

MIL-A-11755D  
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 SUPERSEDING  
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## MILITARY SPECIFICATION

### ANTIFREEZE, ARCTIC-TYPE

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 in regions of very low ambient temperatures (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

- L-P-390 - Plastic Molding and Extrusion Material, Polyethylene and Copolymers (Low, Medium, and High Density)
- O-C-265 - Chemicals, Analytical; General Specification for
- O-S-642 - Sodium Phosphate, Tribasic, Technical, Anhydrous, Dodecahydrate, and Monohydrate
- NH-P-71 - Pallet, Material Handling, Wood, Stringer Construction, 2 Way and 4 Way (Partial)
- SS-S-535 - Sodium Borate, Decahydrate, Technical (Borax)
- UU-T-81 - Tag, Shipping and Stock
- ZZ-N-428 - Hose, Rubber; Preformed and Straight; Hose, Preformed; Flexible, Wire-Reinforced (For the Cooling Systems of Automotive and Other Liquid-Cooled Engines)
- PPF-B-585 - Box, Wood, Wirebound
- PPF-B-601 - Box, Wood, Glued Plywood
- PPF-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.

**MIL-A-11755D**

- PPP-B-640 - Box, Fiberboard, Corrugated, Tripple-Wall
- PPP-C-96 - Cans, Metal, 28 Gage and Lighter
- PPP-C-569 - Containers, Plastic, Molded (For Liquids, Pastes and Powders); Overpacked
- PPP-C-1337 - Containers, Metal with Polyethylene Inserts
- PPP-D-729 - Drums, Metal, 55-Gallon (For Shipment of Non-Corrosive Materials)
- PPP-D-760 - Drums and Pails, Metal (5 and 16.64 Gallons)
- PPP-F-320 - Fiberboard, Corrugated and Solid (Container Grade) and Cut Shapes
- PPP-P-704 - Pail, Metal (Shipping, Steel, 1 Through 12 Gallon)
- PPP-T-60 - Tape, Packaging, Waterproof

**MILITARY**

- MIL-P-116 - Preservation-Packaging, Methods of
- MIL-C-5501/7 - Cap and Plug, Protective, Dust and Moisture Seal (Cap Plug, General Purpose)
- MIL-F-16377 - Fixture, Lighting, and Associated Parts Shipboard Use, General Specification for
- MIL-B-26701 - Bottles, Screwcap and Carboys, Polyethylene Plastic
- MIL-D-43703 - Drum, Shipping and Storage, Molded Polyethylene

**STANDARDS****FEDERAL**

Fed. Std. No. 356 - Commercial Packaging of Supplies and Equipment

**MILITARY**

- 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 of Pallet-Type Base

(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.

MIL-A-11755D

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS**

- D 92 - Flash and Fire Points by Cleveland Open Cup, Test for
- D 119 - Rubber Insulating Tape, Specification for
- D 445 - Kinematic Viscosity of Transparent and Opaque Liquids (And the Calculation of Dynamic Viscosity), Test for
- D 1119 - Ash Content of Engine Antifreezes, Antirusts, and Coolants
- D 1121 - Reserve Alkalinity of Engine Antifreezes, Test for
- 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 2240 - Rubber Property-Durometer Hardness

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

**NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT**

**National Motor Freight Classification**

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., Agent, 1616 P Street, N.W., Washington, DC 20036.)

**UNIFORM CLASSIFICATION COMMITTEE, AGENT**

**Uniform Freight Classification**

(Application for copies should be addressed to the Uniform Classification Committee, Tariff Publishing Officer, Room 202 Union Station, 516 W. Jackson Boulevard, Chicago, IL 60606.)

**CODE OF FEDERAL REGULATIONS**

- 49 CFR 171-179 - Department of Transportation Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles

(The Code of Federal Regulations (CFR) are for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

**GLASS CONTAINERS MANUFACTURERS' INSTITUTE STANDARDS**

(Application for copies should be addressed to the Society of the Plastics Industry, Inc., 250 Park Avenue, New York, NY 10017.)

MIL-A-11755D

### 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 not be affected by storage for periods of up to 6 months (see 4.6) 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.

