SAE INTERNATIONAL

SURFACE VEHICLE STANDARD

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(R) Lubricating Oils, Aircraft Piston Engine (Non-Dispersant)

RATIONALE

Revised specification to include new test methods and incorporate an E-38 Qualified Products Group.

1. SCOPE

This SAE Standard establishes the requirements for non-dispersant lubricating oils to be used in four-stroke cycle piston aircraft engines. This document covers the same lubricating oil requirements as the former military specification MIL-L-6082. Users should consult their airframe or engine manufacturers' manuals for the latest listing of acceptable lubricants.

Compliance with this specification must be accomplished in accordance with the Performance Review Institute (PRI) product qualification process as described in the documents referenced in 2.2.2. Requests for submittal information may be made to the PRI at the address shown in 2.2.2, referencing this specification. Products qualified to this specification are listed on a Qualified Products List (QPL) managed by the PRI. Approval and/or certification for use of a specific piston engine oil in aerospace applications is the responsibility of the individual equipment builders and/or governmental authorities and may be accomplished by compliance with or qualification to this specification.

1.1 Classification

The lubricating oils shall be furnished in the viscosity grades as per Table 1:

Table 1 - Viscosity grade comparison table

SAE Viscosity Table	Military Grade	Commercial Grade	NATO Code Number
30	1065	65	0-113
40	1080	80	none
50	1100	100	0-117
60	1120	120	none
Multigrade	none	none	none

NOTE: The Military Grade designations are being phased out in favor of the NATO Code Numbers, when available, or the SAE viscosity grade classifications. Commercial grade designations are being phased out in favor of the SAE viscosity grade classifications.

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For more information on this standard, visit
https://www.sae.org/standards/content/J1966_202408/

2. REFERENCES

2.1 Applicable Documents

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

2.1.1 SAE Publications

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

SAE J300 Engine Oil Viscosity Classification

SAE J1787 Measurement of the Total Ash Content of Aviation Piston Engine Oils by a Calculation Method

SAE J1899 Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant)

2.1.2 API Publications

Available from API, 1220 L Street, NW, Washington, DC 20005-4070, Tel: 202-682-8000, www.api.org.

API 1509, Annex E API Base Oil Interchangeability Guidelines For Passenger Car Engine Oils and Diesel Engine Oils

2.1.3 ASTM Publications

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

ASTM D92 Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D93 Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

ASTM D97 Standard Test Method for Pour Point of Petroleum Products

ASTM D129 Standard Test Method for Sulfur in Petroleum Products (General High Pressure Decomposition Device Method)

ASTM D130 Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

ASTM D445 Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

ASTM D482 Standard Test Method for Ash from Petroleum Products

ASTM D664 Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration

ASTM D892 Standard Test Method for Foaming Characteristics of Lubricating Oils

ASTM D1298 Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

ASTM D1552 Standard Test Method for Sulfur in Petroleum Products by High Temperature Combustion and Infrared (IR) Detection or Thermal Conductivity Detection (TCD)

ASTM D2270 Standard Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 °C and 100 °C

ASTM D2273 Standard Test Method for Trace Sediment in Lubricating Oils (Use last revision dated 2016)

ASTM D2622 Sulfur in Petroleum Products (Wavelength Dispersive X-ray Fluorescence Spectrometry)

ASTM D4052 Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

ASTM D4683 Standard Test Method for Measuring Viscosity of New and Used Engine Oils at High Shear Rate and High Temperature by Tapered Bearing Simulator Viscometer at 150 °C

ASTM D4684 Standard Test Method for Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature

ASTM D4741 Standard Test Method for Measuring Viscosity at High Temperature and High Shear Rate by Tapered-Plug Viscometer

ASTM D4927 Standard Test Methods for Elemental Analysis of Lubricant and Additive Components—Barium, Calcium, Phosphorus, Sulfur, and Zinc by Wavelength-Dispersive X-Ray Fluorescence Spectroscopy

ASTM D4951 Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry

ASTM D5185 Standard Test Method for Multielement Determination of Used and Unused Lubricating Oils and Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)

ASTM D5293 Standard Test Method for Apparent Viscosity of Engine Oils and Base Stocks Between –10 °C and –35 °C Using Cold-Cranking Simulator

