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TO: API Engine Oil Licensing and Certification System (EOLCS) Licensees
API Lubricants Group
Other Interested Parties

SUBJECT: Technical Bulletin 1
API 1509, *Engine Oil Licensing and Certification System*
16th Edition, April 2007

API's Lubricants Committee has approved by letter ballot the following changes to the 16th Edition of API 1509 (see Attachment 1). These changes result from the committee's adoption of ILSAC GF-5, the latest performance requirements for gasoline engine oils set by the International Lubricant Standardization and Approval Committee (ILSAC), and API Service SN, a new gasoline engine oil service category.

More changes to API 1509 are required to bring the document in line with ILSAC GF-5 and API SN. These will be forwarded to you in subsequent technical bulletins or issued as part of a new edition of API 1509. Of all the changes approved or under consideration, the most important are the following:

- Starting October 1, 2010, ILSAC GF-5 provides a **new** basis for issuance of a license to use the API Certification Mark "Starburst." Until September 30, 2011, ILSAC GF-4 also provides a basis for issuance of a license to use the API Certification Mark.
- Effective October 1, 2011, ILSAC GF-5 provides the **only** basis for issuance of a license to use the API Certification Mark. Oils meeting ILSAC GF-4 will no longer be eligible to display the API Certification Mark after September 30, 2011.
- Oil marketers may now license oils meeting ILSAC GF-5 as ILSAC GF-4 and/or API SM.
- Starting October 1, 2010, API Service SN may be licensed for use in the upper portion of the API Service Symbol "Donut."
- Starting October 1, 2010, oils meeting SN with Resource Conserving requirements may be licensed to display "Resource Conserving" in the lower portion of the API Service Symbol in conjunction with API Service SN in the upper portion.
- Oils meeting API Service SN requirements may now be licensed as API Service SM.

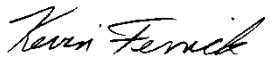
Marketers have a number of options to consider as they plan the introduction of the new oils:

- Marketers are free to identify qualifying oils as meeting ILSAC GF-5 and API SN prior to their first licensing dates but must avoid statements that imply API certification or licensing of ILSAC GF-5 or API SN in advance of those dates.
- Marketers that want to claim their products are licensed by API as meeting ILSAC GF-5 and/or API SN on the first licensing dates must file their Part B information before that time. API will process applications as they are received, but the right to claim API licensing against the ILSAC GF-5 and API SN specifications will not be allowed until October 1, 2010.

These changes are effective as of January 1, 2010, unless otherwise noted.

Please do not hesitate to contact me at 1 202 682 8233 (fax: 1 202 962 4739; e-mail: ferrick@api.org) if you have questions.

Sincerely,



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A number of sections in the 16th Edition of API 1509 must be changed and new paragraphs added to accommodate ILSAC GF-5, API SN and API SN with Resource Conserving. This includes the insertion of the user language below describing SN, new tables in Appendix G, and descriptive information and a new table in Appendix Q.

2.3.2.1 SN—2011 Gasoline Engine Warranty Maintenance Service

API Service Category SN was adopted for use in describing engine oils available in 2011. These oils are for use in service typical of gasoline engines in current and earlier passenger cars, sport utility vehicles, vans, and light-duty trucks operating under vehicle manufacturers' recommended maintenance procedures. Vehicle owners and operators should follow their vehicle manufacturer's recommendations on engine oil viscosity and performance standard.

Engine oils that meet the API Service Category SN designation (see Appendix G, Table G-5) may be used where API Service Category SM and earlier S categories have been recommended.

Engine oils that meet the API Service Category SN designation have been tested in accordance with the ACC Code and may use the API Base Oil Interchangeability Guidelines and the API Guidelines for SAE Viscosity-Grade Engine Testing (see Appendices E and F).

Starting October 1, 2010, oils that have passed the tests for API Service Category SN at the limits shown in Table G-5 and are properly licensed by API may display API Service SN in the upper portion of the API Service Symbol. Before the October 1, 2010, introduction date, oil marketers may license API SN oils as API SM.

