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 SUPERSEDING  
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## MILITARY SPECIFICATION

### ANTIFREEZE, ETHYLENE GLYCOL, INHIBITED, HEAVY DUTY, SINGLE PACKAGE

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

#### 1. SCOPE

1.1 This specification covers one type of antifreeze compound for use in the cooling system of liquid-cooled internal combustion engines other than aircraft for protection against freezing in ambient temperatures as low as minus 60°F. (see 6.1).

#### 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 this specification to the extent specified herein:

#### SPECIFICATIONS

##### FEDERAL

O-1-490	- Inhibitor, Corrosion, Liquid Cooling System
SS-S-535	- Sodium Borate, Decahydrate, Technical (Borax)
PPP-B-636	- Box, Fiberboard
PPP-C-186	- Container, Packaging and Packing for Drugs, Chemicals and Pharmaceuticals
PPP-C-569	- Containers, Plastic, Molded (For Liquids, Pastes and Powders); Overpacked
PPP-C-1337	- Containers, Metal with Polyethylene Inserts
NN-P-71	- Pallets, Material Handling, Wood, Stringer, Construction, 2 way and 4 way (Partial)
UU-T-81	- Tags, Shipping and Stock
PPP-D-1860	- Drums, Plastic, Molded Polyethylene
PPP-C-300	- Chemicals, Liquid: Packaging and Packing of
PPP-B-601	- Box, Wood, Cleated Plywood
PPP-B-621	- Box, Wood, Nailed and Lock Corner

FSC 6850

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Army Materials and Mechanics Research Center, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426 appearing at the end of this document or by letter.

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## MILITARY

- MIL-B-26701 - Bottles, Screwcap and Carboys, Polyethylene Plastic
- MIL-D-43703 - Drums, Shipping and Storage, Molded Polyethylene
- MIL-F-16377 - Fixtures, Lighting and Associated Parts for Shipboard use, General Specification for
- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-147 - Palletized and Containerized Unit Loads, 40" X 48" Pallets, Skids, Runners or Pallet - Type Base
- MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(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.

## CODE OF FEDERAL REGULATIONS

- 49 CFR 177-179 - Department of Transportation Rules and Regulations for the Transport of Explosives and other Dangerous Articles

(Applications for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402.)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- D 92 - Flash and Fire Points by Cleveland Open Cup, Test for
- D 1119 - Ash Content of Engine Antifreezes, Antirusts, and Coolants, Test for
- D 1120 - Boiling Point of Engine Antifreezes, Test for
- D 1121 - Reserve Alkalinity of Engine Antifreeze by the Hydrometer, Test for
- D 1176 - Aqueous Solutions of Engine Antifreezes or Antirusts for Testing Purposes, Sampling and Preparing
- D 1177 - Freezing Point of Aqueous Engine Antifreeze Solution, Test for
- D 1287 - PH of Engine Antifreezes, Antirusts, and Coolants, Test for
- D 1881 - Foaming Tendencies of Engine Coolants in Glassware, Test for
- D 2111 - Specific Gravity of Halogenated Organic Solvents and their Admixtures, Test for
- D 3634 - Trace Chloride Ion in Engine Antifreezes/Coolants in the Presence of Mercaptobenzothiazole, Test for

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

### 3. REQUIREMENTS

3.1 Material. The antifreeze compound shall be a single-phase homogeneous mixture of a formulation conforming to the requirements of this specification. The compound shall be stable in storage for periods of up to 2 years under any climatic conditions, including exposure to temperatures below the freezing point of the material. The quality of the ingredients used in the formulation shall be so controlled as to insure uniformity of performance of the antifreeze compound (see 4.6).

3.2 Composition. The antifreeze compound shall consist of a blend of materials specified in Table I, composition A or composition B.

Table I. Chemical Composition

<u>Components</u>	<u>Composition A Weight Percent</u>	<u>Composition B Weight Percent</u>	<u>Applicable Test Para.</u>
Total Water	5.00 ± 0.50	5.00 ± 0.50	4.5.1
Trisodium phosphate, calculated a dodecahydrate	0.30 ± 0.04	0.30 ± 0.04	4.5.2
Ethylene Glycol, minimum	77.60	77.60	
Total vicinal glycols, minimum	87.60	87.60	4.5.3
Borax (sodium tetraborate, decahydrate) SS=S-535, Type 11	4.00 ± 0.20	4.00 ± 0.20	4.5.4
Sodium Salt of mercaptobenzothiazole, 50% aqueous solution, by weight	0.40 ± 0.05	_____	4.5.5.2
Sodium Salt of Tolyltriazole, 50% aqueous solution, by weight	_____	0.25 ± 0.05	4.5.5.3
Antifoaming agent	<u>1/</u>	<u>1/</u>	

1/ The antifoaming agent shall be of the polyoxyalkylene glycol type such as Pluronic L-61 supplied by BASF, Wyandotte, Inc., Wyandotte, Mich. or equal. It will be added in quantities which will permit the antifreeze to meet the homogeneity requirement of 3.1, and the foaming requirements of 3.4.6.

