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METRIC

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# PERFORMANCE SPECIFICATION

# COOLANT FLUID, HYDROLYTICALLY STABLE, DIELECTRIC

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

Comments, suggestions, or questions on this document should be addressed to AFPET/PTPS, 2430 C Street, Building 70, Area B, Wright-Patterson AFB, OH 45433-7631 or e-mailed to AFPA.PTPS@us.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A

FSC 9150

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1. SCOPE

1.1 Scope. This specification describes the characteristics and provides the requirements for a -54 to 200 °C synthetic hydrocarbon fluid for use in electronic applications. This fluid is identified by NATO Code S-1748 (see 6.10).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

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

(Copies of these documents are available online at http://quicksearch.dla.mil.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEFENSE STANDARDIZATION PROGRAM OFFICE

SD-6 - Provisions Governing Qualification

(Copies of these documents are available online at http://quicksearch.dla.mil.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM D92 - Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D130 - Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration

ASTM D877 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

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| | | |
|---|---|---|
| ASTM D1169 | - | Standard Test Method for Specific Resistance (Resistivity) of Electrical Insulating Liquids |
| ASTM D2532 | - | Standard Test Method for Viscosity and Viscosity Change After Standing at Low Temperature of Aircraft Turbine Lubricants |
| ASTM D4057 | - | Standard Practice for Manual Sampling of Petroleum and Petroleum Products |
| ASTM D4177 | - | Standard Practice for Automatic Sampling of Petroleum and Petroleum Products |
| ASTM D4289 | - | Standard Test Method for Elastomer Compatibility of Lubricating Greases and Fluids |
| ASTM D4636 | - | Standard Test Method for Corrosiveness and Oxidation Stability of Hydraulic Oils, Aircraft Turbine Engine Lubricants, and Other Highly Refined Oils |
| ASTM D6304 | - | Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration |
| ASTM F312 | - | Standard Test Methods for Microscopical Sizing and Counting Particles from Aerospace Fluids on Membrane Filters |

(Copies of these documents are available online at http://www.astm.org.)

SAE INTERNATIONAL

| | | |
|---|---|---|
| AMS3217/2 | - | Test Slabs, Acrylonitrile Butadiene (Nbr-L) Low Acrylonitrile, 65 – 75 |

(Copies of these documents are available online at http://www.sae.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 Qualification. The dielectric coolant fluids furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Materials. The dielectric coolant fluid shall consist of synthetic, hydrocarbon base oil with a suitable additive(s). A hydrogenated, polyalphaolefin base fluid with an additive to inhibit oxidation is recommended but not mandatory. The required properties shall be as specified in tables I and II and sections 3.3 thru 3.4. Additional data is included in table III to serve as user information, which shall be referred to as typical (inherent) for a finished dielectric coolant fluid and shall not be a requirement levied upon the supplier (see 6.1.2).

3.3 Properties of finished fluid. The properties of the finished fluid shall be as specified in tables I and II and sections 3.3 thru 3.4 when tested as specified in section 4.4.

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3.3.1 Swelling of synthetic rubber. When tested as specified in section 4.4, the volume change of the standard synthetic rubber Nbr-L (SAE AMS3217/2) by the dielectric coolant fluid shall be within the range of 0.0 to + 10 percent.

3.3.2 Compatibility. The dielectric coolant fluid shall be compatible with other fluids of the same type covered by this specification when tested in accordance with section 4.4.2.

3.3.3 Low-temperature viscosity stability. The kinematic viscosity shall be tested as specified in section 4.4 at a temperature of -54 ±1 °C. The viscosity at 3 hours and at 72 hours shall not exceed 1300 $mm^2/s$.

3.3.4 Storage stability. The fully blended product shall show no separation of ingredients or evidence of crystallization. The fully blended product shall be clear and transparent when examined visually, and shall conform to the requirements of tables I and II and sections 3.3 thru 3.4 after 12 months of storage when tested as specified in section 4.4.

3.3.5 High-temperature stability. When tested in accordance with section 4.4.3, the change in fluid viscosity at 40 °C shall not exceed 5 percent. The acid number of the fluid shall not increase by more than 0.25 mg KOH/g, and there shall be no formation of precipitate or insoluble material.