2.3.2.5.2 Resource Conserving in Conjunction with API Service Category SN

API Service SN engine oils designated as Resource Conserving are formulated to help improve fuel economy and protect vehicle emission system components in passenger cars, sport utility vehicles, vans, and light-duty trucks powered by gasoline engines. These oils have demonstrated a fuel economy improvement (FEI) in the Sequence VID test at the percentages listed in Table 1 when compared with a baseline oil (BL) used in the Sequence VID test. Additionally, these oils have demonstrated in the tests listed in Table 1 that they provide greater emission system and turbocharger protection and help protect engines when operating on ethanol-containing fuels up to E85.

Many previous S-categories made reference to "Energy Conserving," but this reflected an emphasis on fuel-economy performance alone. Resource Conserving in conjunction with API SN focuses on fuel economy, emission system and turbocharger protection, and compatibility with ethanol-containing fuel up to E85.

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

Table 1—Resource Conserving Primary Performance Criteria with API Service Category SN

Performance Test	Performance Criteria	
Sequence VID (ASTM D7589)[a]		
Viscosity Grade	FEI SUM	FEI2 minimum after 100 hours aging
XW-20	2.6%	1.2%
XW-30	1.9%	0.9%
10W-30 and all other viscosity grades not listed above	1.5%	0.6%
Sequence IIIGB (ASTM D7320)	79% phosphorus retention min	
Emulsion Retention (ASTM D7563)	No water separation	
High Temperature Deposits, TEOST 33C (ASTM D6335), Total Deposit Weight, mg		
SAE 0W-20	Not Required	
All other viscosity grades	30 max	

[a]Viscosity grades are limited to 0W, 5W and 10W multigrade oils.

APPENDIX G—Requirements for API Service Categories SH, SJ, SL, SM, and SN 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 D5800 volatility loss, % max[c]	25	20	18
Test Method D2887 volatility loss at 371°C (700°F), % max[c]	20	17	15
EOFT[d], % flow reduction, max	50	50	NR
Test Method D4951 or D5185, phosphorus % mass, max	0.12	0.12	NR
Test Method D92 flash point, °C, min[e]	200	205	215
Test Method D93 flash point, °C, min[e]	185	190	200
Test Method D892 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 D6082[g]	Report	Report	Report
ASTM D6922, 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 D4485.
[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 D92 or Test Method D93 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 or ASTM D6557[b]	Pass
Sequence IIIE or IIIF or IIIG	Pass
Sequence VE or IVA plus VG[b]	Pass
L-38 or Sequence VIII	Pass

Bench Test and Measured Parameter[a]	Viscosity Grade Performance Criteria	
	SAE 0W-20, SAE 5W-20, SAE 5W-30, SAE 10W-30	All Others
Test Method D5800 volatility loss, % max[c]	22	20[d]
Test Method D6417 volatility loss at 371°C (700°F), % max[c]	17	15[d]
Test Method D5480 volatility loss at 371°C (700°F), % max[c]	17	15[d]
EOFT[e], % 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 D4951 or D5185 phosphorus % mass, max	0.10[f]	NR
Test Method D92 flash point, °C min[g]	200	NR
Test Method D93 flash point, °C min[g]	185	NR
Test Method D892 foaming tendency (Option A)		
Sequence I, max, foaming/settling[h]	10/0	10/0
Sequence II, max, foaming/settling[h]	50/0	50/0
Sequence III, max, foaming/settling[h]	10/0	10/0
Test Method D6082 (optional blending required), static foam max, tendency/stability	200/50[i]	200/50[i]
ASTM D 6922, homogeneity and miscibility	[j]	[j]
L-38 or Sequence VIII shear stability	[k]	[k]
Test Method D6335 high temperature deposits (TEOST), deposit wt, mg, max	60	60
Test Method D5133 gelation index, max[b]	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 D4485.
[b]If CI-4 and/or CJ-4 categories precede the “S” category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.
[c]Volatility requirement shall be met in either Test Method D5800, Test Method D 5480, or Test Method D6417. A passing result in only one of these procedures is required.
[d]Passing volatility loss performance only required for SAE 15W-40 oils.
[e]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.

