

NOT-MEASUREMENT
SENSITIVE

MIL-PRF-46167D

27 January 2005

SUPERSEDING

MIL-PFR-46167C

31 July 1998

PERFORMANCE SPECIFICATION

LUBRICATING OIL, INTERNAL COMBUSTION ENGINE, ARCTIC

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This performance specification covers one grade of internal combustion compression-ignition engine lubricating oil with military symbol OEA-30 and NATO Code O-183, suitable for arctic use (see 6.1, 6.7 and 6.10).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirement documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Comments, suggestions, or questions on this document should be addressed to Tank-automotive and Armaments Command, 6501 E. 11 Mile Road, Warren, MI 48397-5000 or emailed to standardization@tacom.army.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil>

AMSC N/A

FSC 9150

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

MIL-PRF-46167D

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those 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).

INTERNATIONAL STANDARDIZATION AGREEMENTS

STANAG 1135	- Interchangeability Of Fuels, Lubricants And Associated Products Used By The Armed Forces Of The North Atlantic Treaty Nations.
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STANDARDS

FEDERAL

FED-STD-791	- Lubricants, Liquid Fuels and Related Products; Methods of Testing (See 4.3.1).
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SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-2104	- Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service.
MIL-PRF-21260	- Lubricating Oil, Internal Combustion Engine, Preservative Break-in.

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

MIL-PRF-46167D

U.S. DEPARTMENT OF LABOR (DOL)

OSHA 29 CFR 1910.1200 - Hazard Communication; Interpretation Regarding Lubricating Oils.

(Copies of the Code of Federal Regulations (CFR) are available from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402 or website: <http://www.gpoaccess.gov/cfr/>)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

ASTM INTERNATIONAL

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| D92 | - Standard Test Method for Flash and Fire Points by Cleveland Open Cup. |
| D97 | - Standard Test Method for Pour Point of Petroleum Oils (DoD Adopted). |
| D130 | - Standard Test Method for Detection of Copper Corrosion from Petroleum Products, by the Copper Strip Tarnish Test (DoD Adopted). |
| D287 | - Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method) (DoD Adopted). |
| D445 | - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) (DoD Adopted). |
| D524 | - Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products (DoD Adopted). |
| D664 | - Standard Test Method for Neutralization Number by Potentiometric Titration (DoD Adopted). |
| D808 | - Standard Test Method for Chlorine in New and Used Petroleum Products (Bomb Method) (DoD Adopted). |
| D874 | - Standard Test Method for Sulfated Ash from Lubricating Oils and Additives (DoD Adopted). |
| D892 | - Standard Test Method for Foaming Characteristics of Lubricating Oils (DoD Adopted). |
| D1317 | - Standard Test Method for Chlorine in New and Used Lubricants (Sodium Alcoholate Method). |

MIL-PRF-46167D

- D1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale) (DoD Adopted).
- D2270 - Standard Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C (DoD Adopted).
- D2622 - Standard Test Method for Sulfur in Petroleum Products (X-Ray Spectrographic Method) (DoD Adopted).
- D2887 - Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography (DoD Adopted).
- D2896 - Standard Test Method for Base Number of Petroleum Products by Potentiometric Perchloric Acid Titration.
- D3228 - Standard Test Method for Total Nitrogen in Lubricating Oils and Fuel Oils by Modified Kjeldahl Method (DoD Adopted).
- D4057 - Standard Test Method for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted).
- D4177 - Standard Test Method for Automatic Sampling of Petroleum and Petroleum Products (DoD Adopted).
- D4485 - Standard Specification for Performance of Engine Oils.
- D4628 - Standard Test Method for Analysis of Barium, Calcium, Magnesium, and Zinc in Unused Lubricating Oils by Atomic Absorption Spectrometry (DoD Adopted).
- D4629 - Standard Test Method for Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection (DoD Adopted).
- D4683 - Standard Test Method for Measuring Viscosity at High Temperature and High Shear Rate by Tapered Bearing Simulator (DoD Adopted).
- D4684 - Standard Test Method for Determination of Yield Stress and Apparent Viscosity of Engine Oils at Low Temperature (DoD Adopted).
- D4739 - Standard Test Method for Base Number Determination by Potentiometric Titration.
- D4741 - Standard Test Method for Measuring Viscosity at High Temperature and High Shear Rate by Tapered-Plug Viscometer (DoD Adopted).

