate the test—and was in the process of doing so—the data are not valid because it did not come from calibrated equipment.

Answer: Part B of the API Application for Licensure includes the phrase "when applicable" to cover those situations where a calibration requirement does not exist for a test at the time an application for licensure is filed with API. If ASTM has a calibration requirement in place for a test at the time an application is filed, then a calibrated result is required.

If, as noted in the hypothetical question above, a marketer runs a Gelation Index test one day prior to the start of TMC surveillance, the test result would be acceptable only if the marketer files the application for licensure the same day. The result would not be acceptable on an application filed the day after TMC surveillance has begun. This interpretation also applies in a situation where one marketer submits an application for a license before a calibration requirement is in place, and another marketer submits one after the requirement has been implemented. The second marketer must provide a result from a calibrated test.

Please note that the marketer of the formulations has the final responsibility for assuring its products meet API requirements.

No. 21

Question: A marketer of a fully qualified SAE 10W-40 API SJ/CF product wishes to replace 30 percent of the original formulation's Group I base oil with a Group IV and market the product as an SAE 5W-40 API SJ/CF engine oil without further engine testing. The marketer believes this change is possible according to Table E-2 of API 1509. The DI package and VI remain the same, and the base oil viscosities at 100°C are nearly identical. The 5W-40 viscosity grade is a result of the introduction of PAO.

Can a marketer replace 30 percent of a fully qualified 10W-40 SJ/CF's Group I base oil with a Group IV and market the product as a 5W-40 SJ/CF without further testing?

Answer: The answer to the question is no. The marketer must perform additional CF testing to qualify the 5W-40 oil.

To understand why further testing is required, a review of the guidelines for base oil interchange (BOI) and viscosity grade read across (VGRA) found in Appendices E and F of API 1509 is necessary. Under the guidelines spelled out in Appendix E, the BOI described in the question above is possible. Tables E-2 (for SJ) and E-6 (for CF) permit the replacement of up to 30 percent of Group I base oil with a Group IV.

With the question of BOI settled, the marketer must then turn to the VGRA rules in Appendix F. Again, the SJ and CF guidelines must be addressed separately. For SJ oils, read across from a viscosity grade is permitted as long as three criteria are met:

- The detergent (dispersant)-inhibitor (DI) content of the read-across viscosity grade shall be equal to or higher than that of the original viscosity grade. The increase in DI is limited to the maximum allowed by the ACC Code of Practice.
- Base stock blend kinematic viscosity at 100°C of the read-across viscosity grade must be equal to or higher than that of the original viscosity grade, considering the precision of the test method.
- The viscosity modifier (VM) content of the read-across viscosity grade must be equal to or lower than that of the original viscosity grade.

If all these criteria are met, the marketer does not have to run additional SJ tests. However, no such criteria exist for CF. There are currently no read across rules for CF oils that would allow a marketer to read across from a 10W-40 oil to a 5W-40. Further testing on the 5W-40 oil is required to qualify it as CF.

APPENDIX P—EOLCS Licensing Clarifications

Licensing Clarifications are provided to assist Licensees in meeting licensing requirements.

Licensing Clarification: February 5, 1993

Question: A foreign oil company (API licensed) wishes to keep confidential the additive and VI improver packages it is providing to one of its customers. The customer is selling the oil under its name (as a "rebrand") and will be licensed by API. The oil company proposes, as an alternative to providing all the information to the customer, to provide only a proprietary code for the additive and VI improver packages—which will mask the name of the additive manufacturer. Thus, the customer will receive the ACC candidate data package with coded data. Can the customer be licensed by API under these circumstances?

Answer: Yes, the customer can be licensed.

What API does require for licensing is a "YES" attestation in the block related to the line "ACC Petroleum Additives Panel Product Approval Code of Practice" on Part B of the application form (This "YES" attestation is required for "S" Category and ILSAC licensed oils only, at the present time.)

As an API licensee, the customer can receive from API an inquiry about any oil which it has licensed. It is possible that as a result of a monitoring or enforcement inquiry API will request of the licensee certain information which might include information on the VI Improver, for example. In that case the licensee would be required to provide to API, as specified in the license agreement, all necessary information to satisfy the monitoring or enforcement request.

Licensing Clarification: March 31, 1993

Question: The API Application for Licensure form includes spaces for several oil brands and viscosities. It is assumed that alternate brand names for the same oil (and the same viscosity) are acceptable for inclusion on this form.

Answer: Each product, defined as a separate brand or viscosity grade, requires a separate PART B in the Application for Licensure package. The purpose of this requirement is to insure that oils selected from the market for analysis in API's aftermarket audit program can be identified and matched with the data presented for licensing. For example, if the same oil (SAE viscosity grade) is packaged under the label XYZ as well as another label ABC, they are separate oils for purposes of licensing and should be submitted as separate candidates for licensing.

Licensing Clarification: March 31, 1993

Question: Once the Application Form has been submitted and the license obtained, is it possible to change or modify a brand name? Or does a new Application Form and a further administration fee need to be paid?

Answer: If a licensee desires to change or modify a brand name for a specific product, a new Part B must be completed and submitted to API for approval. No additional fees are required.

Licensing Clarification: June 30, 1993

Question: API licenses two marks. What is the correct way to refer to these marks which are identified in API 1509, as ". . . the API Service Symbol and the ILSAC Certification Mark." (Section 2.1) Our company wishes to advertise these marks to both our retail and bulk customers. However, "ILSAC" and "Service Symbol" have no meaning for most customers. What other labelling or identifying terminology are we permitted to use when referring to the marks?

Answer: Section 2.1 specifies the official names of the two marks.

Licensing Clarification: June 30, 1993

Question: We wish to license a product but to market it under more than one name. For example, we plan to market a single formulation in a number of different geographical locations. How should we proceed?

Answer: The EOLCS aftermarket audit program will match the data obtained from an analysis of marketplace samples with the data submitted to API for licensing, for the same formulation. The brand name is one of the elements required to make the match. Therefore, the name of each brand must be available to API. You should submit a separate Part B for each brand.

Licensing Clarification: November 15, 1993

Question: May the words "Energy Conserving" or "Energy Conserving II" or "API Service" be translated into a foreign language within the API Service Symbol (donut).

Answer: No.

Licensing Clarification: April 16, 2001

Question: Can an API engine oil licensee prepackage API Service Category SL products with API SL in the Service Symbol "donut" in advance of the July 1, 2001 date of first licensing? The licensee understands API SL products cannot be offered for sale before the July 1 date, but it would like to have products ready for sale on that date.

Answer: Yes, a marketer may package products displaying API SL in the API Service Symbol before July 1, 2001, but those products cannot be offered for sale before July 1. This assumes the marketer has completed all necessary API licensing requirements.

APPENDIX Q—ILSAC Minimum Performance Standards for Passenger Car Engine Oils

Q.1 ILSAC GF-1 Minimum Performance Standard for Passenger Car Engine Oils (Obsolete August 1, 1997)

Q.1.1 Introduction

The American Automobile Manufacturers Association, Inc. (AAMA) and the Japan Automobile Manufacturers Association, Inc. (JAMA), through an organization called the International Lubricant Standardization and Approval Committee (ILSAC), jointly developed and approved the GF-1 minimum performance standard for gasoline-fueled passenger car motor oils.

This standard includes only the performance requirements and chemical and physical properties of those engine oils that vehicle manufacturers may deem necessary for satisfactory equipment life and performance. It is the oil marketer's responsibility to be aware of and comply with all applicable legal and regulatory requirements on substance use restrictions, labeling, and health and safety information and to conduct its business in a manner that represents minimum risk to consumers and the environment.

This ILSAC minimum performance standard, including all of the additional requirements outlined in Section 4, comprises the first ILSAC standard for passenger car engine oils. Diesel engine oils are not covered in this specification but may be the topic of future discussions between ILSAC and groups representing diesel engine builders.

Q.1.2 Summary

The ILSAC GF-1 standard is composed of five parts. The first section on viscosity uses the Society of Automotive Engineers (SAE) Engine Oil Viscosity Classification, SAE J300. The second section encompasses the American Petroleum Institute (API) SH performance requirements. The third section contains specifications for bench test performance parameters, such as volatility, foaming tendency, high-temperature/high-shear rate viscosity, and filterability. The fourth section contains additional requirements including fuel efficiency, catalyst compatibility, and low-temperature viscosity. Key reference documents are listed in the final section.

The truest evaluation of an engine oil product is satisfactory performance in a variety of vehicle fleet tests that simulate the full range of customer driving conditions. The engine sequence tests listed in this document have been specified instead of fleet testing to minimize testing time and costs. This simplification of test requirements is only possible because the specified engine sequence tests have been correlated to a variety of vehicle tests.

The correlation between engine sequence tests and fleet tests is judged valid based only on the range of base oils, refining processes and additive technologies that have demonstrated satisfactory performance in widespread use at the time this standard was first issued October 22, 1990, and revised October 12, 1992. The introduction of base oils, refining processes or additive technologies that constitute a significant departure from existing practice would require supporting fleet test data and appropriate ASTM engine tests to validate the correlation between the fleet tests and engine sequence tests for that different base oil, refining process, or additive technology. This fleet testing would be in addition to the other requirements listed in this specification.

It is the responsibility of any individual or organization introducing a new technology that they claim will provide equivalent or better performance to ensure their engine test results still correlate with customer field service. Also, the marketer must ensure there is no adverse effect to vehicle components or emission control systems. No marketer can claim to be acting in a reasonable and prudent manner if the marketer knowingly uses a new technology based only on the results of engine sequence testing without verifying suitability in vehicle fleet testing that simulates the full range of customer operation.

Q.1.3 Minimum Performance Standard

The ILSAC GF-1 minimum performance standard is shown in Table Q-1.

Q.1.3.1 Section 1

The first section of the standard deals with viscosity. It utilizes the most widely accepted definition of viscosity, SAE J300. Table Q-1 specifies the latest revision of this document, in order to keep the ILSAC standard current.

Q.1.3.2 Section 2

The second section of the standard defines ASTM engine tests and corresponding requirements used to define API SH Category engine oil performance (see 2.3.2.3 and ASTM D 4485). The American Society for Testing and Materials (ASTM) Sequence IID test is used to define the low-temperature rust and corrosion protection provided by engine oils. High-temperature valve train wear, oil thickening, and deposits are evaluated in the ASTM Sequence IIIE test. Low- to medium-temperature sludge and wear are determined in the ASTM Sequence VE test. The L-38 test method defines the bearing corrosion protection provided by engine oils. The 1H2 or 1G2 test that defined piston cleanliness was dropped from the October 22, 1990, version of this standard because of concern over interpretation of test results. A replacement test is being sought to evaluate high-temperature deposit formation.

