

O-A-548D  
 March 22, 1974  
 SUPERSEDING  
 Int. Fed. Spec. O-A-00548C (GSA-FSS)  
 July 1, 1968 and  
 Fed. Spec. O-A-548A  
 December 30, 1958  
 (See 6.5)

## FEDERAL SPECIFICATION

### ANTIFREEZE/COOLANT, ENGINE: ETHYLENE GLYCOL, INHIBITED, CONCENTRATED

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

#### 1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers concentrated inhibited ethylene glycol, suitable for use in the cooling system of liquid cooled internal combustion engines, other than aircraft, for year round protection against corrosion, scale, sludge, and freezing in ambient temperatures as low as -60°F. (see 6.1).

1.2 Classification. The engine antifreeze/coolant shall be of one type and grade.

#### 2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

##### Federal Specifications:

- UU-T-81 - Tags, Shipping and Stock.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-C-96 - Cans, Metal, 28 Gage and Lighter.
- PPP-C-186 - Containers, Packaging and Packing For Drugs, Chemicals, and Pharmaceuticals.
- PPP-C-569 - Containers, Plastic, Molded (For Liquids, Pastes and Powders): Overpack.
- PPP-C-1337 - Containers, Metal With Polyethylene Inserts.
- PPP-D-729 - Drums: Metal, 55 Gallon (For Shipment of Noncorrosive Material).
- PPP-E-540 - Envelopes: Water-Resistant.
- PPP-P-704 - Pails, Metal: (Shipping, Steel).
- PPP-T-97 - Tape, Pressure-Sensitive Adhesive, Filament Reinforced.

##### Federal Standard:

- Fed. Std. No. 123 - Marking for Domestic Shipment (Civil Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

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Military Specifications:

- MIL-A-46153 - Antifreeze, Ethylene Glycol, Inhibited, Heavy Duty, Single Package.
- MIL-B-26701 - Bottles, Screwcap and Carboys, Polyethylene Plastic.

Military Standards:

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.

(Copies of Military Specifications and Standards 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 a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Association, Inc., Tariff Order Section, 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, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

American Society for Testing and Materials (ASTM) Standards:

- D92 - Test for Flash and Fire Point by Cleveland Cup.
- D97 - Test for Pour Point.
- D1119 - Test for Ash Content of Engine Antifreezes and Antirust.
- D1120 - Test for Boiling Point of Engine Antifreezes.
- D1121 - Reserve Alkalinity of Engine Antifreezes and Antirust.
- D1122 - Specific Gravity of Engine Antifreezes by the Hydrometer.
- D1176 - Sampling and Preparing Aqueous Solutions of Engine Antifreezes or Antirust for Testing Procedures.
- D1177 - Test for Freezing Point of Aqueous Engine Antifreeze Solution.
- D1218 - Test for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids.
- D1287 - Test for pH of Engine Antifreezes and Antirust.
- D1881 - Test for Foaming Tendencies of Engine Antifreezes in Glassware.
- D1882 - Effect of Antifreeze and Cooling System Chemical Solutions on Organic Finishes for Automotive Vehicles.
- D2570 - Simulated Service Corrosion Testing of Engine Coolants.

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

3. REQUIREMENTS

3.1 Qualification. The engine antifreeze/coolant furnished under this specification shall be a product which has been tested, and passed the qualification tests specified herein, and has been listed on or approved for listing on the applicable qualified products list (see 4.4.1.1 and 6.4). Separate qualification test shall be conducted for each formulation. Approval granted on an engine antifreeze/coolant manufactured from specific components, blended to a particular formula, shall not apply to engine antifreeze/coolants manufactured from other components or other formulations.

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3.1.1 Identification of samples. The samples submitted for qualification and acceptance testing will be identified by spectrographic, chromatographic, and spectrophotometric methods plus any other measurements deemed necessary by the Government. This is done to facilitate comparison between the qualification sample and material submitted subsequently for acceptance, and both materials shall be identical.