3.3 Chemical requirements. In addition to conforming to the requirements of 3.2, the packaged material shall conform to the chemical requirements specified in 3.3.1, 3.3.2, 3.3.3 and 3.3.4.

3.3.1 pH value. When determined as specified in 4.5.6, the pH of the undiluted material shall be 5.8 to 6.8 and of a 30 percent aqueous solution (by volume) shall be 7.5 to 8.0.

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3.3.2 Reserve alkalinity. When determined as specified in 4.5.7, the reserve alkalinity shall be not less than 20.

3.3.3 Ash. When determined as specified in 4.5.8, the ash content shall be not more than 2.0 percent by weight.

3.3.4 Alkaline earths, sulfates, carbonates and chlorides.

3.3.4.1 Alkaline earths. When tested as specified in 4.5.9, no immediate precipitate shall form.

3.3.4.3 Chlorides. The antifreeze when tested as specified in 4.5.11, shall give a negative test for chlorides.

3.4 Physical requirements.

3.4.1 Boiling point. The equilibrium boiling point of the antifreeze compound shall be not lower than 300°F. (149°C.) when determined as specified in 4.5.12.

3.4.2 Flash point. The flash point of the antifreeze compound shall be not lower than 230°F. (110°C.) when determined as specified in 4.5.13.

3.4.3 Specific gravity. The specific gravity of the undiluted material shall be 1.105 to 1.135 at 60°/60°F. when determined as specified in 4.5.14.

3.4.4 Freezing point. The freezing point of aqueous solutions of the antifreeze shall be as specified in Table II, when tested as specified in 4.5.15.

Table II. Freezing point of aqueous solutions

Concentration (percent by volume)	Freezing point (max. °F.)
50	Not above minus 30
30	Not above plus 6

3.4.5 Color. The material shall be colored blue-green. The dye used shall be alizarine cyanine green G extra 100 percent, or an approved equal, added in the proportion of 0.3 gram of dye per gallon of antifreeze compound.

3.4.6 Foaming. The material shall show a maximum of 150 ml foam after 5 minutes and the foam shall break within 5 seconds, when tested as specified in 4.5.16.

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#### 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 that supplies and services conform to prescribed requirements.

4.2 Inspection lot. All compounded material of the same type manufactured as one batch and offered for delivery at one time shall be considered a lot for purposes of acceptance inspection and tests.

#### 4.3 Sampling and inspection.

4.3.1 Sampling for inspection. Sampling for inspection and tests shall be performed in accordance with MIL-STD-105.

4.3.2 Examination of the end item. Visual examination of the end item shall be made to determine compliance with specification requirements on presence of foreign particulate matter, and single-phase homogeneity. The sample unit shall be one primary container. The inspection level shall be S-3 and acceptable quality level of 2.5 expressed in defects per hundred units.

4.3.3 Examination of the end item for defects in net contents. The sample unit shall be one filled primary container. The inspection level shall be S-2 or a minimum of 5 sample units randomly selected from the lot. The average net contents shall not be less than the amount specified.

4.3.4 Examination of packaging. An examination shall be made to determine that the preservation, packaging, packing and markings comply with the requirements of Section 5 of this specification. The sample unit shall be one shipping container. The lot size shall be the number of shipping containers offered for delivery at one time. The inspection level shall be S-2 with an acceptable quality level of 4.0 defects per hundred units.

4.3.5 Quality conformance testing of the end item. The end item shall be tested for conformance to the requirements as specified in Section 3 for each lot presented for inspection. The lot size shall be expressed in units of gallons of antifreeze. The sample unit shall be four one quart containers, when quart containers are specified, or not less than one gallon when all other containers are specified. No more than one sample unit shall be taken from any one shipping container. Sample units from containers over one gallon capacity shall be placed in a clean dry container conforming to the requirements of 5.1.1.2 and labeled to identify the lot and container from which it was taken. The inspection level shall be S-1 with no less than three sample units selected. There shall be no evidence of failure to meet the specified requirements.

