METRIC

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29 January 1992

SUPERSEDING
MIL-T-83133C
10 February 1989

# MILITARY SPECIFICATION

# TURBINE FUELS, AVIATION, KEROSENE TYPES, NATO F-34 (JP-8) AND NATO F-35

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

## 1. SCOPE

**1.1 Scope.** This specification covers two grades of aviation turbine fuel.

**1.2 Classification.** Aviation turbine fuel shall be of the following grades, as specified (see 6.2).

| NATO Code No. | Description |
|---|---|
| F-35 | Kerosene type almost identical (without additives) to ASTM D1655 Jet A-1 Fuel |
| F-34 (JP-8) | Same as F-35 but with the corrosion inhibitor/lubricity improver and the fuel system icing inhibitor additives |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASD/ENES, Wright-Patterson AFB OH 45433-6503 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 9130

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## 2. APPLICABLE DOCUMENTS

### 2.1 Government documents

**2.1.1 Specifications and standards.** The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

| | | |
|---|---|---|
| MIL-T-5624 | – | Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5/JP-8 ST |
| MIL-I-25017 | – | Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric) |
| MIL-I-27686 | – | Inhibitor, Icing, Fuel System |
| MIL-I-85470 | – | Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745 |

STANDARDS

FEDERAL

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

MILITARY

| | | |
|---|---|---|
| MIL-STD-290 | – | Packaging of Petroleum and Related Products |

QUALIFIED PRODUCTS LIST

| | | |
|---|---|---|
| QPL-25017 | – | Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble |

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia PA 19111-5094.)

**2.2 Non-Government publications.** The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the non-Government document which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

| | | |
|---|---|---|
| ASTM D56 | – | Flash Point by Tag Closed Tester, Standard Test Method for (DoD adopted) |
| ASTM D86 | – | Distillation of Petroleum Products, Standard Method for (DoD adopted) |



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| | | |
|---|---|---|
| ASTM D93 | – | Standard Test Methods for Flash Point by Pensky–Martens Closed Tester (DoD adopted) |
| ASTM D129 | – | Standard Test Method for Sulfur in Petroleum Products (General Bomb Method) |
| ASTM D130 | – | Standard Test Method for Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test (DoD adopted) |
| ASTM D156 | – | Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method) (DoD adopted) |
| ASTM D240 | – | Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (DoD adopted) |
| ASTM D381 | – | Standard Test Method for Existent Gum in Fuels by Jet Evaporation (DoD adopted) |
| ASTM D445 | – | Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity (DoD adopted) |
| ASTM D976 | – | Standard Test Methods for Calculated Cetane Index of Distillate Fuels (DoD adopted) |
| ASTM D1094 | – | Standard Test Method for Water Reaction of Aviation Fuels (DoD adopted) |
| ASTM D1250 | – | Standard Petroleum Measurement Tables |
| ASTM D1266 | – | Standard Test Method for Sulfur in Petroleum Products (Lamp Method) (DoD adopted) |
| ASTM D1298 | – | Standard Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method |
| ASTM D1319 | – | Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption (DoD adopted) |
| ASTM D1322 | – | Standard Test Method for Smoke Point of Aviation Turbine Fuels (DoD adopted) |
| ASTM D1840 | – | Standard Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry (DoD adopted) |
| ASTM D2276 | – | Standard Test Method for Particulate Contaminant in Aviation Fuel |
| ASTM D2386 | – | Standard Test Method for Freezing Point of Aviation Fuels |
| ASTM D2622 | – | Standard Test Method for Sulfur in Petroleum Products by X–Ray Spectrometry (DoD adopted) |
| ASTM D2624 | – | Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels Containing a Static Dissipator Additive (DoD adopted) |
| ASTM D2887 | – | Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography |
| ASTM D3120 | – | Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry |
| ASTM D3227 | – | Standard Test Method for Mercaptan Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method) (DoD adopted) |



