

MIL-C-47220B
14 May 1985

SUPERSEDING
MIL-C-47220A(USAF)
29 December 1982

MILITARY SPECIFICATION

COOLANT FLUID, DIELECTRIC

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

1. SCOPE

1.1 Scope. This specification describes the characteristics of and provides requirements for, five types of silicate ester coolant fluids for use in electronic applications.

1.2 Classification. The dielectric coolant fluid shall be one of the following types:

- Type I - Suitable for operation over temperature ranges of minus 54 degrees Celsius (C) (minus 65 degrees Fahrenheit (F) to 177 degrees C (350 degrees F).
- Type II - Suitable for operation over temperature ranges of minus 54 degrees C (minus 65 degrees F) to 204 degrees C (400 degrees F).
- Type III - Suitable for operation over temperature ranges of minus 54 degrees C (minus 65 degrees F) to 288 degrees C (550 degrees F).
- Type IV - Suitable for use over a temperature range of minus 54 degrees C (minus 65 degrees F) to plus 149 degrees C (300 degrees F).
- Type V - Suitable for use over a temperature range of minus 54 degrees C (minus 65 degrees F) to plus 372 degrees C (700 degrees F).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to AFWAL/MLSE, Standardization Manager, Wright Patterson AFB OH 45433 by using the self addressed Standardization Document Improvement Proposal (DD Form 1426) at the end of this document or by letter.

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specification and standards. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-R-6855 Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes

STANDARDS

FEDERAL

FED-STD-313 Material Safety Data Sheets, Preparation and Submission of

FED-STD-791 Lubricants, Liquid Fuels, and Related Products, Methods of Testing

MILITARY

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-290 Packaging, Packing and Marking of Petroleum and Related Products

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific acquisition functions should be obtained from the acquisition 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. The issues of the documents which are indicated as DOD adopted shall be the issue listed in the current DODISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 633 Electrodeposited Coatings of Zinc on Iron and Steel

ASTM D 92 Flash and Fire Points by Cleveland Open Cup

ASTM D 97 Pour Point

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ASTM D 445	Viscosity of Transparent and Opaque Liquids (Kinematic and Dynamic Viscosities)
ASTM D 664	Neutralization Number by Potentiometric Titration
ASTM D 877	Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 924	Power Factor and Dielectric Constant of Electrical Insulating Liquids, Test for
ASTM D 941	Density and Specific Gravity of Liquids by Lipkin Biocapillary Pycnometer, Test for
ASTM D 1169	Specific Resistance (Resistivity) of Electrical Insulating Liquids
ASTM D 1533	Water in Insulating Liquids (Karl Fischer Method)
ASTM D 1744	Water in Liquid Petroleum Products by Karl Fisher Reagent, Test for
ASTM D 1903	Coefficient of Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin, and Askarels, Test for
ASTM D 2155	Autoignition Temperature of Liquid Petroleum Products, Test for
ASTM D 2717	Thermal Conductivity of Liquids, Test for
ASTM D 2766	Specific Heat of Liquids and Solids, Test for
ASTM D 4057	Manual Sampling Petroleum and Petroleum Products

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

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATIONS, INC.

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Association, Inc., 1616 P Street N.W., Washington, DC 20036.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

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3. REQUIREMENTS

3.1 Preproduction sample. Unless otherwise specified, a first article sample (see 4.2 and 6.2) shall meet the requirements of this specification.

3.2 Material. Coolants shall consist of silicate ester type liquids with additive materials to improve oxidation resistance and swelling characteristics of elastomeric materials. The fluid shall contain no pour point depressants, viscosity index modifiers, dyes or other additives may be contained in the fluid, and shall meet all requirements of this specification.

3.3 Properties. The properties of the dielectric coolant fluids described shall be as specified in Table I and tested as specified in 4.4.

3.4 Corrosiveness. The sample material shall not exhibit a change in weight greater than stated in Table I. There shall be no pitting, etching, or sign of corrosion on any of the sample surfaces after testing as required when viewed under (20X) magnification. Slight discoloration of the metal surfaces is permitted.

3.5 Compatibility. The coolant fluid shall be compatible with other fluids of the same type approved under this specification when tested herein.

3.6 Workmanship. The dielectric coolant fluid shall be uniform in quality and free from dirt and other foreign material, and shall conform to the best commercial practice applicable to the manufacture and packaging of this class material.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the contractor 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 supplies and services conform to prescribed requirements.