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4.3.6 Reduced testing. Reduced testing is allowed, if the supplier has furnished the same product, using the same formulation, raw materials, manufacturing conditions, and has been fully tested and passed all the section 3 requirements within 2 years of commencement of operations under this contract. The Government Inspector shall verify and the supplier shall certify, this has been accomplished within the last two years. The following minimum testing shall be performed:

Freezing point	4.5.15
pH value	4.5.6
Reserve alkalinity	4.5.7
Specific gravity	4.5.14
Ash content	4.5.8

4.4 Lot acceptance tests. The sample specimens selected in accordance with 4.3.1 shall be subjected separately to the tests specified. If either specimen fails one or more of these tests, the lot shall be rejected. Rejected lots may be resubmitted for acceptance tests, provided the contractor has removed or reworked all nonconforming material.

#### 4.5 Tests.

4.5.1 Water content. The total water content of the material, including the water of hydration of the borax, trisodium phosphate and NaMBT solution shall first be determined by means of the apparatus and procedure specified hereinafter.

4.5.1.1 Apparatus. The apparatus consists of a 250 ml. round-bottom, short-neck flask, with standard taper ground joint 24/40, having one side inlet tube for inserting a 580°F. thermometer. A Dean and Stark (Barrett type) receiver trap, with stopcock and standard taper ground joint 24/40, of 10 ml. capacity, is used. The water condenser is equipped with a male ground joint, standard taper 24/40, and has a water-jacket length of 400 mm. A drying tube containing anhydrous calcium chloride is inserted into the top of the condenser. A 600 watt electric heater of the rheostat type, or similar controllable heat source, is required.

4.5.1.2 Procedure. Transfer a 100 ml. sample of the material to be tested into the round-bottom flask. The weight of the antifreeze sample shall be determined to the nearest tenth of a gram by weighing or calculation from the specific gravity. Add exactly 20 ml. of n-butanol; (distilling range 238° to 243°F.), and a few boiling chips. Insert the thermometer into the side tube of the flask until the bottom of the bulb rests 0.25 inch (0.64 cm.) above the level of the liquid. Connect the

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flask to the trap extension and insert the condenser. Adjust a sufficient flow of water through the condenser to insure proper cooling. Set the heat control so that the temperature will rise slowly but steadily until boiling commences, then adjust the heat source to maintain a slow steady boil. Care should be taken to maintain the lower layer (water layer) in the trap as high as possible during refluxing, so that the temperature of the flask cannot rise much above the boiling temperature of n-butanol. Reflux for 2.5 hours, and check the lower layer in the trap. Check again in 20 minutes. If no visible change in volume is noted, draw off the water layer into 50 ml. glass-stoppered graduate. It may be necessary to draw off portions of the liquid in the trap into the glass-stoppered graduate at regular intervals. Continue the distillation until the temperature of the vapor just reaches 350°F. draw off all remaining liquid in the trap into the graduate, and record the volume of liquid in the stoppered graduate to the nearest 0.5 ml. Add 1 gram of anhydrous potassium carbonate to the liquid in the graduate. Stopper, shake well, and allow to settle. Read the volume of the n-butanol (top layer) to the nearest 0.5 ml. Add 1 more gram of the anhydrous potassium carbonate, stopper, shake well, and allow to settle again. Again read the volume of n-butanol. If the volume of the n-butanol has changed add successive 1 gram portions of the potassium carbonate until no change in n-butanol content is noted. Record the volume of n-butanol and subtract it from the original recorded volume of liquid material. Calculate the percent by weight of water as follows:

$$\text{Water, \% by wt.} = \frac{\text{ml water}}{\text{weight of sample, gms}} \times 100$$

#### 4.5.2 Trisodium phosphate dodecahydrate.

4.5.2.1 Procedure. Weigh approximately 50 gms of antifreeze to the nearest milligram into a 600 ml beaker. Dissolve in 250 ml. of freshly distilled water. Add 20 ml. concentrated nitric acid and 20 grams ammonium nitrate to the beaker. Heat the solution to 30°-45°C. (86°-113°F.). Add 50 ml. ammoniacal molybdate solution (see 4.5.2.2). Do not heat the solution after the addition of the molybdate solution. Agitate the solution for 10 minutes, then allow to settle for about 30 minutes. Filter the solution through fine textured filter paper (Whatman 42 or equivalent) and rinse the beaker with five 15-20 ml. portions of 1.0 percent potassium nitrate solution. Wash the paper with 100 ml. of 1.0 percent potassium nitrate using small portions. Discard all filtrates. Return the paper and precipitate to the beaker and add standardized 0.5 N sodium hydroxide from a buret to decompose the precipitate. Add an excess of 2.0 ml. Record the volume of 0.5 N sodium hydroxide used. Wash the sides of the beaker and dilute to about 150 ml. with distilled water. Titrate the resulting solution with standardized 0.1 N nitric acid to pH 8.5 using glass electrodes and instrument described in ASTM Method D 1121.