3.4 Workmanship. The workmanship shall be in accordance with high-grade, commercial practices covering this type of material. The finished fluid shall be homogeneous and free from suspended matter, dirt, or other foreign material.

3.5 Toxicity. The dielectric coolant fluid shall have no adverse effect on the health of personnel when used for its intended purpose.

3.6 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life-cycle costs.

## 4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

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***TABLE I. Properties of finished coolant fluid and test methods.***

| Property | Limits | Test Method | |
|---|---|---|---|
| | | FED-STD-791 | ASTM/Reference |
| Kinematic viscosity, $mm^2/s$ at | | | |
| -54 °C[1], maximum | 1300 | | D2532 |
| -40 °C, maximum | 300 | | D445 |
| 40 °C, minimum | 5.0 | | D445 |
| 100 °C, minimum | 1.65 | | D445 |
| Dielectric strength, kV, minimum | 35 | | D877 |
| Resistivity @ 25 °C, ohm-cm, minimum | $1.0 \times 10^{10}$ | | D1169 |
| Flash point, °C, minimum | 150 | | D92 |
| Fire point, °C, minimum | 160 | | D92 |
| Acid number, mg KOH/g, maximum | 0.20 | | D664 |
| Water, ppm, maximum | 50 | | D6304 |
| Rubber swell, standard synthetic rubber Nbr-L[2], % | 0.0 – 10 | | D4289 |
| Solid particle contamination | | | 4.4.1 |
| Particle count | See Table II | 3012 | |
| Storage stability | Pass | 3465 | |
| High-temperature stability | Pass | | 4.4.3 |
| Corrosiveness and oxidation stability[3] | | | D4636 |
| Change in acid number, mg KOH/g, maximum | 0.5 | | |
| Metal specimen weight change[4], $mg/cm^2$ | | | |
| Aluminum | ± 0.2 | | |
| Cadmium plated steel [5] | ± 0.2 | | |
| Copper [6] | ± 0.4 | | |
| M-1010 Steel | ± 0.2 | | |
| Magnesium | ± 0.2 | | |
| Percent change in viscosity at 40 °C, maximum | 5 | | |
| Separation of insoluble materials or gumming of the fluid | None | | |

NOTES:

[1] Initial viscosity reading at -54 °C shall be taken at 1.5 hours.

[2] Test conditions: 168 hours at 70 °C.

[3] Test conditions: 168 hours at 121 °C. Use heptane or acetone as the solvent.

[4] There shall be no pitting, etching, or visible corrosion on the surface of the metals viewed under magnification of 20 diameters.

[5] A slight discoloration of the cadmium shall be permitted.

[6] Any corrosion produced on the surface of the copper shall be no greater than No. 3a of the ASTM D130 copper strip corrosion standard.

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***TABLE II. Solid particle contamination limits.***

| Particle Size Range (largest dimension) micrometers (µm) | Allowable Number (max) for each determination automatic count |
|---|---|
| 5 – 15 | 10,000 |
| 16 – 25 | 1,000 |
| 26 – 50 | 150 |
| 51 – 100 | 20 |
| >100 | 5 |

4.2 Qualification inspection. Qualification inspection shall consist of testing to all the requirements specified in sections 3.3 thru 3.4 and tables I and II. When required by the qualifying activity, additional evaluations may be required on candidate formulations.

4.2.1 Qualification process. The general outline of the qualification process (see 6.3.1) is described in SD-6.

4.2.2 Re-qualification. Re-qualification shall be required when any change is made in the source of manufacture, purity, or composition of the fluid's base stock or additives. A minor change in the fluid formulation may be made without re-qualification testing, but only after notification to, and approval by, the qualifying activity (see 6.3.1).

4.2.3 Retention of qualification. In order to retain qualification of a product approved for listing on the QPL, the manufacturer shall verify by certification (DD Form 1718) to the qualifying activity that the manufacturer's product complies with the requirements of this specification. The manufacturer shall also provide a recent Certificate of Analysis (COA), to include all conformance inspection requirements (see 4.3). The time of periodic verification by certification shall be in 2-year intervals from the date of original qualification. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine the product continues to meet any or all of the specification requirements.

