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SURFACE VEHICLE STANDARD

SAE J1966

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Submitted for recognition as an American National Standard

Lubricating Oils, Aircraft Piston Engine (Non-Dispersant Mineral Oil)

1. *Scope*—This SAE Standard establishes the requirements for nondispersant, mineral 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.

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
Multi-Grade	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.

1.2 Commercial Products—Commercial products sold under this document must meet all of the requirements of Sections 3 and 4 of this document with the following exceptions:

a. Qualification samples and test results do not have to be submitted to Naval Air Warfare Center (NAWC), but must be retained by the manufacturer for a period of at least three years.
b. Individual products acceptance lists for commercial aviation piston engine oils will be maintained by each of the original aircraft engine manufacturers.
c. The detailed sampling and inspection procedural requirements of 4.4.2.2 through 4.4.3.2 do not apply.

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2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 GOVERNMENT DOCUMENTS

2.1.1.1 The following publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those numbers listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2). The military specifications are listed only for reference and are not current.

Specifications

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

(Copies of specifications, standards, other Government documents and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.1.1.1.1 Military

MIL-L-6082—Lubricating Oil, Aircraft Piston Engine, Non-Dispersant Mineral Oil, Cancelled November 1995
MIL-L-22851—Lubricating Oil, Aircraft Piston Engine, Ashless Dispersant, Cancelled November 1995

Standards

2.1.1.1.2 Federal

FED-STD-313—Material Safety Data Sheets, Preparation and the Submission of
FED-STD-791—Lubricants, Liquid Fuels and Related Products; Methods of Testing

2.1.1.1.3 Military

MIL-STD-290—Packaging, Packing and Marking of Petroleum and Related Products

2.2 Related Publications—The following publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation (see 6.2).

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J300—Engine Oil Viscosity Classification
SAE J1787—Measurement of the Total Ash Content of Aviation Piston Engine Oil by a Calculation Method
SAE J1899—Lubricating Oil, Aircraft Piston Engine, Ashless Dispersant

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2.2.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 92—Flash and Fire Points by Cleveland Open Cup
ASTM D 93—Flash Point by Pensky-Martens Closed Cup Tester
ASTM D 97—Pour Point of Petroleum Oils
ASTM D 129—Sulfur in Petroleum Products (General Bomb Method)
ASTM D 130—Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test
ASTM D 445—Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 482—Ash from Petroleum Products
ASTM D 664—Neutralization Number by Potentiometric Titration
ASTM D 892—Foaming Characteristics of Lubricating Oils
ASTM D 1298—Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
ASTM D 1552—Sulfur in Petroleum Products (High-Temperature Method)
ASTM D 2270—Calculating Viscosity Index from Kinematic Viscosity at 40 and 100 °C
ASTM D 2273—Trace Sediment in Lubricating Oils
ASTM D 2622—Sulfur in Petroleum Products (X-Ray Spectrographic Method)
ASTM D 4052—Density and Relative Density of Liquids by Digital Density Method
ASTM D 4057—Manual Sampling of Petroleum and Petroleum Products
ASTM D 4177—Automatic Sampling of Petroleum and Petroleum Products
ASTM D 4683—Measuring Viscosity at High Temperature and High Shear Rate by Tapered Bearing Simulator
ASTM D 4684—Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature
ASTM D 4741—Measuring Viscosity at High Temperature and High Shear Rate by Tapered-Plug Viscometer
ASTM D 4927—Elemental Analysis of Lubricant and Additive ComponentsæBarium, Calcium, Phosphorus, Sulfur and Zinc by Wavelength—Dispersive X-Ray Fluorescence Spectroscopy
ASTM D 5119—Evaluation of Automotive Engine Oils in the CRC L-38 Spark-Ignition Engine
ASTM D 5293—Apparent Viscosity of Engine Oils Between -5 and -30 °C Using the Cold-Cranking Simulator
ASTM D 5949—Pour Point of Petroleum Products (Automatic Pressure Pulse Method)
ASTM D 5950—Pour Point of Petroleum Products (Automatic Tilt Method)
ASTM D 5985—Pour Point of Petroleum Products (Rotational Method)

2.2.3 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI Z129.1—American National Standard for the Precautionary Labeling of Hazardous Industrial Chemicals

2.2.4 AMERICAN SOCIETY FOR QUALITY CONTROL (ASQC)—Available from the American Society for Quality Control, P.O. Box 12233, Research Triangle Park, NC 27709.