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4.5.2.2 Ammoniacal molybdate solution. Weigh 61 grams ammonium molybdate and 57 grams ammonium nitrate into a one liter beaker. Add 47 ml. concentrated ammonium hydroxide and 500 ml. distilled water. Warm the beaker to aid dissolution. Filter and make up to 1 liter in a volumetric flask.

4.5.2.3 Calculation of trisodium phosphate dodecahydrate.

$$\% \text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O} = (1.653) \frac{[(\text{ml. NaOH} \times \text{normality NaOH}) - (\text{ml. HNO}_3 \times \text{normality HNO}_3)]}{\text{weight of sample}}$$

4.5.3 Glycols having hydroxyls on adjacent carbons (vicinal glycols). The determination of the content of glycols having hydroxyls on adjacent carbons in their molecular structure shall be made using the reagents and procedure specified hereinafter.

4.5.3.1 Reagents.

- (a) 0.4 N sodium periodate solution (prepared by weighing exactly 10.6 grams of metasodium periodate,  $\text{NaIO}_4$ , and dissolving in sufficient distilled water to make 1 liter of solution).
- (b) 0.2 N sodium thiosulfate solution.
- (c) 30 percent potassium iodide solution.
- (d) Starch solution.
- (e) 20 percent sulfuric acid solution.

4.5.3.2 Procedure. Weigh, by differences, 3.5 to 4.0 grams of the material in a 250 ml. volumetric flask. The weight shall be determined to the nearest tenth of a milligram. Make up to volume mark with distilled water, and mix thoroughly. Transfer a 10 ml. aliquot of the solution to a 500 ml. iodine flask. Add exactly 50 ml. of the sodium periodate solution. stopper the flask, and allow the mixture to react. Run 2 blanks in the same manner. After 1 hour add 150 ml. of distilled water, followed by 20 ml. of the sulfuric acid solution, and 40 ml. of the potassium iodide solution. (Note: The blanks should each require 95 to 100 ml. of the thiosulfate solution for titration, while the sample mixture should require 78 to 90 ml.).

4.5.3.3 Calculation of glycols having hydroxyls on adjacent carbons.

$$\text{percent by weight} = \frac{0.0317 \times 25 \times (B - S) \times N \times 100}{W}$$

Where: B = ml. of thiosulfate solution required by the blank (average of 2 blank runs).

S = ml. of thiosulfate solution required by the sample aliquot.

N = normality of the thiosulfate solution.

W = weight of the sample, grams.



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4.5.4 Borax.

4.5.4.1 Qualitative test. Place 10 ml. of the material in a 500 ml. Erlenmeyer flask. Add 10 ml. of anhydrous methanol, and 10 ml. of concentrated sulfuric acid. Insert a 6 inch piece of 6 mm. OD glass tubing through a 1 hole rubber stopper that fits the flask. The tubing should protrude approximately 6 mm. from the bottom side of the stopper. Place a 4 inch piece of 12 mm. OD glass tubing over the end of the tubing protruding from the top side of the stopper, thus providing a test chimney. Place the assembled apparatus, containing the test material, on an asbestos-centered wire gauze supported over a suitable heat source. Heat the flask contents to boiling. Ignite the vapors escaping through the chimney. The presence of borate is indicated by a green-colored flame.

4.5.4.2 Quantitative test.

4.5.4.2.1 Procedure. Weigh approximately 100 grams of the antifreeze to the nearest 0.1 milligram into a 500 ml. Erlenmeyer flask. Dissolve in 100 ml. freshly boiled distilled water. Add a five percent solution of  $\text{BaCl}_2$  in a slight excess while stirring. After settling for 30 minutes filter the solution through a fine textured filter paper (Whatman 42 or equivalent) into a 500 ml volumetric flask. Wash the residue with two 10 ml. portions of boiled distilled water. Return the paper to the original flask. Dissolve the residue in 6 N HCl and add 50 ml. distilled water. Stir the sample to break up the paper. Reprecipitate the phosphate with 6 N NaOH. Add a few drops of sodium hydroxide and a few drops of barium chloride to check for completeness of precipitation. Filter and wash as before into the 500 ml. volumetric flask. Cool the filtrate to  $20^\circ\text{C}$ . and dilute to the mark with cooled boiled distilled water. Take a 100 ml. aliquot for analysis. Each aliquot contains one-fifth of the sample weight. Adjust the solution to pH 5.5 with 1N HCl using glass electrodes and instrument described in ASTM Method D 1121. Add 1 gram of mannitol and titrate to pH 8.5 with standardized 0.5 N NaOH. Add 0.5 grams of mannitol. If no change in pH is observed the titration is complete. If a change is observed, add 0.5 gram portions of mannitol and subsequently titrate to pH 8.5 until no change in pH occurs. Calculate the percent  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10 \text{H}_2\text{O}$ . One milli-equivalent of NaOH = 0.09537 grams of  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10 \text{H}_2\text{O}$ .