**3.2 Rust inhibitor.** The rust inhibiting material used in the antifreeze compound shall be a blend of materials as specified in table I.

Table I. Chemical composition of corrosion inhibitor

Component	Composition, by weight percent of total antifreeze	Applicable test paragraph
Borax (sodium tetraborate decahydrate)	2.50 ± 0.20	4.5.9
SS-S-535 type II		
Trisodium phosphate calculated as dodecahydrate	0.37 ± 0.04	4.5.10
Sodium salt of mercaptobenzoethiazole solution (normally supplied as a 50% aqueous solution by weight)	0.46 ± 0.05	4.5.11

**3.3 Color.** The antifreeze compound shall be colored fluorescent yellow or yellow orange and the color shall be stable after use. The antifreeze color shall be comparable to that produced by adding 0.36 gram of Acid Red 87 (Color Index No. 45380) dye per gallon of antifreeze compound (see 6.3).

#### 3.4 Physical requirements.

**3.4.1 Boiling point.** The equilibrium boiling point of the antifreeze compound shall be not lower than 110°C (230°F), when determined as specified in 4.5.1.

**3.4.2 Flash point.** The flash point of the antifreeze compound shall be not lower than 68.3°C (155°F), when determined as specified in 4.5.2.

**3.4.3 Freezing point.** The freezing point of aqueous solutions of varying concentrations of the compound, shall be as specified in table II. The freezing point shall be determined as specified in 4.5.3.

MIL-A-11755D

Table II. Freezing point of aqueous solutions of the compound

Concentration, % by volume, of the antifreeze compound	Freezing point
90	Not above minus 60°F (-51°C.)
60	Not above minus 5°F (-21°C)

3.4.4 Compatibility.

3.4.4.1 With water. The antifreeze compound shall be completely miscible with water, in all proportions. Aqueous solutions of the compound in the concentrations specified in table II, shall show no precipitation or liquid separation, when tested as specified in 4.5.4.1. A slight turbidity is allowed.

3.4.4.2 With reference solutions. The solutions obtained by mixing 1 part by volume of the antifreeze compound with 1 part of each of the reference solutions specified in table III shall show no precipitation or liquid separation, when tested as specified in 4.5.4.2.

Table III. Composition, by weight, of the reference solutions

Component	Reference solution, %		
	A	B	C
Ethylene glycol <sup>1/</sup>	54.95	54.95	54.95
Distilled or deionized water	31.90	31.90	31.90
Ethylene glycol monomethyl ether <sup>2/</sup>	9.70	--	--
Ethylene glycol monoethyl ether <sup>3/</sup>	--	9.70	--
Diethylene glycol monomethyl ether <sup>4/</sup>	--	--	9.70
Sodium tetraborate decahydrate (Borax) <sup>5/</sup>	2.50	2.50	2.50
Trisodium phosphate dodecahydrate <sup>6/</sup>	0.40	0.40	0.40
Sodium salt of mercaptobenzothiazole solution <sup>7/</sup>	0.50	0.50	0.50
Antifoaming agent <sup>8/</sup>	0.05	0.05	0.05

<sup>1/</sup>The ethylene glycol used in the reference solutions shall be Analyzed Reagent grade conforming to the latest commercial practice.

<sup>2/</sup>The ethylene glycol monomethyl ether used in the reference solutions shall be Analyzed Reagent grade procured under O-C-265 with requirements conforming to nonmonograph section, USP, latest edition.

<sup>3/</sup>The ethylene glycol monoethyl ether used in the reference solutions shall be Analyzed Reagent grade procured under O-C-265 with requirements conforming to nonmonograph section, USP, latest edition.

MIL-A-11755D

- 4/ The diethylene glycol monomethyl ether used in the reference solutions shall be Reagent Grade conforming to the latest commercial practice.
- 5/ Borax used in the reference solutions shall be technical grade granular sodium tetraborate, conforming to SS-8-535.
- 6/ The trisodium phosphate dodecahydrate used in the reference solution shall conform to O-S-642.
- 7/ The sodium salt of mercaptobenzothiazole solution shall be a 50% aqueous solution by weight.
- 8/ The antifoaming agent shall be of the polyoxyalkylene glycol type such as Pluronic L-61 supplied by BASF, Wyandotte Inc., Wyandotte, MI, or equal.