### 3.2 Requirements for qualifications.

3.2.1 Material. The engine antifreeze/coolant shall be a homogeneous single-phase mixture containing suitable corrosion inhibitors and other chemicals to conform to the performance requirements of this specification. The material shall be stable in storage for periods of up to two 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 engine antifreeze/coolant compound.

3.2.2 Chemical requirements. New engine antifreeze/coolant shall be essentially ethylene glycol. Other glycols such as propylene and diethylene glycol may be included if the chemical and physical properties conform to the requirements in tables I and II.

TABLE I. Chemical Requirements

	Requirements	Test paragraph
Ash, weight percent	5.0 percent (max.)	4.5.1
Reserve alkalinity	10 (min.)	4.5.1
pH undiluted	5.7 - 11.0	4.5.1
33 percent solution (by volume)	7.0 - 11.0	4.5.1
50 percent solution (by volume)	7.0 - 11.0	4.5.1

3.2.3 Physical requirements. New engine antifreeze/coolant shall conform to the requirements in table II.

TABLE II. Physical requirements

	Requirements	Test paragraph
Specific Gravity 60°/60°F. (15.6°C.)		
Undiluted	1.105 - 1.150	4.5.1
33 percent solution (by volume)	1.040 - 1.060	4.5.1
50 percent solution (by volume)	1.065 - 1.085	4.5.1
Freezing Point		
33 percent solution (by volume)	0°F. (max.)	4.5.1
50 percent solution (by volume)	-34°F. (max.)	4.5.1
Pour Point Undiluted	0°F. (max.)	4.5.1
Boiling point undiluted	300°F. (min.)	4.5.1
33 percent solution (by volume)	220°F. (min.)	4.5.1
50 percent solution (by volume)	226°F. (min.)	4.5.1
Flashpoint undiluted	230°F. (min.)	4.5.1
Foaming test 33 percent solution (by volume)		
Increase in volume at 5 minutes	150 milliliters (max.)	4.5.1
Break time	5 seconds (max.)	4.5.1
Effect on organic finishes	No change in surface appearance.	4.5.1
Refractive Index (25°C) (See 6.6)		
33 percent solution (by volume)	1.3665 - 1.3685	4.5.1
50 percent solution (by volume)	1.3840 - 1.3860	4.5.1

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3.2.4 Simulated Service corrosion test. The engine antifreeze/coolant shall meet the requirements in table III when tested in 4.5.1.

TABLE III. Simulated service corrosion test requirements

Metal specimen	Average weight loss per specimen, max., ASTM D2570
Copper	20 milligram (mg)
Solder	60 mg
Brass	20 mg
Steel	20 mg
Cast iron	20 mg
Aluminum	60 mg

3.2.4.1 Termination of test. A malfunction or failure of the cooling system components caused by the antifreeze/coolant during the test in 4.5.1 shall constitute a failure to comply with this specification.

3.2.5 Physical requirements used solution. The used engine antifreeze/coolant from the simulated corrosion test in 3.2.4 shall meet the requirements in table IV.

TABLE IV. Physical requirements used solution

	Requirements	Test paragraph
Specific gravity 60°F./60°F.	1.040 - 1.060	4.5.1
pH	7.0 - 11.0	4.5.1
Foaming test		
Increase in volume at 5 minutes	350 ml.(max.)	4.5.1
Break time	30 seconds(max.)	4.5.1
Reserve Alkalinity	5(min.)	4.5.1

3.2.6 Compatibility. The engine antifreeze/coolant shall be compatible with other products found to be satisfactory under this specification when tested in 4.5.2. There shall be no crystallization, or liquid separation during the test, but the development of a slight cloudiness or turbidity shall not be cause for rejection.

3.3 Requirements for acceptance. The engine antifreeze/coolant shall be of the same color, physical and chemical composition when tested in 4.4.1.2 as that tested for qualification in 3.1.1 and 3.2. Components of the formulations shall be the same as qualified within the following limits: components over 1 percent by composition shall be within + 10 percent of its qualified composition and components under 1 percent by composition shall be within  $\pm$  20 percent of its qualified composition.