4.5.4.2.2 Calculation of Borax.

$$\% \text{Na}_2\text{B}_4\text{O}_7 \cdot 10 \text{H}_2\text{O} \text{ (borax)} = \frac{(\text{ml. NaOH}) (\text{normality of NaOH}) (47.685)}{\text{weight of original sample}}$$

4.5.5 Sodium Salt of mercaptobenzothiazole solution or sodium salt of tolyltriazole solution (50%) by weight.

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4.5.5.1 Quantitative determination. To identify the use of either NaTT or NaMBT a sample is prepared for analysis by ultraviolet absorption techniques by diluting with 0.1N NaOH to an inhibitor concentration of 1 mg l 100 ml. solution. Absorption of NaTT is confirmed at 276 millimicrons and NaMBT is confirmed at 310 millimicrons in a standard 1 cm silica cell.

4.5.5.2 Quantitative Test for Sodium Mercaptobenzothiazole.

4.5.5.2.1 Procedure. Accurately weigh 30 grams of the antifreeze to the nearest milligram into a 250 ml. beaker and dilute to 100 ml. with freshly distilled water. Add 15 ml of the 10 percent copper sulfate solution and allow the mixture to stand for one hour. Add 5 ml. of 1.0 N hydrochloric acid and stir. Digest the mixture at 50°C for 30 minutes and let cool to room temperature. Filter the precipitate of copper mercaptobenzothiazole through a tared Gooch or sintered glass crucible, wash with 0.5 N hydrochloric acid until the precipitate is free of the blue color, then with distilled water until the washings are free from chloride. Dry the crucible in an oven at 105° to 120°C. to constant weight.

4.5.5.2.2 Calculation of sodium salt of mercaptobenzothiazole solution.

$$\% \text{ Sodium mercaptobenzothiazole solution} = \frac{192 \times \text{weight of precipitate}}{\text{weight of antifreeze sample}}$$

4.5.5.3 Quantitative Test for Sodium Tolyltriazole.

4.5.5.3.1 Procedure. Accurately weigh 40 grams of the antifreeze to the nearest milligram into a 250 ml beaker. Add 10 ml of ammonium hydroxide and dilute with freshly distilled water to approximately 100 ml. Add slowly and with continuous stirring 10 ml of 10% silver nitrate solution. Allow the precipitate to coagulate for at least 30 minutes with occasional stirring. Filter through a tared medium porosity fritted glass crucible and wash with four 10 ml portions of dilute ammonium hydroxide. Dry the crucible in an oven at 105°C. for 2 hours, cool and weigh.

4.5.5.3.2 Calculation.

$$\% \text{ Sodium Tolyltriazole Solution} = \frac{\text{wt of precipitate} \times 129.27}{\text{wt of sample}}$$

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4.5.6 pH value. The pH of the undiluted material, and of a 30 percent aqueous solution of the material prepared as specified in 4.5.15.1, shall be determined electrometrically, using the apparatus and the procedure specified in ASTM Method D 1287.

4.5.7 Reserve alkalinity. The reserve alkalinity of the material shall be determined electrometrically using the apparatus and procedure specified in ASTM Method D 1121.

4.5.8 Ash content. The ash content of the material shall be determined in accordance with ASTM Method D 1119.

4.5.9 Alkaline earths. Place 10 ml. of the material in a 30 ml. test tube. Make alkaline to litmus with ammonium hydroxide solution. Add 5 ml. of 95 percent ethyl alcohol, reagent grade. Add 5 ml. of 0.5 N ammonium oxalate. No immediate precipitate shall form.

4.5.10 Sulfates and carbonates. Place 10 ml. of the material in a 30 ml. test tube. Add 10 ml. of distilled water and mix. Add 2 ml. of a 5 percent aqueous solution of barium chloride. A precipitate will form. Add 1 ml. glacial acetic acid. There shall be no undissolved precipitate or effervescence. A slight turbidity is allowed.

4.5.11 Chlorides. The chlorides content of the material shall be determined in accordance with ASTM Method D 3634.

4.5.12 Boiling point. The boiling point of the material shall be determined in accordance with ASTM Method D 1120.

4.5.13 Flash point. The flash point of the material shall be determined in accordance with ASTM Method D 92.

4.5.14 Specific gravity. Specific gravity of the material shall be determined in accordance with ASTM Method D 2111.

4.5.15 Freezing point. The freezing point of aqueous solutions of the material (see Table II) prepared as specified in 4.5.15.1, shall be determined in accordance with ASTM Method D 1177.