MIL-PRF-46167D

- D4927 - Standard Test Method for Elemental Analysis of Lubricants and Additive Components - Barium, Calcium, Phosphorus, Sulfur, and Zinc by Wavelength-Dispersive X-Ray Fluorescence Spectroscopy (DoD Adopted).
- D4951 - Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (DoD Adopted).
- D5293 - Standard Test Method for Apparent Viscosity of Engine Oils between -5 and 35 degrees C Using Cold Cranking Simulator.
- D5481 - Standard Test Method for Measuring Apparent Viscosity at High Temperature and High-Shear Rate by Multicell Capillary Viscometer.
- D5800 - Standard Test Method of Evaporation Loss of Lubricating Oils by the Noack Method.
- D5862 - Standard Test Method for the Evaluation of Engines Oils in the Two-Stroke Turbo-Supercharged 6V92TA Diesel Engine.
- D5966 - Standard Test Method for the Roller Follower Wear Test.
- D5967 - Standard Test Method for Evaluation of Diesel Engine Oils in T-8 Diesel Engine.
- D5968 - Standard Test Method for Evaluation of Corrosiveness of Diesel Engine Oil.
- D6618 - Standard Test Method for Evaluation of Engine Oils in Diesel Four-Stroke Cycle Supercharged 1M-PC Single Cylinder Oil Test Engine
- D6709 - Standard Test Method for the Evaluation of Automotive Engine Oils in Sequence VIII Spark Ignition Engine.
- D6750 - Standard Test Methods for Evaluation of Engine Oils in a High-Speed, Single-Cylinder Diesel Engine 1K Procedure (0.4% Fuel Sulfur) and 1N Procedure (0.04% Fuel Sulfur).
- D6894 - Standard Test Method for Evaluation of Aeration Resistance of Engine Oils in Direct-Injected Turbocharged Automotive Diesel Engine.
- D6922 - Standard Test Method for Determination of Homogeneity and Miscibility in Automotive Engine Oils.
- D6984 - Standard Test Method for Evaluation of Automotive Engine Oils in the SEQUENCE IIIF, Spark-Ignition Engine.

MIL-PRF-46167D

ASTM Adjunct Publications

STOCK# ADJD0130 - Adjunct to D130 Copper Strip Corrosion Standard.

(Application for copies should be addressed to the ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or website: <http://www.astm.org/>)

ALLISON TRANSMISSION DIVISION (ATD)

C-4 Fluid Specification (TES-228).

(Application for copies should be addressed to EG&G Stationary Testing, Attn: ATF/Specialty Lab (C-4), 5904 Bandera Road, San Antonio, TX 78283-1993 or website: <http://www.allisontransmission.com>)

CATERPILLAR INC., ENGINE DIVISION (CAT)

Caterpillar TO-4, Fluid Requirements, VC 70.

(Application for copies should be addressed to Caterpillar, Component Development, Technical Center - G, P.O. Box 1875, Peoria, IL 61656-1875 or website: [http:// www.cat.com](http://www.cat.com))

2.4 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 takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The engine lubricating oil furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.1.1 and 6.4).

3.2 Design, materials, and manufacturing processes. Unless otherwise specified herein, the design, materials, and manufacturing process selection is the prerogative of the contractor as long as all articles submitted to the government fully meet the operating, interface, support and ownership, and operating environment requirements specified.

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

MIL-PRF-46167D

3.3 Operating requirements. The engine lubricating oil shall meet all the finished oil and operating requirements as specified in 3.3.1 through 3.3.9.2.

3.3.1 Finished oil properties. The engine lubricating oil properties, after the application of tolerances (see 4.1.1.1), shall not exceed the maximum (max.) or fall below the minimum (min.) limits as specified in table I.

TABLE I. Finished oil properties.

