**METRIC**

MIL-DTL-83133H
25 October 2011

SUPERSEDING
MIL-DTL-83133G
w/ AMENDMENT 1
1 June 2011

# DETAIL SPECIFICATION

# TURBINE FUEL, AVIATION, KEROSENE TYPE, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)

Comments, suggestions, or questions on this document should be addressed to AFPA/PTPT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB OH 45433-7632 or e-mailed to AFPET.AFTT@wpafb.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.daps.dla.mil.

AMSC N/A FSC 9130

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

## 1. SCOPE

1.1 Scope. This specification covers three grades of kerosene type aviation turbine fuel, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37). This specification was thoroughly reviewed as a part of acquisition reform. While most of the requirements were converted to performance terms, due to the military-unique nature of the product (see 6.1) and the need for compatibility with deployed systems, it was determined that not all requirements could be converted. The issuance of this specification as "detail" is not intended to constrain technology advances in future systems.

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

| Grade | NATO Code No. | Description |
|---|---|---|
| JP-8 | F-34 | Kerosene type turbine fuel which will contain a static dissipater additive, corrosion inhibitor/lubricity improver, and fuel system icing inhibitor, and may contain antioxidant and metal deactivator. |
| --- | F-35 | Kerosene type turbine fuel which will contain a static dissipater additive, may contain antioxidant, corrosion inhibitor/lubricity improver, and metal deactivator but will not contain fuel system icing inhibitor. |
| JP-8+100 | F-37 | JP-8 type kerosene turbine fuel which contains thermal stability improver additive (NATO S-1749) as described in 3.3.6. |

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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, 4, or 5 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.

AIR AND SPACE INTEROPERABILITY COUNCIL (ASIC)

| | |
|---|---|
| AIR STD ACS (FG) 4022 | Guide Specifications (Minimum Quality Standards) for Aviation Turbine Fuels: F-34, F-35, F-40, and F-44 |
| AIR STD 15/09 | Interchangeability Chart of Standardized Aviation Fuels, Lubricants, and Associated Products |

(Copies of these documents are available online at http://www.dtic.mil/asic/index.htm or Defense Technical Information Center 8725 John J. Kingman Road, Suite 0944, Fort Belvoir, VA 22060-6218.)



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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

| | |
|---|---|
| STANAG 1135 | Interchangeability of Fuels, Lubricants, and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations |
| STANAG 3747 | Guide Specifications (Minimum Quality Standards) for Aviation Turbine Fuels (F-34, F-35, F-40, and F-44) |

(Copies of these documents are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia PA 19111-5094 or online at https://assist.daps.dla.mil or https://assist.daps.dla.mil/quicksearch.)

DEPARTMENT OF DEFENSE SPECIFICATIONS

| | |
|---|---|
| MIL-PRF-25017 | Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (NATO S-1747) |
| MIL-DTL-85470 | Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745 |

DEPARTMENT OF DEFENSE STANDARDS

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

QUALIFIED PRODUCTS LIST

| | |
|---|---|
| QPL-25017 | Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (NATO S-1747) |

(Copies of these documents are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia PA 19111-5094 or online at https://assist.daps.dla.mil or https://assist.daps.dla.mil/quicksearch.)

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 D56 | Standard Test Method for Flash Point by Tag Closed Cup Tester (DoD Adopted) |
| ASTM D86 | Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure (DoD Adopted) |
| ASTM D93 | Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester (DoD Adopted) |
| ASTM D129 | Standard Test Method for Sulfur in Petroleum Products (General Bomb Method) (DoD Adopted) |
| ASTM D130 | Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test (DoD Adopted) |
| ASTM D156 | Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method) (DoD Adopted) |



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| | |
|---|---|
| ASTM D381 | Standard Test Method for Gum Content 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 Method for Calculated Cetane Index of Distillate Fuels (DoD Adopted) |
| ASTM D1094 | Standard Test Method for Water Reaction of Aviation Fuels (DoD Adopted) |
| ASTM D1266 | Standard Test Method for Sulfur in Petroleum Products (Lamp Method) (DoD Adopted) |
| ASTM D1298 | Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method (DoD Adopted) |
| 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 Kerosine and Aviation Turbine Fuel (DoD Adopted) |
| ASTM D1655 | Standard Specification for 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 by Line Sampling (DoD Adopted) |
| ASTM D2386 | Standard Test Method for Freezing Point of Aviation Fuels (DoD Adopted) |
| ASTM D2425 | Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry |
| ASTM D2622 | Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry (DoD Adopted) |
| ASTM D2624 | Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels (DoD Adopted) |
| ASTM D2887 | Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography (DoD Adopted) |
| ASTM D3120 | Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry (DoD Adopted) |
| ASTM D3227 | Standard Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method) (DoD Adopted) |
| ASTM D3241 | Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (DoD Adopted) |
| ASTM D3242 | Standard Test Method for Acidity in Aviation Turbine Fuel (DoD Adopted) |
| ASTM D3338 | Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels (DoD Adopted) |



