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## MILITARY SPECIFICATION

### LUBRICATING OIL, INSTRUMENT, JEWEL BEARING

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

#### 1. SCOPE

1.1 This specification covers one grade of low-temperature non-spreading lubricating oil for use on instrument jewel bearings.

#### 2. APPLICABLE DOCUMENTS

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

##### Federal Standards

FED-STD-791

Lubricants, Liquid Fuels, and  
Related Products, Methods of Testing

##### Military Standards

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 Military Specifications and Standards in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

FSC 9150

MIL-L-3918A

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 the date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials Publications  
ASTM Standards Parts 17, 18, and 26

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

### 3. REQUIREMENTS

3.1 Chemical Composition The chemical composition of the oil shall conform to the requirements shown in Table I.

Table I Chemical Composition

	<u>Weight percent</u>
Benzyl phenylundecanoate	59.95 $\pm$ 0.50
Diethylene glycol di-n-caproate	39.45 $\pm$ 0.50
Dodecylpiperidine stearate	0.40 $\pm$ 0.10
p-tertiary - butyl catechol	0.20 $\pm$ 0.10

An affidavit from the contractor shall certify that the composition of the oil is in accordance with Table I.

3.2 Viscosity The viscosity of the oil, when determined at 100°F (38°C) as specified in 4.5, shall be not less than 9.5 centistokes nor more than 10.5 centistokes.

3.3 Neutralization number The total acid number of the oil, when determined as specified in 4.5 shall not exceed 0.60.

3.4 Evaporation loss The evaporation loss of the oil when determined at a temperature of 210°F (99°C) in accordance with 4.5 shall not exceed 2.0 percent.

3.5 Copper strip corrosion When the oil is tested for 3 hours at 212°F (100°C) as specified in 4.5 the discoloration of the copper strip shall not be greater than 1a rating.

3.6 Corrosion and oxidation stability When the oil is tested as specified in 4.5 it shall meet the following requirements:

3.6.1 Corrosion The change in weight of copper and steel specimens shall not exceed 0.5 milligrams per square centimeter of surface. There shall be no pitting, etching, or visible corrosion of the metal surfaces. A slight coloration of the metal surfaces shall not be objectionable.

3.6.2 Oxidation After completion of the corrosion oxidation test the viscosity of the oil shall not have changed more than  $\pm 5$  percent of the original viscosity, the change in neutralization number of the oil shall not exceed 0.15, and the volatile acids evolved into the delivery tube shall not require more than 0.5 milligram of KOH, per gram of oil, for neutralization.

3.7 Spreading on metal When the oil is tested as specified in 4.5.1 the average diameter of three drops of oil on polished steel shall not increase by more than 5 percent. The residue from the oxidation test (3.6.1) shall not spread more than 5 percent in 168 hours.

3.8 Low temperature stability After a dry sample of the oil has been tested as specified in 4.4 for 48 hours at  $-40^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$ ), the oil shall not crystallize, separate or show evidence of precipitates. Cloudiness in the oil shall not be considered objectionable.

3.9 Ingredients

3.9.1 Benzyl phenylundecanoate When the benzyl phenylundecanoate is tested as specified in 4.5.2, its viscosity at  $100^{\circ}\text{F}$  ( $38^{\circ}\text{C}$ ) shall be not less than 15.7 nor more than 16.7 centistokes. The refractive index shall be not less than 1.517 nor more than 1.520. The neutralization number shall be less than 0.10. The saponification number shall be  $159 \pm 1$ .

3.9.2 Diethylene glycol di-n-caproate When the diethylene glycol caproate is tested as specified in 4.5.2, its viscosity at  $100^{\circ}\text{F}$  ( $38^{\circ}\text{C}$ ) shall be not less than 5.0 nor more than 5.5 centistokes. The neutralization number shall be less than 0.10. The refractive index shall be not less than 1.437 nor more than 1.440.

3.9.3 Dodecylpiperidine stearate The dodecylpiperidine stearate, when tested as specified in 4.5.2, shall have an initial melting point of  $97 \pm 4^{\circ}\text{F}$  ( $36 \pm 2^{\circ}\text{C}$ ) and a final melting point of  $102 \pm 4^{\circ}\text{F}$  ( $39 \pm 2^{\circ}\text{C}$ ). The acid number shall be not less than 105 nor more than 115.

MIL-L-3918A

3.9.4 Para-tertiary-butyl catechol The p-tertiary-butyl catechol shall melt between (133°F) 56°C and (135°F) 57°C when tested as specified in 4.5.2.

3.10 Workmanship The oil shall contain no perfume or dye and shall be visually clear and free of sediment.

#### 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 the supplier may utilize 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 that supplies and services conform to prescribed requirements.

##### 4.2 Lot

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

4.2.2 Packaged lot An indefinite number of unit containers of identical size and type, offered for acceptance, and filled with a homogeneous mixture of material from one isolated container; or filled with a homogeneous mixture of material manufactured in a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

##### 4.3 Sampling

###### 4.3.1 Sampling for examination of the preparation for delivery

4.3.1.1 Packaged lot A random sample of packed containers from each lot in accordance with MIL-STD-105 at inspection level II and acceptable quality level = 2.5 percent defective. The sample shall be examined in accordance with 4.4.1.

