

METRIC

MIL-DTL-85470B

15 June 1999

SUPERSEDING

MIL-I-85470A

8 August 1990

DETAIL SPECIFICATION

INHIBITOR, ICING, FUEL SYSTEM, HIGH FLASH
NATO CODE NUMBER S-1745

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 and grade of a high flash, fuel system icing inhibitor soluble in aircraft turbine engine fuel. This inhibitor is primarily composed of diethylene glycol monomethyl ether and is commonly referred to as DiEGME.

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 recommend 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.

2.2 Government documents.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Air Systems Command, Fuels and Lubricants Division, AIR-4.4.5, Bldg. 2360, PSEF Building 22229 Elmer Road, Unit 4, Patuxent River, MD 20670-1534, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6850

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2.2.1 Standards. The following standards 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).

STANDARDS

FEDERAL

FED-STD-791 - Lubricant, Liquid Fuel and Related Products, Methods of Testing

(Unless otherwise indicated, copies of the above standards are available 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 cited herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS specified 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).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-D56	-	Flash Point by Tag Closed Tester (DoD adopted), Standard Test Method for
ASTM-D93	-	Flash Point by Pensky Martens Closed Tester (DoD adopted), Standard Test Method for
ASTM-D891	-	Specific Gravity, Apparent, of Liquid Industrial Chemicals, Standard Test Method for
ASTM-D1078	-	Distillation Range of Volatile Organic Liquids (DoD adopted), Standard Test Method for
ASTM-D1209	-	Color of Clear Liquids (Platinum-Colbalt Scale) (DoD adopted), Standard Test Method for
ASTM-D1364	-	Water in Volatile Solvents (Fischer Reagent Titration Method) (DoD adopted), Standard Test Method for
ASTM-D1613	-	Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products (DoD adopted), Standard Test Method for
ASTM-D3828	-	Flash Point by Setaflash Closed Tester (DoD adopted), Standard Test Method for

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ASTM-D4052	-	Density of Liquids by Digital Density Meter (DoD adopted), Standard Test Method for
ASTM-D4171	-	Fuel System Icing Inhibitors, Standard Specification for
ASTM-E29	-	Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted)
ASTM-E70	-	pH of Aqueous Solutions with the Glass Electrode (DoD adopted), Standard Test Method for
ASTM-E203	-	Water Using Karl Fischer Reagent (DoD adopted), Standard Test Method for
ASTM-E300	-	Sampling Industrial Chemicals, Standard Practice for
ASTM-E450	-	Measurement of Color of Low-Colored Clear Liquids Using Hunterlab Color Difference Meter, Standard Test Method for

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

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 specified exemption has been obtained.

3. REQUIREMENTS

3.1 Materials. The inhibitor shall be composed entirely of diethylene glycol monomethyl ether except that an antioxidant specified in 3.2 shall be added at a concentration from 50 to 150 parts per million by weight. The antioxidant shall be added immediately after processing and before the inhibitor is exposed to the atmosphere. The inhibitor shall conform to the requirements of table I when tested in accordance with section 4.

3.2 Antioxidants. The antioxidant added to the inhibitor shall be one of the following:

- a. 2,6 ditertiary butyl, 4-methylphenol
- b. 2,4 dimethyl, 6-tertiary butylphenol
- c. 2,6 ditertiary butylphenol
- d. Mixed tertiary butylphenol composition:
 - 75 percent, minimum, 2,6 ditertiary butylphenol
 - 25 percent, maximum, tertiary and tritertiary butylphenols

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TABLE I. Properties of the inhibitor and test methods.

Property	Limit	Test Method
Acid number, mg KOH per gram (maximum)	0.09	ASTM-D1613
Color, platinum cobalt (maximum)	10	ASTM-D1209 ^{1/} or ASTM-E450
Distillation: Initial point, minimum Dry point, maximum	191.0 198.0	ASTM-D1078
Ethylene glycol (maximum, percent by weight)	0.5	^{2/}
pH of 25 percent solution in water (25+/- 2°C)	5.5 to 7.5	ASTM-E70 ^{3/}
Relative density (20/20 °C)	1.021 to 1.025	ASTM-D891 ^{1/ 4/} or ASTM-D4052
Water (maximum, mass %)	0.1	ASTM-D1364 ^{1/} , ASTM-E1064 or ASTM-E203
Flash point, °C (°F) (minimum)	85 (185)	ASTM-D93 ^{1/} , ASTM-D56, or ASTM-D3828

Notes: ^{1/} Referee Test Method^{2/} See 4.7.1.1^{3/} See 4.7.1.2^{4/} ASTM-D891 Method A or B

3.3 Workmanship. The inhibitor shall be uniform in quality, clear and bright, and free from suspended and foreign matter (see 4.5.1).