4.2 First article sample. The first article sample shall be prepared using the same methods proposed for the preparation of subsequent production lots of dielectric coolant fluid. The first article sample shall be subjected to all examinations and tests specified herein except the storage stability test in accordance with 4.4.3. Take samples for tests in accordance with ASTM D 4057. Material Safety Data Sheets shall be prepared in accordance with FED-STD-313 and submitted to the contracting agency. Unless otherwise

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TABLE I. Physical properties

Properties	Type I		Type II		Type III		Type IV		Type V	
	Colorless to light amber	Clear	Colorless to light amber	Clear	Colorless	Clear	Colorless to light amber	Clear	Colorless to light amber	Clear
Thermal stability	The change in viscosity at 40°C(104°F) shall not exceed ±5%. The resistivity and power factor shall be determined. The neutralization number shall not exceed 2.0. There shall be no formation of precipitate or insoluble material.									
°C (°F)	177° (350°) ± 2°C	204° (400°) ± 2°C	288° (550°) ± 2°C	149° (300°) ± 2°C	372 (700) ± 2°C					
Specific gravity at 25°C/25°C (77°F/77°F)	0.886 - 0.891	0.884 - 0.890	0.879 - 0.882	0.888 - 0.900	0.879 - 0.882					
Viscosity, Centistokes at -54°C (-65°F) max.	1000	2900	1500	275						1200
at 40° (104°) max.	6.7	12.6	7.0	4.4						7.0
at 100° (212°) min.	2.0	3.8	2.1	1.5						2.20
Pour point, °C (°F) max.	-62° (-80°)	-62° (-80°)	-62° (-80°)	-62° (-80°)	-62° (-80°)					-62° (-80°)
Coefficient of thermal expansion, cubic centimeter cc/cc/°C (0 to 100°C)	0.0008 to .0011	0.0008 to .0011	0.0008 to .0011	0.0008 - 0.0011	0.0001 to 0.0006					

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TABLE I. Physical properties. (Continued)

Properties	Type I	Type II	Type III	Type IV	Type V
Neutralization number mg KOH/gm max.	0.10	0.15	0.05	0.15	0.20
Thermal Conductivity Cal-cm/sec-cm ² -°C @ 25°C (77°F) min	2.7×10^{-4}	2.7×10^{-4}	2.7×10^{-4}	2.7×10^{-4}	2.7×10^{-4}
Flash point, °C (°F) min.	177° (350°)	188° (370°)	188° (370°)	163° (325°)	188° (370°)
Fire point, °C (°F) min.	182° (360°)	221° (430°)	224° (435°)	188° (370°)	221° (430°)
Autoignition Temperature min. °C (°F)	232° (450°)	246° (475°)	246° (475°)	218° (425°)	224° (435°)
Vapor Pressure at 149°C (300°F) mm Hg max.	1.5	1.5	1.5	1.5	0.5
Specific heat at 25°C (77°F) Cal/gm/°C min.	0.40	0.40	0.40	0.40	0.45
Water content PPM max	500	500	200	100	500

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TABLE I. Physical properties. (Continued)

Properties	Type I	Type II	Type III	Type IV	Type V
Storage stability	No sedimentation or turbidity and shall meet all other requirements of this specification after not less than 1 year storage.				
Low temperature storage	The fluid shall not gel, crystallize or solidify after being maintained at -54° (-65°) for 96 hours.				
Corrosiveness and oxidation stability Corrosiveness a) Steel b) Cadmium c) Aluminum Alloy d) Zinc e) Copper weight change in mg/cm ²	a) ±0.2 b) ±0.2 c) ±0.2 d) ±0.4 e) ±0.6	a) ±0.2 b) ±0.2 c) ±0.2 d) ±0.4 e) ±0.6	a) ±0.2 b) ±0.2 c) ±0.2 d) ±0.4 e) ±0.6	a) ±0.2 b) ±0.2 c) ±0.2 d) ±0.2 e) ±0.4	a) ±0.2 b) ±0.2 c) ±0.2 d) ±0.2 e) ±0.6
Resistance to oxidation a) Fluid Viscosity b) Neutralization number	a) ±5% b) ±0.5	a) ±5% b) ±0.5	a) ±5% b) ±0.5	a) ±5% b) ±0.5	a) ±5% b) ±0.5

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TABLE I. Physical properties. (Continued)