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| | | |
|---|---|---|
| ASTM D3241 | – | Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure) |
| ASTM D3242 | – | Standard Test Method for Acidity in Aviation Turbine Fuel |
| ASTM D3338 | – | Standard Test Method for Estimation of Heat of Combustion of Aviation Fuels |
| ASTM D3343 | – | Standard Method for Estimation of Hydrogen Content of Aviation Fuels |
| ASTM D3701 | – | Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry |
| ASTM D3828 | – | Standard Test Methods for Flash Point by Setaflash Closed Tester (DoD adopted) |
| ASTM D3948 | – | Standard Test Methods for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD adopted) |
| ASTM D4052 | – | Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter |
| ASTM D4057 | – | Standard Practice for Manual Sampling of Petroleum and Petroleum Products |
| ASTM D4177 | – | Standard Method for Automatic Sampling of Petroleum and Petroleum Products (DoD adopted) |
| ASTM D4294 | – | Standard Test Method for Sulfur in Petroleum Products by Non-Dispersive X-Ray Fluorescence Spectroscopy |
| ASTM D4306 | – | Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination |
| ASTM D4809 | – | Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Intermediate Precision Method) |
| ASTM D4952 | – | Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents |
| ASTM D5006 | – | Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels |
| ASTM E29 | – | Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted) |
| ASTM E380 | – | Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System) |

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19103-1187.)

DEPARTMENT OF TRANSPORTATION

| | | |
|---|---|---|
| 49 CFR 170-189 | – | Department of Transportation Rules and Regulations for the Transportation of Explosive and Dangerous Articles |

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



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(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

**2.3 Order of precedence.** In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specification, specification sheets, or MS standards), 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 Materials.** The fuel supplied under this specification shall be refined hydrocarbon distillate fuel oils containing additives in accordance with 3.3. The feed stock from which the fuel is refined shall be crude oils derived from petroleum, tar sands, oil shale, or mixtures thereof.

**3.2 Chemical and physical requirements.** The chemical and physical requirements of the finished fuel shall conform to those listed in table I.

**3.3 Additives.** The type and amount of each additive used shall be reported (see 6.2.e).

**3.3.1 Antioxidants.** Immediately after processing and before the fuel is exposed to the atmosphere (i.e., during rundown into feed/batch tankage), add an approved antioxidant (see 3.3.1.1) in order to prevent the formation of gums and peroxides after manufacture. The concentration of antioxidant to be added shall be:

a. Not less than 17.2 mg nor more than 24.0 mg of active ingredient per liter of fuel (6.0 to 8.4 lb/1000 barrels) to all JP-8 fuel that contains blending stocks that have been hydrogen treated.

b. At the option of the supplier, not more than 24.0 mg of active ingredient per liter of fuel (8.4 lb/1000 barrels) may be added to JP-8 fuels that do not contain hydrogen treated blending stocks.

**3.3.1.1** The following antioxidant formulations are approved:

a. 2,6-di-tert-butyl-4-methylphenol

b. 6-tert-butyl-2,4-dimethylphenol

c. 2,6-di-tert-butylphenol

d. 75 percent min-2,6-di-tert-butylphenol
25 percent max tert-butylphenols and tri-tert-butylphenols

e. 72 percent min 6-tert-butyl-2,4-dimethyphenol
28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols



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TABLE I. Chemical and physical requirements and test methods.

| Property | Min | Max | Test Methods ASTM Standards |
|---|---|---|---|
| Color, Saybolt | | 1/ | D156 |
| Total Acid number, mg KOH/gm | | 0.015 | D3242 |
| Aromatics, vol percent | | 25.0 | D1319 |
| Olefins, vol percent | | 5.0 | D1319 |
| Sulfur, total, mass percent | | 0.30 | D129, D1266<br>D2622, D3120<br>D4294 2/ |
| Sulfur Mercaptan, mass percent OR | | 0.002 | D3227 |
| Doctor test | | negative | D4952 |
| Distillation Temperature, °C 3/ | | | D86 2/, D2887 |
| (D2887 limits given in parentheses) | | | |
| Initial boiling point | | 1/ | |
| 10 percent recovered | | 205 (186) | |
| 20 percent recovered | | 1/ | |
| 50 percent recovered | | 1/ | |
| 90 percent recovered | | 1/ | |
| End point | | 300 (330) | |
| Residue, vol percent | | 1.5 | |
| Loss, vol percent | | 1.5 | |
| Flash point, °C (°F) | 38 (100) | 4/ | D93 2/, D3828 4/ |
| Density or Gravity | | | |
| Density, kg/L at 15° C OR | 0.775 | 0.840 | D1298 or D4052 2/ |
| Gravity, API at 60° F | 37.0 | 51.0 | D1298 |
| Freezing point, °C (°F) | | –47 (–53) | D2386 |
| Viscosity, at –20° C, centistokes | | 8.0 | D445 |
| Net heat of combustion, MJ/kg | 42.8 | | D3338, D4809 5/ |
| (BTU/lb) | 18,400 | | D240 2/ |
| Hydrogen content, mass percent | 13.4 | | D3701 2/, D3343 |
| Smoke point, mm, OR | 25.0 | | D1322 |
| Smoke point, mm, AND | 19.0 | | D1322 |
| Naphthalenes, vol percent | | 3.0 | D1840 |



