

<b>METRIC</b>
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**MIL-PRF-7870C**  
**17 February 1998**  
**SUPERSEDING**  
**MIL-L-7870B**  
**24 July 1992**

**PERFORMANCE SPECIFICATION**

**LUBRICATING OIL: GENERAL PURPOSE, LOW TEMPERATURE**

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

**1. SCOPE**

**1.1 Scope.** This specification covers one grade of general purpose, low temperature lubricating oil. This lubricating oil is identified by *NATO Code 0-142* (see 6.4).

**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 requirements documents cited in *sections 3* and *4* of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASC/ENSI, 2530 Loop Road West, Wright-Patterson AFB OH 45433-7101 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.
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AMSC N/A

**FSC 9150**

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

## 2.2 Government documents

**2.2.1 Specifications, standards, and handbooks.** The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents will be those listed in the issue of the *Department of Defense Index Specification and Standards (DoDISS)* and supplement thereto, cited in the solicitation (see 6.2)

### SPECIFICATIONS

#### FEDERAL

P-D-680	Dry Cleaning and Degreasing Solvent
QQ-S-698	Steel Sheet and Strip, Low Carbon

### STANDARDS

#### FEDERAL

FED-STD-791	Lubricants, Liquid Fuels, and Related Products; Methods of Testing
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(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

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

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A304	Standard Specification for Steel Bars, Alloy, Subject to End-Quench Hardenability Requirements (DoD Adopted)
ASTM A322	Standard Specification for Steel Bars, Alloy, Standard Grades (DoD Adopted)
ASTM A331	Standard Specification for Steel Bars, Alloy, Cold-Finished (DoD Adopted)
ASTM B36	Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar (DoD Adopted)
ASTM D91	Standard Test Method for Precipitation Number of Lubricating Oils (DoD Adopted)
ASTM D92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup (DoD adopted)
ASTM D97	Standard Test Method for Pour Point of Petroleum Oils (DoD Adopted)
ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) (DoD Adopted)
ASTM D972	Standard Test Method for Evaporation Loss of Lubricating Greases and Oils (DoD Adopted)
ASTM D974	Standard Test Method for Neutralization Number by Color-Indicator Titration (DoD Adopted)
ASTM D1500	Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale) (DoD Adopted)
ASTM D1748	Standard Test Method for Rust Protection by Metal Preservatives in the Humidity Cabinet (DoD Adopted)
ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D4636	Standard Test Method for Corrosiveness and Oxidation Stability of Hydraulic Oils, Aircraft Turbine Engine Lubricants, and Other Highly Refined Oils (DoD Adopted)

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(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. The documents also maybe available through libraries or other informational services.)

**2.4 Order of precedence.** In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets, or MS standards), the text of this specification will take precedence. Nothing in this specification, however, will supersede applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

**3.1 Qualification.** The instrument oil furnished under this specification shall be a product that is authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL) before contract award (see 4.2.1 and 6.3). Changes shall not be permitted in the formulation of an approved product unless specific written approval of the qualifying activity is obtained.

**3.2 Materials.** The oil shall be formulated to meet the requirements of this specification, and containing additive materials to impart corrosion-protective and oxidation-resistant properties.

**3.3 Properties** The properties of the finished oil shall be as specified in *table I* when tested as specified in *section 4*.

**TABLE I. Properties of the finished oil.**

Characteristics	Value	
	Maximum	Minimum
Viscosity in centistokes at 38° C	4000	10
at -40° C		
Pour point		
Flash point	-57° C	130° C
Precipitation number	0	
Acid number	report	

### 3.4 Performance

**3.4.1 Corrosion and oxidation stability.** When tested as specified in *section 4*, the change in weight of cadmium-plated steel, copper, steel, aluminum alloy, and magnesium alloy, subjected to the action of the oil for 168 hours at 121° C  $\pm$  1° C, shall not be greater than 0.2 mg per cm of surface for each strip. There shall be no pitting, etching, or visible corrosion on the surface of any of the metals when viewed under magnification of 20 diameters. Slight discoloration of the surface of the copper will be permitted, but dark brown, gray or black stain shall be cause for rejection.

**3.4.2 Resistance to oxidation.** When tested as specified in *section 4*, the oil shall not have changed more than -5 to 20 percent from the original viscosity in centistokes at 38° C after the oxidation-corrosion test (see 4.4.2). The neutralization number increase shall not be greater than 0.2 after oxidation. There shall be no evidence of separation of insoluble materials or gumming of the oil.