[f]This is a non-critical specification as described in ASTM D3244.
[g]Either Test Method D92 or Test Method D93 flash point requirement shall be met.
[h]Settling volume determined at 10 min.
[i]Settling volume determined at 1 min.
[ji]Homogeneous with SAE Reference Oils.
[k]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 or IIIG	Pass
Sequence IVA	Pass
Sequence VE	Pass Wear Only Or a minimum 0.08% phosphorus in the form of ZDDP
Sequence VG[b]	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 D6557 (Ball Rust Test), avg. gray value, min[b]	100	100
Test Method D5800 volatility loss, % max	15	15
Test Method D6417 volatility loss at 371°C (700°F), % max	10	10
EOFT[c], % flow reduction, max	50	50
EOWTT[c], % 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 D4951 or D5185 phosphorus % mass, max[d]	0.10[e]	NR
Test Method D892 foaming tendency (Option A)		
Sequence I, max, foaming/settling[f]	10/0	10/0
Sequence II, max, foaming/settling[f]	50/0	50/0
Sequence III, max, foaming/settling[f]	10/0	10/0
Test Method D6082 (optional blending required), static foam max, tendency/stability[g]	100/0	100/0
ASTM D6922, homogeneity and miscibility	[h]	[h]
Sequence VIII shear stability	[i]	[i]
ASTM D7097, high temperature deposits (TEOST MHT), deposit wt, mg, max	45	45
Test Method D5133 gelation index, max[b]	12[j]	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 D4485.

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

[c]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.
[d]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.
[e]This is a non-critical specification as described in ASTM D3244.
[f]Settling volume determined at 10 min.
[g]Settling volume determined at 1 min.
[h]Homogeneous with SAE Reference Oils.
[i]Ten-hour stripped kinematic viscosity (oil shall remain in original viscosity grade).
[j]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
ASTM D7320, (Sequence IIIG)	Pass	Pass
ASTM D4684, (Sequence IIIGA)	Pass	NR
ASTM D6891, (Sequence IVA)	Pass	Pass
ASTM D6593, (Sequence VG)[b]	Pass	Pass
ASTM D6709, (Sequence VIII)	Pass	Pass
Bench Test and Measured Parameter[a]	**Viscosity Grade Performance Requirements**	
	SAE 0W-20, SAE 5W-20, SAE 0W-30, SAE 5W-30, SAE 10W-30	All Others
ASTM D6557 (Ball Rust Test), avg. gray value, min[b]	100	100
ASTM D5800, evaporation loss, 1 hour at 250°C, % max[c]	15	15
ASTM D6417, simulated distillation at 371°C, % max	10	10
ASTM D6795, EOFT, % flow reduction, max	50	50
ASTM D6794, EOWTT, % flow reduction, max		
with 0.6% H_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 D4951, phosphorus % mass, max[d]	0.08[e]	NR
ASTM D4951, phosphorus % mass, min[d]	0.06[e]	0.06[e]
ASTM D4951, or D2622, sulfur % mass, max[d]		
SAE 0W-20, 0W-30, 5W-20, and 5W-30	0.5[e]	NR
SAE 10W-30	0.7[e]	NR
ASTM D892 (Option A), foaming tendency		
Sequence I, mL, max, tendency/stability[f]	10/0	10/0
Sequence II, mL, max, tendency/stability[f]	50/0	50/0
Sequence III, mL, max, tendency/stability[f]	10/0	10/0
ASTM D6082 (Option A), high-temperature foaming mL, max, tendency/stability[g]	100/0	100/0
ASTM D6922, homogeneity and miscibility	[h]	[h]
ASTM D6709, (Sequence VIII) shear stability	[i]	[i]
ASTM D7097, TEOST MHT, high temperature deposits, deposit wt, mg, max[d]	35	45
ASTM D5133, gelation index, max[b]	12[j]	NR

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

[a]Tests are per ASTM requirements.
[b]If CI-4 and/or CJ-4 categories precede the “S” category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.
[c]Calculated conversions specified in ASTM D5800 are allowed.
[d]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.
[e]This is a non-critical specification as described in ASTM D3244.
[f]After 10-minute settling period.
[g]After 1-minute settling period.
[h]Shall remain homogenous and, when mixed with ASTM reference oils, shall remain miscible.
[i]Ten-hour stripped kinematic viscosity at 100°C. Kinematic viscosity must remain in original viscosity grade.
[j]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.

