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SUPERSEDING
MIL-L-14107B
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MILITARY SPECIFICATION

* LUBRICATING OIL, WEAPONS, LOW TEMPERATURE

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

1. SCOPE

* 1.1 This specification covers a preservative lubricating oil for aircraft and ground small arms weapons at temperatures between 0° to -70°F (-17.8° to -56.6°C). This lubricating oil is identified by Military Symbol LAW and NATO Code Number O-157.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

Federal

O-M-232 - Methanol (Methyl Alcohol)
P-D-680 - Dry Cleaning Solvent
QQ-C-576 - Copper, Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed, or Machined Edges (Plate, Bar, Sheet and Strip)
QQ-S-698 - Steel, Sheet and Strip, Low Carbon
RR-S-366 - Sieve, Test.
TT-N-95 - Naphtha, Aliphatic

STANDARDS

Federal

FED-STD-791 - Lubricants, Liquid Fuels, and Related Products; Methods of Testing

FSC 9150

Military

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-290 - Packaging, Packing and Marking of Petroleum and Related Products

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

Standards

D 91 - Precipitation Number of Lubricating Oils
D 92 - Flash and Fire Points by Cleveland Open Cup
D 97 - Pour Point
D 270 - Sampling Petroleum and Petroleum Products
D 445 - Viscosity of Transparent and Opaque Liquids (Kinematic and Dynamic Viscosities)
D 972 - Evaporation Loss of Lubricating Greases and Oils
D 974 - Neutralization Number by Color-Indicator Titration, Test for

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania, 19103).

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. REQUIREMENTS

3.1 Qualification. Lubricating oils furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.5.1 and 6.3). Any change in the formulation of a qualified product will necessitate its requalification.

3.2 Material. The lubricating oil shall consist of tetra-alkyl silicates into which additive materials have been incorporated to inhibit corrosion and oxidation.

3.3 Physical and chemical requirements. The lubricating oil shall conform to the respective requirements specified in Table I and in 3.4 through 3.10.

Table I Requirements (see Table II)

Properties	Values
Flash point, min., °F (°C)	325 (162.7)
Pour point, max., °F (°C)	-75 (-59.4)
Viscosity, kinematic, centistokes	
@ 100°F (37.8°C), min.	5.8
@ -65°F (-54°C), max.	900
Neutralization number, max.	1.0
Precipitation number, ml, max.	0.05
Evaporation loss @ 210°F (98.9°C), percent, max.	3.0
Silica, (SiO_2), percent	10.7 to 12.8

3.4 Humidity cabinet protection. After testing as specified in Table II (400 hours exposure in a humidity cabinet), a total of not more than three corrosion dots, none of which exceeds one millimeter in length, width, or diameter, shall be evident on the test panels. Corrosion on the outer 1/4 inch (6mm) of the panels shall not be cause for rejection.

3.5 Hydrolytic stability. After testing as specified in 4.6.2 (48 hours at 200°F (93.3°C)), the following requirements shall be met:

a. The change in the weight of the copper strip shall not exceed 0.5 mg per square centimeter of surface.

b. The neutralization number of the oil shall not have increased by more than 0.5 mg KOH from the oil's original neutralization number.

c. The viscosity of the oil at 100°F (37.8°C) shall not have changed by more than ± 20 percent from the oil's original viscosity.

d. The neutralization number of the aqueous portion shall not exceed 0.5 mg KOH.

e. The amount of insoluble material produced during the test shall not be greater than 0.5 percent by weight of the original oil sample.

3.6 Swelling of synthetic rubber. After testing as specified in Table II (168 hours at 158°F (70°C)), swelling of the standard synthetic rubber L by the oil shall not exceed 15 percent.