3.4 Protection Table. The protection table shall be in accordance with diagram I.

#### 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, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary that supplies and services conform to prescribed requirements.

#### 4.2 Sampling.

4.2.1 Sampling for qualification. The samples offered for qualification by the manufacturer shall be from production batches of the same size used in producing engine coolants in commercial quantities. Small pilot plant and experimental formulations will not be considered as complying. The inspector shall take 10-gallons of sample representative of the product offered. The containers shall be securely sealed and the label shall show the name of the material, manufacturer, date of manufacture, manufacturer's destination and the place of manufacture.

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4.2.2 Sampling for acceptance. From each inspection lot offered for Government inspection, two 1-gallon specimens shall be taken and placed in separate, clean, dry, metal or glass containers, sealed, marked, and one shall be forwarded to the testing laboratory designated by the bureau or agency concerned (see 6.2). Samples will be taken from a minimum of two containers randomly selected from the lot.

4.3 Inspection. Sampling for inspection shall be performed in accordance with MIL-STD-105, except where otherwise indicated.

4.3.1 Sampling. Samples of shipping containers and filled containers shall be examined for the defects set forth in the applicable subparagraphs. The inspection level shall be I and acceptable quality levels (AQL's) shall be 2.5 defects per hundred units. For sampling purposes, the lot shall consist of all engine antifreeze/coolant of the same formulation, package size, manufactured under the same conditions and essentially at the same time and presented for inspection at one time.

4.3.1.1 Examination of preparation for delivery. An examination shall be made to determine that markings, materials, and workmanship comply with the requirements of section 5. The sample unit shall be one shipping container, fully packed and closed ready for shipment. Examine for defects in table V below.

TABLE V. Examination of preparation for delivery

Examine	Defect
Marking	Incorrect; incomplete; illegible; omitted; improper size, location, sequence, or method of application.
Containers	Not as specified.
Materials	Missing pads; any nonconforming component; component missing, damaged or otherwise defective.
Workmanship	Inadequate application of components, such as incomplete closure of container, loose or inadequate sealing.
Contents	Number of packages per shipping container less than specified. Placement and number of radiator tags of protection tables not as specified.

4.3.1.2 Examination of packages. An examination shall be made to determine that the markings, materials, and workmanship comply with the requirements of section 5. The sample unit shall be one package. Approximately an equal number of packages shall be selected from the shipping containers selected under 4.3.1.1. Examine for defects listed in table VI below.

TABLE VI. Examination of packages

Examine	Defect
Markings	Not as specified; illegible; omitted; of improper size, location, sequence, of method of application.
Material	Not as specified, damaged, leaking, or otherwise defective, not new.
Workmanship	Dents, improper closure.
Contents	Not as specified.

4.3.1.3 Examination of end item. One of the sample specimens selected in 4.2.2 shall be subject to tests specified in 4.4.1.2. If the specimen fails one or more of these tests, the lot shall be rejected. Contractors not having satisfactory laboratory facilities shall engage the services of a commercial testing laboratory acceptable to the Government. The contractor shall furnish the inspector test reports, in duplicate, showing quantitative results for all the required tests, and signed by the director of the laboratory or his authorized assistant. Acceptance or approval of material during the course of manufacturing shall not be construed as a guarantee of approval of the finish product.

#### 4.4 Testing.

4.4.1 Classification of test. The tests performed on the engine antifreeze/coolant furnished under this specification shall be classified as follows:

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4.4.1.1 Qualification tests. The qualification tests shall be in accordance with 4.5. The right is reserved to make such additional analysis and tests as may be deemed necessary by the qualifying agency to determine the suitability of the engine antifreeze/coolant for its intended use and for future identification.

4.4.1.2 Acceptance test. The engine antifreeze/coolant shall be subject to the acceptance test which shall be in accordance with 4.5.1 to make sure that it is the same product that was qualified. The accepting agency reserves the right to make such additional analysis and tests as may be deemed necessary to determine if the product offered is of the same components and formulation as that qualified.