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TABLE I. Chemical and physical requirements and test methods. Continued

| Property | Min | Max | Test Methods ASTM Standards |
|---|---|---|---|
| Calculated Cetane Index | | 1/ | D976 6/ |
| Copper strip corrosion, 2 hr at 100° C (212° F) | | No. 1 | D130 |
| Thermal stability | | | D3241 7/ |
| change in pressure drop, mm Hg | | 25 | |
| heater tube deposit, visual rating | | <3 | |
| Existent gum, mg/100 ml | | 7.0 | D381 |
| Particulate matter, mg/L | | 1.0 | D2276 8/ |
| Filtration time, minutes | | 15 | 8/ |
| Water reaction interface rating | | lb | D1094 |
| Water separation index | 9/ | | D3948 |
| Fuel system icing inhibitor, vol % | 0.10 | 0.15 | D5006 10/ |
| Fuel electrical conductivity, pS/m | 11/ | 11/ | D2624 |

1/ To be reported — not limited.

2/ Referee Test Method.

3/ A condenser temperature of 0° to 4° C (32° to 40° F) shall be used for the distillation by ASTM D86.

4/ ASTM D93 is the referee method. Method IP170 is also permitted. The minimum flash point shall be 40° C by ASTM D56, as it can be 1° to 2° C above those obtained by the other methods.

5/ When the fuel distillation test is performed using ASTM D2887, the average distillation temperature, for use in ASTM D3338 shall be calculated as follows:

$$V = (10\% + 50\% + 95\%)/3$$

6/ Mid-boiling temperatures may be obtained by either ASTM D86 or ASTM D2887 to perform the cetane index calculation. ASTM D86 values should be corrected to standard barometric pressure.

7/ See 4.5.2.1 for ASTM D3241 test conditions and test limits.

8/ A minimum sample size of 3.79 liters (one gallon) shall be filtered. Filtration time will be determined in accordance with the procedure in appendix A. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D2276.

9/ The minimum water separation index rating for JP-8 shall be 85 with all additives except the corrosion inhibitor/lubricity improver additive and the static dissipator additive or 70 with all additives except the static dissipator additive.

10/ Test shall be performed in accordance with ASTM D5006 or method 5327 or 5340 of FED-STD-791. Use the appropriate scale of the refractometer.

11/ The conductivity must be between 150 and 600 pS/m for F-34 and between 50 and 450 pS/m for F-35, unless otherwise directed by the procuring activity.



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**3.3.2 Metal deactivator.** A metal deactivator, N,N'-disalicylidene-1,2-propanediamine or N,N'-disalicylidene-1,2-cyclohexanediamine may be blended into the fuel in an amount not to exceed 5.8 mg active ingredient per liter of fuel (2 lb/1000 barrels or 22 mg/gal (US)).

**3.3.3 Static dissipator additive.** An additive shall be added to the fuels in sufficient concentration to increase the conductivity of the fuel to within the range specified in table I at the point of injection. The point of injection of the additive shall be determined by agreement between the purchasing authority and the supplier. The following electrical conductivity additive is approved: Stadis 450 marketed by E.I. duPont de Nemours Co., Wilmington DE.

**3.3.4 Corrosion inhibitor.** A corrosion inhibitor conforming to MIL-I-25017 shall be blended into the F-34 grade fuel by the contractor. The corrosion inhibitor additive is optional for F-35. The amount added shall be equal to or greater than the minimum effective concentration and shall not exceed the maximum allowable concentration listed in the latest revision of QPL-25017. The contractor or transporting agency, or both, shall maintain and upon request shall make available to the Government evidence that the corrosion inhibitors used are equal in every respect to the qualification products listed in QPL-25017. The point of injection of the corrosion inhibitor shall be determined by agreement between the purchasing authority and the supplier.

**3.3.5 Fuel system icing inhibitor.** The fuel system icing inhibitor is mandatory for F-34 (JP-8) and shall conform to MIL-I-27686 or MIL-I-85470. The fuel system icing inhibitor is not to be added to NATO F-35 unless so directed by the procuring activity.