4.5.15.1 Preparation of aqueous solutions. Aqueous solutions of the material shall be prepared on the basis of percentage by volume of the components in accordance with ASTM Method D 1176.

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4.5.16 Foaming test. The antifreeze shall be tested for foaming tendencies by ASTM D 1881.

#### 4.6 Stability.

4.6.1 In lieu of testing the manufacturer shall certify that the formula supplied under this specification has been stored in the plastic containers specified in 5.1 and found to meet the requirements of the specification after storage. The containers shall not show disintegration due to the action of the antifreeze.

### 5. PACKAGING

5.1 Preservation-packaging. Preservation-packaging shall be level A or Commercial as specified (see 6.2).

#### 5.1.1 Level A.

5.1.1.1 One quart quantity. One quart antifreeze shall be unit packed in a container conforming to PPP-C-569, type I, class A, as specified in appendix thereto or in a one quart capacity polyethylene plastic bottle specified in MIL-B-26701. If the bottle specified in MIL-B-26701 is being used to package Composition A the following requirements shall be mandatory. An additive shall be used in the polyethylene resin which will yield a bottle of MIL-B-26701 no portion of which will transmit more than 1 percent of ultraviolet light at any wavelength in the range of 310 to 325 millimicrons when tested using a calibrated spectrophotometer with air as a reference (see 6.3). If the bottle specified in MIL-B-26701 is being used to package Composition B the ultraviolet additive is not required.

5.1.1.2 One gallon quantity. One U.S. gallon of antifreeze shall be unit packed as specified for the one quart quantity except that the plastic container and box specified in PPP-C-569 shall conform to type I, class B and the bottle specified in MIL-B-26701 (with the ultraviolet exclusion additive) shall conform to the one gallon capacity size. A leak-proof inner seal which shall prevent leakage of container contents without benefit of the screw-cap closure when the container is inverted shall be furnished beneath the screw-cap of each container.

5.1.1.3 Five gallon quantity. Five U.S. gallons of antifreeze shall be unit packed as specified in PPP-C-1337 in a type II, class 1 metal container with a polyethylene insert, or MIL-D-43703 size I container. A leak-proof, either inner seal or pilfer-proof locking seal shall be furnished with the screw-cap closure of each container. The filled container shall be closed tightly so as to prevent leakage of contents.

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5.1.1.4 Fifty-five gallon quantity. Fifty-five U.S. gallons of antifreeze shall be unit packed as specified in PPP-C-1337 in a type II, class 4 metal container with a polyethylene insert or a nominal 55 gallon capacity polyethylene drum conforming to PPP-D-1860. The PPP-D-1860 polyethylene shall have a specific gravity of 0.941 to 0.965 and a melt index of 0.20 to 1.2 gm. per 10 minutes using procedure A, condition E of ASTM D 1238. The filled container shall be closed tightly with rigid plastic fittings to prevent leakage of contents.

5.1.2 Commercial. Preservation shall be in accordance with MIL-STD-1188.

5.2 Packing. Packing shall be level A, B and Commercial (see 6.2).

5.2.1 Level A.

5.2.1.1 One quart and one gallon quantities. Twelve one quart or six one gallon bottles of antifreeze unit packed as specified in 5.1.1.1 and 5.1.1.2 respectively shall be packed within a close fitting box conforming to PPP-B-601, type overseas, or PPP-B-621, class 2, as specified in PPP-C-186 for level of packing of group A, class 2, style 1. Interlocking partitions, fabricated from fiberboard shall be utilized to separate bottles as required.

5.2.1.2 Five gallon and fifty-five gallon quantities. The five and fifty-five gallon quantities shall require no further packing than that specified in 5.1.1.3 and 5.1.1.4 respectively.

5.2.2 Level B.

5.2.2.1 One quart and one gallon quantities. Packing shall be as specified in 5.2.1.1, except exterior box shall conform to PPP-B-636, class weather resistant, V3c.

5.2.3 Commercial. Packing shall be in accordance with MIL-STD-1188.

5.3 Marking. Level A and pallet loads shall be marked in accordance with MIL-STD-129. Commercial containers and pallet loads shall be marked in accordance with MIL-STD-1188. In addition each container shall be marked with the information shown in diagram 1.