Table G-5—Requirements for API Service Category SN and API SN with Resource Conserving

	API SN	API SN	API SN with Resource Conserving
	SAE 0W-20, SAE 5W-20 SAE 0W-30, SAE 5W-30, SAE 10W-30	Other Viscosity Grades	All Viscosity Grades
Engine Test Requirements[a] (see Table Q-5)			
ASTM D7320, (Sequence IIIG)	Pass	Pass	Pass
ASTM D6891, (Sequence IVA)	Pass	Pass	Pass
ASTM D6593, (Sequence VG)[b]	Pass	Pass	Pass
ASTM D7589, (Sequence VID)[c]	NR	NR	Pass
ASTM D6709, (Sequence VIII)	Pass	Pass	Pass
Bench Test and Measured Parameter[a]			
Aged oil low-temperature viscosity			
ASTM D4684, (Sequence IIIGA), aged oil low-temperature viscosity	Pass	Pass[d]	Pass
Or			
ASTM D7528, (ROBO Test), aged oil low-temperature viscosity	Pass	Pass[d]	Pass
ASTM D7320, (Sequence IIIGB) phosphorus retention, % min	NR	NR	79
ASTM D6557 (Ball Rust Test), avg. gray value, min[b]	100	100	100
ASTM D5800, evaporation loss, 1 hour at 250°C, % max[e]	15	15	15
ASTM D6417, simulated distillation at 371°C, % max	10	10	10
ASTM D6795, EOFT, % flow reduction, max	50	50	50
ASTM D6794, EOWTT, % flow reduction, max			
with 0.6% H_2O	50	50	50
with 1.0% H_2O	50	50	50
with 2.0% H_2O	50	50	50
with 3.0% H_2O	50	50	50
ASTM D4951, phosphorus % mass, max[f]	0.08[g]	NR	0.08[g]
ASTM D4951, phosphorus % mass, min[f]	0.06[g]	0.06[g]	0.06[g]
ASTM D4951, or D2622, sulfur % mass, max[f]			
SAE 0W-20, 0W-30, 5W-20, and 5W-30	0.5[g]	NR	0.5[g]
SAE 10W-30	0.6[g]	NR	0.6[g]
All other viscosity grades	NR	NR	0.6[g]

ASTM D892 (Option A), foaming tendency			
Sequence I, mL, max, tendency/stability	10/0[h]	10/0[i]	10/0[h]
Sequence II, mL, max, tendency/stability	50/0[h]	50/0[i]	50/0[h]
Sequence III, mL, max, tendency/stability	10/0[h]	10/0[i]	10/0[h]
ASTM D6082 (Option A), high-temperature foaming mL, max, tendency/stability[h]	100/0	100/0	100/0
ASTM D6922, homogeneity and miscibility	[j]	[j]	[j]
ASTM D6709, (Sequence VIII) shear stability	[k]	[k]	[k]
ASTM D7097, TEOST MHT, high-temperature deposits, deposit wt, mg, max[f]	35	45	35
ASTM D5133, gelation index, max[b]	12[l]	NR	12[l]
ASTM D6335, TEOST 33C, high-temperature deposits, total deposit weight, mg, max			
SAE 0W-20	NR	NR	NR
All other viscosity grades	NR	NR	30
ASTM D7563, emulsion retention	NR	NR	no water separation
ASTM D7216 Annex A2, elastomer compatibility	Table G-6	Table G-6	Table G-6

