INCH-POUND

MIL-DTL-4339E
5 October 2009
SUPERSEDING
MIL-C-4339D
19 July 1990

DETAIL SPECIFICATION

CORROSION PREVENTIVE, SOLUBLE OIL FOR WATER INJECTION SYSTEMS (NATO CODE NUMBER C-630)

Inactive for new design after 23 February 1998.

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

1. SCOPE

1.1 Scope. This specification covers the requirements for one type of corrosion preventive soluble oil conforming to NATO Code Number C-630, used in water-alcohol mixtures. These water-alcohol mixtures are used as thrust augmentation in certain jet aircraft engines and as anti-detonation or internal coolant fluids in certain reciprocating engines (see 6.1 and 6.6).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

Comments, suggestions, or questions on this document should be addressed to Defense Supply Center Richmond, ATTN: DSCR-VEB, 8000 Jefferson Davis Highway, Richmond, VA 23297-5616 or e-mailed to STDZNMGT@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST database at http://assist.daps.dla.mil.

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 cited in the solicitation or contract.

FEDERAL SPECIFICATIONS

O-M-232 - Methanol (Methyl Alcohol)

(Copies of this document 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.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM B272 - Standard Specification for Copper Flat Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)
ASTM D95 - Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
ASTM D97 - Standard Test Method for Pour Point of Petroleum Products
ASTM D130 - Standard Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test
ASTM D482 - Standard Test Method for Ash from Petroleum Products
ASTM D4057 - Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM E29 - Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Electronic copies may be obtained from http://www.astm.org/.)

SAE

SAE AMS-QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet
SAE AMS 5046 - Carbon Steel, Sheet, Strip, and Plate (SAE 1020 and 1025) Annealed

(Application for copies should be addressed to SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Electronic copies may be obtained from http://www.sae.org/.)

IPC

IPC J-STD-006 – Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid solders for Electronic Soldering Applications.

(Application for copies should be addressed to IPC, 3000 Lakeside Drive, Suite 309 S, Bannockburn, IL 60015. Electronic copies may be obtained from http://www.ipc.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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 Material.

3.1.1 Mineral oil. The soluble oil shall contain not less than 85 percent, by weight, mineral oil.

3.1.2 Additives. The soluble oil shall contain suitable emulsifying and corrosion-preventive agents. These agents shall have a petroleum metal sulfonate as a principal constituent. The presence of sulfonate shall be determined by an infrared absorption spectrographic analysis as specified in 4.3.2.7.1.

3.1.3 Fatty acids and fatty acid soaps. The soluble oil shall contain a minimum of fatty acids and fatty acid soaps. The ratio of sulfonate absorbance to fatty acid absorbance and fatty acid soap absorbance, when determined as specified in 4.3.2.7.2, shall not be less than 6.0 to 1 and 3.5 to 1 respectively. If no fatty acids or fatty acid soaps are present, then the mere presence of sulfonate will satisfy this requirement.

3.2 Pour point. The finished oil shall have a pour point not higher than 30°F (-2°C) when tested per 4.3.2.1.

3.3 Corrosion. The copper strip corrosion rating of the finished oil shall not exceed ASTM D130, strip classification 2, moderate tarnish when tested per 4.3.2.2.

3.4 Water content. The water content of the finished oil shall not be more than 3.0 percent when tested per 4.3.2.3.

3.5 Emulsion. Emulsions prepared as specified in 4.3.2.4.2 and 4.3.2.4.3 shall meet the froth and separation requirements below.

3.5.1 Froth. The emulsion shall show not more than a trace of forth 15 minutes after preparation. See 4.3.2.4.2.1 and 4.3.2.4.3.1.

3.5.2 Separation. The volume of finished oil separating from the emulsion in 72 hours shall not exceed 2 percent of the total volume of the emulsion. See 4.3.2.4.2.2 and 4.3.2.4.3.2.

3.6 Hydrogen ion concentration. The pH value of an emulsion prepared with 1 part finished oil and 9 parts distilled water, by volume, shall not be less than 8.5 nor more than 10.0 at a temperature of 77°F (25°C) when determined per 4.3.2.5.