**3.3.6 Premixing of additives.** Additives shall not be premixed with other additives before injection into the fuel so as to prevent possible reactions among the concentrated forms of different additives.

**3.4 Workmanship.** At the time of Government acceptance, the finished fuel shall be visually free from undissolved water, sediment, or suspended matter and shall be clear and bright. In case of dispute, the fuel shall be clear and bright at 21° C (70° F) and shall contain no more than 1.0 mg/L of particulate matter as required by table I.

## 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 (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for 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.

**4.1.1 Responsibility for compliance.** All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system



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or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

**4.2 Classification of inspections.** The inspection requirements specified herein are classified as quality conformance inspections (see 4.4).

**4.3 Inspection conditions.** Requirements contained in table I are absolute, as defined in ASTM E29, and shall not be subject to correction for test tolerances. For rounding off of significant figures, ASTM E29 shall apply to all tests required by this specification.

**4.4 Quality conformance inspections.** Inspection shall be performed in accordance with method 9601 of FED-STD-791.

**4.4.1 Inspection lot**

**4.4.1.1 Bulk lot.** A bulk lot shall consist of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container.

**4.4.1.2 Packaged lot.** A packaged lot shall consist of an indefinite number of 208-liter (55-gallon) drums or smaller unit packages of identical size and shape offered for acceptance and filled from the isolated tank containing a homogeneous mixture of material.

**4.4.2 Sampling plans**

**4.4.2.1 Sampling for verification of product quality.** Each bulk or packaged lot of material shall be sampled for verification of product quality in accordance with ASTM D4057 or ASTM D4177, except where individual test procedures contain specific sampling instructions.

**4.4.2.1.1** A number of jet fuel properties are very sensitive to trace contamination which can originate from sample containers. For recommended sample containers refer to ASTM D4306.

**4.4.2.2 Sampling for examination of filled containers for delivery.** A random sample of filled containers shall be selected from each lot. The samples shall be examined in accordance with 4.5.1.3.

**4.5 Inspection methods**

**4.5.1 Examination of product**

**4.5.1.1 Visual inspection.** Samples selected in accordance with 4.4.1 shall be visually examined for compliance with 3.4.



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**4.5.1.2 Examination of empty containers.** Prior to filling, each empty unit container shall be visually inspected for cleanliness and suitability in accordance with ASTM D4057.

**4.5.1.3 Examination of filled containers.** Samples, taken as specified in 4.4.2 shall be examined for conformance to MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and markings. Any container having one or more defects under the required fill shall be rejected.

**4.5.2 Chemical and physical tests.** Tests to determine conformance to the chemical and physical requirements (3.2) shall be conducted in accordance with the applicable test methods listed in table I and those specified herein.

**4.5.2.1 Thermal stability.** The thermal stability test shall be conducted using ASTM D3241. The heater tube shall be rated visually (see appendix B).

**4.5.2.1.1 ASTM D3241 test conditions**

a. Heater tube temperature at maximum point: 260° C (500° F).

b. Fuel system pressure: 3.45 MPa (500 psig).

c. Fuel flow rate: 3.0 mL/min.

d. Test duration: 150 minutes.

**4.5.2.1.2 Acceptability criteria.** The fuel sample is acceptable if all the following criteria are met:

a. The maximum differential pressure across the test filter does not exceed 25 millimeters of mercury.

b. The maximum visual rating of the heater tube deposits is less than a code 3, and visual rating of the heater tube shows neither peacock type deposits (code P) nor abnormal type deposits (code A) (appendix B, 10.6.3.1 and 10.6.3.2).

c. Remove the reservoir cover and pour into a measuring cylinder the fuel found above the piston only. If this measured fuel is less than 405 mls, reject the test because insufficient fuel has been pumped for a normal 150 minute test. It is suggested to locate the cause of the insufficient flow before running another test.

**4.5.2.1.3 ASTM D3241 reported data.** The following data shall be reported:

a. Differential pressure in millimeter of mercury at 150 minutes, or time to differential pressure of 25 millimeters of mercury, whichever comes first.

b. Heater tube deposit visual code rating at the end of the test.

c. If a Mark 8A tube deposit rater (TDR) is available, the maximum SPUN TDR rating shall be reported.



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**4.6 Test report.** Test data required by 4.5.2 shall be reported in the same order as listed in table I, unless directed otherwise by the procuring activity.