Table Q-1—ILSAC GF-1 Passenger Car Engine Oil Minimum Performance Standard (Obsolete August 1, 1997)

Requirement	Criterion
Viscosity Requirements	As defined by the most recent revision of SAE Standard J300
Engine Test Requirements	As defined by the most recent revision of ASTM D 4485
Engine rusting	ASTM D 5844 Sequence IID test
Average rust rating	8.5 (min)
Stuck lifters	None
Wear and oil thickening	ASTM D 5533 Test Method Sequence IIIE
Increase in viscosity at 40°C	375% (max)
Piston skirt varnish	8.9 (min)
Ring land deposits	3.5 (min)
Average engine sludge	9.2 (min)
Stuck piston rings	No oil related
Cam and lifter wear	
Average, mm	30 (max)
Maximum, mm	64 (max)
Oil consumption, l	5.1 (max)
Sludge and wear	ASTM D 5302 Test Method Sequence VE
Average engine sludge	9.0 (min)
Rocker cover sludge	7.0 (min)
Average engine varnish	5.0 (min)
Piston skirt varnish	6.5 (min)
Cam wear	
Average, mm	130 (max)
Maximum, mm	380 (max)
Oil ring clogging[a]	15% (max)
Oil screen clogging	20% (max)
Hot-stuck rings	None
Bearing corrosion	ASTM D 5119 Test Method L-38
Bearing weight loss, mg	40 (max)
Piston skirt varnish	9.0 (min)

Table Q-1—ILSAC GF-1 Passenger Car Engine Oil Minimum Performance Standard (Obsolete August 1, 1997)

Requirement	Criterion
Bench Test Requirements	
HTHS viscosity at 150°C and 106 s–1	ASTM D 4683, ASTM D 4741, or CEC L-36-A-90
For all viscosity grades, mPa • S	2.9 (min)
Volatility	Sim. dis. (ASTM D 2887) or evaporative loss (CEC L-40-A-93)
ASTM D 2887	20% (max) at 371°C (0W, 5W multigrades)
	17% (max) at 371°C (all other multigrades)
CEC L-40-A-93	25% (max) 1 hr at 250°C (0W, 5W multigrades)
	20% (max) 1 hr at 250°C (all other multigrades)
Filterability	
GM 9099P EOFT	50% (max) flow reduction
Foaming tendency	ASTM D 892 (Option A)
Foaming, ml	
Sequence I	10 (max)
Sequence II	50 (max)
Sequence III	10 (max)
Sequence IV	Report
Settling[b], ml	
Sequence I	0 (max)
Sequence II	0 (max)
Sequence III	0 (max)
Sequence IV	Report
Flash point	ASTM D 93 or D 92
ASTM D 93	185°C (min)
ASTM D 92	200°C (min)
Shear stability	
L-38 test 10-hour stripped viscosity	Must remain in original SAE viscosity grade
Homogeneity and miscibility	
Federal Test Method 791B, Method 3470	Shall remain homogenous and, when mixed with SAE reference oils, shall remain miscible

Additional Requirements

Fuel efficiency			
ASTM RR-D:2-1204 Sequence VI Test			
improvement (EFEI)	2.7% (min)		
Catalyst compatibility			
Phosphorus content	0.12 mass % (max)		
SAE J300 low-temperature viscosity, mPa•S	0W	5W	10W
Cranking	3,250 at -30°C (max)	3,500 at -25°C (max)	3,500 at -20°C (max)
Pumping	30,000 at -35°C (max)	30,000 at -30°C (max)	30,000 at -25°C (max)

Notes:
[a]Effective October 8, 1993, the Oil Ring Clogging parameter has been suspended as a requirement for the Sequence VE test. Therefore, it has been removed as a requirement for licensing. For any programs that include more than one Sequence VE test and the test completion dates include dates both before and after October 8, 1993, Oil Ring Clogging should be ignored for these tests. ASTM re-evaluated this issue in June 1994 and decided to suspend this parameter indefinitely.
[b]Settling determined after 5 minutes, except Sequence IV, in which settling is determined after 5 seconds. Sequence IV test conditions are the same as those in Sequence I, except that the temperature is 150°C and the minimum flow rate is 200 milliliters.

Q.1.3.3 Section 3

The bench test requirements are outlined in Section 3. High-temperature, high-shear-rate viscosity provides an estimate of bearing oil film thickness and, thus, relates to bearing life [1]. A value of 2.9 mPa•S at 150°C and 1 million seconds–1 is considered by AAMA and JAMA members to provide adequate assurance of bearing durability in passenger car engines.

Volatility, as measured by either the NOACK or ASTM simulated distillation method, is included in the standard because volatility has been shown to correlate with oil consumption in the field [2, 3]. The values were selected to provide acceptable oil economy in the field. The higher allowable volatility values specified for the lighter viscosity grade oils are an acknowledgment of the difficulties encountered with existing refining equipment and/or processes when manufacturing the lighter base stocks necessary for such oils. There is a real need to improve this limit over time, and base oil manufacturers should make plans to modify equipment and/or processes to satisfy future requirements that will likely be more stringent.

A filterability test is incorporated in the standard to ensure the water tolerance of oils under low-temperature conditions. The limits in the General Motors Engine Oil Filterability Test (GM 9099P) correspond to GM's and Ford's initial fill requirements. ASTM has been requested to standardize this test and to consider having the ASTM Test Monitoring Center handle distribution of reference oils and filter paper. This would provide worldwide availability of the test method and test materials.

ASTM Foam Test (D 892) limits similar to Ford and General Motors' initial fill and U.S. military specifications are incorporated in the ILSAC standard to ensure that foaming will not be a problem in current and future engines, which tend to run at higher speeds and sometimes incorporate balance shafts, both of which can promote foaming. The Sequence IV portion of this test, although not formally part of the ASTM procedure yet, is believed to correlate better with foaming under high-speed engine operating conditions. The intent of including the Sequence IV portion of this test as a report-only item is to gather data on this procedure so that, after it has become an ASTM standard, it can be added to the ILSAC standard with an appropriate maximum acceptable limit.

Two alternative flash point methods are also included in the standard, primarily to cover safety and materials handling concerns.

A shear stability requirement for the 10-hour oil sample from the L-38 test to remain within the original SAE viscosity grade is also included. An investigation into alternative shear stability methods will be conducted for possible use in future standards.
Requirements for homogeneity and miscibility are included in the standard primarily as quality control checks, to ensure that the oil is blended properly (i.e., that the additives have not settled out).

Q.1.3.4 Section 4

Section 4 of the ILSAC standard incorporates additional requirements. All three of the additional requirements listed in Section 4 must be met in order for an oil to satisfy the licensing requirements of the API Certification Mark in the API Engine Oil Licensing and Certification System (EOLCS). The fuel efficiency requirement is important since widespread use of engine oils providing at least a 2.7 percent fuel economy improvement in the ASTM Sequence VI test could provide fuel savings in the country as a whole as compared to what the situation would be if other oils were used, although the fuel economy obtained by individual vehicle operators may differ because of many factors.

No currently acceptable standard test exists for determining the catalyst poisoning effect of engine oils. In the absence of such a test, and since it has been shown that engine-oil-derived phosphorus poisons emission control devices [4], it is believed prudent to limit the phosphorus content of the engine oil to 0.12 mass percent maximum.

The last portion of Section 4 of the standard deals with the low-temperature viscosity of engine oils, as defined by SAE J300. The low-temperature viscometric properties of multiviscosity grade engine oils are important as they relate to cold starting performance in gasoline-fueled passenger cars.

Q.1.3.5 Section 5

Section 5 of the standard references procedures for conducting the tests included in the standard.

References

1. Spearot, J. A.; Murphy, C. K.; and Deysarkar, A. K.; “Interpreting Experimental Bearing Oil Film Thickness Data” (Paper No. 892151), Society of Automotive Engineers, Warrendale, Pennsylvania.

2. Didot, F. E.; Green, E.; and Johnson, R. H.; “Volatility and Oil Consumption of SAE 5W-30 Engine Oil” (Paper No. 872126), Society of Automotive Engineers, Warrendale, Pennsylvania.

3. Carey, L. R.; Roberts, D. C.; and Shaub, H.; “Factors Influencing Engine Oil Consumption in Today’s Automotive Engines” (Paper No. 892159), Society of Automotive Engineers, Warrendale, Pennsylvania.

4. SAE Fuels and Lubricants Technical Committee 1, *Engine Oil/Catalyst and Oxygen Sensor Compatibility Task Force Status Report*, Society of Automotive Engineers, Warrendale, Pennsylvania, October 1985.

Q.2 ILSAC GF-2 Minimum Performance Standard for Passenger Car Engine Oils (Obsolete March 31, 2002)

The American Automobile Manufacturers Association of the United States, Inc. (AAMA) and the Japan Automobile Manufacturers Association, Inc. (JAMA), through an organization called the International Lubricants Standardization and Approval Committee (ILSAC), jointly developed and approved an ILSAC GF-2 minimum performance standard for gasoline-fueled passenger car engine oils.

This standard specifies the minimum performance requirements (both engine sequence and bench tests) and chemical and physical properties for those engine oils that vehicle manufacturers deem necessary for satisfactory equipment performance and life.

In addition to meeting the requirements of the standard as shown in Table Q-2, it is the oil marketer's responsibility to be aware of and comply with all applicable legal and regulatory requirements on substance use restrictions, labeling, and health and safety information when marketing products meeting the GF-2 standard. It is also the marketer's responsibility to conduct its business in a manner that represents minimum risk to consumers and the environment.

The ultimate assessment of an engine oil's performance must include a variety of vehicle fleet tests that simulate the full range of customer driving conditions. The engine sequence tests listed in this document have been specified instead of fleet testing to minimize testing time and costs. This simplification of test requirements is only possible because the specified engine sequence tests have been correlated to a variety of vehicle tests.

The correlation between engine sequence tests and vehicle fleet tests is judged valid based only on the range of base oils and additive technologies that have proven to have satisfactory performance in service and that are in widespread use at this time. The introduction of base oils or additive technologies that constitute a significant departure from existing practice requires sufficient supporting vehicle fleet testing data to validate the correlation between vehicle and ASTM sequence test performance and to ensure there is no adverse effect to vehicle components or to emission control systems. This vehicle fleet testing should be conducted in addition to the other performance requirements listed in this specification.

It is the responsibility of any individual or organization introducing a new technology to perform this vehicle fleet testing, and the responsibility of the oil marketer to ensure the above testing of new technology was satisfactorily completed. No marketer can claim to be acting in a reasonable and prudent manner if the marketer knowingly uses a new technology based only on the results of engine sequence testing without verifying the suitability of the new technology in vehicle fleet testing that simulates the full range of customer operation.