3.4.5 Kinematic viscosity. The kinematic viscosity of the antifreeze compound shall be not more than 1750 centistokes at minus 54°C (-65°F), when determined as specified in 4.5.5.

3.4.6 Foaming. When tested as specified in paragraph 4.5.6, the volume of foam and "break time" shall not exceed the values of at least 1 of the reference solutions (see table III) similarly tested.

### 3.5 Chemical requirements.

3.5.1 pH value. The pH value of the antifreeze compound, and of a 60% aqueous solution by volume of the antifreeze compound, shall be within the range of 7.0 to 8.5, when determined as specified in 4.5.7.

3.5.2 Reserve alkalinity. The reserve alkalinity of the antifreeze compound shall be within the range of 13.5 to 18.5, when determined as specified in 4.5.8.

3.5.3 Ash. The ash content of the antifreeze compound shall be within the range of 0.7 to 1.3 percent, by weight, when tested as specified in 4.5.12.

3.5.4 Odor. The antifreeze compound shall emit no offensive pungent odor when heated to its boiling point, as specified in 4.5.13.

3.6 Rubber softening. The rubber softening caused by the antifreeze compound, when tested as specified in 4.5.14, shall not exceed the softening caused by at least 1 of the reference solutions (see table III) similarly tested.

3.7 Alkaline earths. When tested as specified in 4.5.15, no immediate precipitate shall form.

MIL-A-11755D

3.8 Sulfates and carbonates. When tested as specified in 4.5.16, there shall be no undissolved precipitate or effervescence, a slight turbidity is allowed.

3.9 Chlorides. The antifreeze when tested as specified in 4.5.17 shall give a negative test for chlorides.

3.10 Workmanship. The antifreeze compound shall be processed in accordance with the best commercial practices so as to produce a clean, homogeneous and uniform product.

#### 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 considered 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 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 all stipulations with respect to uniformity, 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.

MYL-A-11755D

4.3.4 Examination of preparation for delivery. 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. 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.

4.3.6 Reduced testing. Unless otherwise specified, reduced testing may be performed on the lot if the supplier has previously tested and furnished satisfactory material under this specification. The supplier shall certify that the lot of material furnished is manufactured under the same conditions using the same formulation and raw materials as previously tested and conforming to all requirements of this specification. The following minimum testing shall be performed:

Freezing point	4.5.3
pH value	4.5.7
Reserve alkalinity	4.5.8
Ash content	4.5.12

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 Boiling point. Place 60 ml of the antifreeze compound in a 100 ml round-bottom flask, having a female ground-glass joint and a side tube through which a calibrated 304°C(580°F) thermometer is inserted until it reaches within 6mm (1/4 inch) of the center of the bottom of the flask. Two or three boiling stones, such as 8-grit silicon carbide, should be used to prevent bumping. A small straight glass tube water-cooled reflux condenser, having a minimum jacket length of 200mm, and male ground drip-tip glass joint, shall



MIL-A-11755D

be fitted to the flask. The material shall then be heated to boiling. The rate of reflux shall be adjusted over a 10 minute period to 1 to 2 drops of reflux per second. ~~The desired rate of reflux shall be maintained for 5 minutes.~~ The temperature reading at this time shall be considered the boiling point of the material. Correct all temperature readings to  $1.01325 \times 10^5$  Pascal (Pa).

4.5.2 Flash point. The flash point shall be determined by ASTM D 92.

4.5.3 Freezing point. The freezing points of the solutions of the compound in the concentrations specified in table II, shall be determined by means of the apparatus and procedure specified in ASTM D 1177 with the following modifications.

4.5.3.1 Freezing tube. The freezing tube shall be a 200 ml air jacketed Dewar flask with a side tube for evacuating the air jacket. The freezing tube shall have a seeding tube at the bottom so that a very small quantity of the test materials is exposed to the temperature of the cooling bath. The tube shall be fitted with a 2-hole cork stopper for inserting a thermometer and the rod of the stirring mechanism.