Properties	Type I	Type II	Type III	Type IV	Type V
Particulate Contamination per 100 ml Sample	N/A	N/A	N/A		N/A
Particle size micrometers				a) 32,000 b) 5,700 c) 1,012 d) 180 e) 32	--
a) 5-15 b) 16-25 c) 26-50 d) 51-100 e) greater than 100 to include fibers					
Rubber swell, %	N/A	N/A	N/A	0-7.5	--
Dielectric strength (0.1 inch gap at 25°C (77°F), Kilo-volts (Kv) min.	35	27	35	35	35
Dielectric constant (at 1000 hertz (Hz), 25°C (77°F) max.	2.8	2.8	2.8	2.8	2.5
Resistivity, ohm-cm, min 25°C (77°F)	1.0×10^{10}	1.0×10^{10}	1.0×10^{10}	10×10	1.0×10^{13}
Power factor, max (at 10^3 Hz, 25°C (77°F))	0.01	0.01	0.01	0.008	--

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specified, the contractor shall perform the examinations and tests for first article sample acceptance at the contractor's plant. First article samples which do not meet all the requirements of this specification shall be rejected and returned to the contractor. Subsequent quantities will not be considered for acceptance until approval of the first article sample has been obtained.

4.3 Inspection provisions.

4.3.1 Lot size. A lot shall consist of material from the same batch or blending operation from one manufacturer and one unchanged process. In the event of a continuous process, a lot shall consist of material subjected to the same processing operations and conditions.

4.3.2 Sampling.

4.3.2.1 For visual examination. Unless otherwise specified, sampling for visual examination shall be in accordance with MIL-STD-105 at inspection S1 to determine sample size. A zero (0) acceptance level shall be applicable at all times. Sample selection shall be in a manner that will assure each unit in the lot has an equal chance of being selected.

4.3.2.2 For examination testing. Unless otherwise specified (see 6.2), sampling for examination testing shall be one gallon from each lot. Sample selection among containers and within containers shall be randomly made.

4.3.2.3 For inspection testing. Unless otherwise specified (see 6.2), a sample size of one gallon shall be provided for inspection testing. Inspection testing shall be conducted on the first article sample only. Sample selection among containers and within containers shall be randomly made.

4.3.3 Examination.

4.3.3.1 Visual examination. Visual examination of the samples specified in 4.3.2.1 shall be conducted to determine compliance with the requirements specified in 3.2 and 3.6 and preparation for delivery specified in Section 5.

4.3.3.2 Examination testing. Examination testing of the samples specified in 4.3.2.2, to determine compliance with the following characteristics, shall be conducted in accordance with the test methods appearing in 4.4.

Characteristics

Color
Appearance
Specific gravity

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Viscosity @ 40°C and 100°C
Neutralization number
Dielectric strength
Flash point
Water content
Resistivity
Particulate contamination (Type IV only)

4.3.4 Inspection testing. Inspection testing specified in 4.3.2.3 shall include compliance with all the characteristics contained in Table I for the particular type dielectric coolant being inspected and shall be conducted in accordance with the test methods appearing in 4.4.

4.3.5 Inspection equipment. In examining the contractor's inspection equipment, the Government inspector will determine whether the contractor has available, and utilizes correctly, gauging, measuring, and test equipment of required accuracy and precision, and that the instruments are of a proper type and range to make measurements within the required accuracy. The contractor shall have available a set of master gauges, standards, and appropriate instruments to conduct regularly scheduled calibrations of his inspection equipment. Records of such calibrations shall be maintained by the contractor and made available for Government review. The calibration of gauges, standards, and instruments will be checked periodically by authorized Government personnel.

4.4 Test methods and procedures.

4.4.1 Test methods. The tests to determine compliance with the requirements of this specification, except for vapor pressure, compatibility thermal stability, storage stability and low temperature storage shall be conducted in accordance with the respective test methods of FED-STD-791 or ASTM standards as specified in Table II.

4.4.2 Thermal stability.

4.4.2.1 Procedure. The dielectric coolant (350ml minimum sample volume) shall be thoroughly agitated and placed in an oven for two (2) hours at the temperature specified for the particular fluid to be tested as indicated in Table I. When removed from the oven, the dielectric coolant fluid shall be examined visually then cooled to room temperature and tested to determine compliance with the thermal stability requirements of Table I.

4.4.3 Storage stability. An unopened container of dielectric coolant fluid shall be allowed to stand for one year under storage conditions of 16°C (60°F) to 32°C (90°F). The container shall then be opened and the contents visually examined for evidence of sedimentation or turbidity. The contents shall conform to the requirements of this specification and tested in accordance with the requirements of Table I.

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TABLE II. Test methods.