The ILSAC GF-2 Minimum Performance Standard includes the new Sequence VIA test. Viscosity Grade Read Across and Base Oil Interchange Guidelines have been developed specifically for the Sequence VIA test. These guidelines will be reviewed and, if appropriate, updated by API with the approval of AAMA. The current guidelines can be applied for viscosity grade read across and base oil interchange in the Sequence IID, IIIE, and VE and L-38 tests. API has been requested to continue to solicit and review data confirming the applicability of these guidelines to GF-2 oils. Oil marketers use the above guidelines at their own judgment and at their own risk. The use of these guidelines does not absolve the marketer of the responsibility for meeting all specified requirements for any products the marketer sells in the marketplace that are licensed as ILSAC GF-2 with API.

Note: This paragraph has been updated since the ILSAC GF-2 Minimum Performance Standard was issued November 6, 1995.

Table Q-2—ILSAC GF-2 Passenger Car Engine Oil Minimum Performance Standard (Obsolete March 31, 2002)

Requirement	Criterion	
Viscosity Requirements	Viscosity, mPa•S, at Temperature, °C	
	Cranking:	Pumping:
	ASTM D 5293	ASTM D 4684
	3500 (max) at – 20°C	60,000 (max) at – 30°C
	Gelation Index ASTM D 5133: • 12.0 (max) • To be evaluated from – 5°C to temperature at which 40,000 cP is attained or – 40°C, whichever occurs first Other Requirements: As defined by the latest revision of SAE Standard J300	

Table Q-2—ILSAC GF-2 Passenger Car Engine Oil Minimum Performance Standard (Obsolete March 31, 2002)

Requirement	Criterion
Engine Test Requirements	As defined by the most recent revision of ASTM D 4485
Engine rusting	ASTM D 5844 Sequence IID test
Average rust rating	8.5 (min)
Stuck lifters	None
Wear and oil thickening	ASTM D 5533 Test Method Sequence IIIE
Hours to 375% increase In viscosity @ 40°C	64 (min)
Piston skirt varnish	8.9 (min)
Ring land deposits	3.5 (min)
Average engine sludge	9.2 (min)
Stuck piston rings	No oil related
Cam and lifter wear	
Average, mm	30 (max)
Maximum, mm	64 (max)
Oil consumption, l	5.1 (max)
Sludge and wear	ASTM D 5302 Test Method Sequence VE
Average engine sludge	9.0 (min)
Rocker cover sludge	7.0 (min)
Average engine varnish	5.0 (min)
Piston skirt varnish	6.5 (min)
Cam wear	
Average, mm	127 (max)
Maximum, mm	380 (max)
Oil screen clogging	20% (max)
Hot-stuck rings	None
Piston undercrown deposits	Rate and report
Ring land deposits	Rate and report
Cylinder bore wear	Rate and report
Oil ring clogging	Rate and report
Bearing corrosion	ASTM D 5119 Test Method L-38
Bearing weight loss, mg	40 (max)
Fuel economy improvement (FEI)	ASTM D 6202 Sequence VIA Test For SAE 0W-20 and 5W-20 viscosity grades: 1.4% (min) vs. ASTM BC-2 For other SAE 0W and 5W multi-viscosity grades: 1.1% (min) vs. ASTM BC-2 For all SAE 10W multi-viscosity grades: 0.5% (min) vs. ASTM BC-2

Table Q-2—ILSAC GF-2 Passenger Car Engine Oil Minimum Performance Standard (Obsolete March 31, 2002)

Requirement	Criterion
Bench Test Requirements	
Volatility	Simulated distillation (ASTM D 2887 extended) or (ASTM D 5480) 17% (max) at 371°C - or - Evaporative loss (CEC L-40-A-93) or JPI 5S-41-93 (Method B) 22% (max), 1 h at 250°C
Filterability	GM 9099P EOFT 50% (max) flow reduction allowable GM EOFT with following modifications (Rate and Report only): 1. Dry ice is not to be used during sample preparation. 2. Sample is to be placed in oven at 70°C for 6.0 hours (±0.25 hours). 3. Tests to be run at 0.6, 1.0, 2.0, and 3.0% water. 4. Test formulation with the highest additive (DI/VI) combination. Read across results to all other base oil/viscosity grade formulations using same or lower concentration of identical additive (DI/VI) combination. Each different (DI/VI) combination must be tested.
Foaming tendency	ASTM D 892 (Option A)
Foaming, ml	
Sequence I	10 (max)
Sequence II	50 (max)
Sequence III	10 (max)
Settling[a] ml	
Sequence I	0 (max)
Sequence II	0 (max)
Sequence III	0 (max)
High temperature foaming[b]	
Static foam max, tendency/stability	200/50[c]
Flash point	ASTM D 93 (ISO 2719) or ASTM D 92
ASTM D 93 (ISO 2719)	185°C (min)
ASTM D 92	200°C (min)
Shear stability	
L-38 test 10-hour stripped viscosity	Must remain in original SAE viscosity grade
Homogeneity and miscibility Federal Test Method 791B, Method 3470	
Additional Requirements:	
High temperature deposits	ASTM D 6335
Chrysler TEOST Test (Method 33)	60 mg deposit (max)
Catalyst Compatibility	
Phosphorus Content	

[a]Settling determined after 10 minutes.
[b]Follow High Temperature Foam Test in ASTM D 6082.
[c]Settling determined after 1 minute.

Q.3 ILSAC GF-3 Minimum Performance Standard for Passenger Car Engine Oils (Effective July 1, 2001)

The Japan Automobile Manufacturers Association, Inc. and representatives from DaimlerChrysler Corporation, Ford Motor Company and General Motors Corporation, through an organization called the International Lubricant Standardization and Approval Committee (ILSAC), jointly developed and approved an ILSAC GF-3 minimum performance standard for gasoline-fueled passenger car engine oils.

This standard specifies the minimum performance requirements (both engine sequence and bench tests) and chemical and physical properties for those engine oils that vehicle manufacturers deem necessary for satisfactory equipment performance and life.

In addition to meeting the requirements of the standard as shown in Table Q-3, it is the oil marketer's responsibility to be aware of and comply with all applicable legal and regulatory requirements on substance use restrictions, labeling, and health and safety information when marketing products meeting the GF-3 standard. It is also the marketer's responsibility to conduct its business in a manner which represents minimum risk to consumers and the environment.

The ultimate assessment of an engine oil's performance must include a variety of vehicle fleet tests that simulate the full range of customer driving conditions. The engine sequence tests listed in this document have been specified instead of fleet testing to minimize testing time and costs. This simplification of test requirements is only possible because the specified engine sequence tests have been correlated to a variety of vehicle tests.

The correlation between engine sequence tests and vehicle fleet tests is judged valid based only on the range of base oils and additive technologies that have proven to have satisfactory performance in service and that are in widespread use at this time. The introduction of base oils or additive technologies which constitute a significant departure from existing practice requires sufficient supporting vehicle fleet testing data to validate the correlation between vehicle and ASTM sequence test performance and to ensure there is no adverse effect to vehicle components or to emission control systems. This vehicle fleet testing should be conducted in addition to the other performance requirements listed in this specification.

Engine oil compatibility with sealing materials and gaskets is not controlled by performance tests in this specification. However, an SAE Committee on Automotive Rubber Specifications (CARS) has established a slate of reference elastomers that may be used for testing of different base oils and additive technologies that constitute a significant departure from existing materials. The CARS committee has also established an ASTM reference oil (TMC1006) that should be considered as an aggressive oil and could also be used as a reference. ILSAC recommends that additive or base oil technologies that exceed the aggression of this reference oil be revised or adequately field tested to ensure no chance of customer seal failures when placed in commercial service.

It is the responsibility of any individual or organization introducing a new technology to perform this vehicle fleet testing, and the responsibility of the oil marketer to ensure the above testing of new technology was satisfactorily completed. No marketer can claim to be acting in a reasonable and prudent manner if the marketer knowingly uses a new technology based only on the results of engine sequence testing without verifying the suitability of the new technology in vehicle fleet testing that simulates the full range of customer operation.

The ILSAC GF-3 Minimum Performance Standard includes the new Ball Rust Test, the new Sequence IIIF test, the new Sequence IVA test, the new Sequence VG test, the new Sequence VIB test, the new Sequence VIII test, and the new TEOST MHT test. Viscosity grade read across and base oil interchange for these tests may be applicable after VGRA and BOI Guidelines for them are supported by test data and developed by the appropriate groups. It should be pointed out, however, that when oil marketers use the guidelines, they do so based on their own judgment and at their own risk. The use of these guidelines does not absolve the marketer of the responsibility for meeting all specified requirements for any products the marketer sells in the marketplace that are licensed as ILSAC GF-3 with API.

Table Q-3—ILSAC GF-3 Passenger Car Engine Oil Minimum Performance Standard (Effective July 1, 2001)

Requirement	Criterion
Viscosity Requirements	Oils shall meet all requirements of SAE J300 and low temperature requirements of either SAE 0W, 5W or 10W viscosity grades Gelation Index ASTM D 5133: • 12.0 (max) • To be evaluated from –5°C to temperature at which 40,000 cP is attained or –40°C, whichever occurs first

Table Q-3—ILSAC GF-3 Passenger Car Engine Oil Minimum Performance Standard (Effective July 1, 2001)

Requirement	Criterion
Engine Test Requirements	As defined by the most recent revision of ASTM D 4485
Engine rusting	ASTM Ball Rust Test
Average rust rating	100 (min)
Wear and oil thickening	ASTM Sequence IIIF Test
Viscosity increase (kV 40°C)	275% (max)
Low temp viscosity	Report[a]
Average piston skirt varnish rating	9.0 (min)
Weighted piston deposit rating	4.0 (min)
Hot stuck piston rings	None allowed
Cam plus lifter wear, average, mm	20 (max)
Oil consumption, l	5.2 (max)
Cam wear	ASTM Sequence VE Test[b]
Average, mm	127 (max)
Maximum, mm	380 (max)
Sludge and varnish	ASTM Sequence VG Test
Average engine sludge rating	7.8 (min)
Rocker cover sludge rating	8.0 (min)
Average engine varnish rating	8.9 (min)
Average piston skirt varnish rating	7.5 (min)
Oil screen clogging,%	20 (max)
Hot-stuck compression rings	None
Cold stuck rings	Rate and report
Oil screen debris,%	Rate and report
Oil ring clogging	Rate and report
Valvetrain wear	ASTM Sequence IVA Test
Average cam wear (7 position avg.), mm	120 (max)
Bearing corrosion	ASTM Sequence VIII Test
Bearing weight loss, mg	26.4 (max)
Fuel economy improvement (FEI)	ASTM Sequence VIB Test[c] For SAE 0W-20 and 5W-20 viscosity grades: 2.0% FEI 1 (min) after 16 hours aging 1.7% FEI 2 (min) after 96 hours aging For SAE 0W-30 and 5W-30 viscosity grades: 1.6% FEI 1 (min) after 16 hours aging 1.3% FEI 2 (min) after 96 hours aging Sum of FEI 1 and FEI 2 must be 3.0% (min) For SAE 10W-30 and all other viscosity grades not listed above: 0.9% FEI 1 (min) after 16 hours aging 0.6% FEI 2 (min) after 96 hours aging Sum of FEI 1 and FEI 2 must be 1.6% (min)