ASTM D5481 Standard Test Method for Measuring Apparent Viscosity at High-Temperature and High-Shear Rate by Multicell Capillary Viscometer

ASTM D5949 Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)

ASTM D5950 Standard Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)

ASTM D5985 Standard Test Method for Pour Point of Petroleum Products (Rotational Method)

ASTM D6709 Standard Test Method for Evaluation of Automotive Engine Oils in the Sequence VIII Spark-Ignition Engine (CLR Oil Test Engine)

ASTM D6922 Standard Test Method for Determination of Homogeneity and Miscibility in Automotive Engine Oils

2.1.4 NIST Publications

Available from NIST, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070, Tel: 301-975-6478, www.nist.gov.

NIST Handbook 130 Uniform Laws and Regulations in the Areas of Legal Metrology and Fuel Quality

2.1.5 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.p-r-i.org.

c-frm-12 Mark of Conformity and Program Name

OP 2007 QPL Operating Procedure, QPG Operation

PD2000 PRI-QPL Program Requirements

2.1.6 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

MIL-L-6082 Lubricating Oil, Aircraft Piston Engine (Non-Dispersant Mineral Oil), canceled Nov. 1995

MIL-L-22851 Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant), canceled Nov. 1995

2.1.7 United Nations Publications

Available from United Nations Economic Commission for Europe, Palais des Nations, CH-1211, Geneva 10, Switzerland, Tel: +41-0-22-917-12-34, www.unece.org.

ST/SG/AC.10/30 Globalized Harmonized System of Classification and Labelling of Chemicals (GHS), Appendix D Safety Data Sheets

2.1.8 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

PERFORMANCE REVIEW INSTITUTE (PRI): An SAE affiliate with the objectives of providing global, unbiased, independent manufacturing process and product assessments and certification services.

QUALIFIED PRODUCTS GROUP (QPG): A mandated body designated by the PRI Qualified Product Management Council (QPMC) in accordance with PRI PD2000. This body is responsible for assessing whether a manufacturer's products comply with the relevant standards. The mandated body is known as a Qualified Products Group (QPG) and is composed of members from the original equipment manufacturers (OEMs) and government agencies. The QPMC has mandated a QPG for Aerospace Piston Engine Oils.

QUALIFIED PRODUCTS LIST (QPL): A list of products qualified by the QPG to this specification and issued by the PRI.

4. REQUIREMENTS

4.1 Qualification

Qualification to this specification must be accomplished in accordance with the PRI product qualification process as described in the documents referenced in 2.2.2 (refer to OP 2007). The lubricating oils furnished under this specification shall be products that have been evaluated under the PRI product qualification process and that have been found to meet the applicable specification requirements by the QPG. Products qualified to this specification are listed on a QPL managed by the PRI.

Commercial products sold under this document must meet all of the requirements of Sections 4 and 5 of this document. Approval and/or certification for use of a specific piston engine oil in aero applications is the responsibility of the individual equipment builders and/or governmental authorities and may be accomplished by compliance with or qualification to this specification. Individual products acceptance lists for commercial aviation piston engine oils will be maintained by each of the original aircraft engine manufacturers.

Qualification samples and the corresponding test results must be retained by the oil manufacturer for a period of at least 3 years.

4.1.1 Read-Across Approvals

Read-across approvals will only be granted to different grades of oil that are composed of varying percentages of the same base stocks blended with identical additive packages (adjustments in pour point depressant concentration will be permitted). Complete chemical and physical property test results shall be submitted for each grade of oil for which qualification is requested. Single cylinder engine tests shall be performed on the lightest and heaviest single SAE grade oils to be blended from the same base stock materials (neutral and bright stock). All single grade oils blended from the same base stock materials and meeting SAE viscosity classification standards between the two tested products will be granted qualification approval based on similarity. No read-across approvals will be granted for multigrade oils.

4.1.2 Requalification

Requalification is used to maintain or improve the configuration management and quality control of the original product. Requalification shall be required when any reformulation or change is made in source of manufacture, purity, origin, or composition of the lubricating oil base stock(s) or additives. Requalification is also required for any changes in the manufacturing process or plant locations of the finished product, its additives, or base stock(s).