3.7 Oxidation stability. After testing as specified in 4.6.4 (168 hours of exposure at 212°F (100°C)), the following requirements shall be met:

a. The change in weight of the copper and steel shall not exceed 0.2 mg per square centimeter of surface.

b. The viscosity of the oil at -65°F (-54°C) shall not exceed 1200 centistokes.

c. The neutralization number of the oil shall not have increased by more than 0.5 mg KOH from the oil's original neutralization number.

d. The neutralization number of any volatile components formed shall not exceed 0.5 mg KOH.

e. There shall be no visual evidence of separation of insoluble materials or gumming of the oil.

3.8 Storage stability.

3.8.1 Low temperature. After testing as specified in 4.6.5.1 (-65°F (-54°C) for 168 hours), the oil shall show no evidence of precipitation or separation of additives when inspected visually. A slight cloudiness shall not be cause for rejection.

3.8.2 Ambient temperature. After testing as specified in 4.6.5.2 (65° to 95°F (18° to 35°C) for 6 months), the oil shall show no evidence of precipitation or separation when inspected visually. In addition, the oil shall meet the hydrolytic stability (see 3.5) and evaporation loss (see 3.3) requirements. A slight cloudiness shall not be cause for rejection.

3.9 Gun performance. Stoppages of the gun attributable to the lubricant, or a reduction in the rate of fire of more than 75 rounds per minute under the original rate, shall constitute performance failure. The rate of fire, however, shall not be less than 500 rounds per minute. The weapon shall not show evidence of abnormal wear.

3.10 Workmanship. The oil shall be clear and uniform in appearance. It shall show no evidence of sediment or suspended matter when examined visually.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as

otherwise specified in the contract or order, the supplier may use his own or any other facilities 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 specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Lot.

4.2.1 Bulk lot. An indefinite quantity of a homogeneous mixture 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.

4.2.2 Packaged lot. An indefinite number of 55-gallon drums or smaller unit containers of identical size and type, offered for acceptance, and filled with a homogeneous mixture of oil manufactured in a single plant run (not exceeding 24 hours), through the same processing equipment, with no change in the ingredient materials.

4.3 Sampling.

4.3.1 Sampling for examination of filled containers. Take a random sample of filled containers from each lot in accordance with MIL-STD-105 at inspection level II and acceptable quality level (AQL) = 2.5 percent defective.

4.3.2 Sampling for tests. Take samples for tests in accordance with ASTM Method D 270.

4.4 Inspection.

4.4.1 Inspection of material. Perform inspection of material in accordance with Method 9601 of Fed. Test Method Std. No. 791.

4.4.2 Examination of filled containers. Examine samples taken in accordance with 4.3.1 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 underfilled containers exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, reject the lot represented by the sample.

4.5 Classification of tests.

a. Qualification tests.
b. Quality conformance tests.

4.5.1 Qualification tests. Qualification tests consist of tests for all the requirements specified in section 3.

4.5.2 Quality conformance tests. Quality conformance tests consist of tests for all the requirements specified in Section 3 except the six month storage stability test (4.6.5) and gun performance test (4.6.6).

4.6 Test methods. Perform tests in accordance with applicable methods listed in Table II and in paragraphs 4.6.2 through 4.7.

Table II. Test Methods

Test	Method No., Fed. Std. 791	Method No. ASTM
Pour point		D97
Viscosity, kinematic		D445
Evaporation loss		D972 1/
Flash point		D92
Precipitation number		D91
Neutralization number		D974
Humidity cabinet protection	5329	
Swelling of synthetic rubber	3603 2/	

1/ Conduct this test at 210°F (98.9°C).
2/ Test each rubber specimen in a separate tube.

4.6.2 Hydrolytic stability. Conduct this test in accordance with Method 3457 of Fed. Test Method Std. No. 791 with the following changes:

a. Polish the copper strip with silicon carbide or aluminum oxide having cloth or paper backing rather than emery paper.

b. The Gooch crucible to be used is described as follows: Filtering crucible, fritted glass disk, low form Gooch type, Pyrex brand, 30 ml capacity, medium porosity, 14 microns nominal maximum pore size.