#### 4.5 Test methods.

##### 4.5.1 Chemical and physical test.

TABLE VII. Instructions for testing material

Characteristic	Requirement	Reference	Requirement		Results Reported to nearest
	Reference	Test Method	Applicable to Qual. Accept.		
Sampling and preparing	4.4	D1176	X	X	
Ash	3.2.2	D1119	X		0.5 percent
Reserve Alkalinity	3.2.2 &3.2.5	D1121 D1121	X X	X	0.1 1.0
pH Undiluted	3.2.2	D1287	X	X	0.1
33% solution	3.2.3	D1287	X		0.1
50% solution	&3.2.5 3.2.2	D1287 D1287	X X		0.1 0.1
Specific Gravity Undiluted	3.2.3	D1122	X		0.002
33% solution	3.2.3	D1122	X		0.002
50% solution	&3.2.5 3.2.3	D1122 D1122	X X		0.002 0.002
Refractive Index	3.2.3	D1218	X	X	0.0001
Freezing point Undiluted	3.2.3	D1177	X	X	1°F.
33% solution	3.2.3	D1177	X		1°F.
50% solution	3.2.3	D1177	X		1°F.
Pour Point	3.2.3	D97	X		5°F.
Boiling Point Undiluted	3.2.3	D1120	X	X	1°F.
33% solution	3.2.3	D1120	X		1°F.
50% solution	3.2.3	D1120	X		1°F.
Flash Point	3.2.3	D92	X	X	5°F.
Foaming Test	3.2.3 &3.2.5	D1881 D1881	X X	X	5 ml - 0.2 sec. 5 ml - 0.2 sec.
Effect on Organic Finishes	3.2.3	D1882	X		Pass-Fail
Simulated Service Test	3.2.4	D2570	X		0.5 mg
Compatibility	3.2.6	4.5.2	X		Pass-Fail

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**4.5.2 Compatibility.** The engine antifreeze/coolants under test shall be compatible with material conforming to Military Specification MIL-A-46513. Place 25 ml of test material, 25 ml of MIL-A-46513 material and 50 ml of distilled water in an oil sample bottle, and allow to stand in darkness for 24 hours at room temperature (70-80°F.) and examine for appearance. The samples shall then be heated in the dark for 24 hours in an oven maintained at 180°F.  $\pm$  5°F., and again examined for appearance according to 3.2.6.

## 5. PREPARATION FOR DELIVERY

**5.1 Packaging.** Packaging shall be level A, B, and C (see 6.2).

### 5.1.1 Level A.

**5.1.1.1 One quart quantity.** One quart of antifreeze shall be packaged as specified in PPP-B-569 in type I, class A molded plastic container in a fiberboard box, or in a one quart capacity polyethylene plastic bottle specified in MIL-B-26701, except that if the bottle specified in MIL-B-26701 is used 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 shall transmit more than 1 percent of ultraviolet light at any wavelength in the range of 310 to 325  $\mu$ m when tested using a calibrated spectrophotometer with air as a reference (see 6.3).

**5.1.1.2 One gallon quantity.** One U.S. gallon of antifreeze shall be packaged as specified for the one quart quantity except that the plastic container and box specified in PPP-B-569 shall conform to type I, class B and the bottle specified in MIL-B-26701 (with ultraviolet exclusion additive) shall conform to the one gallon capacity size.

**5.1.1.3 Five gallon quantity.** Five U.S. gallons of antifreeze shall be packaged as specified in PPP-C-1337 in a type II, class I metal container with a polyethylene insert. The filled container shall be closed tightly so as to prevent leakage of contents.

**5.1.1.4 Fifty-five gallon quantity.** Fifty-five U.S. gallons of antifreeze shall be packaged as specified in PPP-C-1337 in a type II, class 4 metal container with a polyethylene insert. The filled container shall be closed tightly so as to prevent leakage of contents.

### 5.1.2 Level B.

**5.1.2.1 One gallon quantity.** One U.S. gallon of antifreeze shall be packaged as specified in PPP-C-96 in a type I, class 3 metal can, except that the minimum weight of the metal plate shall be 100-pounds per base box for the body.