Property	Arctic
Kinematic viscosity, Centistokes (cSt):	
@ 100 degrees Celsius (°C), min.	9.3
@ 40°C	X <u>1</u> /
@ -40°C, max.	18 000
@ -48°C, max.	55 000
High-temperature/high shear viscosity, Centipoise (cP), min.	2.9
Low Temperature Cranking Viscosity, cP, max. @ -35°C	6200
Low Temperature Pumping Viscosity, @ -40°C, cP, max.(no yield stress)	60 000
Viscosity index	X
Pour point, °C, max.	-55
Stable pour point, °C, max. <u>2</u> /	-55
Flash point, °C, min.	220
Evaporative loss, percent (%), max. <u>3</u> /	18
Other properties:	
Gravity	X
Carbon residue	X
Sulfur	X
Sulfated ash	X
Total acid number (TAN)	X
Total base number (TBN)	X
Phosphorus	X
Nitrogen	X
Metallic components	X
Chlorine	X
Color	X
Boiling range	X

1/ Limits for the values marked by “X” can not be established, as different additive technologies and base stocks will give different results. However, knowledge of these values is needed to judge performance considerations and to ascertain the potential effects of changes in oil formulations.

2/ After being cooled down to its pour point, the oil shall regain its homogeneity on standing at a temperature not more than 6°C above the pour point. However, it should not exceed the indicated limits.

3/ The indicated limits apply when ASTM D5800 is used.

MIL-PRF-46167D

3.3.2 Foaming. The oil shall not produce foam which will cause inadequate lubrication, cavitation, overflow loss of lubricant, mechanical failure, or any other detrimental effect that compromises performance.

3.3.3 Oxidation and wear protection characteristics. The oil shall protect internal loaded engine components against excessive wear and oxidation.

3.3.4 Rolling valvetrain wear protection. The oil shall protect hydraulic roller followers from excessive wear.

3.3.5 Ring-sticking, wear, and accumulation of deposits. The oil shall prevent the sticking of piston rings and port clogging, and shall minimize the wear of cylinders, rings, and loaded engine components such as cam followers, valve rocker arms, rocker arm shafts, and the oil pump and fuel injection pump drive gears.

3.3.6 Friction retention characteristics and wear. The oil shall maintain a stable coefficient of friction and shall minimize distress and wear during use in power shift transmissions and other cooled friction compartments, or hydraulic systems such as steering and disconnect clutches.

3.3.7 Seal deterioration. The oil shall minimize the deterioration of seal and friction materials.

3.3.8 Soot Dispersing characteristics. The oil shall minimize engine deposits and increased oil viscosity by stably dispersing soot, produced during diesel combustion, in the lubricating oil.

3.3.9 Corrosion. The oil shall meet the requirements as specified in 3.3.9.1 through 3.3.9.2.

3.3.9.1 Bearing corrosion. The oil shall not corrode alloy bearings.

3.3.9.2 Metal corrosion. The oil shall not corrode metals.

3.4 Interface requirements. The oil shall meet the following interface requirement.

3.4.1 Homogeneity and miscibility. The oil shall be and shall remain homogeneous under normal operational and storage conditions.

3.5 Support and ownership requirements. The oil shall meet the following support and ownership requirement.

MIL-PRF-46167D

3.5.1 Hazardous materials. The oil shall not contain carcinogenic or potentially carcinogenic constituents as defined under the Hazard Communication Standard 29 CFR 1910.1200.

4. VERIFICATION

4.1 Classification of inspections. Inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.1.1).
- b. Conformance inspection (see 4.1.2).

4.1.1 Qualification inspection. Qualification inspection shall consist of all the verifications listed in table II and shall be in accordance with acceptable tolerances (see 4.1.1.1).

4.1.1.1 Tolerances. Acceptable tolerances for values or limits in 3.3.1 through 3.3.9.2 shall be as specified by the qualifying activity (see 6.2).

Table II. Verification methods.

Title	Require-ments	Verifi-cation	Title	Require-ments	Verifi-cation
Operating requirements	3.3	4.3.3	Corrosion	3.3.9	4.3.3.9
Finished oil properties	3.3.1	4.3.3.1	Bearing corrosion	3.3.9.1	4.3.3.9.1
Foaming	3.3.2	4.3.3.2	Metal corrosion	3.3.9.2	4.3.3.9.2
Oxidation/wear protection	3.3.3	4.3.3.3	Interface requirements	3.4	4.3.4
Rolling valvetrain wear protection	3.3.4	4.3.3.4	Homogeneity	3.4.1	4.3.4.1
Ring sticking/wear	3.3.5	4.3.3.5	Support and ownership requirements	3.5	4.3.5
Friction retention/wear	3.3.6	4.3.3.6	Hazardous materials	3.5.1	4.3.5.1
Seal deterioration	3.3.7	4.3.3.7			
Soot dispersing characteristics	3.3.8	4.3.3.8			

4.1.2 Conformance inspection. The engine lubricating oil supplied under contract shall have the same base stocks and additive components, at the appropriate concentrations, as when qualified. Unless otherwise specified (see 6.2, 6.5, and 6.5.1), the finished oil properties and the foaming characteristics shall be tested as specified in table II to ensure that purchased oils are of the same composition and quality as the respective qualification samples, and to identify the products. The results obtained shall fall within the tolerances/specific values determined at the time of qualification (see 4.1.1.1).