Note: All oils must meet the requirements of the most recent edition of SAE J300; NR = Not required.
[a]Tests are per ASTM requirements.
[b]If CI-4 and/or CJ-4 categories precede the “S” category and there is no API Certification Mark, the Sequence VG (ASTM D6593), Ball Rust (ASTM D6557), and Gelation Index (ASTM D5133) tests are not required.
[c]Viscosity grades are limited to 0W, 5W and 10W multigrade oils.
[d]Not required for monograde and 15W, 20W, and 25W multigrade oils.
[e]Calculated conversions specified in ASTM D5800 are allowed.
[f]For all viscosity grades: If CH-4, CI-4 and/or CJ-4 categories precede the "S" category and there is no API Certification Mark, the “S” category limits for phosphorus, sulfur, and the TEOST MHT do not apply. However, the CJ-4 limits for phosphorus and sulfur do apply for CJ-4 oils. Note that these “C” category oils have been formulated primarily for diesel engines and may not provide all of the performance requirements consistent with vehicle manufacturers' recommendations for gasoline-fueled engines.
[g]This is a non-critical specification as described in ASTM D3244.
[h]After 1-minute settling period.
[i]After 10-minute settling period.
[j]Shall remain homogenous and, when mixed with ASTM reference oils, shall remain miscible.
[k]Ten-hour stripped kinematic viscosity at 100°C. Kinematic viscosity must remain in original viscosity grade.
[l]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.

Table G-6—Elastomer Compatibility

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

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

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 D4485). 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 J300
Engine Test Requirements	As defined by the most recent revision of ASTM D4485
Engine rusting	ASTM D5844 Sequence IID test
Average rust rating	8.5 (min)
Stuck lifters	None
Wear and oil thickening	ASTM D5533 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 D5302 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 D5119 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 (Continued) (Obsolete August 1, 1997)

Requirement	Criterion
Bench Test Requirements	
HTHS viscosity at 150°C and 106 s–1	ASTM D4683, ASTM D4741, or CEC L-36-A-90
For all viscosity grades, mPa • S	2.9 (min)
Volatility	Sim. dis. (ASTM D2887) or evaporative loss (CEC L-40-A-93)
ASTM D2887	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 D892 (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 D93 or D92
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

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

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 (D892) 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 D5293	ASTM D4684
	3500 (max) at – 20°C	60,000 (max) at – 30°C
	Gelation Index ASTM D5133: • 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 J300	

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

Requirement	Criterion
Engine Test Requirements	As defined by the most recent revision of ASTM D4485
Engine rusting	ASTM D5844 Sequence IID test
Average rust rating	8.5 (min)
Stuck lifters	None
Wear and oil thickening	ASTM D5533 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 D5302 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 D5119 Test Method L-38
Bearing weight loss, mg	40 (max)
Fuel economy improvement (FEI)	ASTM D6202 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 (Continued) (Obsolete March 31, 2002)

Requirement	Criterion
Bench Test Requirements	
Volatility	Simulated distillation (ASTM D2887 extended) or (ASTM D5480) 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 D892 (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 D93 (ISO 2719) or ASTM D92
ASTM D93 (ISO 2719)	185°C (min)
ASTM D92	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 D6335
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 (Obsolete April 30, 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 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 (Obsolete April 30, 2004)

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 D5133: • 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 (Continued) (Obsolete April 30, 2004)

Requirement	Criterion
Engine Test Requirements	As defined by the most recent revision of ASTM D4485
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 (Continued) (Obsolete April 30, 2004)

Requirement	Criterion
Bench Test Requirements	As defined by the most recent revision of ASTM D4485
Volatility	
Evaporation loss	ASTM D5800 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 D892 (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 D6082 (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 D6922, Method 3470.1 Shall remain homogeneous and, when mixed with SAE reference oils, shall remain miscible
Catalyst compatibility	ASTM D4951 or D5185
Phosphorus content	0.10 mass % (max)

[a]80-hour test oil sample shall be evaluated by ASTM Test Method D4684 (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 D5293 (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 (Obsolete September 30, 2011)

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 (Obsolete September 30, 2011)