## 5. PACKAGING

**5.1 Packaging, packing, and marking.** Packaging, packing, and marking shall be in accordance with MIL-STD-290. All fuel containers shall be marked with the flash point obtained in 4.5.2 in both degrees F and degrees C of the fuel contained therein.

**5.2 Transportation of fuels.** The transportation of the JP-8 fuel shall be in accordance with 49 CFR 170-189 Department of Transportation Rules and Regulations listed in 2.2.

## 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 fuels covered by this specification are intended for use in aircraft turbine engines. When authorized, NATO F-34 (JP-8) may be used in ground-based turbine and diesel engines. NATO F-35 is intended for commercial aviation, but can be converted to NATO F-34 (JP-8) by the addition of the appropriate additives. A JP-5/JP-8 ST (special test) fuel, included in MIL-T-5624, is intended for use in the development and qualification testing of engines and aircraft designed to operate with JP-5 and JP-8.

**6.2 Acquisition requirements.** Acquisition documents must specify the following:

a. Title, number, date of specification, and grade (type) of fuel.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2).

c. Quantity required and size containers desired.

d. Level of packaging and packing required (see 5.1).

e. Location and injection method for addition of electrical conductivity additive, fuel system icing inhibitor and corrosion inhibitor, as required.

**6.3 Conversion of measurement units.** If test results are obtained in units other than International Systems of Units (SI) or there is a requirement to report dual units, ASTM E280 or ASTM D1250 Volume XI/XII should be used to convert the units.



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**6.4 Subject term (key word) listing**

Antioxidants
Aviation fuel
Butylphenol
Corrosion inhibitor
Dimethyphenol
Fuel
F-34
F-35
Flash point
Freezing point
Hydrocarbon distillate fuel
Hydrogen content
Icing inhibitor
JP-8
Jet A-1
Kerosene
Lubricity improver
Methylphenol
Single fuel
Special test fuel
Static dissipator
Sulfur
Turbine

**6.5 International agreements.** Certain provisions of this specification are the subject of international standardization agreement ASCC Air Std 15/6, ASCC Advisory Publication 15/9, STANAG 1135, and STANAG 3747. When amendment, revision, or cancellation of this specification is proposed which affects or violates the international agreement concerned, the preparing activity shall take appropriate reconciliation action through international standardization channels including departmental standardization office, if required.

**6.6 Changes from previous issue.** Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army – MR
Navy – AS
Air Force – 11
DLA – PS

Review Activities:
Army – AV, AR
Air Force – 68

Preparing Activity:
Air Force – 11

Project No. 9130-0157



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# APPENDIX A

## METHODS FOR DETERMINATION OF FILTRATION TIME AND TOTAL SOLIDS (PARTICULATE)

**10. Scope.** This method describes a procedure for determining singularly or simultaneously the filterability characteristics and solids contamination of jet fuel. The purpose is to detect and prevent contaminants in jet fuel that can plug and cause rupture of ground filtration equipment, thereby affecting flight reliability of aircraft.

**20. Summary of methods.** 3.79 liters (one gallon) of jet fuel is filtered through a membrane filter in the laboratory. The time required to filter this volume is measured in minutes and solids content is determined gravimetrically.

**30. Apparatus**

a. Membrane filter: White, plain 47 mm diameter, nominal pore size 0.8 micron. The membrane must be approved by ASTM for use with ASTM D2276.

b. Filtration apparatus: Of the types shown in ASTM D2276, figure A3. It consists of a funnel and funnel base with a filter support such that a membrane filter can be securely locked or clamped between the sealing surfaces of the funnel and its base. The funnel and funnel base shall be of stainless steel or glass construction.

c. Insert ring: A 47–mm diameter paper flow reducer ring with dimensions to give filtering area of 4.8 $cm^2$. (Millipore Corporation Part No. XX10 04710.)

d. Vacuum flask: A minimum of 4 liters.

e. Vacuum system: That develops in excess of 67.5 kPa (20 inches of mercury) vacuum.

f. Oven: Of the static type (without fan assisted circulation) controlling to 90° ± 5° C (194° ± 9° F).

g. Forceps: Flat–bladed with unserrated nonpointed tips.

h. Solvent filtering dispenser: Containing a 1.2 micron maximum pore size filter in the delivery line.

i. Glass petri dish: Approximately 125 mm in diameter with removable cover.

j. Analytical balance: Single or double pan, the precision standard deviation of which must be 0.07 mg or better.