ASQC-Z1.4—Sampling Procedures and Tables for Inspection by Attributes (DoD Addopted)

2.2.5 ORDER OF PRECEDENCE—In the event of a conflict between the text of this document and the references cited herein (except for associated detail specifications, specification sheets, or MS standards), the text of this document shall take precedence. Nothing in this document, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

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3. Requirements

3.1 Qualification—The lubricating oils furnished under this document shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time for opening of bids (see 4.3 and 6.2.2). Detailed information on the procedures to be followed when submitting a candidate lubricating oil are available from the Naval Air Systems Command, AIR-4.4.5, Fuels and Lubricants Division, Building 2360, 22229 Elmer Road, Unit 4, Patuxent River, MD 20670.

3.1.1 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. L-38 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 multi-grade oils.

3.1.2 REQUALIFICATION—Requalification will be required in the event any change is made in the source or composition of the lubricant, the ingredients used, the manufacturing processes, or the plant location.

3.2 Materials—The single grade lubricating oils shall be refined petroleum products and may contain pour point depressants up to a maximum amount of 1.0% by weight as well as an antioxidant in an amount not to exceed 0.5% by weight. In addition to these materials, multi-grade oil may also contain a viscosity index improver. Silicone antifoam additives may be used up to a maximum of 25 parts per million. Crude source(s) and the types of processing used in the manufacture of the base stocks shall be identified in accordance with Appendix A. If re-refined materials are used, the manufacturer must demonstrate the consistency of the products to the qualifying agency.

3.3 Chemical and Physical Properties—The finished lubricating oil shall conform to the physical and chemical property requirements specified in Table 2.

3.4 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.

3.5 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 °API of the qualification value, or within a 2.0 °API range selected by the manufacturer to bracket the qualification value.

3.6 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.

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TABLE 2—CHEMICAL AND PHYSICAL PROPERTY REQUIREMENTS FOR FINISHED LUBRICANT

Characteristic (Limits) SAE Grade	30	40	50	60	Multi-Grade	Test Method
Viscosity, cSt,						ASTM D 445
@ 100 °C, Min	9.3	12.5	16.3	21.9	(1)	
@ 100 °C, Less Than	12.5	16.3	21.9	26.1	(1)	
Flash Point, °C Min	220	225	243	243	220	ASTM D 92
Flash Point, °C	Report	Report	Report	Report	Report	ASTM D 93
Sulfur, Mass % Max	0.6	0.8	1.0	1.2	0.6	ASTM D 129, ASTM D 1552, ASTM D 2622
Pour Point, °C Max	–18	–15	–12	–9	—	ASTM D 97 ASTM D 5949 ASTM D 5950 ASTM D 5985
Viscosity, Low Temp., Pumping	—	—	—	—	(1)	ASTM D 4684
Viscosity, Low Temp., Cold Crank Sim.	—	—	—	—	(1)	ASTM D 5293
Viscosity, High Temp., High Shear, at 150 °C, cP, Min	3.3	3.7	3.7	3.7	(1)	ASTM D 4683 ASTM D 4741
	---------- All Grades ----------					
Viscosity, cSt, @ 40 °C	report					ASTM D 445
Viscosity Index, Min.	85					ASTM D 2270
Total Acid Number, mg K0H/g, Max(2)	0.10					ASTM D 664
Density @ 15 °C, kg/L	report					ASTM D 4052
Gravity @ 60 °F, °API(3)	report					ASTM D 1298, ASTM D 4052
Ash Content(4) Mass % Max	0.011					ASTM D 482, SAE J1787
Trace Sediment ml/100 mL Oil, Max.	0.005					ASTM D 2273
Copper Strip Corrosion, Max Rating	1					ASTM D 130
3 h @ 100 °C	3					
3 h @ 204 °C(5)						
Foaming Tendency/Stability						ASTM D 892
Sequence 1						
Aerated Volume, mL, max	50					
Volume after 10 min, mL, max	0					
Sequence 2						
Aerated Volume, mL, max	50					
Volume after 10 min, mL, max	0					
Sequence 3						
Aerated Volume, mL, max	50					
Volume after 10 min, mL, max	0					
Compatibility(6)	pass					FTM 791, Method 3470