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 D5133 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 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 D4684 (MRV TP-1)	The ASTM D4684 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 (ASTMD6593)
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 D6891)
Average cam wear (7 position avg.), µm	90 (max)
Bearing corrosion	ASTM Sequence VIII (ASTM D6709)
Bearing weight loss, mg	26 (max)
Fuel efficiency	ASTM Sequence VIB[b] (ASTM D6837) 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 D4951 0.08 (max)
Sulfur content	ASTM D4951 or D2622
SAE 0W and 5W multigrades, % (mass)	0.5 (max)
SAE 10W multigrades, % (mass)	0.7 (max)
Wear	ASTM D4951
Phosphorus content, % (mass)	0.06 (min)
Volatility	ASTM D5800
Evaporation loss, %	15 (max), 1 hour at 250°C (Note: Calculated conversions specified in D 5800 are allowed.)
Simulated distillation, %	ASTM D6417 10 (max) at 371°C
High temperature deposits	TEOST MHT
Deposit weight, mg	35 (max)
Filterability	
EOWTT, %	ASTM D6794
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 D6795 50 (max) flow reduction
Foaming characteristics	ASTM D892 (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 D6082 (Option A)
Tendency, mL	100 (max)
Stability[d], mL	0 (max)
Shear stability	ASTM Sequence VIII (ASTM D6709)
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 D6922 Shall remain homogeneous and, when mixed with ASTM reference oils, shall remain miscible.
Engine rusting	Ball Rust Test (ASTM D6557)
Average gray value	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

Q.5 ILSAC GF-5 Standard for Passenger Car Engine Oils (Effective October 1, 2010)

The Japan Automobile Manufacturers Association, Inc. and representatives from Chrysler Group LLC, Ford Motor Company and General Motors LLC, through an organization called the International Lubricants Standardization and Approval Committee (ILSAC), jointly developed and approved an ILSAC GF-5 minimum performance standard for engine oils for spark-ignited internal combustion engines.

This standard specifies the minimum performance requirements (both engine sequence and bench tests) and chemical and physical properties for engine oils for spark-ignited internal combustion engines. It is expected that many engine manufacturers will recommend ILSAC GF-5 oil. However, performance parameters other than those covered by the tests included or more stringent limits on those tests included in this standard may be required by individual OEMs.

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 ILSAC GF-5 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 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 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 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 testing of new technology was satisfactorily completed. No marketer can claim to be acting in a reasonable and prudent manner if they knowingly use 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-5 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-5 with API.

Table Q-5—ILSAC GF-5 Passenger Car Engine Oil 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 D5133 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 appropriate MRV TP-1 temperature (defined by SAE J300), whichever occurs first
Engine Test Requirements	
Wear and oil thickening	ASTM Sequence IIIG (ASTM D7320)
Kinematic viscosity increase @ 40°C, %	150 (max)
Average weighted piston deposits, merits	4.0 (min)
Hot stuck rings	None
Average cam plus lifter wear, µm	60 (max)
Wear, sludge, and varnish	ASTM Sequence VG (ASTM D6593)
Average engine sludge, merits	8.0 (min)
Average rocker cover sludge, merits	8.3 (min)
Average engine varnish, merits	8.9 (min)
Average piston skirt varnish, merits	7.5 (min)
Oil screen sludge, % area	15 (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
Valvetrain wear	ASTM Sequence IVA (ASTM D6891)
Average cam wear (7 position avg), µm	90 (max)
Bearing corrosion	ASTM Sequence VIII (ASTM D6709)
Bearing weight loss, mg	26 (max)
Fuel efficiency	ASTM Sequence VID (ASTM D7589)
SAE XW-20 viscosity grade	
FEI SUM	2.6% min
FEI 2	1.2% min after 100 hours aging
SAE XW-30 viscosity grade	
FEI SUM	1.9% min
FEI 2	0.9% min after 100 hours aging
SAE 10W-30 and all other viscosity grades not listed above	
FEI SUM	1.5% min
FEI 2	0.6% min after 100 hours aging

Table Q-5—ILSAC GF-5 Passenger Car Engine Oil Standard (Continued)