**40. Preparation of apparatus and sample containers.** All components of the filtration apparatus (except the vacuum flask), sample containers and their caps must be cleaned as described in A2.6.1.1



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through A2.6.1.7 of ASTM D2276. All metal parts of the filtration apparatus are to be electrically bonded and grounded, including the fuel sample container and the metal insert ring, if used. See ASTM D2276 for other safety precautions.

**50. Sampling.** Obtain a representative one gallon sample as directed in A2.7 of ASTM D2276. When sampling from a flowing stream is not possible, an all level sample or an average sample, in accordance with ASTM D4057 and/or ASTM D4177 shall be permitted. The one-gallon sample container shall be an interior epoxy-coated metal can, a brown glass bottle, or a clear glass bottle protected by suitable means from exposure to light.

**60. Test procedure**

a. Membrane filters shall be removed from the package and placed in an oven for a minimum of 15 minutes to 90° C. After preheating, but prior to weighing, the membrane filters shall be stored in a desiccator.

b. Each membrane filter shall be weighed. A filter weighing in excess of 90 mg will not be used in the test.

c. The membrane filter shall be placed directly over the insert ring. The top funnel shall be locked into place.

d. Immediately prior to filtering the fuel, shake the sample to obtain a homogenous mix and assure that fuel temperature does not exceed 30° C (86° F). Clean the exterior or top portion of the sample container to insure that no contaminants are introduced. Any free water present in the fuel sample will invalidate the filtration time results by giving an excessive filtration time rating.

e. With the vacuum off, pour approximately 200 ml of fuel into the funnel.

f. Turn vacuum on and record starting time. Continue filtration of the 3.79 liters (one gallon) sample, periodically shaking the sample container to maintain a homogenous mix. Record the vacuum in kPa (inches of mercury) one minute after start and again immediately prior to completion of filtration. Throughout filtration, maintain a sufficient quantity of fuel in the funnel so that the membrane filter is always covered.

g. Report the filtration time in minutes expressed to the nearest whole number. If filtration of the 3.79 liters (one gallon) is not completed within 30 minutes, the test will be stopped and the volume of the fuel filtered will be measured. In these cases, results will be reported as 30+minutes/volume of fuel filtered.

h. Report the vacuum in kPa (inches of mercury) as determined from the average of the two readings taken in 60.f.

i. After recording the filtration time, shut off the vacuum and rinse the sample container with approximately 100 ml of filtered petroleum ether and dispense into the filtration funnel. Turn the vacuum on and filter the 100 ml. Rinse. Turn vacuum off and wash the inside of the funnel with



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approximately 50 ml of filtered petroleum ether. Turn vacuum on and filter. Repeat the funnel rinse with another 50 ml of petroleum ether but allow the rinse to soak the filter for approximately 30 seconds before turning the vacuum on to filter the rinse. With vacuum on, carefully remove the top funnel and rinse the periphery of the membrane filter by directing a gentle stream of petroleum ether from the solvent dispenser from the edge of the membrane toward the center, taking care not to wash contaminants off the filter. Maintain vacuum after final rinse for a few seconds to remove the excess petroleum ether from the filter.

j. Using forceps, carefully remove the membrane filter from the filter base and place in a clean Petri dish. Dry in the oven at 90° C (194° F) for 15 minutes with the cover on the Petri dish slightly ajar. Place dish in a dessicator and allow to cool for a minimum of 15 minutes. If more than one sample is processed, cooling time will have to be increased. Reweigh the filter.

k. Report the total solids content in mg/liter by using the following formula:

$$\frac{\text{Weight gain of filter in mgs}}{3.785} = \text{mg/liter}$$

l. Should the sample exceed the 30-minute filtration time and a portion of the fuel is not filtered, the solids content in mg/liter will be figured as follows: Determine the volume of fuel filtered by subtracting the ml of fuel remaining from 3785.

$$\frac{\text{Weight gain of filter in mgs}}{\text{ml of fuel filtered} \times 0.001} = \text{mg/liter}$$

**70. Test limits**

a. Filtration time:

(1) The maximum allowable filtration time shall be 15 minutes for Grade JP-8.

(2) The vacuum should exceed 67.5 kPa (20 inches of mercury) throughout the test (i.e., the differential pressure across the filter should exceed 67.5 kPa (20 inches of mercury)).