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5.4 Protection table and radiator tags. Unless otherwise specified by the procuring agency, protection tables and radiator tags for the anti-freeze shall be provided on, or with, containers of antifreeze in the following quantities. Not less than 4 tags or labels shall be furnished with each 24 one quart containers or 6 one gallon containers, 3 tags or labels with each 5 gallon container and 20 tags or labels with each 55 gallon container. Pressure sensitive labels may be used in lieu of radiator tags. Radiator tags shall conform to type B, grade 20R, wire strung size 5 of UU-T-81 and shall be marked on side 1 and 2 as shown in figure 2. Radiator labels shall conform to MIL-F-16377 except that the adhesive shall be water-insoluble, pressure-sensitive, and protected by release paper backing. These labels shall be 2-3/8 in. wide and 5-7/8 in. long  $\pm$  1/16 (6 cm by 15 cm  $\pm$  2mm) and shall be marked as shown in figure 3.

5.5 Palletization. When specified in the contract or order (see 6.2), like packs of one quart, one gallon, and five gallon quantities shall be palletized. Level A packs shall be palletized in accordance with the applicable requirements including those for opaque shrink film bonding of MIL-STD-147, using the pallet conforming to type IV, size 2 of NN-P-71. The alternate five gallon polyethylene container conforming to MIL-D-43703 shall be palletized using the vertical frame supports in the form of side frames, storage aid 10, and frame supports, storage aid 13 with the wood cap storage aid 5. A maximum of 24 five gallon drums shall be placed on a pallet. Commercial packs shall be palletized to meet the basic requirements for packing as specified in MIL-STD-1188.

## 6. NOTES

6.1 Intended use. Inhibited ethylene glycol is intended for use in the cooling systems of liquid-cooled internal combustion engines, other than aircraft, for protection against freezing in ambient temperatures as low as minus 55°F. when diluted to 60 percent by volume with water. It may also be used as a **coolant** in some types of automatic guns such as water-cooled machine guns. This antifreeze is intended for use in lieu of type 1 of O-A-548. This antifreeze is essentially type 1 of O-A-548 plus inhibitor conforming to O-1-490.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Unit quantities required (see 5.1.1 and 5.1.2)
- (c) Level of packaging and packing required (see 5.1 and 5.2)
- (d) Marking required (see 5.3).
- (e) Palletization required (see 5.5).
- (f) Special color containers if required (see section 5).

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6.3 Additive to plastic containers. An additive which is known to be effective in excluding ultraviolet light from the interior of polyethylene containers is phthalocyanine blue.

Custodians:

Army - MR  
Navy - SH  
Air Force - 68

Preparing activity:

Army - MR

(Project No. 6850-0638)

Review activities:

Army - AT, MU, SM  
Air Force - 68  
DSA - GS

User activities:

Army - ME  
Navy - SH, MC  
Air Force - 68

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**DIRECTIONS**

Before installation, inspect cooling system, repair leaks and replace worn parts. If solution or system is dirty, flush thoroughly. Install antifreeze coolant as required; see table. Add fresh water to within one inch of overflow. Immediately (and before driving) run engine to normal driving temperature (or until thermostat opens) with heater on full. This mixes solution to prevent freezing and releases trapped air. If necessary add more water. Check solution level and concentration periodically. If level falls without visible leakage check for internal leaks which may cause serious damage with any type of antifreeze coolant. Add antifreeze coolant and fresh water as required.

**WARNING**

**HARMFUL OR FATAL IF SWALLOWED.** Do not drink antifreeze or solution. If swallowed, induce vomiting immediately. Call a physician. Ethylene glycol base. Do not store in open or unlabeled containers. **KEEP OUT OF REACH OF CHILDREN.**

**CAUTION**

Protect from freezing. The materials as packaged will freeze at temperatures below 0°F. Freezing will not damage the material but may damage the inner polyethylene container. For necessary dilution for freeze protection, consult protection table.

Insert quantity

**U.S. GOVERNMENT PROPERTY**

**ETHYLENE GLYCOL anti-freeze**

STOCK NO. Insert Stock No.

CONTRACT NO. Insert Contract No.

Insert manufacturers name and address

**WARNING**  
HARMFUL OR FATAL IF SWALLOWED

**PROTECTION CHART**

Cooling System Capacity in Quarts	ANTI-FREEZE REQUIRED* (IN QUARTS)											
	2	3	4	5	6	7	8	9	10	11	12	13
5	-10	-9										
6	1	-30	-73									
7	9	-15	-46									
8		-5	-30	-61								
9		1	-19	-43	-73							
10		6	-10	-30	-55	-82						
11		10	-4	20	-41	-64						
12			1	-13	-30	-51	-73					
13			5	-7	-22	-38	-68	-80				
14			9	-2	-15	-30	-47	-67				
15				1	-10	-23	-38	-55	-73			
16				5	-5	-17	-30	-45	-61	-79		
17				7	-1	-12	-24	-37	-52	-67		
18				9	1	-8	-19	-30	-43	-57	-73	
19					4	-4	-14	-24	-36	-49	-63	-78
20					6	-1	-10	-19	-30	-42	-55	-68
21					9	2	-7	-15	-25	-36	-47	-59
22						4	-4	-11	-20	-30	-41	-52
23						6	-1	-8	-16	-25	-35	-46
24						8	1	-6	-13	-21	-30	-40