c. Prepare the Gooch crucible as follows Screen white, sharp silica sand through a No. 40 sieve conforming to specification RR-S-366. Transfer the sand remaining on the sieve to a beaker and wash it with 6 normal hydrochloric acid, 6 normal sodium hydroxide, and hot distilled water or water of equal purity until the rinse water is neutral to litmus. Wash the sand with methyl alcohol. Wash the crucible with hot glass cleaning solution (potassium dichromate and sulfuric acid), distilled water or water of equal purity, and methyl alcohol. Place

25 grams of the cleaned sand in the crucible and wash it several times with distilled water or water of equal purity and methyl alcohol to distribute the sand uniformly. Place the crucible and contents in a gravity convection oven maintained at 250° ± 5°F (121.1° ± 2°C) for 15 ± 2 minutes. Remove the crucible from the oven, cool it and weigh it to within 0.2 mg. Repeat the heating and cooling until a constant weight is obtained.

d. After filtering the liquid contents through the tared Gooch crucible, rinse the container with 25 ml of distilled water or water of equal purity, and filter the washings through the Gooch crucible.

4.6.3 Determination of silica. Weigh a 0.5 g sample of the oil to the nearest 0.1 mg in a 300 ml Erlenmeyer flask. Add to the flask 5 ± 0.5 g of reagent grade ammonium sulfate, 25 ± 2.0 ml of concentrated reagent grade sulfuric acid, and 10 ± 1 ml of concentrated reagent grade nitric acid. Heat the flask on a hot plate until voluminous fumes of SO_3 are evolved. Add several 2 ± 0.5 ml portions of concentrated nitirc acid to the flask to destroy all the organic material and allow the flask to fume for 5 ± 1 minutes. Remove the flask from the hot plate and permit it to cool to room temperature. Wash down the inside surfaces of the flask with a minimum amount of distilled water or water of equal purity. Again heat the flask and allow it to fume for 5 ± 1 minutes. Remove the flask from the hot plate, permit it to cool to room temperature and add 150 ± 5 ml of distilled water or water of equal purity. Immediately filter the contents of the flask through a No. 40 Whatman filter paper or equivalent. Wash the residue on the paper with hot 1:10 sulfuric acid followed by washing with hot distilled water or water of equal purity. Place the wet filter paper and contents in a platinum crucible and heat it gently to promote charring. After charring has been completed, heat at 1000°-1100° C to constant weight, cool in a desiccator, and weigh. Add 2 drops of reagent grade sulfuric acid and 5 ml of reagent grade hydrofluoric acid (HF). Evaporate to dense fumes of sulfuric acid, continue fuming until the free sulfuric acid is expelled, and then ignite at 900°-1000° C for 5 minutes. Cool in a desiccator and weigh. Calculate the percent silica as follows:

$$\text{Percent silica} = \frac{100\ (A - B)}{W}$$

Where:

A = wt. of crucible plus impure silica before addition of HF.
B = wt. of crucible plus residue after addition of HF.
W = wt. of sample.

4.6.4 Oxidation stability.

4.6.4.1 Preparation of test specimens. Use two metal specimens for this test, each approximately 1.75 in (4.45 cm) by 0.375 in (0.95 cm) by 0.025 in (0.06 cm). Make one specimen from copper conforming to QQ-C-576 and one specimen from steel conforming to FS 1009, QQ-S-698. Polish the specimens to remove all pits, burrs and irregularities from the faces and edges. Initial polishing may be done with the aid of a slow-speed horizontal metallurgical polishing wheel. Final polishing may be done with 240 grit silicon carbide or aluminum oxide abrasive having cloth or paper backing. Moisten the cloth or paper bonded abrasive with solvent conforming to P-D-680. After polishing, spray the specimens with naptha conforming to TT-N-95 followed by a rinse in hot naphtha and hot methanol conforming to O-M-232. Do not touch the specimens with the hands after they have been polished and cleaned.