Table Q-3—ILSAC GF-3 Passenger Car Engine Oil Minimum Performance Standard (Effective July 1, 2001)

Requirement	Criterion
Bench Test Requirements	As defined by the most recent revision of ASTM D 4485
Volatility	
Evaporation loss	ASTM D 5800 15% (max), 1 hour at 250°C
Simulated distillation	ASTM D 6417 10% (max) at 371°C
High temperature deposits	TEOST MHT-4
Deposit weight, mg	45 (max)
Filterability	
Engine oil filterability test (EOFT)	50% (max) flow reduction allowable
Engine oil water tolerance test (EOWTT)	50% (max) flow reduction allowable 1. Dry ice not to be used during sample preparation. 2. Sample to be placed in oven at 70°C for 6 hours (±0.25 hours). 3. Tests to be run at 0.6, 1.0, 2.0 and 3.0% H2O. 4. Test formulation with highest additive (DI/VI) concentration. Read across results to all other base oil/viscosity grade formulations using same or lower concentration of identical additive (DI/VI) combination. Each different DI/VI combination must be tested.
Foaming tendency	ASTM D 892 (Option A)
Foaming, ml	
Sequence I	10 (max)
Sequence II	50 (max)
Sequence III	10 (max)
After settling[d], ml	
Sequence I	0 (max)
Sequence II	0 (max)
Sequence III	0 (max)
High temperature foaming	ASTM D 6082 (optional blending required)
Foaming, ml	100 (max)
After settling[e], ml	0 (max)
Shear stability	ASTM Sequence VIII Test
10-hour stripped 100°C kinematic viscosity	Must remain in original SAE viscosity grade
Homogeneity and miscibility	ASTM D 6922, Method 3470.1 Shall remain homogeneous and, when mixed with SAE reference oils, shall remain miscible
Catalyst compatibility	ASTM D 4951 or D 5185
Phosphorus content	0.10 mass % (max)

[a]80-hour test oil sample shall be evaluated by ASTM Test Method D 4684 (MRV TP-1) at the temperature indicated by the low-temperature grade of oil as determined on the 80-hour sample by ASTM Test Method D 5293 (CCS viscosity).
[b]Not required for oils containing a minimum of 0.08% phosphorus in the form of zinc dialkyldithiophosphates (ZDDP).
[c]All FEI 1 and FEI 2 values determined relative to ASTM Reference Oil BC.
[d]Settling determined after 10 minutes.
[e]Settling determined after 1 minute.

Q.4 ILSAC GF-4 Minimum Performance Standard for Passenger Car Engine Oils (Effective July 31, 2004)

The Japan Automobile Manufacturers Association, Inc. and representatives from DaimlerChrysler Corporation, Ford Motor Company and General Motors Corporation, through an organization called the International Lubricants Standardization and Approval Committee (ILSAC), jointly developed and approved an ILSAC GF-4 minimum performance standard for gasoline-fueled passenger car engine oils.

This standard specifies the minimum performance requirements (both engine sequence and bench tests) and chemical and physical properties for those engine oils that vehicle manufacturers deem necessary for satisfactory equipment performance and life.

In addition to meeting the requirements of the standard, it is the oil marketer's responsibility to be aware of and comply with all applicable legal and regulatory requirements on substance use restrictions, labeling, and health and safety information when marketing products meeting the GF-4 standard. It is also the marketer's responsibility to conduct its business in a manner which represents minimum risk to consumers and the environment.

The ultimate assessment of an engine oil's performance must include a variety of vehicle fleet tests which simulate the full range of customer driving conditions. The engine sequence tests listed in this document have been specified instead of fleet testing to minimize testing time and costs. This simplification of test requirements is only possible because the specified engine sequence tests have been judged to be predictive of a variety of vehicle tests.

The relationships between engine sequence tests and vehicle fleet tests are judged valid based only on the range of base oils and additive technologies investigated—generally those which have proven to have satisfactory performance in service, and which are in widespread use at this time. The introduction of base oils or additive technologies which constitute a significant departure from existing practice requires sufficient supporting vehicle fleet testing data to ensure there is no adverse effect to vehicle components or to emission control systems. This vehicle fleet testing should be conducted in addition to the other performance requirements listed in this specification.

Engine oil compatibility with sealing materials and gaskets is not controlled by performance tests in this specification. However, an SAE Committee on Automotive Rubber Specifications (CARS) has established a slate of reference elastomers (see SAE J2643) which may be used for testing of different base oils and additive technologies which constitute a significant departure from existing materials. The CARS committee has also established an ASTM reference oil (Service Oil 105) which should be considered as an aggressive oil and could also be used as a reference. ILSAC recommends that additive or base oil technologies that exceed the aggression of this reference oil be revised or adequately field tested to ensure no chance of customer seal failures when placed in commercial service.

It is the responsibility of any individual or organization introducing a new technology to perform this vehicle fleet testing, and the responsibility of the oil marketer to ensure the above testing of new technology was satisfactorily completed. No marketer can claim to be acting in a reasonable and prudent manner if the marketer knowingly uses a new technology based only on the results of engine sequence testing without verifying the suitability of the new technology in vehicle fleet testing which simulates the full range of customer operation.

The ILSAC GF-4 Minimum Performance Standard includes tests for which Viscosity Grade Read Across and Base Oil Interchange Guidelines have been developed by the appropriate groups. It should be pointed out, however, that when oil marketers use the Guidelines, they do so based on their own judgment and at their own risk. The use of any guidelines does not absolve the marketer of the responsibility for meeting all specified requirements for any products the marketer sells in the marketplace that are licensed as ILSAC GF-4 with API.

Table Q-4 — ILSAC GF-4 Passenger Car Engine Oil Minimum Performance Standard

Requirement	Criterion
Fresh Oil Viscosity Requirements	
SAE J300	Oils shall meet all requirements of SAE J300. Viscosity grades are limited to SAE 0W, 5W, and 10W multigrade oils.
Gelation index	ASTM D 5133 12 (max) To be evaluated from –5˚C to temperature at which 40,000 cP is attained or –40˚C, or 2 Celsius degrees below the appropriate MRV TP-1 temperature (defined by SAE J300), whichever occurs first.
Engine Test Requirements	
Wear and oil thickening	ASTM Sequence IIIG
Kinematic viscosity increase @ 40°C, %	150 (max)
Average weighted piston deposits, merits	3.5 (min)
Hot stuck rings	None
Average cam plus lifter wear, µm	60 (max)
Aged oil low temperature viscosity	ASTM Sequence IIIGA
Evaluate the EOT oil from the ASTM Sequence IIIGA test with ASTM D 4684 (MRV TP-1)	The ASTM D 4684 viscosity of the EOT sample must meet the requirements of the original grade or the next higher grade
Wear, sludge, and varnish	ASTM Sequence VG (ASTM D 6593)
Average engine sludge, merits	7.8 (min)
Average rocker cover sludge, merits	8.0 (min)
Average engine varnish, merits	8.9 (min)
Average piston skirt varnish, merits	7.5 (min)
Oil screen sludge, % area	20 (max)
Oil screen debris, % area	Rate and report
Hot-stuck compression rings	None
Cold stuck rings	Rate and report
Oil ring clogging, % area	Rate and report
Follower pin wear, cyl #8, avg, µm	Rate and report[a]
Ring gap increase, cyl #1 and #8, avg, µm	Rate and report[a]
Valvetrain wear	ASTM Sequence IVA (ASTM D 6891)
Average cam wear (7 position avg.), µm	90 (max)
Bearing corrosion	ASTM Sequence VIII (ASTM D 6709)
Bearing weight loss, mg	26 (max)
Fuel efficiency	ASTM Sequence VIB[b] (ASTM D 6837) SAE 0W-20 and 5W-20 viscosity grades: 2.3% FEI 1 (min) after 16 hours aging 2.0% FEI 2 (min) after 96 hours aging SAE 0W-30 and 5W-30 viscosity grades: 1.8% FEI 1 (min) after 16 hours aging 1.5% FEI 2 (min) after 96 hours aging SAE 10W-30 and all other viscosity grades not listed above: 1.1% FEI 1 (min) after 16 hours aging 0.8% FEI 2 (min) after 96 hours aging

[a] ASTM Surveillance Panel will review statistics annually.
[b] All Fuel Economy Improvement (FEI) 1 and FEI 2 values determined relative to ASTM Reference Oil BC.

Table Q-4— ILSAC GF-4 Passenger Car Engine Oil Minimum Performance Standard (continued)

Requirement	Criterion
Bench Test Requirements	
Catalyst compatibility	
Phosphorus content, % (mass)	ASTM D 4951 0.08 (max)
Sulfur content	ASTM D 4951 or D 2622
SAE 0W and 5W multigrades, % (mass)	0.5 (max)
SAE 10W multigrades, % (mass)	0.7 (max)
Wear	ASTM D 4951
Phosphorus content, % (mass)	0.06 (min)
Volatility	ASTM D 5800
Evaporation loss, %	15 (max), 1 hour at 250°C (Note: Calculated conversions specified in D 5800 are allowed.)
Simulated distillation, %	ASTM D 6417 10 (max) at 371°C
High temperature deposits	TEOST MHT
Deposit weight, mg	35 (max)
Filterability	
EOWTT, %	ASTM D 6794
with 0.6% H_2O	50 (max) flow reduction
with 1.0% H_2O	50 (max) flow reduction
with 2.0% H_2O	50 (max) flow reduction
with 3.0% H_2O	50 (max) flow reduction (Note: Test formulation with highest additive (DI/VI) concentration. Read across results to all other base oil/viscosity grade formulations using same or lower concentration of identical additive (DI/VI) combination. Each different DI/VI combination must be tested.)
EOFT, %	ASTM D 6795 50 (max) flow reduction
Foaming characteristics	ASTM D 892 (Option A)
Tendency, mL	
Sequence I	10 (max)
Sequence II	50 (max)
Sequence III	10 (max)
Stability[c], mL	
Sequence I	0 (max)
Sequence II	0 (max)
Sequence III	0 (max)
High temperature foaming characteristics	ASTM D 6082 (Option A)
Tendency, mL	100 (max)
Stability[d], mL	0 (max)
Shear stability	ASTM Sequence VIII (ASTM D 6709)
10-hour stripped KV @ 100°C	Kinematic viscosity must remain in original SAE viscosity grade.