3.4 Precautionary markings. The following precautionary marking shall be included on containers of this product:

**"TO BE USED ONLY AS AN ANTI-ICING ADDITIVE
FOR AIRCRAFT TURBINE ENGINE FUELS"**

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4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as conformance inspection.

4.2 Inspection lot.

4.2.1 Bulk lot. A bulk lot shall consist of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container; or manufactured by a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

4.2.2 Packaged lot. A packaged lot shall consist of an indefinite number of 208 liter (55 gallon) drums or smaller unit packages of identical size and type, offered for acceptance, and filled with an homogeneous mixture from one isolated container, or filled with an homogeneous mixture of material manufactured by a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

4.3 Inspection. Inspection shall be in accordance with FED-STD-791, Method 9601.

4.3.1 Inspection conditions. Requirements contained in table I are absolute, as defined in ASTM-E29, and shall not be subject to correction for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerance may be averaged. For rounding off of significant figures, ASTM-E29 shall apply to all tests required by this specification.

4.4 Sampling.

4.4.1 Sampling of inhibitor. Each bulk or packaged lot shall be sampled in accordance with ASTM-E300. The samples shall be subjected to the examination of inhibitor specified in 4.5.1 and tested per 4.7.

4.4.2 Sampling for inspection of filled containers. A random sample of filled containers shall be selected from each lot. The sample containers shall be subjected to the examination of filled containers as specified in 4.5.2.

4.5 Examinations.

4.5.1 Examination of inhibitor. Samples selected in accordance with 4.4.1 shall be visually examined for compliance with 3.3.

4.5.2 Examination of filled containers. Each container selected shall be examined for defects of the container and closure, for evidence of leakage, for markings specified in 3.4 and all other

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packaging requirements. Each filled container shall also be weighed to determine the amount of contents. Any container in the sample having one or more defects or under the required fill shall be rejected.

4.5.3 Examination of empty containers. Containers shall not contain any foreign material such as solids, corrosion products, water, or other sediments. Container seams shall be inspected for evidence of metal corrosion, flux, solder and such materials as would contaminate the product. Any container not meeting these criteria shall be rejected.

4.6 Rejection. Failure of any sample of the inhibitor to conform to any one of the requirements to this specification shall be cause for rejection of the lot represented.

4.7 Test methods.

4.7.1 Inhibitor properties. The inhibitor properties shall be tested in accordance with the ASTM test methods listed in table I and as specified in 4.7.1.1 through 4.7.1.2.

4.7.1.1 Ethylene glycol (percent by weight). The percent of ethylene glycol component in the diethylene glycol monomethyl ether shall be determined as specified in subparagraphs 4.7.1.1.1, 4.7.1.1.2, and 4.7.1.1.3 (titration method) or ASTM-D4171 Annex A1 Test Method for Determining Purity of Fuel System Icing Inhibitors Using Ultra High Purity Ethylene Glycol Monomethyl Ether (anhydrous, 99.5+%) as the calibration standard for the analysis of diethylene glycol monomethyl ether.

4.7.1.1.1 Reagents and materials. Unless otherwise indicated, all reagents shall be American Chemical Society reagent grade or equivalent. Reference to water indicates distilled or deionized water. The following materials shall be prepared:

a. Oxidizing reagents: To a solution containing 5 grams of periodic acid (HIO_4) or 5.9 grams of paraperiodic acid ($\text{HIO}_4 \cdot 2\text{H}_2\text{O}$) in 200 milliliters (ml) of water, add 800 ml of glacial acetic acid. Store the solution in a dark, well-stoppered bottle.

b. Potassium iodide: Twenty percent aqueous solution. Weigh out 20 grams of potassium iodide and dilute to 100 ml with distilled water.

c. Sodium thiosulfate, standard 0.2N: Standardize weekly or before using by an accepted procedure.

d. Starch indicator solution: One percent aqueous.