**3.4.3 Low temperature stability.** When tested as specified in *section 4*, there shall be no gelling or separation of solid or liquid phases in the oil after storage at a temperature at or below -54° C for 72 hours. The presence of a dense cloud, which does not “settle out,” shall not be the cause for rejection.

**3.4.4 Evaporation.** When tested as specified in *section 4*, there shall be not more than 25 percent by weight evaporation loss after the oil has been subjected to the test conditions, at 100° C.

**3.4.5 Corrosivity.** When subjected to the test specified in *section 4*, the test areas of the three discs shall show no evidence of corrosion, pitting, or other attack. The third disc may show no more than three spots within the area covered by the clip.

**3.5 Color and appearance.** When tested as specified in *section 4*, the oil shall be clear, transparent, and uniform in appearance, and not darker than No. 5 Union Colorimeter of *ASTM D1500*.

**3.6 Protection of panels.** When tested as specified in *section 4*, not more than one panel out of five panels shall fail after being covered with a film of lubricating oil for 100 hours. If more than one panel fails, the product shall be retested by repeating the same test with an additional ten panels. Not more than four panels shall fail out of the total 15 panels, (five on an original test plus ten on retest).

**3.7 Workmanship.** The oil shall be entirely homogeneous and free from lumps of undissolved additive, water, dirt, lint, or sediment. Prior to final packaging the oil shall be filtered through a 5.0 micrometer pore-size filter.

## 4. VERIFICATION

**4.1 Classification of inspections.** The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Quality conformance inspection(see 4.3).

**4.2 Qualification inspection.** Qualification inspection shall consist of a review for approval of the submitted manufacturers test report and subjecting the qualification samples (see 4.2.1) to examination and testing for all the requirements of this specification.

**4.2.1 Qualification samples.** The qualification sample(s) shall consist of 1 gallon finished oil, 1 pint base stock (before the additive agents) and 1 ounce of compounds used for improving the oxidation stability and corrosion protection. In the event that the additives are supplied as concentrated solutions, an equivalent quantity of the solution shall be furnished.

**4.2.2 Qualification tests.** Qualification sample(s) shall be subjected to all tests specified in 4.4, method of inspection.

**4.2.3 Retention of qualification.** In order to retain qualification of a product approved for listing on the QPL, the manufacturer shall verify by certification to the qualifying activity that the manufacturer's product complies with the requirements of this specification. The time of periodic verification by certification shall be in 2-year intervals from the date of original qualification. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine that the product continues to meet any or all of the specification requirements.

**4.3 Quality conformance inspection.** Quality conformance tests shall be as specified in *table II*. Samples shall be labeled completely with information identifying the purposes of the sample, name of product, specification number, lot and batch number (see 6.5), date of sampling, and contract number.

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**TABLE II. Quality conformance tests.**

Inspection	Paragraph Requirement	Test
Corrosion and oxidation stability	3.41, 3.4.2	4.4.2
Low temperature stability	3.4.3	4.4.6
Viscosity	3.3	4.4.2
Pour point	3.3	4.4.2
Flash point	3.3	4.4.2
Precipitation number	3.3	4.4.2
Evaporation	3.4.4	4.4.2

### 4.4 Method of inspection

**4.4.1 Inspection.** Inspection shall be in accordance with *Method 9601* of *FED-STD-791*.

**4.4.2 Test methods.** The oil properties shall be determined in accordance with the applicable methods specified in *table III* and 4.4.3 through 4.4.5. Physical and chemical values specified in *section 3* apply to the arithmetic average of the determinations made on the samples for those values that fall within any stated repeatability or reproducibility limits of the applicable test method.

**TABLE III. Test methods for oil properties.**

Characteristics	ASTM Test methods
Corrosion and oxidation stability	D4636 <sup>Ⓛ</sup>
Pour point	D97
Flash point (open cup method)	D92
Precipitation number	D91
Viscosity	D445
Color	D1500
Evaporation loss of lubricating greases and oils	D972
Acid number	D974

<sup>Ⓛ</sup> Test shall be run for 168 hours at 121°C. Use hexane, heptane, and/or acetone to clean coupons.  
 Use Alternate Procedure 2.