[c]After 10-minute settling period.
[d]After 1-minute settling period.

Table Q-4—ILSAC GF-4 Passenger Car Engine Oil Minimum Performance Standard (continued)

Requirement	Criterion
Bench Test Requirements (continued)	
Homogeneity and miscibility	ASTM D 6922 Shall remain homogeneous and, when mixed with ASTM reference oils, shall remain miscible.
Engine rusting Average gray value	Ball Rust Test (ASTM D 6557) 100 (min)

Applicable Documents:

1. SAE Standard, Engine Oil Viscosity Classification—SAE J300, *SAE Handbook*.
2. SAE Standard, Standard Reference Elastomers (SRE) for Characterizing the Effects on Vulcanized Rubbers, Proposed Draft 2003-5—SAE J2643, *SAE Handbook*.
3. ASTM Annual Book of Standards, Volume 5, Petroleum Products and Lubricants, current edition.
4. ASTM Sequence IIIG Test Research Report.
5. M. Batko and D. F. Florkowski, “Low Temperature Rheological Properties of Aged Crankcase Oils,” SAE Paper 2000-01-2943.
6. M. Batko and D. F. Florkowski, “Lubricant Requirements of an Advanced Designed High Performance, Fuel Efficient Low Emissions V-6 Engine,” SAE Paper 01FL-265

APPENDIX R—API Guidelines for Use of a Single Technology Matrix

R.1 General

A Single Technology Matrix (STM) approach may be used in addition to the Base Oil Interchangeability (BOI) and SAE Viscosity-Grade Testing (VGRA) Guidelines included in Appendices E and F. The STM approach must follow the guidelines outlined in R.2 and any engine-test-specific amendments listed in R.6.

R.1.1 INTRODUCTION

The BOI/VGRA guidelines in API 1509 are developed through industry consensus. Each guideline is generally derived using the 'minimum quality and quantity of data' rule. This rule requires that three technologies from at least two companies agree on the characteristic behavior of the base oil and/or SAE viscosity grade. This process has the benefit of industry consensus and public display of data, but it is not without limitations: reaching consensus on guidelines is often slow, over-testing in some areas occurs, and the type of data that can be viewed is limited.

The STM approach encompasses a technology or family of technologies from a single supplier in lieu of at least three technologies from different suppliers. The purpose of this approach is to offer an alternate, cost-effective, and technically valid process to demonstrate the performance capability of an additive technology. The matrix can be as broad or narrow in its application as are the industry guidelines. Note that while the guidelines developed through the traditional three-technologies approach applies to all technologies tested in the future, the guidelines developed from a Single Technology Matrix approach apply only to the technology or technologies used in that Matrix.

The additive technology supplier will provide the Oil Marketer with appropriate information from the Single Technology Matrix that the Oil Marketer may elect to utilize in applying for an API License.

R.1.2 DEFINITIONS

R.1.2.1 A *Single Technology* as designed for use in a Single Technology Matrix is a single additive package (DI) at a constant treat rate, with a single viscosity modifier, and in a single viscosity grade.

R.1.2.2 A *Single Technology Matrix* consists of a group of data meeting the criteria outlined in R.2. The test results in the matrix reflect data from a Single Technology as described in R.1.2.1.

R.1.2.3 A *Multiple Technology Matrix* consists of two or more Single Technology Matrices meeting the criteria outlined in R.2. A Multiple Technology Matrix developed within an API category cannot extend to future API categories unless recommended by the API BOI/VGRA Task Force and approved by the API Lubricants Committee.

R.1.2.4 A *Base Stock* is a lubricant component that is produced by a single manufacturer to the same specifications (independent of feed source or manufacturer's location); that meets the same manufacturer's specification; and that is identified by a unique formula, product identification number, or both. Base stocks may be manufactured using a variety of different processes including but not limited to distillation, solvent refining, hydrogen processing, oligomerization, esterification, and rerefining.

Rerefined stock shall be substantially free from materials introduced through manufacturing, contamination or previous use.

R.1.2.5 A *Base Oil* used in a Technology Matrix can consist of a single base stock or a blend of base stocks. The *Base Oil* can consist of the same or multiple slates of base stocks. The *Base Oil* is defined, at minimum, by the following variables:

a. Base Oil Saturates (ASTM D 2007)
b. Base Oil Sulfur (API Approved Tests from Appendix E, Table E-1)
c. Base Oil Viscosity at 100°C (ASTM D 445)
d. Base Oil Viscosity Index (ASTM D 2270)
e. Noack Volatility of the fully formulated oil (finished oil) (ASTM D 5800)

R.1.2.6 An *Outlier* is a test result in which the Studentized Residual for that observation from the analysis is at the one-sided 97.5^{th} percentile, or beyond, on a Student T distribution.

R.1.2.7 A *Spread Requirement* is a stipulation on the base oil variable results in the Matrix that facilitates a more even spread in those results throughout the Matrix.

R.2 Scope and Criteria for a Single Technology Matrix

R.2.1 MATRIX DATA CRITERIA

The Matrix data must be developed using a Single Technology as described in R.1.2.1. A minimum of X operationally valid tests on X different base oils is required for a suitable matrix (see Table R-1). X is either equal to 5 or equal to the number of base oil variables of interest plus 2 (to ensure that there are enough degrees of freedom to estimate the error term from the matrix), whichever is greater. Base oil variables of interest are determined by the API BOI/VGRA Task Force on a per test-type basis. The range of base oil variables of interest plus, if not included in that list, the ranges of base oil VI, base oil sulfur, base oil saturates, base oil viscosity at 100°C and finished oil Noack volatility (note that finished oil Noack volatility is considered a base oil variable for this STM application even though the volatility measurement is on the finished fluid) in that Matrix must cover any base oil interchange. To extend to another base oil beyond this range would require at least one additional test using a base oil that extends the range.

The base oil saturates in the Matrix must also meet a spread requirement. The maximum difference in saturates between two consecutive base oils sorted and listed by saturates can be no greater than the difference between the base oil with the highest saturates and the base oil with the lowest saturates, divided by 2.

To improve data efficiencies, multiple Single Technology Matrices may be combined and analyzed. This combination is known as the Multiple Technology Matrix. Whereas X tests on X different base oils are required from the first Single Technology Matrix, only X-1 operationally valid tests on X-1 different base oils are required from an additional Single Technology Matrix if that second Matrix is combined and analyzed with the first. If a third Single Technology Matrix is combined with the first two, that third Matrix would need a minimum of X-2 operationally valid tests on X-2 different base oils. Any additional Single Technology Matrices combined and analyzed with the others would require a minimum of X-2 operationally valid tests on X-2 different base oils. Note that in this combined Multiple Technology Matrix, the extremes of the base oils in terms of saturates, sulfur, VI, base oil viscosity, and other pertinent parameters must be represented. In addition, the maximum difference in saturates between two

consecutive base oils sorted and listed by saturates can be no greater than the difference between the base oil with the highest saturates and the base oil with the lowest saturates, divided by 2 for the second technology only. The maximum difference in saturates rule does not apply to the third or subsequent added technologies.

Note: A Multiple Technology Matrix developed within an API category cannot extend to future API categories unless recommended by the API BOI/VGRA Task Force and approved by the API Lubricants Committee.

Table R-1—Minimum Number of Base Oils for Matrix

Technology in the Matrix	Minimum Number of Base Oils per Technology
First Technology	The greater of 5 or (defined base oil variables + 2)
Second Technology	The greater of 4 or (defined base oil variables + 1)
Third Technology and Subsequent Technologies	The greater of 3 or (defined base oil variables)

R.2.2 INTERCHANGE CRITERIA BASED ON STATISTICAL CONFIDENCE LIMITS

Based on the Matrix and subsequent analysis, the predicted engine test result for the new base oil (interchange base oil) must meet the performance specification of interest. In addition, the width of the 95% confidence interval (based upon the Student T distribution) for the predicted mean performance cannot be greater than the width of the 95% confidence interval (based upon the Normal Frequency Distribution and the current standard deviation of the test used in the calculation of severity adjustments as defined in ASTM Test Monitoring Center Technical Memorandum 94-200, Appendix C of the LTMS Manual) for the mean based on a single test result at the predicted performance level. Although the confidence intervals must be calculated in the appropriate transformed units, the comparison must be made in original units.

Given that the interchange criteria from the Matrix and statistical analysis are met, base oil interchange may be used for the technology from the Single Technology Matrix and/or the technologies from the Multiple Technology Matrix. Base oil interchange may also be used for all minor formulation modifications of these technologies with the proper Level 1 and/or Level 2 Support as defined in Appendix H of the *American Chemistry Council Product Approval Code of Practice* (ACC Code).

The Matrix data and analysis must be shown to the Oil Marketer. A test result for a test parameter may be declared as an outlier and dropped from the analysis in accordance with R.2.4. However, the minimum number of base oils per technology criteria as outlined in R.2.1 as well as all other analysis and confidence limit requirements must be met. The observation must be an outlier for it to be dropped from the analysis. While observations may be dropped according to the Multiple Test Evaluation Procedure (MTEP) to determine pass/fail, those observations may not be dropped from the Single Technology Matrix analysis unless declared an outlier according to R.2.4.

Non-conformance through an audit will be subject to enforcement action as described in Appendix M and Section 5.

R.2.3 CALCULATION OF WIDTH OF 95% CONFIDENCE INTERVAL

R.2.3.1 Confidence Interval Width for a Mean Based on a Single Test Result

$$2 \times Z_{0.05} \times \sigma$$

Where:

$Z_{0.05}$ = 1.96

σ = current standard deviation of the test used in the calculation of severity adjustments as defined in ASTM Test Monitoring Center Technical Memorandum 94-200, Appendix C, of the LTMS Manual.

This is the shortcut method for calculating the width of the confidence interval. If a transformation is required, the shortcut method cannot be used. The actual confidence interval must be calculated for the predicted result for the oil on the transformed scale. This is done by adding and subtracting $Z_{0.05} \times \sigma$ from the predicted test result, transforming the confidence limits back, and then subtracting the limits on the original scale.

R.2.3.2 PREDICTED TEST RESULT CONFIDENCE INTERVAL WIDTH

$$2 \times t_{0.05,df} \times S \times \sqrt{h_i}$$

Where:

$t_{0.05,df}$ = Student T distribution at the 95% Confidence Level with degrees of freedom equal to the degrees of freedom used in the estimate of the Root Mean Squared Error (RMSE)

S = Root Mean Squared Error from the analysis

h_i = $x_i (X'X)^{-1} x_i'$

X = the factor matrix

x_i = a particular factor setting

This is the shortcut method for calculating the width of the confidence interval. If a transformation is required, the shortcut method cannot be used. The actual confidence interval must be calculated for the predicted result for the oil on the transformed scale. This is done by adding and subtracting $t_{0.05,df} \times S \times \sqrt{h_i}$ from the transformed predicted result, transforming the confidence limits back, and then subtracting the limits on the original scale.