3.7 Corrosion (of the emulsion). Clean, bright, mechanically polished strips of aluminum, copper, steel, and clean strips of tin-lead solder shall show no evidence of etching, pitting, or other corrosion and shall show not more than a slight discoloration when treated with an emulsion prepared with 1 part oil and 4 parts distilled water at a temperature of 77° ± 9°F (25° ± 5°C) for 168 hours, when tested as specified in 4.3.2.6.2, and at a temperature of 100° ± 7°F (38° ± 4°C) for 168 hours, when tested as specified in 4.3.2.6.3.

3.8 Ash content. The finished oil shall not contain more than 2 percent ash by weight (10 gram sample) when tested per 4.3.2.8.

3.9 Workmanship. The finished oil shall be clear and homogeneous and shall not contain suspended matter or sediment when examined per 4.3.1.

3.10 Limiting values. The following applies to all specified limits in this specification: for purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off to the nearest unit in the last right-hand place of figures used in expressing the limitation value, in accordance with ASTM E29.

4. VERIFICATION

4.1 Conformance inspection. Inspections of individual lots, whether bulk lot or container lot, which serve as a basis of acceptance shall consist of all the examinations and tests specified under 4.3. (See 6.4 for definition of bulk and container lot.)

4.2 Sampling. Sampling shall be accordance with ASTM D4057.

4.2.1 Sample submission. When required (see 6.2), a one gallon sample shall be forwarded to the laboratory designated by the procuring activity for subjection to the tests specified herein.

4.3 Verification methods.

4.3.1 Examination of product. The finished oil shall be inspected visually for clearness, homogeneity, suspended matter, sediment or free water (see 3.9).

4.3.2 Tests.

4.3.2.1 Pour point. Pour point shall be determined by testing per ASTM D97. See 3.2 for specified pour point.

4.3.2.2 Corrosion. Corrosion shall be determined by testing per ASTM D130. For less volatile materials, use a test bath temperature of 212°F (100°C). See 3.3 for specified corrosion limits.

4.3.2.3 Water content. Water content shall be determined by testing per ASTM D95. See 3.4 for specified water limit.

4.3.2.4 Testing of emulsion.

4.3.2.4.1 Preparation of synthetic hard water. Synthetic hard water shall be prepared by adding the following chemicals, of chemically pure grade, to 10 liters of distilled water and bubbling carbon dioxide through the solution until the chemicals are completely dissolved:

Calcium carbonate, anhydrous, $CaCO_3$	1.000 g
Calcium Chloride, anhydrous, $CaCl_2$	0.250 g
Calcium Sulfate, anhydrous, $CaSO_4$	2.500 g
Magnesium Carbonate, anhydrous, $MgCO_3$	1.000 g
Sodium sulfate, anhydrous, Na_2SO_4	1.000 g

If anhydrous salts are not available, proportionately larger weights determined by the chemical formula of the corresponding hydrates may be used.

4.3.2.4.2 Water emulsion. Five milliliter (5 ml) of the finished oil shall be added to 45 ml of the synthetic hard water contained in a 100 ml graduated cylinder with an inside diameter of approximately 1.125 in (28.6 mm). The temperature of the liquid shall be adjusted to 77° ± 5°F (25° ± 3°C). The mixture shall then be stirred vigorously for 5 minutes by means of an apparatus similar to that shown in Figure 1. The heating bath should be deep enough to cover the 85 ml mark on the graduated cylinder. The stirring mechanism consists of the following:

a. Paddle, copper strip, 4.75 in X 0.75 in X 0.062 in (12.1 cm X 1.9 cm X 0.16 cm).
b. Shaft, stirring, with means to attach paddle, long enough to immerse paddle to approximately 0.25 in (0.64 cm) from the bottom of the graduated cylinder.
c. Motor, stirring, approximately 1500 rpm, for rotating shaft and paddle.

As soon as the stirring is completed, the paddle shall be withdrawn from the emulsion and held for approximately 3 minutes in such a position that the greater part of the emulsion clinging to it will drain into the cylinder.