No changes shall be made unless approved by the E-38 QPG. When a manufacturer or authorized distributor fails to comply or demonstrates an inability to comply with requalification requirements, the E-38 QPG will remove the products from the electronic QPL.

When applicable, each manufacturer shall provide evidence to the E-38 QPG outside of the AEO format (e.g., a Certificate of Analysis or simliar) that confirms the interchanging of their new raw crude sources input materials proposed for their base stocks demonstrates same (or improved) holistic performance as the original raw crude sources used in the original base stock. Equivalency of a base stock material can be shown through a variety of means including, but not limited to, chemistry testing (bench, analytical), performance testing, statistical modeling, and chemical modeling.

4.2 Materials

The lubricating oils shall be derived from petroleum fractions, synthetically prepared compounds, or a combination of the two types of products. Single grade oils may only contain:

- Pour point depressants up to a maximum of 1.0% by weight
- Antioxidant additives up to a maximum of 0.5% by weight
- Silicone antifoam additives up to a maximum of 25 ppm

Multigrade lubricating oils shall be derived from petroleum fractions, synthetically prepared compounds, or a combination of the two types of products. In addition to the above additives, multigrade oils may contain:

- Viscosity index improver

When applying for qualification, refiners shall provide the following information about the crude oil and the processing used in the manufacture of each base stock blended into their product:

- Name of original base stock refiner or processer
- Location of refinery or processing plant by city and state (U.S.), province (Canada), and country.
- Definition of base stock category per American Petroleum Institute classification of base oils (refer to API 1509, Annex E, Subsection E.1.3)

Exceptions to these requirements shall be directed to the E-38 QPG. If re-refined materials are used, the manufacturer must demonstrate the consistency of the products to the qualifying activity.

4.3 Physical and Chemical Properties

The finished lubricating oil shall conform to the physical and chemical property requirements specified in Table 2.

4.4 Sulfur

The sulfur content of the oil shall not exceed the value shown for each grade in Table 2. For quality conformance inspection, the sulfur content shall be within ±0.15% mass of the qualification value or within a 0.3% mass range selected by the manufacturer to bracket the qualification value.

Table 2 - Chemical and physical property requirements for finished lubricant

Characteristic (Limits) SAE Grade	30	40	50	60	Multigrade	Test Method
Viscosity, mm^2/s (cSt), @ 100 °C, Min @ 100 °C, Less Than	9.3 12.5	12.5 16.3	16.3 21.9	21.9 26.1	(1) (1)	ASTM D445
Flash Point, °C Min	220	225	243	243	220	ASTM D92
Flash Point, °C	Report	Report	Report	Report	Report	ASTM D93
Sulfur, Mass % Max	0.6	0.8	1.0	1.2	0.6	ASTM D129-2013, ASTM D1552, ASTM D2622, ASTM D4951, ASTM D5185
Pour Point, °C Max	-18	-15	-12	-9	--	ASTM D97, ASTM D5949, ASTM D5950, ASTM D5985
Viscosity, Low Temp, Pumping	--	--	--	--	(1)	ASTM D4684
Viscosity, Low Temp, Cold Crank Sim.	--	--	--	--		ASTM D5293
Viscosity, High Temp, High Shear, at 150 °C, cP, Min	2.9	3.7	3.7	3.7	(1)	ASTM D4683, ASTM D4741, ASTM D5481
	---------- All Grades ----------					
Viscosity, mm^2/s (cSt), @ 40 °C	Report					ASTM D445
Viscosity Index, Min	85					ASTM D2270
Acid Number, mg KOHO/g, Max(2)	0.10					ASTM D664
Density @ 15 °C, g/mL	Report					ASTM D4052
Gravity @ 60 °F, °API(3)	Report					ASTM D1298, ASTM D4052
Ash Content(4) Mass % Max	0.011					ASTM D482, SAE J1787
Trace Sediment mLL/100 mL Oil, Max	0.005					ASTM D2273-2016
Copper Strip Corrosion, Max Rating 3 hours @ 100 °C 3 hours @ 204 °C(5)	 1 3					ASTM D130
Foaming Tendency/Stability Sequence 1 Aerated Volume, mL, Max Volume after 10 minutes, mL, Max Sequence 2 Aerated Volume, mL, Max Volume after 10 minutes, mL, Max Sequence 3 Aerated Volume, mL, Max Volume after 10 minutes, mL, Max	 50 0 50 0 50 0					ASTM D892
Compatibility(6)	Pass					ASTM D6922