4.6.4.2 Test procedure. Weigh the metal specimens. Weigh 150 ± 5 grams of the lubricating oil into a Pyrex test tube approximately 500 mm long by 50 mm O.D. fitted with an air inlet tube and reflux condenser. Connect the copper and steel specimens with a copper wire and support them with a glass holder equipped with glass hooks. Arrange the specimens so that they will not touch each other during the test. Immerse the specimens in the oil so that they are completely covered. Place the tube and condenser assembly in a bath maintained at 212° ± 1°F (100° ± 0.5°C). By means of a glass tube, pass air which has previously passed through two towers, one containing soda lime and the second containing glass wool, through the oil at a rate of 5 ± 0.2 liters per hour. Pass the gases which escape through the reflux condenser into a trap containing 50 ± 1 ml of 0.1 normal KOH diluted to 150 ml of distilled water or water of equal purity. Conduct the test for a total of 168 ± 1 hours. At the end of the test period, remove the test tube and condenser assembly from the bath, disassemble it and remove the metal specimens. Wash the metal specimens with reagent grade benzene and reagent grade acetone. Weigh the specimens. Examine the oxidized oil visually for insoluble materials and gumming. Determine the viscosity of the oxidized oil at -65° ± 0.2°F (-53.9° ± 0.1°C). Determine the neutralization number of the oil by ASTM Method D 974. If this method does not provide a definite end point, the alternate procedure described in 4.6.4.3 may be used. Determine the acid number of the volatile components (material collected in the trap) as specified in 4.6.4.4.

4.6.4.3 Alternate procedure for neutralization number. Weigh 10 ± 0.5 grams of oil to the nearest 0.1 gram into a 300 ml Erlenmeyer flask and add 50 ± 1 ml of neutralized reagent grade ethyl alcohol. Agitate the flask thoroughly, heat it to boiling and cool it to room temperature. Remove the oil layer by decantation. Heat the alcohol phase in the flask to boiling and titrate to the end point using phenolphthalein as the indicator. If the end point is in doubt add 50 ± 2 ml of boiling neutralized

distilled water or water of equal purity and observe the solution for the end point color. If necessary, additional titration will produce the desired color which marks the end point.

4.6.4.4 Acid number of volatile components. Determine the acid number of the volatile components formed by the oxidation of the oil by back titration of the solution in the potassium hydroxide trap. Add a known amount of 0.1 normal sulfuric acid, approximately 10 percent in excess of the potassium hydroxide contained in the solution. Boil the mixture for 5 ± 1 minutes under a reflux condenser. Remove the reflux condenser and titrate the hot solution with standard 0.1 normal potassium hydroxide using phenolphthalein indicator.

4.6.5 Storage stability.

4.6.5.1 Low temperature. Maintain a sample of the oil, not less than 4 ounces, at a temperature of -65° ± 5°F (-53.9° ± 2°C) for a period of 168 ± 4 hours and examine it for conformance with the requirements of 3.8.1.

4.6.5.2 Ambient temperature. Maintain a one-quart sample of the oil, in a glass-stoppered, clear, wide mouth glass container, at a temperature of 65° to 95°F (18.3° to 35.0°C) for a period of 6 months (180 days) ± 5 days. Test the oil for conformance with the requirements of 3.3 and 3.8.2.

* 4.6.6 Gun performance. The lubricating performance of the oil shall be determined on a 7.62mm M60 machine gun, air-cooled, link-belt fed, and gas operated. The gun shall be disassembled and cleaned of all traces of lubricant and dirt by washing with a volatile mineral spirits, such as P-D-680 dry cleaning solvent or TT-N-95 naphtha. After complete removal of the solvent from all surfaces of the gun by use of a water-free air hose or by air-drying, all components except the barrel shall be coated with the test lubricant by brushing. The barrel, both in the bore and the external surface, shall be coated lightly with the lubricant using a clean, lint-free patch. The patch shall be dipped in the oil and then squeezed to remove excess oil. The gun shall then be reassembled and bench tested for operational use. The gun shall be test fired for 20 rounds in an ambient temperature of 50° to 100°F (10° to 37.8°C) and the cyclic rate of fire recorded. Upon satisfactory completion of the ambient temperature test, the gun shall be disassembled, cleaned and relubricated for the next phase of test. With the bolt in the rearward (firing) position and the selector lever set on "safe" the weapon shall be loaded with a 50 round belt of ammunition and conditioned at -70° ± 5°F (-56.6° ± 2°C) for 16 ± 1 hours. The weapon shall then be placed in the firing fixture, the selector lever set on "fire", and the entire 50 rounds fired with one pull of the trigger, recording the cyclic rate of fire. Reload the weapon as above and condition at -70° ± 5°F (-56.6° ± 2°C) for an additional 3 hours. Fire the entire 50 rounds and again record the cyclic rate of fire.