#### 4.4.3 Protection test.

##### 4.4.3.1 Preparation of panels. The following procedures shall be conducted:

- a. Cut five panels from steel that conforms to *QQ-S-698*.
- b. Size the panels and locate the holes as shown in *figure A7* of *ASTM D1748*. Remove all burrs, sharp edges, and corners, including the edges of the holes.
- c. Highly polish the panel with No. 3/0 emery paper prior to use. Next wash and clean the panel in a solvent conforming to *P-D-680*, type II. Then drain thoroughly and agitate in boiling 95 percent methanol.
- d. After cleansing, cool the panels in a desiccator. Care must be taken during cleaning and preparation to ensure that the surfaces are not contaminated by fingerprints. Handle the panels only with tongs during the cleaning operation and only with hooks during and after dipping.

##### 4.4.3.2 Procedure. These steps shall be conducted:

- a. Dip five panels in a suitable sample of lubricating oil, which is maintained at  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , remove and allow to drain for 2 hours at that temperature from glass, monel, or stainless steel supports.
- b. At the end of this period, suspend the panels in a humidity cabinet conforming to *ASTM D1748* for a period of 100 hours, and in such a manner that the drippage from the supports will not fall onto the panels. Maintain the humidity within the cabinet at 100 percent relative humidity and at a dry bulb temperature of  $49^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for a 100-hour exposure period.
- c. Remove the panels from the cabinet, clean them with naphtha, and examine. Panels have failed the protection test if at the end of the test period one of the following conditions exists in the significant areas of the panels as defined by *ASTM D1748*, *figure A1.8*, considering both sides of the panel:
  - (1) A corroded area of 2-mm diameter or larger
  - (2) Two or more spots of between 1 mm and 2 mm maximum diameter. If more than one panel in five panels fail the protection test as defined above, a retest will be permitted. Retests shall consist of repeating the protection test using ten additional panels. Reject the lubricating oil if more than four panels fail the test (adding failures of both test and retest).

**4.4.4 Stability at low temperature.** A 100-ml sample of the oil shall be maintained at or below  $-54^{\circ}\text{C}$  for 72 hours in a stoppered flask. At the end of that time there shall be no visual evidence of gelling, separation, or crystallization of the oil. Presence of a dense cloud, which does not “settle out,” shall not be cause for rejection.

#### 4.4.5 Corrosivity test

##### 4.4.5.1 Preparation of panels (also see 4.4.3.1)

##### 4.4.5.2 Preparation of steel disc. The following steps shall be performed:

- a. Cut three discs 0.5 inch thick from a 1-inch diameter bar stock that conforms to *ASTM A304*, *ASTM A322*, and *ASTM A331*, composition *FS E52100*.
- b. Heat-treat the discs to a hardness of Rockwell C-62. (Rollers that may be obtained from roller-bearings with similar chemical, physical, and dimensional properties to the above bar stock after heat treatment, can be substituted for the formation of the discs. In this case, no additional heat treatment is necessary.)

c. Now, slowly surface grind on one side to a finish of less than 20 micro-inches rms. If coolant is used during grinding, slush the discs in absolute methanol. Next, abrade the discs on the surface-ground side with successive applications of emery polishing paper grades 1/0, 2/0, 3/0, and finally 4/0. Papers incorporated iron oxide as the polishing medium and wet-dry type papers shall not be used.

d. Wipe the discs clean with sterile absorbent gauze and examine under a 10X magnification for any signs of corrosion or other defects. Do not use defective specimens. Store the discs in a desiccator containing silica gel until ready for use.

**4.4.5.3 Preparation of brass clips.** The following steps shall be performed:

a. Fabricate clips from commercial 0.0225-inch brass sheet conforming to *ASTM B36*, copper alloy UNS No. C26000, spring temper. The size and shape of the clips are illustrated in *figure 1*.

b. Immerse the clips for 20 seconds in the following etching solution:

450 ml water  
300 ml conc sulfuric acid  
225 ml conc nitric acid  
8 ml cone hydrochloric acid

After etching, wash the clips in cold running tap water and then in distilled water. Dry with acetone and store the clips in a desiccator containing silica gel as desiccant until ready for use.

**4.4.5.4 Procedure.** The following procedures shall be performed:

a. Coat the three discs with test oil by dipping and stirring the rod in the test oil and allowing the oil from the rod to drop onto the polished side of the discs.

b. Clamp the brass clips over the coated discs and the assemblies and place them in a test chamber, which is maintained at  $27^{\circ}\text{C} \pm 1^{\circ}\text{C}$  and 50 percent relative humidity, for a period of 10 days. For a 50 percent relative humidity, use a sulfuric acid solution with density of 1.338 at  $20^{\circ}\text{C}$ .