4.5.3.2 Temperature measuring device. A resistance thermometer or other suitable temperature measuring device, having an overall sensitivity of  $0.1^\circ\text{C}$  ( $0.2^\circ\text{F}$ ) in the range specified in table II shall be used. A thermometer of the liquid-in-glass type such as ASTM 119C or 119F may be used provided it has been calibrated against reference standards.

4.5.4 Compatibility.

4.5.4.1 With distilled water. The aqueous solutions of the compound used in the determination of the freezing points (see 4.5.3), shall be allowed to warm to room temperature (approximately  $77^\circ\text{F}$  or  $25^\circ\text{C}$ ), without agitating the samples, and examined for appearance. The samples shall then be transferred to 125 ml oil sample bottles, stoppered with corks, and kept for  $24 \pm 2$  hours in an oven maintained at  $82^\circ \pm 3^\circ\text{C}$  ( $180^\circ \pm 5^\circ\text{F}$ ). Exposure to light shall be kept to a minimum. At the end of this period the samples shall again be examined for appearance.

4.5.4.2 With reference solutions. One hundred milliliters of 1-to-1 mixtures (by volume) of the antifreeze compound and each of the reference solutions specified in table III (see 3.4.4.2) shall be placed in 125 ml oil sample bottles, and exposed for  $24 \pm 2$  hours at minus  $68^\circ\text{C}$  ( $-90^\circ\text{F}$ ). At the end of this period the samples shall be examined for appearance. The samples shall then be allowed to warm to room temperature (approximately  $77^\circ\text{F}$  or  $25^\circ\text{C}$ ) and again examined for appearance. The samples shall then be heated for  $24 \pm 2$  hours in an oven maintained at  $82^\circ \pm 3^\circ\text{C}$  ( $180^\circ \pm 5^\circ\text{F}$ ). At the end of which they shall be again examined for appearance. During this procedure, exposure to light shall be kept to a minimum.

MIL-A-11755D

4.5.5 Kinematic viscosity. The kinematic viscosity of the antifreeze compound shall be determined by ASTM D 445.

4.5.6 Foaming test. The antifreeze shall be tested for foaming tendencies by ASTM D 1881. The test shall be conducted on the concentrated packaged material.

4.5.7 pH value. The pH value shall be determined electrometrically using the procedure specified in ASTM D 1287.

4.5.8 Reserve alkalinity. The reserve alkalinity shall be determined electrometrically, using the procedure specified in ASTM D 1121. Calculations shall be based on the antifreeze solution as supplied.

4.5.9 Borax.

4.5.9.1 Qualitative test. Place 10 ml of the antifreeze compound in a 500 ml Erlenmeyer flask. Add 10 ml of anhydrous methanol and 10 ml of concentrated sulfuric acid. Fit the flask with a 1-hole rubber stopper, and insert a 152mm (6 inch) piece of 6mm O.D. glass tubing through the stopper until the end of the tubing protrudes approximately 6mm from the bottom of the stopper. Place the other end of the tubing into a 102mm (4-inch) piece of 12mm O.D. glass tubing which shall serve as a test chimney. The Assembled apparatus shall then be heated until the solution boils. The vapor escaping from the test chimney shall then be ignited. The presence of borax is indicated by a green-colored flame produced by the ignited vapors.

4.5.9.2 Quantitative test.

4.5.9.2.1 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 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°C (68°F) 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 milliequivalent of NaOH = 0.09537 grams of  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ .

MIL-A-11755D

#### 4.5.9.2.2 Calculation of borax.

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

#### 4.5.10 Trisodium phosphate dodecahydrate.

4.5.10.1 Procedure. Accurately weigh approximately 50 gms of antifreeze to 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 4.5.10.2). 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.

4.5.10.2 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 one liter in a volumetric flask.

#### 4.5.10.3 Calculation of trisodium phosphate dodecahydrate.

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

#### 4.5.11 Sodium salt of mercaptobenzothiazole solution (NaMBT plus H<sub>2</sub>O, 50% by weight).

4.5.11.1 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 a 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 (221° to 248°F) to constant weight.