4.2.4 Qualification inspection sample. A qualification sample shall consist of a one-gallon container of dielectric coolant fluid. The following may also be requested at the option of the qualifying activity: 1 quart of the base stock before the addition of any additive agents, and 1 ounce of oxidation inhibitor, if applicable. In the event additives are supplied as concentrated solutions, an equivalent quantity of the solution shall be furnished. The qualifying activity will request data as noted in section 6.3.1 prior to authorizing submission of the qualification sample.

4.3 Conformance inspection. The conformance inspection shall consist of all the tests in tables I and II and sections 3.3 thru 3.4 with the exception of rubber swell and storage stability. In the event of a solid particle contamination count failure, the referee method shall be the microscopic method, ASTM F312, using Method A with white and/or black filters at the Government's discretion. Unless otherwise specified by the procuring activity, sampling of the dielectric coolant fluid shall be in accordance with section 4.3.1.

4.3.1 Sampling for tests. Sampling for tests shall be conducted in accordance with ASTM D4057 or ASTM D4177. Failure of any conformance test shall result in rejection of the lot.

4.4 Methods of inspection. Tests shall be performed in accordance with the applicable methods specified in table I and sections 4.4.1 through 4.4.3. Physical and chemical values specified in section 3

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apply to the arithmetic average of the determinations made on the samples for those values which fall within any stated repeatability or reproducibility limits of the applicable test method.

4.4.1 Particulate contamination. Particle count shall be measured by the use of an automatic particle counter employing the light interruption principle or by the microscopical method to the limits specified in table II. The operating instructions in the respective instrument manual shall be used.

4.4.2 Compatibility. Samples of candidate dielectric coolant fluid in amounts of 20 mL, 100 mL, and 180 mL shall be mixed with samples from each of the fluids 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 shaken and then stored in an oven at 135 °C 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 for a period of 2 hours. Slight turbidity during this time, which later disappears, will be permitted in the samples.

4.4.3 High-temperature stability.

4.4.3.1 Apparatus. Thermal-stability characteristics of the coolant fluid shall be determined using the following apparatus: a 50 mL round-bottom flask or test tube (25 mm x 50 cm) with a 24/40 taper; a 75° angle adapter; gas inlet tube (6-mm OD Pyrex tubing); and a high-temperature bath capable of maintaining a temperature of 200 ± 2 °C.

4.4.3.2 Procedure. Place 25 mL of candidate fluid in a flask or test tube fitted with the 75° angle adapter and gas inlet tube. The height of the gas inlet tube should be adjusted to within 1.0 cm above the level of the fluid. Place a 2.5 cm length of 6-mm OD stainless steel tubing, type 304, in the fluid. Heat the fluid for 100 hours at a temperature of 200 ± 2 °C while maintaining a 1-liter-per-hour flow of dry nitrogen (lamp grade) on the surface of the fluid via the gas inlet tube. Upon completion of the test, the fluid shall meet the requirements of section 3.3.5.

4.5 Examination of filled containers. A random sample of filled containers from each packaged lot (see 6.7) shall be examined with regard to fill, closure, sealing, and leakage.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's System Commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

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

6.1 Intended use. The material covered by this specification is intended for use as a heat-transfer medium in closed military systems and capable of functioning as a dielectric coolant fluid over the temperature range of -54 °C to 200 ºC. Dielectric coolant fluid is used to cool military aircraft systems, including radar, aircraft avionics systems, missiles, and navigation systems.

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6.1.1 Storage conditions. Prior to use in intended equipment, the product may be stored under conditions of covered or uncovered storage in geographic areas ranging in temperature from -54 °C to 50 ºC.

6.1.2 Additional data for typical properties of the finished coolant fluid. Additional data is included in table III to serve as user information which will be referred to as typical (inherent) and will not be a requirement levied upon the supplier.