MIL-PRF-46167D

4.2 Sampling. Samples from bulk or packaged lots (see 6.8), shall be taken for testing in accordance with ASTM D4057 or D4177, as appropriate.

4.3 Verification methods. The types of verification methods included in this section are visual inspection, measurement, sample tests, full-scale demonstration tests, simulation, modeling, engineering evaluation, component properties analysis, and similarity to previously approved or previous qualified designs.

4.3.1 Verification alternatives. The manufacturer may propose alternative test methods, techniques, or equipment, including the application of statistical process control, tool control, or cost effective sampling procedures, to verify performance. See the contract for alternatives that replace verification required by this specification.

4.3.2 Inspection conditions. Tests may be conducted, in any sequence, in any plant or laboratory approved by the qualifying activity (see 6.2 and 6.4).

4.3.3 Operating requirements verification. Complete each test under 4.3.3.

4.3.3.1 Finished oil property verifications. Use the test methods as specified in table III to determine that finished oil properties are as specified.

Table III. Finished oil property test methods.

Property	Test methods	
	FED-STD-791 or equivalent (see 4.3.1)	ASTM
Viscosity, kinematic	203	D445
Viscosity, low temperature cranking		D5293
High temperature/shear		D4683, D4741, D5481
Viscosity index		D2270
Pour point		D97
Stable pour point		
Viscosity, low temperature pumping		D4684
Flash point		D92
Evaporative loss		D5800
Gravity, API		D287
Color		D1500
Carbon residue		D524
Chlorine 1/		D808, D1317
TAN		D664
TBN		D2896, D4739
Phosphorus		D4951

MIL-PRF-46167D

Table III. Finished oil property test methods – Continued.

Property	Test methods	
	FED-STD-791 or equivalent (see 4.3.1)	ASTM
Sulfur		D2622, D4951
Nitrogen		D3228, D4629
Boiling range distribution		D2887
Sulfated ash		D874
Metallic components		D4628, D4927, D4951

1/ ASTM D808 is the preferred method.

4.3.3.2 Foaming test. All grades of oil shall be subject to the following tests and shall exhibit the correlative results:

- Initial test. Test oil in accordance with sequence I of ASTM D892. Not more than 10 milliliters (mL) of foam shall remain immediately following the end of the 5 minute blowing period. No foam shall remain at the end of the 10 minute settling period.
- Intermediate test. Test oil in accordance with sequence II of ASTM D892. Not more than 20 mL of foam shall remain immediately following the end of the 5 minute blowing period. No foam shall remain at the end of the 10 minute settling period. Option A is not allowed.
- Final test. Repeat procedures under initial test, sequence III of ASTM D892.
- Engine Oil Aeration Test. Test Oil in accordance with ASTM D6894. No more than a 10% increase in aerated oil volume shall be present after a 30 minute settling period.

4.3.3.3 Oxidation and wear protection test. The oil shall be tested in accordance with ASTM D6984, Appendix X1 (Seq. IIIFHD Test Procedure) and shall exhibit results (single or average) meeting the following criteria:

60 h viscosity at 40°C, increase from	<u>1 Test</u>	<u>2 Tests</u>	<u>3 Tests</u>
10 min sample, % max	325	349	360

4.3.3.4 Rolling valvetrain wear test. The oil shall be tested in accordance with ASTM D5966 and shall exhibit results meeting the following criteria:

	<u>1 Test</u>	<u>2 Tests</u>	<u>3 Tests</u>
Pin wear, µm avg. max.	11.4	12.4	12.7
mils, avg. max.	0.45	0.49	0.50

4.3.3.5 Ring-sticking, wear, and accumulation of deposits tests. Test oil as specified in 4.3.3.5.1 through 4.3.3.5.3.

MIL-PRF-46167D

4.3.3.5.1 Four-stroke cycle diesel engine - low sulfur fuel. The oil shall be tested in accordance with ASTM D6750 (CAT 1N) test procedure using low-sulfur fuel. (Only one test is required; however, the test limits are adjusted according to the number of tests submitted and equivalency to original limits.) The test results shall meet the following criteria:

	<u>1 Test</u>	<u>2 Tests</u>	<u>3 Tests</u>
Top groove filling, % avg. max.	20	23	25
WTD, demerits, avg. max.	286.2	311.7	323.0
Top land heavy carbon, % avg. max.	3	4	5
Oil consumption, grams per kilowatt hour (g/kW-h)	0.5	0.5	0.5
Scuffing, piston/rings/liners, avg. max.	none	none	none
Stuck rings, avg. max.	none	none	none

4.3.3.5.2 Four-stroke cycle diesel engine - higher sulfur fuel. The oil shall be tested in accordance with ASTM D6618 (CAT 1M-PC) test procedure using high-sulfur fuel. (Only one test is required; however, when three or more tests are run, one test may be discarded and the average determined from the remaining test results.) The test results shall meet the following criteria:

Top groove filling, % avg. max.	70
WTD, avg. max.	240
Ring side clearance loss, millimeter max.	0.013
Piston ring sticking	none
Scuffing, piston/rings/liners	none

4.3.3.5.3 Two-stroke cycle diesel engine. The oil shall be tested in accordance with ASTM D5862 (DDC 6V92-TA). (Only one test is required. However, if more than one test is run, the test limits are adjusted according to the number of tests run, maximum of three tests, and equivalency to original limits and in accordance with A5.1 thru A5.6 under ASTM D 4485.) The test results shall meet the following criteria:

	<u>1 Test</u>	<u>2 Tests</u>	<u>3 Tests</u>
Piston, average % area			
Skirts tin removed	Report	Report	Report
Wrist pin slipper bushing copper exposed	Report	Report	Report
Average ring face distress, demerits (max.)			
Fire ring, avg.	0.33	0.34	0.36
Nos. 2 and 3 compression rings, avg.	0.28	0.29	0.30
	<u>1 Test</u>	<u>2 Tests</u>	<u>3 Tests</u>

MIL-PRF-46167D

Broken rings, avg.	None	None	None
Cylinder liner area			
Average liner distress, % area (avg. max.)	60.0	63.5	65.0
Port plugging, % area, (avg. max.)			
Average	2	2	2
Single cylinder	5	5	5

4.3.3.6 Friction retention and wear tests. Complete each test under 4.3.3.6.

4.3.3.6.1 Slip time and torque test. The oil shall be tested in accordance with ATD C-4 fluid specification. The test results shall meet the following nominal criteria, as adjusted to accommodate slight changes in individual friction plate batches:

	Graphite	Paper
	<u>0 - 5500 cycles</u>	<u>0 - 10 000 cycles</u>
Slip time at cycles, seconds (s) max.	0.74	0.67
Mid-point coefficient, min.	0.097	0.080

4.3.3.6.2 Friction coefficient and wear test. The oil shall be tested in accordance with Caterpillar VC 70 fluid requirements and shall meet the following criteria, as adjusted to accommodate slight changes in individual fluoroelastomer batches and performance of the reference oil:

	<u>Sequence 1220</u>	<u>Sequence FRRET</u>
Avg. dynamic coefficient, %	90 - 140	----
@ 3000 cycles	----	85 - 130
@ 8000 cycles	----	90 - 125
@ 15 000 cycles	----	90 - 125
@ 25 000 cycles	----	95 - 125
Avg. static coefficient, %	91 - 127	----
Disc wear, mm max.	0.04	----
Energy limit, %	25	----

MIL-PRF-46167D

4.3.3.7 Seal compatibility test. The oil shall be tested in accordance ATD C-4 and shall exhibit results meeting the following nominal criteria, as adjusted to accommodate slight changes in individual elastomer batches:

Buna N:	
Volume changes, %	0 to +5
Hardness change, points	0 \pm 5
Polyacrylate:	
Volume changes, %	0 to +10
Hardness change, points	0 to +5
Silicone:	
Volume changes, %	0 to +5
Hardness change, points	0 to -10
Fluoroelastomer:	
Volume changes, %	0 to +4
Hardness change, points	-4 to +4
Ethyl Acrylic:	
Volume changes, %	+12 to +28
Hardness change, points	-6 to -18