MIL-A-11755D

4.5.11.2 Calculation of sodium salt of mercaptobenzothiazole solution.

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

4.5.12 Ash. The ash content of the antifreeze shall be determined according to the procedure specified in ASTM D 1119.

4.5.13 Odor. Heat a small portion of the antifreeze compound in an open beaker until it boils. Note if any offensive pungent odor is emitted from the boiling material.

4.5.14 Rubber softening. The following materials, apparatus, and procedure shall be used in determining the rubber-softening property of the antifreeze compound and of the reference solutions.

4.5.14.1 Rubber hose. Three specimens of hose shall be used for each immersion test in the antifreeze compound and in the reference solutions. The hose shall conform to type I, II or III, grade A, class 2 or 4 of ZZ-H-428. The outside diameter of the hose shall be approximately 51mm (2 inches). Each hose specimen shall consist of a 13mm (1/2 inch) wide ring of hose, split crosswise so that it may be opened.

4.5.14.2 Procedure.

4.5.14.2.1 Hardness (Shore durometer). The hardness of each hose specimen shall be determined, before and after the immersion test, on the inside surface of the hose tube using the Shore A durometer apparatus detailed in ASTM D2240. The durometer shall be grasped between the thumb and forefinger of one hand, with the thumb resting against the penetrator, and the dial facing the operator. The thumb of the other hand shall be placed over the thumb resting on the penetrator, and full pressure exerted with both hands. (Note: Reproducible results can be obtained with a little practice, by placing the tip of the thumbs in line with the penetrator.)

4.5.14.2.2 Immersion. Place 3 specimens (split rings) of the rubber hose in each of four 1-pint glass jars having tight fitting lids (Mason jar type). Add 100 ml of the test antifreeze and each of the reference solutions (table III) to separate jars. Tighten the lids on the jars and place in an oven maintained at  $71^{\circ} \pm 3^{\circ}\text{C}$  ( $160^{\circ} \pm 5^{\circ}\text{F}$ ) for  $120 \pm 2$  hours. At the end of the heating period the hose specimens shall be removed from the jars, rinsed with tap water, followed by ethyl alcohol, and dried by blowing compressed air over them. A durometer reading shall be made on each specimen as soon as the specimens are dried. The durometer readings on the hose specimens from each reference solution shall be compared with those obtained on the specimens from the test antifreeze.

MIL-A-11755D

4.5.15 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.

4.5.16 Sulfate 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.

4.5.17 Chlorides. Place 10 ml of the material in a 30 ml test tube, add 10 ml of distilled water and mix thoroughly. Add 10 drops of concentrated nitric acid, agitate and add 2 ml of a 3 percent aqueous solution of silver nitrate. Filter and discard the filtrate. Wash the residue with concentrated ammonium hydroxide, recover the filtrate and acidify with concentrated nitric acid. No precipitate indicates absence of chlorides. A slight turbidity is allowed.

#### 4.6 Stability.

4.6.1 The manufacturer shall certify that the formula supplied under this specification has been stored for a minimum of 6 months in the containers furnished with the contract or order 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 (Unit Packing). Packaging shall be level A, B, or commercial as specified. (see 6.2)

#### 5.1.1 Level A

5.1.1.1 One-gallon quantity. One US gallon (gal) of antifreeze shall be packaged in a nominal 1-gal capacity polyethylene, metal, or composite polyethylene-fiberboard container as specified by the procuring activity. The polyethylene container shall conform to MIL-B-26701, except that a compact commercial container meeting the ultraviolet light restriction requirements specified below and not complying with color and shape requirements, shall be acceptable. Also, an additive shall be used in the polyethylene of the MIL-B-26701 bottle, which shall yield a bottle of which no portion shall transmit more than one (1) percent of ultraviolet light at any wave length in the range of 310 to 325 nanometers (nm) when tested using a calibrated spectrophotometer with air as a reference. Each container shall be furnished with a leak-proof inner seal. The metal container shall conform to type 1, class 3 of PPP-C-96. The can shall be formed from commercial designation minimum No. 25 electrolytic tinplate. The minimum plate base weight for the ends shall be 100, and for the body 107 pounds. The inside surface of the metal container shall be coated with an organic coating which shall neither affect nor be affected by the antifreeze.