4.7.1.1.2 Procedure. The following procedure shall be performed:

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- a. Pipette 100 ml of the oxidizing reagent into each of four 500 ml iodine flasks. Reserve two of the flasks for the blank determination.
- b. Introduce 15 grams of the sample, weighed to the nearest 0.1 gram, into each of two flasks and swirl to effect solution.
- c. Allow the flasks to stand for 30 minutes at room temperature.
- d. While swirling, add 20 ml of 20 percent potassium iodide solution to each flask, in turn, immediately before titrating.
- e. Titrate the contents of each flask to a pale yellow color with standard 0.2N sodium thiosulfate. Add 2 ml of starch indicator and titrate to the disappearance of the blue color.
- f. If the net titration is more than 20 ml, repeat the determination, using a smaller sample size.

4.7.1.1.3 Calculations. Calculate the concentration of ethylene glycol as:

$$\text{Weight percent ethylene glycol} = \frac{(B-A) \times N \times 3.103}{(s)}$$

Where: A = ml of sodium thiosulfate required for the sample.

B = average ml of sodium thiosulfate required for the blank.

N = normality of sodium thiosulfate.

s = grams of sample.

4.7.1.2 pH of 25 percent solution in water. Twenty-five ml of the inhibitor shall be pipetted into a 100 ml volumetric flask and filled with freshly boiled and cooled distilled water having a pH of 6.5 to 7.5. The pH value shall be measured with a pH meter calibrated in accordance with ASTM-E70. To avoid error caused by carbon dioxide in the air, the gas space over the solution shall be purged with carbon dioxide-free air.

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 of materiel 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 Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military

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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.

6. NOTES

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

6.1 Intended use. The inhibitor is intended for use as an anti-icing agent to be added to military aircraft turbine engine fuels. The requirements defining the product covered by this specification are needed for the unique operating environment of military aircraft and are not identical to similar commercial specifications. Products defined by commercial specifications with the same chemical name are only acceptable for use in military equipment if they meet all of the requirements of this specification. The military is the only entity actively pursuing the development of environmentally friendly anti-icing agents. This specification will be used as a platform to define the requirements of future environmentally friendly anti-icing agents.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. FSII - DiEGME.
- c. 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).
- d. Quantity desired.
- e. Special markings (see 3.4).
- f. Packaging requirements (see 5.1).

6.2.1 Unit of purchase. Unit of purchase is 3.8 liters (U.S. gallon of 231 cubic inches) at 15.5 °C (60 °F). When weight is used as the basis for quantity determination, table II should be used to determine the quantity in liters at 15 °C, or gallons at 60 °F.

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TABLE II. Conversion factors - weight to liters at 15 °C (or gallons at 60 °F).

If the specific gravity at 20/20 °C is:	To obtain liters at 15 °C, divide kilograms by:	To obtain gallons at 60 °F, divide pounds by:	To obtain gallons at 60 °F, divide kilograms by:
1.020	1.023 kg/L	8.530 lb/gal	3.869 kg/gal
1.021	1.024	8.539	3.873
1.022	1.025	8.547	3.877
1.023	1.026	8.546	3.881
1.024	1.027	8.564	3.885
1.025	1.028	8.572	3.888

6.3 International standardization. Certain provisions of this specification are the subject of international standardization agreements ASCC Air Std 15/1 and STANAG 1135. When amendment, revision, or cancellation of this specification is proposed which will 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.

6.4 Warning. Undiluted diethylene glycol monomethyl ether (DiEGME) is combustible. Before handling DiEGME, consult appropriate safety and occupational health directives and Material Safety Data Sheets.

6.5 Subject term (key word) listing.

FSII
Diethylene glycol monomethyl ether
DiEGME

6.6 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.

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CONCLUDING MATERIAL

Custodians:

Army - CR4
Air Force - 11
Navy - AS

Preparing activity:

Navy - AS

(Project No. 6850-1426)

Review activities:

Army - AV
Air Force - 68
DLA - PS

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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
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2. DOCUMENT DATE (YYYYMMDD)
99/06/15

3. DOCUMENT TITLE

INHIBITOR, ICING, FUEL SYSTEM, HIGH FLASH, NATO CODE NUMBER S-1745

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, First, Middle Initial)*

b. ORGANIZATION

c. ADDRESS *(Include ZIP Code)*

d. TELEPHONE *(Include Area Code)*
(1) Commercial
(2) DSN
(If applicable)

7. DATE SUBMITTED
(YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME
COMMANDER
NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION

b. TELEPHONE *(Include Area Code)*
(1) Commercial (732) 323-2947
(2) DSN 624-2947

c. ADDRESS *(Include ZIP Code)*
CODE 414100B120-3
HIGHWAY 547
LAKEHURST, NJ 08733-5100

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