4.3.3.8 Soot dispersing test. The oil shall be tested in accordance with the ASTM D5967 (T-8) and shall exhibit test results meeting the following criteria:

	<u>1 Test</u>	<u>2 Tests</u>	<u>3 Tests</u>
Viscosity increase, cSt max. from min. corrected to 3.8 % Soot by TGA	11.5	12.5	13.0
Oil consumption grams/brake horsepower-hour (g/Bhp-h), max.	0.0005	0.0005	0.0005
Filter plugging, differential pressure (kPa max.)	138	138	138

4.3.3.9 Corrosion. Complete each test under 4.3.3.9.

4.3.3.9.1 Bearing corrosion. The oil shall be tested in accordance with ASTM D6709 (Seq. VIII) and shall exhibit results meeting the following criteria:

	<u>1 Test</u>	<u>2 Tests</u>	<u>3 Tests</u>
Bearing weight loss, milligrams (mg), avg. max.	29.3	31.9	33.0

MIL-PRF-46167D

4.3.3.9.2 Metal corrosion test. The oil shall be tested in accordance with ASTM D130 and shall not exhibit copper strip discoloration in excess of ASTM No. 3 when compared to ASTM Copper Strip Corrosion Standard, Adjunct to ASTM D130. The oil shall also be tested in accordance with ASTM D5968 and shall exhibit results meeting the following criteria:

Copper, parts per million (ppm) max.	20
Lead, ppm max.	60

4.3.4 Interface requirements verification. Complete each test under 4.3.4.

4.3.4.1 Homogeneity and miscibility test. An unmixed sample of oil shall show no evidence of separation when tested in accordance with method ASTM D6922, or equivalent (see 4.3.1).

4.3.5 Support and ownership requirement verification. Complete each test under 4.3.5.

4.3.5.1 Hazardous materials test. Using one or more of the methods outlined in 4.3 and 4.3.1 to verify the absence of hazardous materials.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. The lubricating oil covered by this specification is intended for the crankcase lubrication of reciprocating compression-ignition engines used in all types of military combat/tactical ground equipment. The oils are also intended for the same application in power transmissions, hydraulic systems, and non-hypoid gear units of engineer/construction equipment, materials handling equipment and combat/tactical ground equipment. The specification product is intended for crankcase lubrication under all conditions of service, as defined by appropriate lubrication orders, when ambient temperatures are in the range shown in table IV. In addition