(1) Oil shall meet the viscosity requirements of SAE J300 for the designated grade.
(2) Titrate to a pH 11 end point.
(3) API gravity may be computed from the relative density measured by ASTM D4052.
(4) ASTM D482 is required for qualification. Either ASTM D482 or SAE J1787 may be used for Quality Assurance Testing.
(5) Conduct the test in accordance with ASTM D130 but at the temperature specified.
(6) Specific reference oils will be identified by the E-38 QPG at the time of candidate submission.

4.5 API Gravity

The American Petroleum Institute (API) gravity of the oil shall be determined but not limited on qualification inspection. For quality conformance inspection, the gravity shall be within ±1.0 degree API of the qualification value or within a 2.0 degree API range selected by the manufacturer to bracket the qualification value.

4.6 Workmanship

The lubricating oil shall be a homogeneous blend when examined visually at room temperature (25 °C ± 3 °C) in a well-lighted room or daylight. It shall exhibit no separation or fallout of the additives. Any jelly-like substance or very viscous material observed in the bottom of the container will be considered evidence of additive fallout.

4.7 Bench Performance Requirements (Single Cylinder Engine Test)

4.7.1 The finished lubricating oil shall meet the requirements of Table 3 when tested in the Sequence VIII spark-ignition engine test run in accordance with ASTM D6709, except as modified herein. The test shall be run with the oil gallery temperature controlled at 135 °C ± 1 °C (275 °F ± 2 °F).

4.7.1.1 The test fuel shall be Soltrol 10 plus 0.779 to 0.806 mL/L (2.95 to 3.05 mL/gallon) tetraethyllead (TEL) in place of the KA24E unleaded fuel. The air-to-fuel ratio is to be 14.0:1 as calculated by exhaust gas analysis (refer to ASTM D6709, paragraph 7.6).

4.7.1.2 The test need not be conducted using an ASTM test monitoring center (TMC) calibrated test stand and power section (refer to ASTM D6709, paragraph 10). In place of TMC reference oils, a substitute aviation piston engine reference oil shall be used to validate test operation for individually authorized qualification programs as follows:

4.7.1.2.1 A separate aviation reference oil test shall be conducted one test prior to performing a candidate lubricant test. The oil used in the reference test shall be determined by the E-38 QPG based on discussions with the candidate oil supplier. The reference lubricant shall be a retained sample of an originally qualified product (or a recent production batch of the manufacturer's qualified lubricant) conforming to the SAE Standard for which candidate approval is sought. The results obtained with the reference oil must be reported to the E-38 QPG immediately following completion of the reference test and before conducting the candidate oil test. The results obtained with the reference oil must correlate with the ASTM D5119 or ASTM D6709 data previously obtained on that approved formulation.

4.7.1.2.2 Laboratory operators should be aware of the impact of conducting non-standard Sequence VIII test on their TMC calibration status (refer to ASTM D6709, paragraph 10.1.3.3).

4.7.1.3 The final lab test report shall be the same format as that used for the normal ASTM D6709 test but shall also include the following supplemental report items for aviation piston engine oil approval:

- Viscosity at 40 °C and 100 °C on the 20-, 30-, and 40-hour oil samples.
- Stripped viscosity (per ASTM D6709, Annex A14) at 40 °C on the 40-hour oil sample for single grade products.
- Stripped viscosity (per ASTM D6709, Annex A14) at both 40 °C and 100 °C on the 10-hour and 40-hour oil samples for multigrade products.
- Acid Number per ASTM D664 on the new oil, 10-, 20-, 30-, and 40-hour oil samples.
- Post-test photographs of the bearing (top and bottom halves) and of the piston skirts (thrust and non-thrust sides).