MIL-A-11755D

The composite polyethylene-fiberboard container shall conform to type I, class B of PPP-C-569 and the following requirements: Each bottle shall be furnished with a nonintegral spout, injection molded from virgin natural, high density polyethylene conforming to class A, grade 3 of MIL-P-22748; or medium density polyethylene conforming to type I, class M, grade 2, category 5 of L-P-390. The spout shall be designed and sized to conform to Glass Container Manufacturers' Institute Standards as modified by the Society of the Plastics Industry, Inc., for a nominal 38 millimeter diameter screw-cap, and having a minimum of 1-1/2 turns of a buttress thread. The inner surface and top rim of the spout shall be properly sized, sufficiently smooth, and concentric to form a leak-proof mating surface with the plug which is inserted after filling. A snug-fitting plug conforming to MIL-C-5501/7 shall be inserted in the opening of the spout of the filled bottle, until the underside of the shoulder of the plug is in full contact with the top rim of the spout. Before applying the screw-cap, the exterior of the filled bottle shall show no signs of leakage of antifreeze when positioned upright and then inverted. The plug shall then be secured tightly in place in the spout by an extra-length-nominal 38 millimeter diameter buttress screw-thread-cap designed to match the spout. Each container shall be closed as specified in the appendix to the applicable specification, except as otherwise specified above.

**5.1.1.2 Five-gallon quantity.** Five US gal of antifreeze shall be packaged in a nominal 5-gal capacity polyethylene, metal or composite polyethylene-metal container. The polyethylene container shall conform to size I of MIL-D-43703 or Department of Transportation (DOT) specification 34, except that the requirements of 5.1.1.1 pertaining to restriction of ultraviolet light shall apply, and compact commercial containers, meeting all other requirements of these specifications except those of configuration, shall be acceptable. Four integral rolling rings or reinforcing bands, located circumferentially in the sides of the polyethylene drum, shall be required. The metal container shall conform to class 5 of PPP-P-704 and shall be completely lined with an organic coating which shall neither affect nor be affected by the antifreeze. The composite metal-polyethylene container shall conform to type II, class 1 of PPP-C-1337. The filled containers shall be closed, preventing leakage as specified in the applicable specification, and shall be fitted with a pilferage deterrent outer or inner seal for each closure. Tags or labels shall be secured to each container (see 5.4).

**5.1.1.3 Fifty-five gallon quantity.** Fifty-five US gal of antifreeze shall be packaged in a nominal 55-gal capacity metal or composite polyethylene-metal container. The metal drum shall conform to type II of PPP-D-729 or to rule 40, tighthead, of the Uniform Freight Classification (UFC). The rule 40 drum shall be cleaned, phosphatized and painted as specified for the PPP-D-729 drum. Both the rule 40 and PPP-D-729 drums shall be furnished with an organic lining and closures as specified for the PPP-D-729 drum. The composite polyethylene-metal drum shall conform to type II, class 4 of PPP-C-1337. Each of the specified drums shall be closed, preventing leakage as specified in the applicable specification. Each drum having exposed closures shall be furnished with pilferage deterrent outer seals. Tags or labels shall be secured to each drum (see 5.4).



MIL-A-11755D

**5.1.2 Level B (Same as Level A).**

**5.1.3 Commercial.** Antifreeze in the quantity specified (see 6.2) shall be unit packed in accordance with Fed. Std. No. 356.