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 D 4052.
4. ASTM D 482 is required for qualification. Either ASTM D 482 or SAE J1787 may be used for Quality Assurance Testing.
5. Conduct the test in accordance with ASTM D 130 but at the temperature specified.
6. Only required for qualification. Reference oils may be obtained from NAWC.

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3.7 Bench Performance Requirements (L-38 Engine Test)—The finished lubricating oil shall meet the requirements of Table 3 when tested in the L-38 engine in accordance with ASTM D 5119. The test shall be run with the oil gallery temperature controlled at 135 °C ± 1 °C (275 °F ± 2 °F).

TABLE 3—L-38 ENGINE TEST REQUIREMENTS AT 40 h (END OF TEST)(1)

End of Test Characteristic	Limit Single Grade	Limit Multigrade	Test Method
BEARING			
Bearing Weight Loss, Total, mg, Max	500	500	ASTM D 5119
USED OIL			
Viscosity, % Change, Max, @ 40 °C	–5 to +10	report	ASTM D 445
Viscosity, @ 100 °C	—	(2)	ASTM D 445
Total Acid Number Change, Max(3)	2.0	2.0	ASTM D 664

1. L-38 engine test is to be run in accordance with ASTM D 5119 with an oil gallery temperature controlled at 135 °C ± 1 °C (275 °F ± 2 °F).
2. Stipped viscosity of the 10 hour sample shall remain in original SAE grade.
3. Titrate to a pH 11 end point.

3.8 Material Safety Data Sheets—When applying for qualification, the manufacturer shall submit to the qualifying activity Material Safety Data Sheets prepared in accordance with FED-STD-313 (see 6.4).

4. Quality Assurance Provisions

4.1 Responsibility for Inspection—Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facility suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the document where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 RESPONSIBILITY FOR COMPLIANCE—All items shall meet all requirements of Sections 3 and 5. The inspection set forth in this document shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the document shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of Inspections—The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.3).
b. Quality assurance inspection (see 4.4).

4.3 Qualification Inspection—The qualification inspection shall consist of a review and acceptance of the manufacturer's test results (see 4.3.2) by the Naval Air Systems Command and its field activity, the NAWC. Additional testing of the qualification inspection sample by the NAWC will be performed to confirm compliance with the requirements of Table 2.

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4.3.1 QUALIFICATION INSPECTION SAMPLE—All qualification and NAWC testing must be conducted on the same homogeneous batch of oil. The qualification inspection test samples to be tested by NAWC shall consist of a 3.8 L (1 gal) sample of each grade of blended base oil without additives and a 38 L (10 gal) sample of each grade of the finished oil for which qualification approval is sought. Material Safety Data Sheets completed in accordance with FED-STD-313 shall also be included with the test samples. At the direction of the Naval Air Systems Command, AIR-4.4.5, these samples should be forwarded to the Naval Air Warfare Center, (AIR-4.4.5), at an address to be specified at the time of sample submission. The sample should be plainly identified by a securely attached durable tag or label marked with the following information:

SAMPLE FOR QUALIFICATION INSPECTION
LUBRICATING OIL, AIRCRAFT PISTON ENGINE,
(NONDISPERSANT MINERAL OIL)
Type of sample (base stock or finished oil)
Name of manufacturer
Product code number
Batch number
Date of manufacture
Submitted by (name) (date) for qualification inspection in accordance with SAE J1966 under authorization of (reference authorizing letter) (see 6.2.2).