Requirement	Criterion
Bench Test Requirements	
Catalyst compatibility	
Phosphorus content, % (mass)	ASTM D4951 0.08 (max)
Phosphorus volatility (Sequence IIIGB, phosphorus retention)	ASTM D7320 79% (min)
Sulfur content	ASTM D4951 or D2622
SAE 0W and 5W multigrades, % (mass)	0.5 (max)
SAE 10W-30, % (mass)	0.6 (max)
Wear	ASTM D4951
Phosphorus content, % (mass)	0.06 (min)
Volatility	ASTM D5800
Evaporation loss, %	15 (max), 1 hour at 250°C (Note: Calculated conversions specified in D5800 are allowed.)
Simulated distillation, %	ASTM D6417 10 (max) at 371°C
High temperature deposits	TEOST MHT (ASTM D7097)
Deposit weight, mg	35 (max)
High temperature deposits	TEOST 33C (ASTM D6335)
Total deposit weight, mg	30 (max) Note: No TEOST 33C limit for SAE 0W-20.
Filterability	ASTM D6794
EOWTT, %	
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 D6795 50 (max) flow reduction
Fresh oil foaming characteristics	ASTM D892 (Option A and excluding paragraph 11)
Tendency, mL	
Sequence I	10 (max)
Sequence II	50 (max)
Sequence III	10 (max)
Stability, mL, after 1-minute settling	
Sequence I	0 (max)
Sequence II	0 (max)
Sequence III	0 (max)
Fresh oil high temperature foaming characteristics	ASTM D6082 (Option A)
Tendency, mL	100 (max)
Stability, mL, after 1-minute settling	0 (max)

Table Q-5—ILSAC GF-5 Passenger Car Engine Oil Standard (Continued)

Requirement	Criterion
Bench Test Requirements (continued)	
Aged oil low temperature viscosity Measure CCS viscosity of EOT ROBO sample at CCS temperature corresponding to original viscosity grade	ROBO (ASTM D7528) a) If CCS viscosity measured is less than or equal to the maximum CCS viscosity specified for the original viscosity grade, run ASTM D4684 (MRV TP-1) at the MRV temperature specified in SAE J300 for the original viscosity grade. b) If CCS viscosity measured is higher than the maximum viscosity specified for the original viscosity grade in J300, run ASTM D4684 (MRV TP-1) at 5°C higher temperature (i.e., at MRV temperature specified in SAE J300 for the next higher viscosity grade). c) EOT ROBO sample must show no yield stress in the D4684 test and its D4684 viscosity must be below the maximum specified in SAE J300 for the original viscosity grade or the next higher viscosity grade, depending on the CCS viscosity grade, as outlined in a) or b) above.
	or
Aged oil low temperature viscosity	ASTM Sequence IIIGA (ASTM D7320) a) If CCS viscosity measured is less than or equal to the maximum CCS viscosity specified for the original viscosity grade, run ASTM D4684 (MRV TP-1) at the MRV temperature specified in SAE J300 for the original viscosity grade. b) If CCS viscosity measured is higher than the maximum viscosity specified for the original viscosity grade in J300, run ASTM D4684 (MRV TP-1) at 5°C higher temperature (i.e., at MRV temperature specified in SAE J300 for the next higher viscosity grade). c) EOT IIIGA sample must show no yield stress in the D4684 test and its D4684 viscosity must be below the maximum specified in SAE J300 for the original viscosity grade or the next higher viscosity grade, depending on the CCS viscosity grade, as outlined in a) or b) above.
Shear stability 10-hour stripped KV @ 100°C	ASTM Sequence VIII (ASTM D6709) Kinematic viscosity must remain in original SAE viscosity grade
Homogeneity and miscibility	ASTM D 6922 Shall remain homogeneous and, when mixed with ASTM Test Monitoring Center (TMC) reference oils, shall remain miscible.
Engine rusting Average gray value	Ball Rust Test (ASTM D6557) 100 (min)
Emulsion retention 0°C, 24 hours 25°C, 24 hours	ASTM D7563 No water separation No water separation
Elastomer compatibility	ASTM D7216 Annex A2 Candidate oil testing for elastomer compatibility shall be performed using the five Standard Reference Elastomers (SREs) referenced herein and defined in SAE J2643. Candidate oil testing shall be performed according to ASTM D7216 Annex A2. The post-candidate-oil-immersion elastomers shall conform to the specification limits detailed below:

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

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.
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