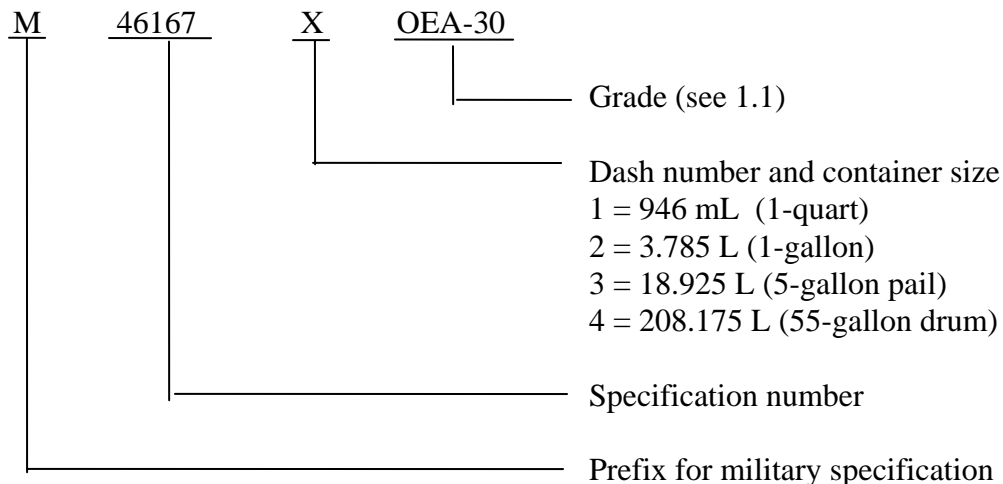
MIL-PRF-46167D

the lubricating oil covered by this specification is intended for use in arctic regions as an all weather (year-round) power transmission fluid for military combat/tactical ground equipment. The lubricating oils covered by this specification meet service classifications API CG-4, CF, and a modified CF-2 of ASTM D4485. The lubricating oil under this specification can be used at all temperatures for transmission, hydraulic, and non-hypoid gear applications provided the use of the arctic grade is warranted for winter operations, otherwise, the appropriate grade under MIL-PRF-2104 is the recommended choice for these applications (see 6.7). This specification requires an oil formulation that is both versatile (used as engine oil, transmission fluid, and hydraulic fluid) and meets extreme operating conditions for use in combat/tactical ground equipment. These requirements cannot be found in current industry standards and are not appropriate for other government vehicles.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- c. Specification of values and tolerances for finished oil requirements (see table I and 4.1.1.1).
- d. If conformance testing is other than as specified (see 4.1.2).
- e. Approved plants or laboratories for testing (see 4.3.2).
- f. Packaging requirements, quantity and PIN (see 5 and 6.3).

6.3 Part or identifying number (PIN) configuration. The PIN to be used for oils acquired to this specification are created as follows:



6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified

MIL-PRF-46167D

Products List QPL No. 46167 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 or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from U.S. Army Tank-automotive and Armaments Command, Warren, Michigan 48397-5000.

6.5 Conformance testing. Affordable conformance inspection with confidence varies depending upon a number of procurement risk factors. Some of these factors include: Contractor past performance, government schedules and budget, product material and design maturity, manufacturing capital equipment and processes applied, the controlled uniformity of those processes, labor skill and training, and the uniformity of measuring processes and techniques. During the solicitation, contracting documents should indicate those tests desired from table II and their designated frequency based on a risk assessment for the procurement.

6.5.1 Other requirements for tolerances for conformance testing. Definite numerical values are not specified for certain of the physical and chemical properties listed in table I, and for which corresponding test methods are given in table III. Values of some properties vary from one brand of oil to another for the same grade. These values are influenced by the source of the base stock, the identities and quantities of additives, etc. Definite numerical values are not always functionally important except, for some properties, within specified maximum and minimum limits. It is not possible (or necessary) to assign restrictive values in the specification before the testing of qualification samples. During qualification, test values will be determined which are characteristics of a particular product and which can serve thereafter to identify the product. Using the results of qualification testing, the qualifying activity can set values, including permissible tolerances, for future conformance testing.

6.6 Reference oils. Reference oils for conducting compatibility tests are to be obtained from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

6.7 Temperature range. Recommended ambient temperature ranges for specific grade oils are shown in table IV.

MIL-PRF-46167D

TABLE IV. Recommended ambient temperature ranges for usage of arctic engine oil.

E X P E C T E D T E M P E R A T U R E S														
°F	<-50	-25	0	15	25	40	50	60	70	80	90	100	110	120
°C	<-46	-32	-18	-10	-5	5	10	16	21	27	32	38	44	49
OEA-30 (O-183) (See Note Below)														
OEA-30 (O-183) Engine														

NOTE: For power transmission, hydraulic system and non-hypoid gearbox applications, lubricant may be used at all temperatures.

6.8 Definitions.

6.8.1 Bulk lot. An indefinite quantity of a homogeneous mixture of one grade of oil offered for acceptance in a single, isolated container; or manufactured in a single plant run (not exceeding 24 hours), through the same processing equipment, with no change in the ingredient materials.

6.8.2 Packaged lot. An indefinite number of 208.175 L (55 gallon drum) or smaller unit containers of identical size and type, offered for acceptance, and filled with a homogeneous mixture of one grade of oil from a single, isolated container; or filled with a homogeneous mixture of one grade of oil, manufactured in a single plant run (not exceeding 24 hours), through the same processing equipment, with no change in the ingredient materials.

6.9 Subject term (key word) listing.

Combat service
Tactical service
Compression-ignition
Power transmission fluid
Tribology

6.10 International standardization agreement implementation. This specification implements STANAG 1135 "Interchangeability Of Fuels, Lubricants And Associated Products Used By The Armed Forces Of The North Atlantic Treaty Nations". When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at www.dodssp.daps.mil

6.11 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

MIL-PRF-46167D

Custodians:

Army - AT
Navy - SH
Air Force - 68

Preparing Activity:

Army - AT

(Project 9150 -1290)

Review Activities:

Army - AR, MI, SM
Navy - AS, MC, OS, SA, YD
Air Force - 11, 99
DLA - GS

Industry Associations:

ASTM
SAE

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database a <http://assist.daps.dla.mil>