(3) The fuel temperature shall be between 18° and 30° C (64° and 86° F). If artificial heat (i.e., a hot water bath) is used to heat the sample, erroneously high filtration times may occur, but this approach is allowed.

b. Total solids: Maximum allowable particulate matter is 1.0 mg/liter.

**80. NOTES:**

**80.1** If it is desired to determine the filtration time and not the total solids content, perform the test by omitting steps 60.i, 60.j, 60.k, and 60.l.

**80.2** If it is desired to determine the total solids content and not the filtration time, use of the insert ring may be omitted. It is also permissible, but not required, to use a control filter for a specific analysis or a series of analyses. When this is accomplished, the procedures specified in A.2 of ASTM D2276 apply.



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# APPENDIX B

## HEATER TUBE DEPOSIT RATING

**10. Visual method**

**10.1** Snap the upper end of the heater tube into the clamp of the adapter for the heater tube.

**10.2** Push the heater tube against the stop of the adapter tube.

**10.3** Slide the adapter with the heater tube over the guide rod into the tuberator equipped with a magnifying glass assembly.

**10.4** Insert the ASTM color standard into the tuberator.

**10.5** Rotate the adapter and position the heater tube so that the side with the maximum deposit is visible.

**10.6** Within 30 minutes after completion of the test, visually examine the heater tube in a tuberator. The entire portion of the test section between the bottom shoulder and the top shoulder of the heater tube test section shall be carefully examined using a magnifying glass in conjunction with the tuberator for any signs of discoloration, scratches, or other visually identified defects. When an area of the tube corresponds visually to an ASTM color standard, the color standard code number shall be recorded. If the area being rated has a color between two adjacent color standards, it shall be rated as the lighter (that is lower number) color standards. (NOTE: It is important that all light bulbs in the tuberator are functioning as a change in light intensity can shift the rating significantly.) (NOTE: The person rating the tube should have normal ability to distinguish between colors: i.e., the rater should not be color blind.)

**10.6.1** In rating the heater tube, the darkest deposits govern and the code number representative of the darkest section, rather than the average deposit, shall be reported.

**10.6.2** If a spot or streak is found on the heater tube, it shall be carefully examined under various lighting conditions using a magnifying glass to determine if it is a deposit, a scratch, or tube defect (note that the tube defects should have been found during the pretest inspection of the tube). If the spot or streak is determined to be a scratch or tube defect, it shall be disregarded. If the spot or streak is a deposit, it shall be rated against the ASTM color standards, if larger in area than about 0.025 sq cm (0.004 sq inch); i.e., approximately 1.5 mm X 1.5 mm (1/16 inch X 1/16 inch) square or an equivalent area. However, a streak deposit shall be ignored if less than 0.8 mm (1/32 inch) wide, regardless of length. Note that the tube section is about 3 mm (1/8 inch) in diameter; thus a 1.5 mm (1/16 inch) wide spot is half the diameter of the tube test section and 0.8 mm (1/32 inch) wide streak is one fourth the diameter of the tube test section.



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**10.6.3** If the heater tube has deposits which do not match the color standards, the following criteria shall be used.

**10.6.3.1** If the deposit has peacock (rainbow) colors, rate this as code P (P for peacock). If some portion of the deposit does match the color standards, it shall be rated.

**10.6.3.2** Deposits having abnormal colors (for example, blue or gray) shall have a rating of code A (A for abnormal color) assigned.

**10.6.3.3** When reporting the overall tube rating, record the rating of the maximum deposit which matches the color standards plus P or A if the tube contains deposits which do not match the color standards. If the tube contains only P or A deposits, just report the appropriate letter (A); do not try to assign a numerical rating to a P or A deposit. Examples of how the rating procedure is to be used are given below:

Example 1: The darkest deposits on the heater tube match color standard 3. Also present are peacock colors. Thus, the overall tube rating to be reported is 3P.

Example 2: The heater tube has maximum deposits falling between color standards 2 and 3 and has no peacock or abnormal colors. The total tube rating is 2.

Example 3: The heater tube matches color standard 1 except for an abnormal deposit which does not match the ASTM color standards. The overall tube rating to be reported is 1A.



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|---|---|---|
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3 DOCUMENT TITLE

TURBINE FUELS, AVIATION, KEROSENE TYPES, NATO F-34 (JP-8) AND NATO F-35

4 NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible Attach extra sheets as needed )*

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| a. NAME *(Last, First, Middle Initial)* | b ORGANIZATION | |
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