R.2.4 CALCULATION OF THE STUDENTIZED RESIDUAL AND OUTLIER TEST

$$e^*_i = e_i / (S(i) \times (\sqrt{1-h_i}))$$

Where:

e^*_i = the Studentized Residual, which is distributed closely to the Student T distribution. In this application, the ith observation for a test parameter may be declared as an outlier and removed from the analysis if e^*_i is greater than the one sided $t_{0.025,df}$ with degrees of freedom equal to the degrees of freedom used in the estimate of the Root Mean Squared Error

e_i = the residual from the analysis, the actual test result for the ith observation for a parameter minus the predicted test result for the ith observation for a parameter

S(i) = Root Mean Squared Error from the analysis with the ith observation removed from the analysis

h_i = $x_i (X'X)^{-1} x_i'$

X = the factor matrix
x_i = a particular factor setting

R.3 Summary of Requirements for the Single Technology Matrix

The requirements for the Single Technology Matrix are summarized below:

a. A new test is developed and introduced as a part of a new specification.
b. The API BOI/VGRA Task Force reviews the new test, defines the critical base oil variables, and recommends use of the Single Technology Matrix.
c. The API Lubricants Committee approves the critical base oil variables and use of the Single Technology Matrix for the new test.
d. The Matrix Data Criteria must be met as defined in R.2.1.
e. All tests in the development of the Single Technology Matrix dataset and analysis must be registered according to the ACC Code.
f. The technology must pass within a single test result or by using the appropriate MTEP for each base oil in the Single Technology Matrix for all relevant test parameters.
g. Test results or observations dropped for evaluation in an MTEP procedure may not be dropped from the Single Technology Matrix analysis unless declared an outlier according to R.2.4.
h. The width of the 95% Confidence Interval (based upon the Student T distribution) for the predicted mean performance based on the Single Technology Matrix model cannot be greater than the width of the 95% Confidence Interval (based upon the Normal Frequency Distribution and the current standard deviation of the test used in the calculation of severity adjustments as defined in ASTM Test Monitoring Center Technical Memorandum 94-200, Appendix C, of the LTMS Manual) for the mean based on a single test result at the predicted performance level.
i. Single Technology Matrix results must be included in ACC candidate data packages.
j. Notification of use of Single Technology Matrix data for API licensure will be present on an Oil Marketer's API License Form and must be checked if used. An example is provided in R.5.
k. API will survey additive companies on a regular basis for Single Technology Matrix data.

R.4 Examples for Single Technology Matrix Approach

Note: The examples below only use some of the base oil variables required for the Single Technology Matrix. All of the required variables must be used when a Single Technology Matrix is being assembled.

R.4.1 EXAMPLE 1

Do we have base oil interchange for Technology 1 shown in Table R-2 in a new base oil that is 75% saturates in a test where the pass limit is a minimum of 8.0?

Table R-2—Example 1 Variables

Technology	Base Oil	Saturates	Test Result
1	1	60	8.1
1	2	70	8.6
1	3	80	8.4
1	4	90	8.9
1	5	100	9.2

The difference between the base oil with the highest saturates and the base oil with the lowest saturates, divided by 2, is equal to 20. No two consecutive base oils sorted by saturate amount have a difference greater than 20.

The Model based on saturates has an R^2 of 85% with a RMSE of 0.1889 with 3 degrees of freedom. The width of the 95% Confidence Interval for Technology 1 in the new base oil is 0.5702.

The industry standard deviation for the test is 0.25; therefore, a reasonable and fair estimate of the width of the 95% Confidence Interval for the mean based on a single test result is 0.98.

Since the width of the Confidence Interval from the Model is less than the width of the Confidence Interval for the mean based on a single test result, we have base oil interchange.

R.4.2 EXAMPLE 2

Do we have base oil interchange for Technology 1 shown in Table R-3 in a new base oil that is 75% saturates in a test where the pass limit is a minimum of 8.0?

Table R-3—Example 2 Variables

Technology	Base Oil	Saturates	Test Result
1	1	60	8.6
1	2	70	8.4
1	3	80	9.2
1	4	90	8.1
1	5	100	8.9

The difference between the base oil with the highest saturates and the base oil with the lowest saturates, divided by 2, is equal to 20. No two consecutive base oils sorted by saturate amount have a difference greater than 20.

The Model is just the mean of the data with a RMSE of 0.4278 with 4 degrees of freedom. The width of the 95% Confidence Interval for Technology 1 in the new base oil is 0.5311.

The industry standard deviation for the test is 0.25; therefore, a reasonable and fair estimate of the width of the 95% Confidence Interval for the mean based on a single test result is 0.98.

Since the width of the Confidence Interval from the Model is less than the width of the Confidence Interval for the mean based on a single test result, we have base oil interchange.

R.4.3 EXAMPLE 3

Do we have base oil interchange for Technology 1 shown in Table R-4 in a new base oil that is 75% saturates in a test where the pass limit is a minimum of 8.0?

Table R-4—Example 3 Variables

Technology	Base Oil	Saturates	Test Result
1	1	**60**	8.6
1	2	**81**	8.4
1	3	85	9.2
1	4	90	8.1
1	5	100	8.9

No. The difference between the base oil with the highest saturates and the base oil with the lowest saturates, divided by 2, is equal to 20. However, the difference in saturates between the two base oils with the lowest amount of saturates is 21. Since we have two consecutive base oils sorted by saturate amount that have a difference greater than 20, we cannot analyze this Matrix for base oil interchange.

R.4.4 EXAMPLE 4

Do we have base oil interchange for Technology 1 shown in Table R-5 in a new base oil that is 75% saturates in a test where the pass limit is a minimum of 8.0?

Table R-5—Example 4 Variables

Technology	Base Oil	Saturates	Test Result
1	1	60	9.8
1	2	70	7.1
1	2	70	8.9
1	3	80	8.9
1	4	90	5.0
1	4	90	7.9
1	4	90	8.1
1	5	100	9.4

The difference between the base oil with the highest saturates and the base oil with the lowest saturates, divided by 2, is equal to 20. No two consecutive base oils sorted by saturate amount have a difference greater than 20.

The Model is just the mean of the data with a RMSE of 1.535 with 7 degrees of freedom. The width of the 95% Confidence Interval for Technology 1 in the new base oil is 2.5670.

The industry standard deviation for the test is 0.25; therefore, a reasonable and fair estimate of the width of the 95% Confidence Interval for the mean based on a single test result is 0.98.

Since the width of the Confidence Interval from the Model is more than the width of the Confidence Interval for the mean based on a single test result, we DO NOT have base oil interchange.

However, we notice that the test result of 5.0 is unusually low. The Studentized Residual for this observation is 3.6, which is greater than the one sided $t_{0.025,7}$ of 2.4. The observation may then be removed from the analysis since the number of base oils remains at five. If the observation were to be removed as an outlier, then the Confidence Interval for Technology 1 in the new base oil would be less than 0.98 and we would have base oil interchange.

R.4.5 EXAMPLE 5

Do we have base oil interchange for Technology 1 shown in Table R-6 in a new base oil that is 75% saturates in a test where the pass limit is a minimum of 8.0?

Table R-6—Example 5 Variables

Technology	Base Oil	Saturates	Test Result
1	1	60	9.8
1	2	70	7.1
1	2	70	8.0
1	3	80	8.9
1	4	90	5.0
1	4	90	7.9
1	4	90	8.1
1	5	100	9.4

No. We do not have a pass in Base Oil Number 2 for this Technology. Note that we do have a pass in Base Oil Number 4 using MTAC.

R.4.6 EXAMPLE 6

Do we have base oil interchange for both Technology 1 and Technology 2 shown in Table R-7 in a new base oil that falls between the extremes of the base oil characteristics in a test where the pass limit is a minimum of 8.0?

Table R-7—Example 6 Variables

Technology	Base Oil	Base Oil Characteristics	Test Result
1	1	Extreme High	8.1
1	2	Medium	8.6
1	3	Low	8.4
1	4	High	8.9
1	5	Extreme Low	9.2
2	1	Extreme High	8.9
2	6	Medium	9.2
2	7	High	9.6
2	5	Extreme Low	8.8

The Model based on Technology 1 has an R^2 of 32% with a RMSE of 0.3999 with 7 degrees of freedom. The width of the 95% Confidence Interval for Technology 1 in the new base oil is 0.846. The width of the 95% Confidence Interval for Technology 2 in the new base oil is 0.946.

The industry standard deviation for the test is 0.25; therefore, a reasonable and fair estimate of the width of the 95% Confidence Interval for the mean based on a single test result is 0.98.

Since the width of the Confidence Interval from the Model is less than the width of the Confidence Interval for the mean based on a single test result for both Technologies, we have base oil interchange for both Technologies.

R.5 Notification of Single Technology Matrix Use to API

Oil Marketers must notify API on Part B of the EOLCS Application for Licensure whenever Single Technology Matrix data is used to qualify an oil formulation for API licensing. The Part B form includes a check box that specifically asks if STM has been used. It is below the BOI and VGRA check boxes. Part B also asks the Oil Marketer to identify which test(s) use the STM support data. An example of the information requested is shown in Figure R-1.

Note: The Oil Marketer must have the STM support data on-file.

API Base Oil Interchangeability	Y
API Viscosity Grade Read Across	N
Single Technology Matrix	Y
Sequence IIIF	Y
Sequence IVA	N
Sequence VG	N
Sequence VIB	N
Sequence VIII	N

(Y=yes if BOI, VGRA and/or STM guidelines used for formulation; N=no)

Figure R-1—Example of STM Check-Off in Part B Form

R.6 Specific Engine Tests Approved for STM

R.6.1 SEQUENCE IIIF

The critical base oil variables are:

- Base Oil Saturates (ASTM D 2007)
- Base Oil Sulfur (API approved tests from Appendix E, Table E-1)
- Base Oil Viscosity at 100°C (ASTM D 445)
- Base Oil Viscosity Index (ASTM D 2270)
- Noack Volatility of the fully formulated oil (finished oil) (ASTM D 5800)

The Single Technology Matrix must consist of at least 7 different base oils. The relevant test parameters are:

- Percent Viscosity Increase at 80 Hours
- Weighted Piston Deposits
- Average Piston Varnish
- Average Camshaft plus Lifter Wear
- Stuck Rings

Each technology in the STM must pass each relevant test parameter (within 1 test or by MTAC) in each base oil.