Properties	FED-STD-791 Method No.	ASTM No.	Other
Appearance			Visual
Specific gravity		D-941	
Viscosity		D-445	
Water content		D-1744, 1533	
Dielectric strength		D-877	
Flash point		D-92	
Fire point		D-92	
Color			Visual
Pour point		D-97	
Coefficient of thermal expansion		D-1903	
Thermal conductivity		D-2717	
Dielectric constant		D-924	
Resistivity 1/		D-1169	
Power factor		D-924	
Vapor Pressure			2/
Specific heat		D-2766	
Corrosiveness 3/	5308		
Resistance to oxidation	5308		
Autoignition temp		D-2155	
Neutralization No.		D-664 4/	
Rubber swell	3603 4/		

1/ Resistivity - A 3 terminal or guarded cell (Balsbough Model 100 T3 or equal) at 500 volts DC shall be utilized. The reading shall be made after one minute electrification. If a cell different than the 100 T3 is used, the voltage should be adjusted to provide a stress level of 10 volts per mil. Typical cells or equivalents are as follows:

- a. Beckman Model ETP-1, Volume Resistivity Test System.

Beckman Instruments, Inc.
89 Commerce Road
Cedar Grove, New Jersey 07009

- b. Model 1730-3T Test Cell

Rutherford Research Products Company
P.O. Box 249
Rutherford, New Jersey 07070

2/ Vapor Pressure - Will be measured by an acceptable method that permits accuracy within 0.1 MM Hg (e.g. isoteniscope, knudsen, etc.).

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3/ Corrosiveness - Zinc in accordance with QQ-Z-325 to be used in lieu of magnesium.

4/ Rubber Swell - Use MIL-R-6855 Class II, Grade 60 synthetic rubber.

4.4.4 Low temperature storage. A 200 ml sample of the coolant shall be stored at a temperature of -52°C to 56°C (-62°F to 69°F) for 96 hours. The coolant fluid shall remain in a liquid state and shall show no visual evidence of crystallization or separation. A slight turbidity shall not be cause for rejection.

4.4.5 Compatibility. Samples of candidate coolant fluid in amounts of 20 ml, 100 ml, and 180 ml shall be mixed with samples from each of the fluids of the same type previously approved under this specification. Total volume of each mixture shall be 200 ml. Mixtures shall be prepared in 250 ml stoppered flasks. The flasks shall be thoroughly agitated and then stored in an oven at the upper limits stated in 1.2 for 2 hours. At the end of this time none of the mixtures shall show any signs of sediment, turbidity, or crystallization. The samples shall then be stored at -54°C (-65°F) for a period of 2 hours, at which time slight turbidity that later disappears will be permitted in the sample.

4.4.6 Solid particle size measurement. Particle contamination shall be measured by the use of automatic particle counters employing the light interruption principle. The automatic counter shall count particles to the limits specified in Table I. The directions in the manual for the respective instruments shall be used.

4.4.7 Examination of filled containers. Each sample of filled container and shipping container shall be examined for defects of construction of the container and closure, evidence of leakage, and net content. Any container in the sample having one or more defects or under required fill shall be rejected, and if the number of defective containers in any sample exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected. Rejected lots may be resubmitted for acceptance inspection provided that the contractor has removed or repaired all non-conforming containers.

5. PACKAGING

5.1 Packaging, packing, and marking. Packaging, packing, and marking (see 6.2), of the dielectric coolant fluid shall be in accordance with MIL-STD-290. In addition each container shall be marked as to lot number and date of manufacture. The container closure, lining, or space filler shall not interact physically with or chemically alter the strength, purity, or quality of the container contents. All containers shall be new and free from contamination. The dielectric coolant fluid shall be filtered through an 0.8 micron filter during container filling. The size of the container

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shall be not greater than 1 gallon. Shipping containers shall conform to the Uniform Freight Classification Rules and Regulations or other regulations applicable to the mode of transportation.

6. NOTES

6.1 Intended use. The material covered by this specification is intended for use as a heat transfer medium in closed systems and capable of functioning as a dielectric fluid over a wide range of operating temperatures.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and data of this specification.
- b. Quantity and unit package size (see 5.1).
- c. Whether packaging and packing for overseas or domestic shipping is desired (see 5.1).
- d. Whether a first article sample is required (see 3.1 and 4.2).
- e. Method of sampling and inspection, if other than specified (see 4.3.2).
- f. Whether a test report showing the results of examinations and tests is required by the acquisition agency.

6.3 Supersession data. This specification includes the requirements of Missile Interim Specification MIS-14752C dated 28 January 1974, and MIL-C-47220(MI) dated 12 July 1974.

Custodian:
Air Force - 20
Army - MI
Navy - AS

Preparing Activity:
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Reviewer:
Air Force -68
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