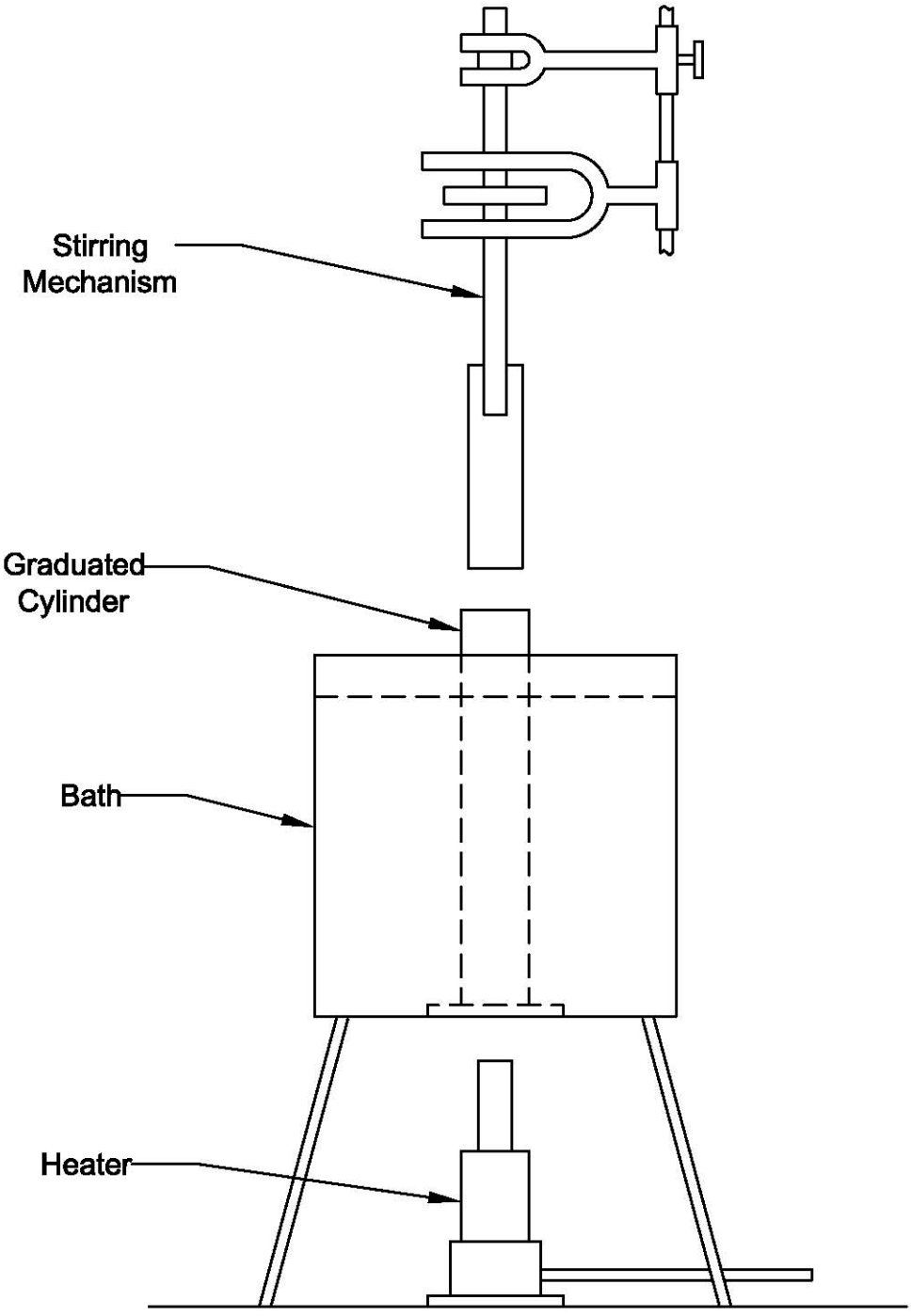

FIGURE 1. Mixing apparatus.

4.3.2.4.2.1 Froth. The cylinder containing the emulsion shall be allowed to stand without any agitation, at a temperature of 77° ± 5°F (25° ± 3°C) for 15 minutes, measured from the time of withdrawal of the paddle, and shall then be inspected for the presence of froth (see 3.5.1).

4.3.2.4.2.2 Separation. The cylinder and its contents shall then be allowed to stand undisturbed for 72 hours at 77° ± 5°F (25° ± 3°C), and shall then be inspected for evidence of separation (see 3.5.2). Creaming (formation of a creamy portion of emulsion which tends to rise to the top without actually separating as a layer of free oil) shall not be considered separation.

4.3.2.4.3 Water-alcohol emulsion. Five milliliter (5 ml) of the finished oil shall be added to 45 ml of the synthetic hard water contained in a 100 ml graduated cylinder with an inside diameter of approximately 1.125 in (28.6 mm). The temperature of the liquid shall be adjusted to 77° ± 5°F (25° ± 3°C). The mixture shall then be stirred vigorously for 5 minutes in a manner similar to that specified in 4.3.2.4.2. As soon as stirring is completed, 50 ml of methyl alcohol conforming to O-M-232, grade A shall be added. The emulsion shall be stirred for an additional 5 minutes.