Confidence Intervals are applicable to each relevant test parameter except Average Camshaft plus Lifter Wear and Stuck Rings.

Passenger car motor oil (PCMO) technologies cannot be used with heavy duty diesel engine oil (HDEO) technologies in the same Multiple Technology Matrix. If a Multiple Technology Matrix is used, it must consist of either all PCMO technology or all HDEO technology.

In addition to a spread requirement for the base oil saturates in the matrix, there is a spread requirement for base oil viscosity index. The maximum difference in base oil viscosity index between two consecutive base oils sorted and listed by base oil viscosity index can be no greater than the difference between the base oil with the highest base oil viscosity index and the base oil with the lowest base oil viscosity index, divided by 2.

R.6.2 DETAILED EXAMPLE USING THE SEQUENCE IIIF

Do we have base oil interchange for Technology 1 shown in Table R-8 in a new base oil that is within the ranges for base oil saturates, sulfur, viscosity, viscosity index and blend volatility in the IIIF?

Table R-8—Sequence IIIF Parameters for Example Using STM

Base Oil	Base Oil Saturates D 2007	Base Oil Sulfur D 4294	Finished Oil Noack Volatility D 5800	Base Oil Viscosity @ 100°C D 445	Base Oil Viscosity Index D 2270	IIIF Percent Viscosity Increase	IIIF Weighted Piston Deposits	IIIF Average Piston Varnish	IIIF Average Cam plus Lifter Wear	IIIF Stuck Rings
1	75.4	0.2049	16.9	5.61	105	311.2	4.92	9.1	10.8	0
1	75.4	0.2049	16.9	5.61	105	190	4.44	9.4	7.0	0
2	68.3	0.3055	18.2	4.46	100	270.4	4.17	9.1	7.9	0
3	70.7	0.3132	15.8	4.39	102	108.3	3.76	8.9	6.8	0
3	70.7	0.3132	15.8	4.39	102	268	4.44	9.1	8.2	0
4	66.7	0.2171	16.6	4.86	104	111.4	5.20	9.2	7.7	0
5	73.9	0.3423	13.9	5.10	103	162.1	4.32	9.2	5.6	0
6	84.1	0.0740	14.7	5.47	102	67	4.2	9.4	5.1	0
7	61.2	0.3641	16.0	4.31	96	311.1	3.95	9.5	8.7	0
7	61.2	0.3641	16.0	4.31	96	212	3.97	9.5	5.7	0
New	72	0.25	16.2	5.00	102					

Step 1: Do we have enough base oils in the Matrix?

Yes. We have 7 base oils in the Matrix. The minimum number of tests is the number of critical base oil variables (saturates, sulfur, viscosity at 100°C, and viscosity index) and the Noack volatility of the fully formulated oil plus two.

Step 2: Do we have an approximate evenly distributed spread of base oils in the Matrix?

Yes. Maximum saturates minus minimum saturates divided by 2 equals 11.45 ((84.1 – 61.2)/2 = 11.45). This represents the maximum allowable difference in saturates between two consecutive base oils sorted by saturate level. The maximum difference from the actual Matrix is 8.7 (84.1 – 75.4 = 8.7). Maximum base oil viscosity index minus minimum base oil viscosity index divided by 2 equals 4.5 ((105 – 96)/2 = 4.5). This represents the maximum allowable difference in base oil viscosity index between two consecutive base oils sorted by base oil viscosity index. The maximum difference from the actual Matrix is 4 (100 – 96 = 4).

Step 3: Do we pass Technology 1 in every base oil in the Matrix?

Yes. Some pass with one test and some pass by MTAC.

Step 4: Do we predict a pass for Technology 1 in the new base oil based on the analysis of the Matrix?

Yes. The prediction for the new base oil is based on a very simple model (see Table R-9), the average over all other base oils since no base oil effects were evident with this technology over the range tested.

Table R-9—Step 4: Model Predicted

Base Oil	Base Oil Saturates D 2007	Base Oil Sulfur D 4294	Finished Oil Noack Volatility D 5800	Base Oil Viscosity @ 100°C D 445	Base Oil Viscosity Index D 2270	Model Predicted				
						IIIF Percent Viscosity Increase	IIIF Weighted Piston Deposits	IIIF Average Piston Varnish	IIIF Average Cam plus Lifter Wear	IIIF Stuck Rings
New	72	0.25	16.2	5.00	102	201	4.3	9.2	7.4	0

Step 5: Are there any outliers?

Possible outliers would include test results in which the Studentized residuals exceed the Student T distribution at the one-sided 0.025 percentile with degrees of freedom used in the calculation of the Root Mean Squared Error from the model, which is 9.

$$t_{0.05,9} = 2.262$$

According to the calculations in R.2.4, there are two possible outliers (see Table R-10). These outliers should be investigated as to their possible cause. Given that an investigation has not yet taken place, the outliers are not removed in this example. After future investigation, the test sponsor may remove these identified outliers on a parameter-by-parameter basis. However, please note that the outlier of 2.65 identified for Weighted Piston Deposits CANNOT be removed unless another test is run on this Technology to bring the number of base oils in the Matrix for Weighted Piston Deposits back to seven.

Table R-10—Step 5: Studentized Residuals

Test Number	IIIF Percent Viscosity Increase	IIIF Weighted Piston Deposits	IIIF Average Piston Varnish	IIIF Average Cam plus Lifter Wear	IIIF Stuck Rings
1	1.38	1.47	-0.71	*2.86*	0
2	-0.13	0.23	0.82	-0.20	0
3	0.81	-0.38	-0.71	0.32	0
4	-1.13	-1.45	-2.09	-0.32	0
5	0.78	0.23	-0.71	0.50	0
6	-1.08	*2.65*	-0.20	0.20	0
7	-0.45	-0.04	-0.20	-1.09	0
8	-1.79	-0.31	0.82	-1.48	0
9	1.38	-0.91	1.44	0.82	0
10	0.12	-0.86	1.44	-1.02	0

Step 6: Is the width of the 95% Confidence Interval (based upon the Student T distribution) for the predicted mean performance based on the Single Technology Matrix model less than or equal to the width of the 95% Confidence Interval (based upon the Normal Frequency Distribution and the current standard deviation of the test used in the calculation of severity adjustments as defined in ASTM Test Monitoring Center Technical Memorandum 94-200, Appendix C, of the LTMS Manual) for the mean based on a single test result at the predicted performance level for all relevant test parameters?

Yes. Calculations are presented below for Percent Viscosity Increase and summarized for all other test parameters.

Confidence Interval for the Mean Based on a Single Test Result:

$$\text{Transform(Result)} + (Z_{0.05} \times \sigma) \quad \text{to} \quad \text{Transform(Result)} - (Z_{0.05} \times \sigma)$$

Where:

Result = predicted test result for the new Base Oil based on the STM analysis
Transform = Industry transformation for this test; the inverse square root
σ = current standard deviation of the test used in the calculation of severity adjustments as defined in ASTM Test Monitoring Center Technical Memorandum 94-200, Appendix C, of the LTMS Manual.

$$1/(\text{Result})^{1/2} + (1.96 \times 0.0129546) \text{ to } 1/(\text{Result})^{1/2} - (1.96 \times 0.0129546)$$

$$1/(201)^{1/2} + (1.96 \times 0.0129546) \text{ to } 1/(201)^{1/2} - (1.96 \times 0.0129546)$$

0.0959 to 0.0451 in transformed units

95% Confidence Interval for the true mean of Percent Viscosity Increase based on a single test result using the industry-published standard deviation equals 109 to 491
The width of the Confidence Interval in original units equals 491 – 109 = 382

Predicted Test Result Confidence Interval Width:

$$\text{Transform(Result)} + (t_{0.05,df} \times S \times \sqrt{h_i}) \text{ to } \text{Transform(Result)} - (t_{0.05,df} \times S \times \sqrt{h_i})$$

Where:
Result = predicted test result for the new base oil based on the STM analysis
Transform = transformation used in this STM analysis: none
S = Root Mean Squared Error (RMSE) from this STM analysis
df = degrees of freedom used in calculating the RMSE

$$(\text{Result}) - (2.262 \times 88.13112 \times 0.3162) \text{ to } (\text{Result}) + (2.262 \times 88.13112 \times 0.3162)$$

(201) – (63.0353) to (201) + (63.0353)
95% Confidence Interval for the true mean of Percent Viscosity Increase based on the data and analysis of the STM equals 138 to 264.
The width of the Confidence Interval in original units equals 264 – 138 = 126. A summary of the confidence interval widths is shown in Table R-11.

Table R-11—Summary of Confidence Interval Widths

IIIF Parameter	Confidence Interval Width for a Mean Based on a Single Test Result	Predicted Test Result Confidence Interval Width	Predicted Test Result Confidence Interval Width Smaller?
Percent Viscosity Increase	382	126	YES
Weighted Piston Deposits	2.58	0.63	YES
Average Piston Varnish	0.86	0.29	YES

Step 7: Do we have base oil interchange for Technology 1 in a new base oil that is within the ranges for base oil saturates, sulfur, viscosity, viscosity index, and blend volatility in the Sequence IIIF?

Yes

R.6.3 SEQUENCE IIIF-HD

The critical base oil variables are:

- Base Oil Saturates (ASTM D 2007)
- Base Oil Sulfur (API approved tests from Appendix E, Table E-1)
- Base Oil Viscosity at 100°C (ASTM D 445)
- Base Oil Viscosity Index (ASTM D 2270)
- Noack Volatility of the fully formulated oil (finished oil) (ASTM D 5800)

The Single Technology Matrix must consist of at least 7 different base oils. The relevant test parameter is:

- Percent Viscosity Increase at 60 Hours

Each technology in the STM must pass each relevant test parameter (within 1 test or by MTAC) in each base oil.

Confidence Intervals are applicable to each relevant test parameter except Hot Stuck Piston Rings.

Passenger car motor oil (PCMO) technologies cannot be used with heavy duty diesel engine oil (HDEO) technologies in the same Multiple Technology Matrix. If a Multiple Technology Matrix is used, it must consist of either all PCMO technology or all HDEO technology.

In addition to a spread requirement for the base oil saturates in the matrix, there is a spread requirement for base oil viscosity index. The maximum difference in base oil viscosity index between two consecutive base oils sorted and listed by base oil viscosity index can be no greater than the difference between the base oil with the highest base oil viscosity index and the base oil with the lowest base oil viscosity index, divided by 2.