**TEMPERATURES SHOWN IN DEGREES FAHRENHEIT**

Anti-freeze: 25% 32% 40% 50% 60% 68%  
Protein is: -12 +2 -10 -20 -50 -77

NOTE: Do not use without same water base protection.  
\* Use at least 32% concentration for protection against rust and corrosion.





## Attach Near Radiator Filler Neck

This Cooling System Contains Ethylene Glycol Base Antifreeze U. S. Government MIL-A-46153

**DO NOT OVERFILL**

REPLACE AFTER ONE YEAR'S USE

DATE INSTALLED \_\_\_\_\_

Speedometer Mileage \_\_\_\_\_

Quarts put in \_\_\_\_\_

Protects to \_\_\_\_\_ °F.

Installed by \_\_\_\_\_



PROTECTION CHART																							
Cooling System Capacity in Quarts	ANTI FREEZE REQUIRED* (IN QUARTS)																						
	2	3	4	5	6	7	8	9	10	11	12	13											
5	-19	-49	Antifreeze: 33% 33% 40% 50% 60% 60%																				
6	1	-30	-73	Protects to: 17° 1° -10° -20° -27° -37°																			
7	8	-15	-48	Note: Do not use without some water; 60% concentration gives maximum freeze protection.																			
8		-5	-23	-61	*Use at least 33% concentration for protection against rust and corrosion.																		
9		1	-19	-43	-73																		
10		6	-10	-23	-55	-82																	
11		10	-4	-20	-41	-64																	
12			1	-13	-20	-51	-73																
13			5	-7	-22	-39	-58	-80															
14			8	-3	-15	-30	-47	-67															
15				1	-10	-23	-35	-55	-73														
16				5	-5	-17	-30	-43	-61	-79													
17				7	-1	-12	-24	-37	-52	-67													
18				9	1	-8	-19	-32	-43	-57	-73												
19				4	-4	-14	-24	-35	-49	-63	-78												
20				8	-1	-10	-19	-28	-42	-55	-69												
21				9	2	-7	-15	-25	-36	-47	-59												
22				4	-4	-11	-20	-30	-41	-52													
23				8	-1	-8	-18	-25	-35	-46													
24				8	1	-8	-13	-21	-30	-40													
TEMPERATURES SHOWN IN DEGREES FAHRENHEIT																							

Side 2

Figure 2. TAG

## Attach Near Radiator Filler Neck

This Cooling System Contains Ethylene Glycol Base Antifreeze U. S. Government MIL-A-46153

**DO NOT OVERFILL**

REPLACE AFTER ONE YEAR'S USE

DATE INSTALLED \_\_\_\_\_

Speedometer Mileage \_\_\_\_\_

Quarts put in \_\_\_\_\_

Protects to \_\_\_\_\_ °F.

Installed by \_\_\_\_\_

PROTECTION CHART																							
Cooling System Capacity in Quarts	ANTI FREEZE REQUIRED* (IN QUARTS)																						
	2	3	4	5	6	7	8	9	10	11	12	13											
5	-10	-49	Antifreeze: 33% 33% 40% 50% 60% 60%																				
6	1	-30	-73	Protects to: 17° 1° -10° -20° -27° -37°																			
7	8	-15	-48	Note: Do not use without some water; 60% concentration gives maximum freeze protection.																			
8		-5	-23	-61	*Use at least 33% concentration for protection against rust and corrosion.																		
9		1	-19	-43	-73																		
10		6	-10	-23	-55	-82																	
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13			5	-7	-22	-39	-58	-80															
14			8	-3	-15	-30	-47	-67															
15				1	-10	-23	-35	-55	-73														
16				5	-5	-17	-30	-43	-61	-79													
17				7	-1	-12	-24	-37	-52	-67													
18				9	1	-8	-19	-32	-43	-57	-73												
19				4	-4	-14	-24	-35	-49	-63	-78												
20				8	-1	-10	-19	-28	-42	-55	-69												
21				9	2	-7	-15	-25	-36	-47	-59												
22				4	-4	-11	-20	-30	-41	-52													
23				8	-1	-8	-18	-25	-35	-46													
24				8	1	-8	-13	-21	-30	-40													
TEMPERATURES SHOWN IN DEGREES FAHRENHEIT																							

Figure 3. LABEL