4.7 Toxicity. The supplier shall furnish the qualifying activity (see 6.3) with all the information necessary to evaluate the safety of the product. Such information shall be furnished in one of the following forms, at the discretion of the qualifying activity:

a. A complete listing of the constituent materials, giving the percentages of composition and using standard chemical nomenclature. (This is the simplest and most direct method. In most instances, it will completely satisfy the requirement for information.)

b. Results of toxicological testing of a scope and quality acceptable to the qualifying activity.

c. Some other form acceptable to the supplier and to the qualifying activity.

All information furnished by suppliers in connection with the evaluation of toxicity shall be signed by a responsible official of the supplying firm. Such information shall be held in strict confidence by the qualifying activity and shall not be divulged to other suppliers.

4.8 Rejection of lots. If the sample of lubricating oil fails to meet any of the specified tests, reject the lot represented by this sample.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be in accordance with MIL-STD-290, level A, B, or C for petroleum and related products in metal cans.

5.2 Intermediate packaging. Intermediate packaging, when required, shall be in accordance with MIL-STD-290.

5.3 Packing. Packing shall be in accordance with MIL-STD-290, level A, B, or C for metal cans.

5.4 Additional marking. In addition to the marking required by MIL-STD-290 and such marking as may be required in the contract or purchase order, each unit container shall be marked as follows.

WARNING !

Do not use this lubricating oil in food-processing or food-handling machinery on surfaces that may contact food. Do not allow the oil to contaminate foodstuffs.

Caution This lubricant may soften paint, natural rubber, plastics, or neoprene with which it comes in contact.

6. NOTES

6.1 Intended use. The lubricating oil covered by this specification is intended primarily for the lubrication of aircraft and ground weapons to insure efficient firing at low temperatures.

* 6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification.
b. Quantity of lubricating oil required. The unit of purchase is the U.S. gallon (231 cubic inches) at 60°F (15.6°C).
c. Type and size of container.
d. Level of packaging and packing protection (see 5.1, 5.2 and 5.3).
e. Additional marking (see 5.4).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which 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 suppliers is called to this requirement, 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 orders for the products covered by this specification. The activity responsible for the Qualified Products list is U.S. Army Armament Command, General Thomas J. Rodman Laboratory at Rock Island Arsenal, ATTN: SARRI-LR, Rock Island, Illinois, 61201, and information pertaining to qualification of products may be obtained from that activity.

6.4 Storage conditions. Before use, the lubricating oil may be stored under conditions of covered or uncovered storage at temperature ranging from -70° to +120°F (-94° to 48.9°C).

6.5 International standardization agreement. Certain provisions of this specification are the subject of international standardization agreement (NATO STANAG 1135). When amendment, revision, or cancellation of this specification is proposed which would 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.

6.6 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue have been made. This was done as a convenience

only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

* 6.7 National stock numbers. The following National stock numbers have been assigned to the lubricating oil covered by this specification:

4 - oz. can	9150-00-664-0038
1 - qt. can	9150-00-292-9689
5 - gal. can	9150-00-292-9687

Custodian:
Army - WC
Navy - OS
Air Force - 11

Review activities:
Army - AV, MR, WV
Navy -
Air Force -
DSA - PS

User activities:
Army - FA, ME
Navy -
Air Force -
DSA - GS

Preparing activity:
Army - WC

Project Number 9150-0401