**5.2 Packing.** Packing shall be level A, B, or commercial as specified (see 6.2).

**5.2.1 Level A.****5.2.1.1 One-gallon quantity.**

**5.2.1.1.1 Polyethylene containers.** Six 1-gal polyethylene containers of antifreeze of 5.1.1.1 shall be packed upright in a close-fitting box conforming to class 3, style optional of PPP-B-585, overseas type, style A, B or I of PPP-B-601, class 2, style 4 of PPP-B-621 or for Navy consignees, in a box conforming to class 2, style A of PPP-B-640. Each box shall be for a type 2 average load, and shall be furnished with full bottle-height partitions between each bottle. All inside surfaces of each box shall be lined with fiberboard. Partitions and fiberboard lining shall be formed from material conforming to grade V3c of PPP-F-320. Tags or labels shall be included in each pack (see 5.4).

**5.2.1.1.2 Metal containers.** Six metal containers of antifreeze of 5.1.1.1 shall be packed upright as specified for the polyethylene bottles of 5.2.1.1.1. Tags or labels shall be included in each pack (see 5.4).

**5.2.1.1.3 Composite polyethylene-fiberboard containers.** Six composite polyethylene-fiberboard containers of 5.1.1.1 shall be packed upright as specified for level A packing in the appendix to PPP-C-569, except that for Navy consignees, the box shall conform to class 2, style A of PPP-B-640. Tags or labels shall be included in each pack (see 5.4).

**5.2.1.2 Five-gallon and 55-gallon quantities.** The 5- and 55-gal quantities of 5.1.1.2 and 5.1.1.3, respectively, shall require no further protection for shipment.

**5.2.2 Level B (Same as Level A).**

**5.2.3 Commercial.** Antifreeze in the quantity specified (see 6.2) shall be packed together with tags and labels (see 5.4) in accordance with Fed. Std. No. 356.

**5.3 Marking.** Level A and B marking shall be in accordance with MIL-STD-129 and in accordance with Fed. Std. No. 356 for commercial. In addition, each container shall be marked to show the lot number and date of manufacture and the following:

**"INSTRUCTIONS FOR USE."**

For use at temperatures of minus 40°F to minus 90°F (-40°C to -68°C).  
DO NOT DILUTE - USE AS PACKAGED.

**MIL-A-11755D**

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 instructions) to within 25mm (1 inch) of overflow. Immediately (and before driving) run engine to normal driving temperature (or until thermostat opens) with heater on full. This releases trapped air. If necessary, add more antifreeze. Check solution level 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 as required.

**WARNING.**

**HARMFUL OR FATAL IF SWALLOWED.** Do not drink antifreeze. 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.**

**5.4 Radiator tags.** Unless otherwise specified by the procuring agency, radiator tags for the antifreeze shall be provided on, or with, containers of antifreeze in the following quantities: Not less than 4 tags or labels with each 5-gal container and 40 tags or labels with each 55-gal 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 1 (see inclosure 1). Radiator labels shall conform to MIL-P-16377, except that the adhesive be water-insoluble, pressure-sensitive, and protected by release paper backing. These labels shall be 60mm wide and 150mm long  $\pm$  2mm (2-3/8 inches by 5-7/8 inches  $\pm$  1/16 inch) and shall be marked as shown in figure 2 (see inclosure 1). Tags or labels shall be packaged together in a bag, method IC-3 of MIL-P-116. The bag shall be placed in the box or on the drum, as applicable. When placed in a box, the bag shall be placed flat on the top of the contents and beneath the box flaps. When placed on the drum, it shall be secured to the drum with tape conforming to type V, class 1 of PPP-T-60, in an area not normally exposed to abrasion.

**5.5 Palletization.** When specified in the contract or order (see 6.2), like packs of 1-gal and 5-gal quantities shall be palletized. Level A and B packs shall be palletized in accordance with the applicable requirements, including those for opaque shrink film bonding of MIL-STD-147, using new, unused seasoned softwood or hardwood pallets conforming to type IV of MN-P-71. Polyethylene containers, with or without fiberboard overpack, shall be palletized using an open wood sheathing cap (Storage Aid 5) over the load and an inverted-like cap beneath the load, fastened to side frames (Storage Aid 10) as specified in MIL-STD-147. A maximum of 24 5-gal drums shall be placed on each pallet. Excess shipping containers which do not constitute a full pallet course, but having a combined gross weight of 91 kilograms (200 pounds) or more, shall be prepared for shipment in a manner assuring transport of the containers in a unitized state from



MIL-A-11755D

initial source to ultimate activation. The containers shall be consolidated in such a manner that the load can be moved by forklift truck or other mechanical means. Excess shipping containers which do not constitute a full pallet course but having a combined gross weight of 90.5 kilograms (199 pounds) or less may be consolidated as specified above or may be shipped as individual containers.