4.3.2 Sampling for tests The sample for tests shall be eight ounces of oil taken in accordance with ASTM Method D270 and a sample of each of the ingredients from each lot of oil offered or processed for delivery under a

MIL-L-3918A

contract or order. The lot shall be unacceptable if a sample fails to meet any of the test requirements specified.

4.4 Inspection Inspection shall be performed in accordance with Method 9601 of FED-STD-791.

4.4.1 Examination of the preparation for delivery Samples taken in accordance with 4.3.1 shall be examined for compliance with MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing and marking requirements. Any container having one or more defects or under the required fill shall be rejected. If the number of defective or underfilled containers exceeds the acceptance number for the appropriate plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.5 Inspection methods The tests listed in Table II shall be performed in accordance with the applicable method as given in FED-STD-791 or ASTM Standard on Petroleum Products and Lubricants.

TABLE II

Requirement Paragraph		FED-STD-791 Method No	ASTM Designation
3.2	Viscosity		D445
3.3	Neutralization Number		D974
3.4	Evaporation loss		D972
3.5	Copper corrosion by Petroleum Products		D130
3.6	Corrosiveness and Oxidation Stability of Light oils (Metal Strip)	5308	
3.8	Low temperature stability	3459	

4.5.1 Spreading on metal

4.5.1.1 Preparation of metal surface A steel surface with a minimum area of 0.25 square inch shall be polished with metallographic papers Nos. 0, 2/0, 3/0, and 4/0 in that order and finally with Fisher's "Gamal" or equivalent polishing alumina on a wheel covered with heavy broadcloth. After the surface has been polished it shall be washed with water, swabbed with wet absorbent cotton, and rinsed thoroughly with distilled water. The surface shall then be rinsed with reagent grade 99 percent methanol and dried for 15 minutes

MIL-L-3918A

in an oven at 221°F (105°C). The specimen shall then be allowed to cool to room temperature in a desiccator.

**4.5.1.2 Procedure** Three drops of oil shall be placed on the metal surface with a clean platinum wire. The drops shall be between 1.0 and 2.0 mm in diameter. (A platinum wire 0.005 inch in diameter is suitable for depositing a drop of this size.) After the wire has been recleaned, two drops of reagent grade of orthotricresyl phosphate shall be placed on the metal surface in a similar manner. The metal and the drops shall be covered and allowed to stand for 15 minutes. The diameters of each of the five drops shall be measured with a measuring apparatus having an accuracy of one percent and the values recorded. The metal shall be carefully transferred to an air bath maintained at  $113 \pm 3^\circ\text{F}$  ( $45 \pm 2^\circ\text{C}$ ) and allowed to remain for 1 week. The drops shall be measured. If the oil spreads appreciably and the tricresyl phosphate does not, the oil is not in the nonspreading category. If both the oil and the tricresyl phosphate appear to be spreading the test should be repeated on a freshly prepared surface. If no evidence of spreading is observed the test is continued and the diameter of the drop examined after 1 week.

**4.5.1.3 Results** The increase in diameter of each drop shall be calculated as follows:

$$\text{Percent increase} = \frac{D_7 - D_0}{D_0} \times 100 \text{ when}$$

$D_7$  = diameter of drop after 7 days

$D_0$  = diameter of drop after 15 minutes

The average of the values for the three drops shall be reported as the percent spreading in a week.

#### 4.5.2 Ingredients

TABLE III  
Methods for Determining Ingredients

<u>Method Title</u>	<u>ASTM Method No.</u>
Viscosity	D445
Refractive Index	D1218
Neutralization No.	D974
Saponification No.	D94
Melting Point	D1519

MIL-L-3918A

## 5. PREPARATION FOR DELIVERY

5.1 Packaging, packing and marking The oil shall be packaged, packed, and marked in accordance with the provisions of MIL-STD-290 and in accordance with the details specified by the procuring activity with respect to the various options, choices, and alternatives indicated in MIL-STD-290 (see 6.2)

## 6. NOTES

6.1 Intended use The oil covered by this specification is intended for the lubrication of steel pivot and jewel bearing combinations in timepieces and other fine instruments. It does not spread on highly polished clean metal or jewel surfaces but may tend to spread when used on unpolished surfaces, especially when it is contaminated with dust or other foreign materials. It will allow operation of most instrument mechanisms at temperatures as low as -40°F (-40°C).

6.2 Ordering data Procurement documents should specify the following:

- (a) Title and number of this specification
- (b) Quantity of oil required (the unit of purchase is the fluid ounce)
- (c) ~~Size~~ and type of container in which oil is to be furnished (see 5.1)
- (d) Packaging, packing, and marking data with requirements in detail (see 5.1)

Preparing Activity

Navy - AS

(Proj. No 9150-0143)

Custodians

Army - MR

Navy - AS

Airforce - 11

Review Activities

Army MR, MU, AV

Navy OS, SA

Airforce - 11, 68

User Activities

Army - WC, MI

Navy - SH