**5.1.2.2 Five gallon quantity.** Five U.S. gallons of antifreeze shall be packaged as specified in PPP-P-704, type I, class B with flexible spout and screwcap closure or as specified in PPP-C-569, class D, grade G-P with flexible spout. The height polyethylene container and the inner top closure of the box.

**5.1.2.3 Fifty-five gallon quantity.** Fifty-five U.S. gallons of antifreeze shall be packaged as specified in PPP-D-729, type I or II. The metal drums shall be lined with an organic coating and the lining shall not affect or be affected by the engine antifreeze/coolant compound.

**5.1.3 Level C.** The concentrated antifreeze in 1-quart, 1-5-, or 55-gallon quantities, shall be packaged to afford adequate protection against damage during shipment from the supply source to the first receiving agency.

**5.2 Packing.** Packing shall be level A, B, or C (see 6.2).

### 5.2.1 Level A.

**5.2.1.1 One quart quantities.** Twelve one quart bottles of antifreeze packaged as specified in 5.1.1.1 shall be packed as specified in PPP-C-186 for level of packing of group A, class 2, style 1.

**5.2.1.2 One-gallon quantities.** The one-gallon containers shall be packed six units in a box conforming to PPP-B-636, class weather resistant, V3c. One-gallon bottles conforming to MIL-B-26701 shall be separated by interlocking partitions fabricated from fiberboard having 275 psi minimum bursting strength.



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5.2.1.3 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 quantities. Twenty-four (24) filled containers shall be packed in a box conforming to PPP-B-636, Class domestic and the special requirements of table I. The box shall be closed in accordance with Method II of the appendix to the box specification. The box shall be provided with partitions or separation top and bottom pads of fiberboard and conforming to PPP-F-320 grade 275.

5.2.2.2 One gallon quantities. Six filled 1-gallon cans as specified in 5.1.2.1 shall be packed in accordance with the appendix of PPP-C-96 as specified. There shall be top and bottom pads and the box shall be for special requirements (275 pounds).

5.2.2.3 Five gallon quantities. The filled five gallon overpack plastic containers as specified in 5.1.2.2 shall be packed in accordance with the appendix PPP-C-569. The filled five gallon metal drums require no further packing.

5.2.2.4 Fifty-five gallon quantities. The filled fifty-five gallon drums as specified in 5.1.2.2 require no further packing.

5.2.3 Level C. Unless otherwise specified, the 1-quart and 1-gallon containers shall be packed in substantial commercial containers of the type, size and kind commonly used for the purpose, in such a manner as to insure safe delivery to the receiving point by common or other carrier, at the lowest rate available. Containers and packing shall comply with Uniform Freight Classification Rules and National Motor Freight Classification Rules.

5.3 Labeling and marking. In addition to any special marking required in the procurement documents, the marking of the interior packages and exterior shipping containers shall be in accordance with Fed. Std. No. 123 for civil agencies or MIL-STD-129 for military agencies, as applicable (see 6.2).

5.4 Radiator tags. Radiator tags shall be supplied conforming to type B, class 1, grade 15 CSU, size 4 strung with wire but without metal eyelet. The tags may be white or colored and shall be printed in a contrasting color. Pressure sensitive labels may be used in lieu of radiator tags. The tags or labels shall be printed with the protection table as shown in diagram I. The radiator tags or pressure sensitive labels shall be packaged in an envelope conforming to PPP-E-540, class I, style 4, size 20 and secured with the filled shipping containers in the following quantities:

- (a) 1-quart containers - 4 with 24 quarts
- (b) 1-gallon containers - 4 with 6 gallons
- (c) 5-gallon containers - 4 with 5 gallons
- (d) 55-gallon containers - 40 with 55 gallons

For the 5- and 55-gallon containers, the envelope will be attached to the container or head of the pail or drum. The envelope does not require any printing.