## 6. NOTES

6.1 Intended use. Arctic-type nonvolatile antifreeze compound is intended for use in the cooling system of liquid cooled internal combustion engines for protection against freezing in regions where the ambient temperature remains for extended periods of time close to minus 40°F (-40°C), but may drop as low as minus 90°F (-68°C). This material may also be used as a heat transfer liquid for military applications where low temperatures are encountered.

6.2 Ordering data. Purchasers should exercise any desired options offered herein and procurement documents should specify the following:

- a. Title, number and date of this specification.
- b. Unit quantities required (see 5.1).
- c. Degree of preservation 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).
- g. Type of container (see 5.1.1).

6.3 The Color Index, published by The American Association of Textile Chemists and Colorists, lists the commercial names and manufacturers of dyes conforming to Acid Red 87 (Color Index No. 45380).

6.4 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.

MIL-A-11755D

6.5 The reserve alkalinity of antifreeze which has been stored for periods longer than 6 months shall be tested before use by means of test kit, reserve alkalinity, FSN 6630-169-1506. If the reserve alkalinity test strip shows green or yellow the antifreeze shall be discarded.

**Custodians:**

Army - MR  
Navy - YD  
Air Force - 68

**Preparing activity:**

Army - MR

Project No. 6850-0594


**Review activities:**

Army - MR, SM, MU  
Navy - YD  
Air Force - 68  
DSA - GS

**User activities:**

Army - ME  
Navy - SH, MC

MIL-A-11755D

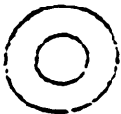
  
**Attach Near  
Radiator Filler Neck**

---

This Cooling System Contains  
 Ethylene Glycol Base Antifreeze  
 U. S. Government MIL-A-11755  
**DO NOT OVERFILL**  
**REPLACE AFTER ONE YEAR'S USE**

DATE INSTALLED \_\_\_\_\_  
 Speedometer Mileage \_\_\_\_\_  
 Quarts put in \_\_\_\_\_  
 Protect to \_\_\_\_\_ °F.  
 Installed by \_\_\_\_\_

Side 1

  
**INSTRUCTIONS FOR USE**

For use at temperatures of  
 minus 40°F to minus 90°F  
 (-40° to -90°C). DO NOT  
 DILUTE - Use as packaged.

Side 2

Figure 1. TAG

**Attach Near  
Radiator Filler Neck**

---

This Cooling System Contains  
 Ethylene Glycol Base Antifreeze  
 U. S. Government MIL-A-11755  
**DO NOT OVERFILL**  
**REPLACE AFTER ONE YEAR'S USE**

DATE INSTALLED \_\_\_\_\_  
 Speedometer Mileage \_\_\_\_\_  
 Quarts put in \_\_\_\_\_  
 Protect to \_\_\_\_\_ °F.  
 Installed by \_\_\_\_\_

**INSTRUCTIONS FOR USE**

For use at temperatures of  
 minus 40°F to minus 90°F  
 (-40° to -90°C) DO NOT  
 DILUTE - Use as packaged.

Figure 2. LABEL



**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL**

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**NOTE:** This form shall not be used to submit requests for waivers, deviations or clarification of specification 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.

**DOCUMENT IDENTIFIER (Number) AND TITLE**

**MTL-A-11755D, Antifreeze, Arctic-Type**

**NAME OF ORGANIZATION AND ADDRESS OF SUBMITTER**

☐ **VENDOR**      ☐ **USER**      ☐ **MANUFACTURER**

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**C. REASON FOR RECOMMENDED CHANGE(S)**

**2. REMARKS**

**SUBMITTED BY (Printed or typed name and address — Optional)**

**TELEPHONE NO.**

**DATE**

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1 OCT 76

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