4.3.2 TEST RESULTS—The manufacturer shall forward a certified copy of the test report to the NAWC. The report shall contain complete test data showing the results of all tests required by this document. Photographs of the test parts from the L-38 engine will be included along with data on the test oil's viscosity (measured at 40 °C), and TAN, properties at 0, 10, 20, 30, and 40 h into the test (including the stripped 40 °C viscosity of the 10 h sample for multi-grade oils). The test report shall also include complete formulation data including the brand name and manufacturer of each of the additives used, the concentration of each additive in the finished oil, the percentages of neutral and bright stock used in the blending of the base stock, as well as the crude oil sources and type of processing used in the manufacture of these base stock components.

4.4 Quality Conformance Inspection—Quality assurance inspection shall consist of all the tests included in Table 4. Oil manufacturers must retain a copy of each batch test report in their files for at least three years. A copy of the test report on each batch of oil produced for the U.S. Government shall be forwarded to Naval Air Systems Command.

4.4.1 LOT FORMATION

4.4.1.1 Bulk Lot—A bulk lot is considered as an indefinite quantity of homogeneous mixture of material in a single isolated container or manufactured by a single plant run (not exceeding 24 h) through the same processing equipment, with no change in ingredient material.

4.4.1.2 Packaged Lot—A packaged lot is considered as an indefinite number of 208 L (55 gal) drums or smaller unit packages of identical size and type filled with a homogeneous mixture of material manufactured by a single plant run (not exceeding 24 h) through the same processing equipment, with no change in ingredient material.

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TABLE 4—QUALITY ASSURANCE TEST REQUIREMENTS FOR FINISHED LUBRICANT

Characteristic (Limits) SAE Grade	30	40	50	60	Multi-Grade	Test Method
Viscosity, cSt,						ASTM D 445
@ 100 °C, Min	9.3	12.5	16.3	21.9	(1)	
@ 100 °C, Less Than	12.5	16.3	21.9	26.1	(1)	
Flash Point, °C Min	220	225	243	243	220	ASTM D 92
Sulfur, Mass % Max(2)	0.6	0.8	1.0	1.2	0.6	ASTM D 129, ASTM D 1552, ASTM D 2622
Pour Point, °C Max	–18	–15	–12	–9	—	ASTM D 97 ASTM D 5949 ASTM D 5950 ASTM D 5985
Viscosity, Low Temp., Cold Crank Sim.	—	—	—	—	(1)	ASTM D 5293
---------- All Grades ----------						
Total Acid Number, mg K0H/g, Max(3)	0.10					ASTM D 664
Density @ 15 °C, kg/L	report					ASTM D 4052
Gravity @ 60 °F, °API(4)	report					ASTM D 1298, ASTM D 4052
Ash Content(5) Mass % Max	0.011					ASTM D 482, SAE J1787
Trace Sediment ml/100 mL Oil, Max.	0.005					ASTM D 2273
Copper Strip Corrosion, Max Rating 3 h @ 100 °C	1					ASTM D 130
Foaming Tendency/Stability Sequence 2						ASTM D 892
Aerated Volume, mL, max	50					
Volume after 10 min, mL, max	0					

1. Oil shall meet the viscosity requirements of SAE J300 for the designated grade.
2. See 3.4 for conformance limit range.
3. Titrate to a pH 11 end point.
4. API gravity may be computed from the relative density measured by ASTM D 4052.
5. ASTM D 482 is required for qualification. Either ASTM D 482 or SAE J1787 may be used for Quality Assurance Testing.