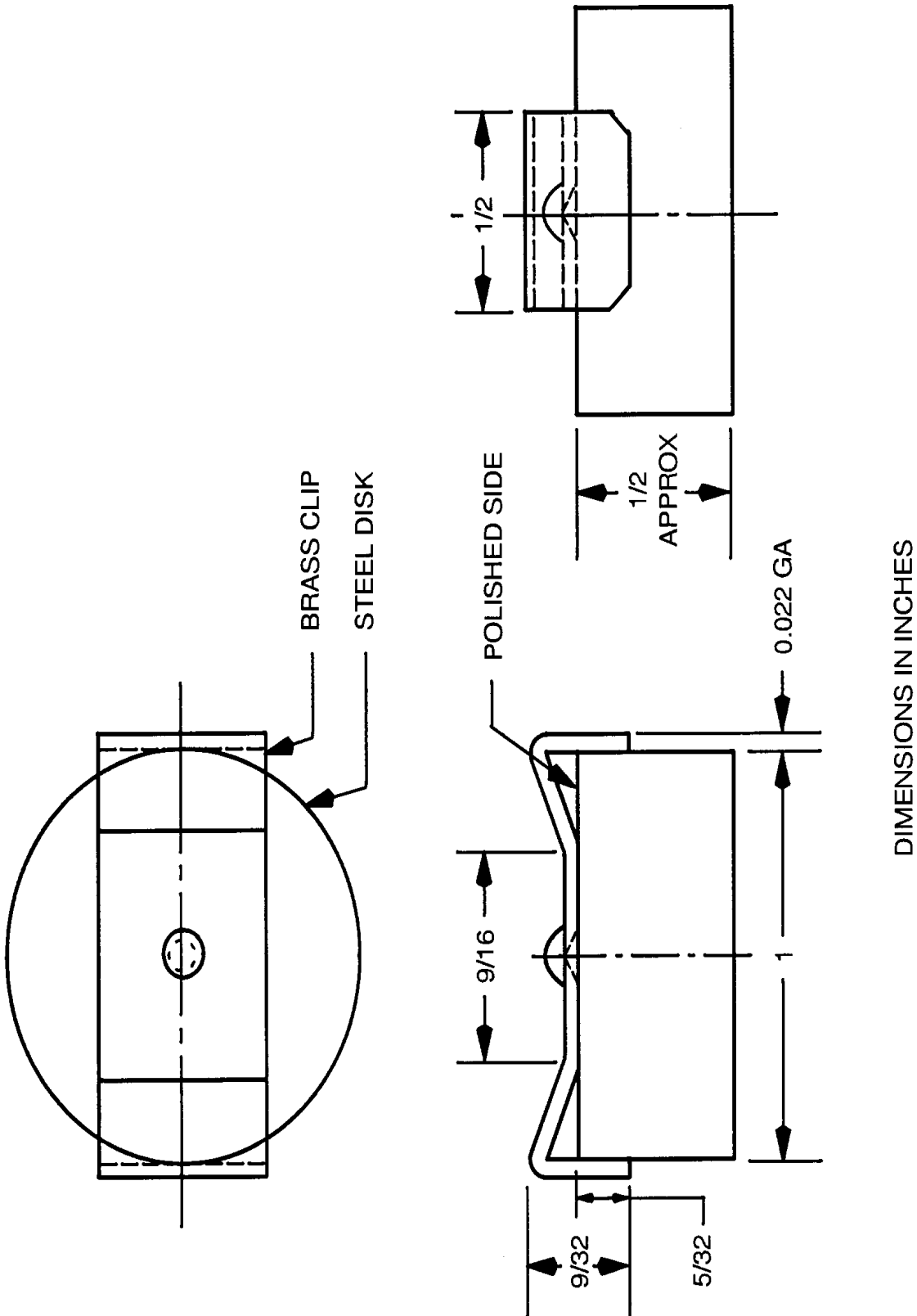
c. After exposure, remove the assemblies and outline the brass clips on the discs using the clips as templates. Then remove the clips and wipe the test oil from the discs.

d. Examine the discs under 10X magnification for signs of corrosion, pitting, or other detrimental effects. If the test results are questionable, repeat the entire test using new specimens, except extend the time period to 20 days. In this case, examine the discs as in the previous manner.