As soon as the stirring is completed, the paddle shall be withdrawn from the emulsion and held for approximately 3 minutes in such a position that the greater part of the emulsion clinging to it will drain into the cylinder.

4.3.2.4.3.1 Froth. The cylinder containing the emulsion shall be allowed to stand without any agitation, at a temperature of 77° ± 5°F (25° ± 3°C) for 15 minutes, measured from the time of withdrawal of the paddle, and shall then be inspected for the presence of froth (see 3.5.1).

4.3.2.4.3.2 Separation. The cylinder and its contents shall then be allowed to stand undisturbed for 72 hours at 77° ± 5°F (25° ± 3°C), and shall then be inspected for evidence of separation (see 3.5.2). Creaming (formation of a creamy portion of emulsion which tends to rise to the top without actually separating as a layer of free oil) shall not be considered separation.

4.3.2.5 Hydrogen ion concentration (pH). An emulsion shall be prepared by vigorously shaking 5 ml of the finished oil and 45 ml of distilled water, having a pH value of 6.5 to 7.0, in a glass-stoppered flask. An immediate determination of the pH value shall be made electrometrically, using a glass electrode. pH shall be in the range specified in 3.6.

4.3.2.6 Corrosion test (of the emulsion). See 3.7.

4.3.2.6.1 Emulsion mixture. The emulsion shall be of 1 parts of finished oil and 4 parts of distilled water, by volume.

4.3.2.6.2 Spot test.

4.3.2.6.2.1 Test specimens. Test panels shall be approximately 2 inches (5.1 cm) square. There shall be a test panel of each of the following materials:

- Aluminum conforming to SAE AMS-QQ-A-250/4
- Copper conforming to ASTM B272
- Low-carbon steel conforming to SAE AMS 5046

The panels shall be polished on one face to a finish of 6 to 8 micro inches (0.15-0.20 micrometers) roughness height rating (RHR) by any suitable means.

- 50/50 tin-lead solder conforming to J-STD-006. The sample shall be solid and have a surface area of not less than 1 square inch (6.45 cm^2).

4.3.2.6.2.2 Test procedure. Just before testing, the panels shall be finish cleaned with a paste of magnesium oxide (heavy powder magnesium oxide, Fisher Scientific part # M68-3 or equivalent) and water until free of water break. The test panels shall be rinsed in distilled water, then 95 percent ethyl alcohol, dried and placed polished side up on a glass or other noncorroding surface. One-half milliliter of emulsion (4.3.2.6.1) shall be placed on each panel. The solder sample shall be rinsed with distilled water, then 95 percent ethyl alcohol, dried, dipped in the emulsion and placed with the test panels. The test specimens shall then be allowed to stand undisturbed and exposed in an atmosphere of 50 ± 5 percent relative humidity at a temperature of 77º ± 9ºF (25º ± 5ºC) for 168 hours. The test specimens shall then be washed successively with distilled water, ethyl alcohol, and ASTM precipitation naphtha, and blown dry with compressed air. The test specimens shall then be examined visually for evidence of discoloration and under a magnification of 20 to 30 diameters for evidence of etching, pitting, or other corrosion (see 3.7).

4.3.2.6.3 Immersion test.

4.3.2.6.3.1 Test specimens. Test strips shall be approximately 0.5 inch wide X 3 inch long (1.27 cm X 7.62 cm). There shall be a test strip of each of the following materials:

- Aluminum conforming to SAE AMS-QQ-A-250/4
- Copper conforming to ASTM B272
- Low-carbon steel conforming to SAE AMS 5046

The strips shall be polished to a finish of 6 to 8 micro inches (0.15-0.20 micrometers) roughness height rating (RHR) by any suitable means.

- 50/50 tin-lead solder conforming to J-STD-006. The sample shall be solid and have a length of approximately 3 inches (7.62 cm) and a diameter of not less than 0.062 inch (0.16 cm).