#### 6. NOTES

6.1 Intended use. Inhibited ethylene glycol is intended for use in the cooling system of liquid-cooled internal combustion engines, other than aircraft. This material is to provide one years' protection to the cooling system by providing adequate heat transfer, a corrosion resistant environment, adequate freeze protection during cold weather, and preventing scale and sludge deposits. This material will provide cold weather protection in ambient temperatures as low as -60°F. when diluted to 60 percent antifreeze/coolant by volume with water. A minimum of 50 percent antifreeze/coolant is recommended for adequate year round corrosive protection. This material is procured based on performance and is available commercially.



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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 and package type (see 5.1).
- (c) Level of packaging and packing (see 5.1 and 5.2).
- (d) Marking required (see 5.3).
- (e) Designated laboratory address (see 4.2.2).

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.

6.4 The attention of suppliers and procuring activities is called to the requirements for qualification as provided in section 3 of this specification. GSA Reg. 1-II-201.03 provides that solicitations for bids by advertising shall contain, in substance, the following statement: In the procurement of products requiring qualification, bids secured through formal advertising

will be considered only for such products as have, prior to the bid opening date, been tested and approved for inclusion in the qualified products list whether or not such products have actually been so listed by that date. Manufacturers are urged to communicate with the Director, Chemicals and Paints Division, Federal Supply Service, General Services Administration, Washington, DC 20406, and arrange to have the product they propose to offer tested for qualification.

6.5 This specification supersedes type II of O-A-00548C and O-A-548A. For type I of O-A-00548C and O-A-548A refer to MIL-A-46153.

6.6 The intent of this specification is to rely on the refractive index for acceptance testing, using the specific gravity method to referee borderline cases.

**MILITARY INTEREST**

Custodians:

Army - MR  
Navy - YD  
Air Force - 68  
DSA - GS

Preparing activity:

GSA-FSS

**CIVIL AGENCY COORDINATING ACTIVITIES:**

HEW-FDA  
NASA-JFK  
DMS-VA

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Note: Below freezing temperatures may be shown in contrasting colors.

DIAGRAM I

PROTECTION TABLE

Cooling System Capacity in Quarts	ANTI-FREEZE COOLANT REQUIRED* (in Quarts)													
	2	3	4	5	6	7	8	9	10	11	12	13	14	
5	-12°	-62°												
6	0°	-34°												
7	6°	-17°												
8	10°	-7°	-54°	-69°										
9	0°	0°	-21°	-50°										
10	4°	4°	-12°	-34°										
11	8°	8°	-6°	-23°										
12	10°	10°	0°	-15°	-62°									
13			3°	-9°	-47°	-57°								
14			6°	-5°	-34°	-45°	-66°							
15			8°	0°	-26°	-34°	-54°							
16			10°	2°	-19°	-43°	-62°							
17				5°	-4°	-14°	-27°	-42°						
18				7°	0°	-10°	-21°	-34°	-58°					
19				9°	2°	-7°	-16°	-28°	-50°					
20				10°	4°	-3°	-12°	-22°	-42°	-65°				
21					6°	0°	9°	-17°	-34°	-48°				
22					8°	2°	6°	-14°	-28°	-41°	-54°			
23					9°	4°	3°	-10°	-23°	-34°	-47°	-68°		
24					10°	5°	0°	-7°	-19°	-29°	-40°	-52°		
									-15°	-24°	-34°	-46°		

Anti-Freeze Protects to 25% 33% 40% 50% 60% 68%  
 +10° 0° -12° -34° -62° -90°

Note: Do not use without some water;  
 68% concentration gives maximum protection  
 \*Use at least 50% concentration for protection against rust and corrosion.

TEMPERATURES ARE SHOWN IN DEGREES F.

Orders for this publication are to be placed with the General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein. Price 15 cents each.

## SPECIFICATION ANALYSIS SHEET

Form Approved  
Budget Bureau No. 119-R004INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

ORGANIZATION (of submitter)

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

DIRECT GOVERNMENT CONTRACT

SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

 YES NO

IF "YES", IN WHAT WAY?

4. REMARKS (attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

DATE

FOLD

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Director  
Army Materials & Mechanics Research Center  
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