## **5. PACKAGING**

**5.1 Packaging** For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2) When actual packaging is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity with the Military Department or Defense Agency, or within the Military Department's System Command. 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.

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**FIGURE 1. Typical test specimens for corrosivity test.**



## 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 oil covered by this specification is intended for use wherever a general purpose, low temperature, lubricating oil is required.

**6.2 Acquisition requirements.** Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Issue of *DoDISS* to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
- c. Type and size of containers (see 5.1).
- d. Quantity.
- e. Selection of applicable levels of packaging and packing with requirements in detail (see 5.1).

**6.2.1 Purchase unit.** This instrument oil covered by this specification should be purchased by volume.

**6.3 Qualification.** With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable QPL whether or not such products have been so listed by that date. The attention of the supplier is called to this requirement, and manufacturers are urged to have the products 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 QPL is AFRL/MLSE, Bldg 652, 2179 Twelfth St, Room 122, Wright-Patterson AFB OH 45433-7718. Information pertaining to qualification of products may be obtained from that activity.

**6.3.1 Qualification information.** It is understood that the material furnished under this specification subsequent to final approval will be of the same composition and will be equal to products on which approval was originally granted. In the event that oil furnished under contract is found to deviate from the composition of the approval product, or that the product fails to perform satisfactorily, approval of such products will be subjected to immediate withdrawal from the QPL at the discretion of the approving activity.

**6.3.2 Data to accompany qualification samples.** The samples will be accompanied by a material safety data sheet and a test report, from the manufacturer or a commercial laboratory, containing complete information about the source, type of base stock and additive materials used; the formulation and composition of the finished fluid; and laboratory data showing quantitative results of all the tests required by this specification, except storage stability. Separate qualification inspection will be required for each base stock used. The samples will be plainly identified by securely attached durable tags or labels marked with the following information:

Sample for qualification inspection

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Name of ingredient (for ingredient material)

Name of manufacturer

Product code number

Date of manufacture

**6.3.2.1 Formulation sheet example.** An example of a satisfactory form for the formulation sheet indicating the weight percentage and nature of each ingredient:

Oil base stock	percentage
Oxidation inhibitor (manufacturer's name and number)	percentage
Corrosion inhibitor (manufacturer's name and number)	percentage

**6.4 International agreements.** The provisions of 1.1 of this specification are the subject of international standardization agreement (*ASCC 15/1* and *STANAG-1135*). When amendment, revision or cancellation of this specification is proposed, the departmental custodians will inform their respective Departmental Standardization Office (DEPSO) so that appropriate action may be taken respecting the international agreement concerned.

## 6.5 Definitions

**6.5.1 Bulk lot.** A bulk lot (batch) is an indefinite quantity of a homogeneous material mixture 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.

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

## 6.6 Subject term (keyword) listing

Corrosion-protective  
Flash point  
Low temperature oil  
Lubricating oil  
Oil  
Oxidation resistant Petroleum  
Pour point  
Toxicity

**6.7 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. The changes are due to Acquisition Reform initiatives requiring Government specifications to be performance-based.

### Custodians:

Army – CR4  
Navy – AS  
Air Force –11

Preparing activity:  
Air Force –11

(Project 9150-0828)

### Review activities:

Army – MI, SM, AR  
Navy – SA, OS, SH  
Air Force – 68  
DLA – GS

International interest  
NATO  
ASCC

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

### INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.  
 NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

2. DOCUMENT DATE (YYMMDD)

**MIL-PRF-7870C**

**98/02/17**

3. DOCUMENT TITLE

**LUBRICATING OIL: GENERAL PURPOSE, LOW TEMPERATURE**

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, Middle Initial)

b. ORGANIZATION

c. ADDRESS (include Zip Code)

d. TELEPHONE (Include Area Code)  
(1) Commercial

e. DATE SUBMITTED  
(YYMMDD)

(2) AUTOVON  
(If applicable)

8. PREPARING ACTIVITY

a. NAME

ASC/ENSI  
Air Force Code 11

b. TELEPHONE (Include Area Code)

(1) Commercial  
(937) 255-0175

(2) AUTOVON  
785-0175

c. ADDRESS (Include Zip Code)

2530 Loop Road West  
Wright-Patterson AFB OH 45433-7101

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:

Defense Quality and Standardization Office  
5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466  
Telephone (703) 756-2340 AUTOVON 289-2340