4.3.2.6.3.2 Test procedure. Just before testing, the 3 strips shall be finish cleaned with a paste of magnesium oxide (heavy powder magnesium oxide, Fisher Scientific part # M68-3 or equivalent) and water until free of water break. The 4 test pieces (3 metal strips and solder sample) shall be rinsed in distilled water, then 95 percent ethyl alcohol, dried and placed in individual test tubes. Sufficient emulsion (4.3.2.6.1) shall be added to each test tube to completely immerse the test piece. The test tubes will be tightly stoppered and allowed to stand vertically at a temperature of 100º ± 7ºF (38º ± 4ºC) for 168 hours. The test specimens shall then be washed successively with distilled water, ethyl alcohol, and ASTM precipitation naphtha, and blown dry with compressed air. The test specimens shall then be examined visually for evidence

of discoloration and under a magnification of 20 to 30 diameters for evidence of etching, pitting, or other corrosion (see 3.7).

4.3.2.7 Finished oil composition tests.

4.3.2.7.1 Infrared sulfonate determination. Infrared spectra shall be obtained on a double beam recording spectrophotometer operating from 2 to 16 micrometers. The presence of petroleum sulfonate shall be determined by the presence of 2 strong absorption bands located at 8.40 and at 9.45 micrometers. Cell thickness shall be chosen so that the sulfonate absorption at 8.4 micrometers lies between 0.5 and 0.6. See 3.1.2.

4.3.2.7.2 Infrared fatty acid and fatty acid soap determination. The concentration of fatty acids and fatty acid soaps shall be expressed as a ratio of sulfonate absorbance to the acid and soap absorbances. The fatty acid absorbance shall be calculated from the carbonyl absorption band at approximately 5.8 micrometers. The absence of a distinct peak at this wavelength shall be considered as no fatty acids present. If a peak is present, a line to be known as the I_0 baseline for fatty acids shall be drawn from the curve at 5.50 micrometers to the curve at 6.5 micrometers. The fatty acids soap absorbance shall be calculated at the 6.40 micrometer absorption band. A line to be known as the I_0 baseline for fatty acid soaps shall be drawn from the curve at 5.50 micrometers to the curve at 7.80 micrometers. The petroleum sulfonate absorbance shall be calculates at the 8.40 micrometer absorption band. Its I_0 baseline shall be drawn from the curve at 7.8 micrometers to the curve at 10.0 micrometers. The ratio of sulfonate absorbance to fatty acid absorbance and to fatty acid soap absorbance shall be as specified in 3.1.3

4.3.2.8 Ash content. Ash content shall be determined by testing to ASTM D482. See 3.8 for specified ash limits.

4.3.3 Rejection and retest. Materials not conforming to the requirements of this specification shall be rejected. Rejected material shall not be submitted without furnishing full particulars concerning the rejection and measures taken to overcome the defects.

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 that may be helpful, but is not mandatory.)

6.1 Intended use. The finished oil is intended only to be used to prevent corrosion caused by water-alcohol mixtures contained in ground handling equipment and used in aircraft water-alcohol injected systems. The aircraft water-alcohol injection systems include the thrust augmentation system used in certain jet aircraft engines and the anti-detonation injection system used in certain reciprocating aircraft engines.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Where test samples should be sent, if applicable (see 4.2.1)
c. Size of container
d. Packaging requirements (see 5.1)

6.3 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313. 29 CFR 1910.1200 requires the material Safety Data Sheet for each hazardous chemical used in an operation must be readily available to personnel using the material. Contracting officers will identify the activities requiring copies of the Material Safety Data Sheet.

6.4 Definitions.

6.4.1 Bulk lot of material. A bulk lot of material is defined as an indefinite quantity of a homogeneous mixture of material contained in one isolated tank, kettle, or manufactured by a single plant run through the same processing equipment during one continuous operation not exceeding a 24-hour period.

6.4.2 Container lot of material. A container lot of material is defined as an indefinite number of 55 gallon drums (400 pound drums where applicable) or smaller unit containers of identical size and type, filled with a homogeneous mixture of material manufactured by a single plant run through the same processing equipment during one continuous operation not exceeding a 24 hour period.

6.5 Subject term (key word) listing.

Thrust augmentation
Anti-detonation

6.6 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 http://assist.daps.dla.mil.

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.

Custodians:
Air Force – 68
Navy – SH
DLA – GS

Preparing Activity:
DLA-GS3

(Project 6850-2009-010)

Review Activity:
Air Force – 11
International Interest – Navy – NI (see 6.6)

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 database at http://assist.daps.dla.mil.