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4.4.2 SAMPLING

4.4.2.1 *Sampling for Verification of Product Quality*—Each bulk lot of material shall be sampled at random in accordance with ASTM D 4057 or ASTM D 4177 for verification of product quality as specified in 4.4.

4.4.2.2 *Sampling for Examination of Filled Containers*—Each packaged lot of containers shall be sampled in accordance with ASQC-Z1.4 for leakage, fill, closure, and preparation for shipment (packaging, packing, marking) in accordance with Section 5.

4.4.2.3 *Sampling for Examination of Sedimentation of Filled and Sealed Containers*—Samples of filled and sealed 0.95 L (1 qt) containers shall be taken at such periodic intervals as to be representative of each day of operation. The number of samples to be taken each day shall be in accordance with ASQC-Z1.4, when tested against the sedimentation requirement of Table 3.

4.4.3 INSPECTION

4.4.3.1 *Inspection of Material*—Inspection shall be performed in accordance with Method 9601 of FED-STD-791.

4.4.3.2 *Examination of Filled Containers*—Examine samples taken in accordance with 4.4.2.2 for compliance with MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and marking requirements. Reject any container having one or more defects or under the required fill. If the number of defective or unfilled containers exceeds the acceptance number for the appropriate plan of ASQC-Z1.4, reject the lot represented by the sample.

4.5 **Test Methods—**Tests shall be performed in accordance with the applicable methods of Tables 2, 3, and 4.

5. Packaging (For Military Procurements)

5.1 **Preservation and Packing—**For acquisition purposes, the packaging requirements shall be as specified in the contrct order (see 6.2.1.1).

5.2 **Marking—**All unit, intermediate, and shipping containers shall be marked in accordance with the contract order. All unit and intermediate packs of toxic and hazardous chemicals and materials shall also be labeled in accordance wit the applicable laws, statutes, regulations, or ordinances, including Federal, State, and Municipal requirements. In addition, unit or intermediate containers, including unit containers that serve as shipping containers, such as pails and drums, shall be marked with the applicable precautionary information detailed in ANSI Z129.1.

*6. Notes—*This section contains information of a general or explanatory nature that may be helpful but is not mandatory.

6.1 **Intended Use—**The lubricating oil covered by this document is intended for use in four cycle piston aircraft engines where the dispersant additives found in SAE J1899 (formerly military specification MIL-L-22851) oil are not needed or desired. 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.

6.2 **Military Procurements**

6.2.1 ORDERING DATA

6.2.1.1 *Acquisition Requirements*—Procurement documents should specify the following:

a. Title, number, and date of this document.
b. Grade of lubricating oil required (see 1.2).
c. Type and size of containers required (see 5.1).
d. Level of packing required (see 5.1).
e. Quantity desired.
f. Submittal of test results (see 4.4).

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6.2.2 QUALIFICATION—With respect to products requiring qualification, awards will be made only for the products that are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the federal government tested for qualification in order that they may be eligible to be awarded contracts of purchase orders for the products covered by this document. The activity responsible for the Qualified Products List is Commander Naval Air Systems Command, AIR-4.4.5, Fuels and Lubricants Division, Buidling 2360, 22229 Elmer Road, Unit 4, Patuxent River, MD 20670. Information pertaining to qualification of products may be obtained from that activity.

6.2.3 INTERNATIONAL STANDARDIZATION AGREEMENT—Certain provisions of this document are the subject of an international standardization agreement with NATO (STANAG 1135). When amendment, revision, or cancellation of this document is proposed, which will affect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels, including departmental standardization offices, if required.

6.3 Revisions—Revisions or changes to this document must have concurrence from the Naval Air Systems Command.

6.4 Material Safety Data Sheets—Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in Section 4 of FED-STD-313.

6.5 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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PREPARED BY THE SAE FUELS AND LUBRICANTS TECHNICAL COMMITTEE 8—
AVIATION PISTON ENGINE FUELS AND LUBRICANTS