***TABLE III. Typical properties of the finished dielectric coolant fluid.***

| Characteristic | Inherent Value |
|---|---|
| Specific Gravity<br>@ 25 °C (77 °F)<br>@ 15.6 °C (60 °F) | <br>0.789<br>0.800 |
| Coefficient of thermal expansion ($cm^3/cm^3$ °C) | $8.1 \times 10^{-4}$ |
| Thermal conductivity (cal-cm/s-$cm^2$ °C)<br>@ -40 °C (-40 °F)<br>@ 0 °C (32 °F)<br>@ 150 °C (302 °F) | <br>$4.5 \times 10^{-4}$<br>$3.8 \times 10^{-4}$<br>$3.0 \times 10^{-4}$ |
| Specific Heat<br>@ -40 °C (-40 °F)<br>@ 25 °C (77 °F)<br>@ 75 °C (167 °F)<br>@ 149 °C (300 °F) | <br>0.48<br>0.53<br>0.55<br>0.65 |

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of the specification.
b. Quantity required.
c. Type and capacity of containers.
d. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for the products which are, at the time of award of contract, qualified for inclusion in the Qualified Products List, QPL No. 87252, whether or not such products have actually been listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Air Force Petroleum Office, AFPET/PTPS, 2430 C Street, Building 70, Area B, Wright-Patterson AFB, OH 45433-7631. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.3.1 Qualification process. Clarification information concerning submitting a test sample to the Air Force Petroleum Office for qualification to MIL-PRF-87252 follows.

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6.3.1.1 Requesting qualification. At the initiation of the qualification process, prospective suppliers must forward a written request for such action to the Air Force Petroleum Office. The activity responsible for qualification is the Air Force Petroleum Office, AFPET/PTPS, 2430 C Street, Building 70, Area B, Wright-Patterson AFB, OH 45433-7631. The written request should contain the following:

a. Letter indicating the company's interest in either qualifying or re-qualifying a product and stating they will adhere to the appropriate provisions of the SD-6.

b. Complete formulation of the candidate fluid, including chemical composition in weight percent, the manufacturer and trade name of each ingredient, and the purity of each ingredient.

c. Certified lab results on the product per section 4.2 of this specification from the manufacturer, a commercial laboratory, or a combination thereof.

d. Safety Data Sheets (SDS) of the candidate product and for each component of the formulation. The SDS may not be older than 5 years.

e. Verification that the System for Award Management (CAGE Codes for corporate office and plant) is current. This can be viewed at https://www.sam.gov.

f. Identification of the manufacturing site of the specific batch of test sample to be submitted.

6.3.2 Qualification sample. Upon receiving authorization from the Air Force Petroleum Office, qualification samples may be forwarded to the qualification activity, as detailed in the authorization letter. These samples will be tested in accordance with the letter of authorization. Each sample must be plainly identified by a securely attached, durable tag, or label marked with the following information:

QUALIFICATION SAMPLE
COOLANT FLUID, HYDROLYTICALLY STABLE, DIELECTRIC
MIL-PRF-87252
Name of Manufacturer: _____
Product Code Number: _____
Batch Number: _____
Date of Manufacture: _____
Submitted by (name and date): _____

6.3.2.1 Data to accompany qualification samples. The samples will be accompanied by an SDS and a Certificate of Analysis.

6.4 Qualified Products Database. Current fluids qualified to this specification can be found in the QPD at https://assist.dla.mil. Manufacturers with fluids qualified to this specification are required to update their CAGE code listing annually at https://www.sam.gov. Even if a fluid formulation does not have any changes (as described in 4.2), manufacturers are required to recertify their products every two years (as described in 4.2.2).

6.5 Safety Data Sheets. Contracting officers will identify those activities that require copies of completed SDS prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.6 Toxicity. Questions pertinent to this effect should be referred by the contracting activity to the appropriate departmental medical service who will act as its advisor.

6.7 Definitions.

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

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

6.8 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: https://www.shelflife.hq.dla.mil/.

6.9 Subject term (key word) listing.

Heat transfer fluid
Insulating fluid
Liquid coolant
Synthetic hydrocarbon
Synthetic rubber

6.10 International standardization agreement implementation. This specification implements NATO STANAG 1135, Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations, and ASIC AIR STANDARD FG 4024, Interchangeability Chart of Standardized Aviation Fuels, Lubricants and Associated Products. When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at https://assist.dla.mil.

6.11 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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CONCLUDING MATERIAL

Custodians:
Army – CR4
Navy – AS
Air Force – 68

Review activities:
Army – AT, MI
Navy – SH
Air Force – 20
DLA – GS

Preparing activity:
Air Force – 68
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