R.6.4 SEQUENCE IIIG

The critical base oil variables are:

- Base Oil Saturates (ASTM D 2007)
- Base Oil Sulfur (API approved tests from Appendix E, Table E-1)
- Base Oil Viscosity at 100°C (ASTM D 445)
- Base Oil Viscosity Index (ASTM D 2270)
- Noack Volatility of the fully formulated oil (finished oil) (ASTM D 5800)

The Single Technology Matrix must consist of at least 7 different base oils. The relevant test parameters are:

- Percent Viscosity Increase at 100 Hours
- Weighted Piston Deposits
- Average Cam plus Lifter Wear
- Hot Stuck Piston Rings

Each technology in the STM must pass each relevant test parameter (within 1 test or by MTAC) in each base oil.

Confidence Intervals are applicable to each relevant test parameter except Hot Stuck Piston Rings.

Passenger car motor oil (PCMO) technologies cannot be used with heavy duty diesel engine oil (HDEO) technologies in the same Multiple Technology Matrix. If a Multiple Technology Matrix is used, it must consist of either all PCMO technology or all HDEO technology.

In addition to a spread requirement for the base oil saturates in the matrix, there is a spread requirement for base oil viscosity index. The maximum difference in base oil viscosity index between two consecutive base oils sorted and listed by base oil viscosity index can be no greater than the difference between the base oil with the highest base oil viscosity index and the base oil with the lowest base oil viscosity index, divided by 2.

R.6.5 SEQUENCE IIIGA

The critical base oil variables are:

- Base Oil Saturates (ASTM D 2007)
- Base Oil Sulfur (API Approved Tests from Appendix E, Table E-1)
- Base Oil Viscosity at 100°C (ASTM D 445)
- Base Oil Viscosity Index (ASTM D 2270)
- Noack Volatility of the fully formulated oil (finished oil) (ASTM D 5800)

The Single Technology Matrix must consist of at least 7 different base oils. The relevant test parameter is:

- MRV TP-1

Each technology in the STM must pass the relevant test parameter (MTAC is not applicable) in each base oil.

Confidence Intervals are not applicable to MRV TP-1 due to the nature of test result distribution and extraordinary size of the test variability.

Passenger Car Motor Oil (PCMO) technologies cannot be used with Heavy Duty Engine Oil (HDEO) technologies in the same Multiple Technology Matrix. If a Multiple Technology Matrix is used it must consist of either all PCMO technology or all HDEO technology.

In addition to a spread requirement for the base oil saturates in the matrix, there is a spread requirement for base oil viscosity index. The maximum difference in base oil viscosity index, between two consecutive base oils sorted and listed by base oil viscosity index, can be no greater than the difference between the base oil with the highest base oil viscosity index and the base oil with the lowest base oil viscosity index, divided by 2.

An additional requirement for use of the Sequence IIIGA matrix is that the fresh oil MRV of the candidate oil, blended to the same viscosity grade, is equal to or less than the fresh oil MRV of at least one of the passing oils in the matrix, within the precision of the test. ASTM D4684 MRV testing is to be carried out at the appropriate temperature as defined in SAE J300.

APPENDIX S—PERFORMANCE REQUIREMENTS FOR C CATEGORY SUPPLEMENTS

S.1 Scope

This appendix describes the supplemental bench and engine test requirements adopted by the API Lubricants Committee for an existing C Category. Oils that meet the requirements for a supplement as defined in this appendix and are properly licensed by API may display the supplement's classification in the lower portion of the API Service Symbol in conjunction with the associated C Category in the upper portion.

S.2 Bench and Engine Test Requirements for CI-4 PLUS and CJ-4

Oils that meet the engine and bench requirements for CI-4 PLUS as defined below and are properly licensed by API may display CI-4 PLUS in the lower portion of the API Service Symbol in conjunction with API Service CI-4 and/or CJ-4 in the upper portion. The requirements in this appendix include initial base oil interchange and viscosity grade read-across guidelines for the Mack T-11 test. Marketers must also refer to API 1509 for additional guidelines for licensing CI-4 PLUS.

S.2.1 90-PASS SHEAR STABILITY BENCH TEST[a]

The final formulation must meet the following shear stability requirement: The 100°C kinematic viscosity of the oil must stay within its SAE grade after 90 passes in the injector shear bench test.[b]

S.2.2 MACK T-11 ENGINE TEST[a]

All candidate tests must be conducted in an ASTM-calibrated stand. The limits for the Mack T-11 are noted below:

TGA % Soot @ 12.0 cSt increase @ 100°C Linear Interpolation–from 2 data points [New viscosity–after 90 passes (method as per section S.2.1)]	6.00 min[c,d]

S.2.2.1 Base Oil Interchange

This section summarizes the method for comparing the base oil saturates of the formulation being licensed to that in the test oil. The saturate level of the test oil refers to a value for the base oil blend as determined by ASTM D 2007. Additive adjustments from the test oil to the final formulation are limited to the Minor Formulation Guidelines contained in the current edition of the ACC Code of Practice.

For the Mack T-11 test, base oil interchange is allowed per the equation below:

Tested Oil	Candidate Oil
X ≤ 70.0	80.0 minimum
70.0 < X < 95.0	(0.6*X + 38) minimum
X ≥ 95.0	95.0 minimum

In addition to using the equation, the limits can be defined by graphical means (see Figure S-1) or the use of tabulated limits (see Table S-1).

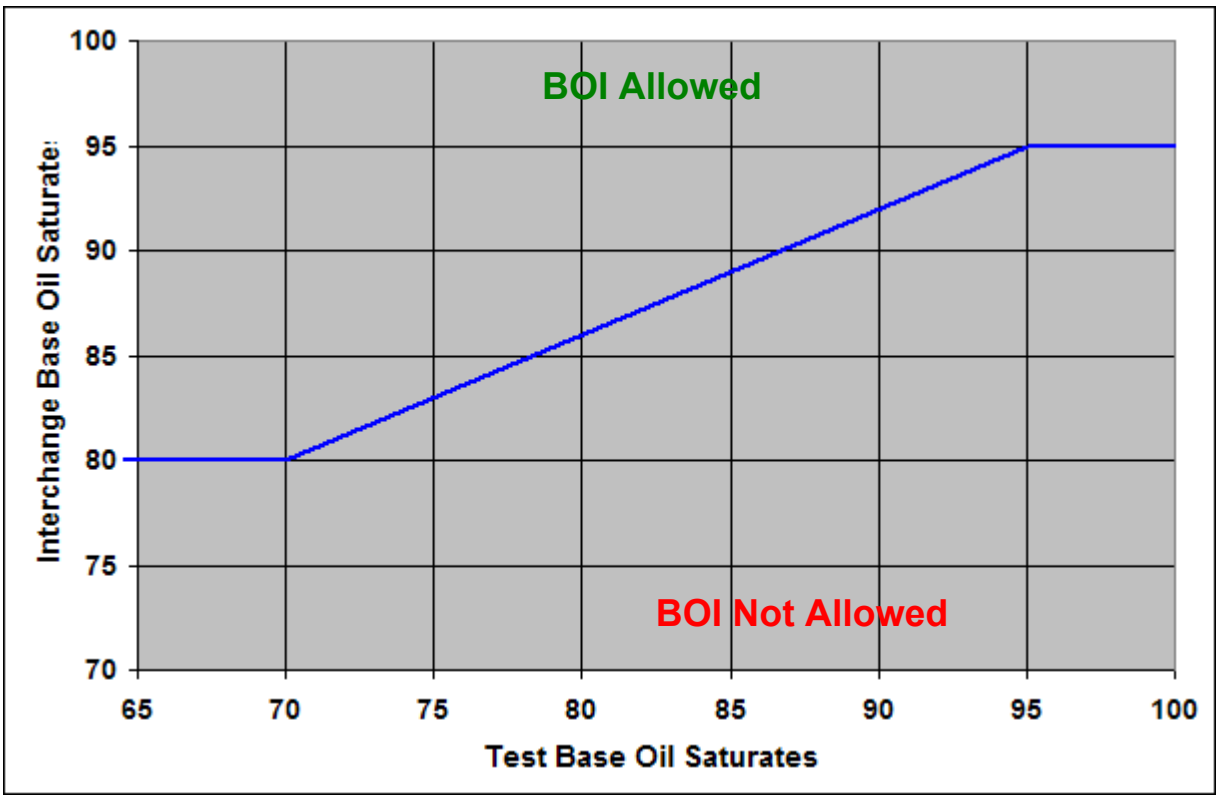

Figure S-1—Plot of Saturates for the Test and Interchange Base Oils

Table S-1—Base Oil Saturates Requirements for BOI

Base Oil Originally Tested for Licensing	Minimum Saturates for Interchange Base Oil
≤70.0	80.0
71.0	80.6
72.0	81.2
73.0	81.8
74.0	82.4
75.0	83.0
76.0	83.6
77.0	84.2
78.0	84.8
79.0	85.4
80.0	86.0
81.0	86.6
82.0	87.2
83.0	87.8
84.0	88.4
85.0	89.0
86.0	89.6
87.0	90.2
88.0	90.8
89.0	91.4
90.0	92.0
91.0	92.6
92.0	93.2
93.0	93.8
94.0	94.4
≥95.0	95.0

This method for determining Base Oil Interchange applies to all Mack T-11 engine tests associated with API CJ-4 and to Mack T-11 engine tests associated with API CI-4 with CI-4 PLUS that were started after April 28, 2006.

S.2.2.2 Viscosity Grade Read-Across

Table S-2 contains the VGRA read-across matrix for the Mack T-11 test. When applying the viscosity grade reads allowed by this matrix, two additional conditions must also be met: (1) Base oil saturates in the test and final formulations must comply with the guidelines in S.2.2.1, and (2) in cases where a dispersant viscosity modifier (DVM) is used, the DVM level in the final formulation must be equal to or greater than the level in the test oil.

Table S-2—Viscosity Grade Read-Across for the Mack T-11

	Read-Across Grades					
Vis Grade Tested	10W-30	10W-40	15W-40	15W-50	20W-40	20W-50
10W-30	NA	X	—	—	—	—
10W-40	X	NA	—	—	—	—
15W-40	X	X	NA	X	—	—
15W-50	X	X	X	NA	—	—
20W-40	X	X	X	X	NA	X
20W-50	X	X	X	X	X	NA

Note: X = Read-across allowed; — = Read-across not allowed.

[a]90-Pass Shear Stability Test (ASTM D 7109); Mack T-11 Test (ASTM D 7156).
[b]As defined in the most recent edition of SAE J300.
[c]If technical judgment is used to support Mack T-11 performance, please refer to Appendix D, paragraph D.5.2, to determine the appropriate licensing procedure.
[d]For situations where multiple tests are run on the same formulation, the following tiered limits can be applied:

Number of Tests	1	2	3 or More
Minimum %TGA Soot @12.0 cSt increase @100°C	6.00	5.89	5.85