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| | |
|---|---|
| ASTM D3343 | Standard Test Method for Estimation of Hydrogen Content of Aviation Fuels (DoD Adopted) |
| ASTM D3701 | Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry (DoD Adopted) |
| ASTM D3828 | Standard Test Methods for Flash Point by Small Scale Closed Cup Tester (DoD Adopted) |
| ASTM D3948 | Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD Adopted) |
| ASTM D4052 | Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter (DoD Adopted) |
| ASTM D4057 | Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted) |
| ASTM D4177 | Standard Practice for Automatic Sampling of Petroleum and Petroleum Products (DoD Adopted) |
| ASTM D4294 | Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectrometry (DoD Adopted) |
| ASTM D4306 | Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination (DoD Adopted) |
| ASTM D4529 | Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels |
| ASTM D4629 | Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection (DoD Adopted) |
| ASTM D4737 | Standard Test Method for Calculated Cetane Index by Four Variable Equation |
| ASTM D4809 | Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method) (DoD Adopted) |
| ASTM D4952 | Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test) (DoD Adopted) |
| ASTM D5006 | Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels (DoD Adopted) |
| ASTM D5291 | Standard Test Method for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants |
| ASTM D5452 | Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration (DoD Adopted) |
| ASTM D5453 | Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence |
| ASTM D5972 | Standard Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method) (DoD Adopted) |
| ASTM D6045 | Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method |



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| | |
|---|---|
| ASTM D6304 | Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration (DoD Adopted) |
| ASTM D6890 | Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber |
| ASTM D7153 | Standard Test Method for Freezing Point of Aviation Fuels (Automatic Laser Method) |
| ASTM D7154 | Standard Test Method for Freezing Point of Aviation Fuels (Automatic Fiber Optical Method) |
| ASTM D7170 | Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Fixed Range Injection Period, Constant Volume Combustion Chamber Method |
| ASTM D7224 | Standard Test Method for Determining Water Separation Characteristics of Kerosine-Type Aviation Turbine Fuels Containing Additives by Portable Separometer |
| ASTM D7359 | Standard Test Method for Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC) |
| ASTM E29 | Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD Adopted) |
| IEEE/ASTM SI10 | American National Standard for Metric Practice (DoD Adopted) |

(Copies of these documents are available at ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken PA 19428-2959. Electronic copies of ASTM standards may be obtained from http://www.astm.org.)

UNIVERSAL OIL PRODUCTS

| | |
|---|---|
| UOP 389 | Trace Metals in Organics by Wet Ashing-ICP-OES |

(Copies of these documents are available at Universal Oil Products, UOP LLC, 25 East Algonquin Road, P.O. Box 5017 Des Plaines, IL 60017. Electronic copies are available through ASTM International at http://www.astm.org.)

ENERGY INSTITUTE

| | |
|---|---|
| IP 170 | Determination of Flash Point -- Abel Closed-Cup Method |
| IP 540 | Determination of the Existent Gum Content of Aviation Turbine Fuel -- Jet Evaporation Method |
| IP 564 | Determination of the Level of Cleanliness of Aviation Turbine Fuel -- Laboratory Automatic Particle Counter Method |
| IP 565 | Determination of the Level of Cleanliness of Aviation Turbine Fuels -- Portable Automatic Particle Counter Method |
| IP 577 | Determination of the Level of Cleanliness of Aviation Turbine Fuel -- Automatic Particle Counter Method Using Light Extinction |



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| | |
|---|---|
| IP 585 | Determination of Fatty Acid Methyl Esters (FAME), Derived from Bio-Diesel Fuel, in Aviation Turbine Fuel - GC-MS with Selective Ion Monitoring/Scan Detection Method |
| IP 590 | Determination of Fatty Acid Methyl Esters (FAME) in Aviation Turbine Fuel - HPLC Evaporative Light Scattering Detector Method |

(Copies of these documents are available from the Energy Institute, 61 New Cavendish Street, London, WIG 7AR, UK. Electronic copies of Energy Institute documents may be obtained from http://www.energyinst.org.uk)

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, 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. Unless otherwise specified (see 3.1.1), fuel supplied under this specification shall be refined hydrocarbon distillate fuel oil containing additives in accordance with 3.3. The feedstock from which the fuel is refined shall be crude oils derived from petroleum, tar sands, oil shale, or mixtures thereof.

3.1.1 Synthesized Materials. With the approval of both the procuring activity and the applicable fuel technical authorities listed below, up to a total 50 volume percent of the finished fuel may consist of Synthesized Paraffinic Kerosene (SPK) derived from a Fischer-Tropsch (FT) process meeting the requirements of Appendix A (see A.2) or SPKs derived from Hydroprocessed Esters and Fatty Acids (HEFA) meeting the requirements of Appendix B (see B.2). HEFA-SPK has also been called Hydroprocessed Renewable Jet or Hydrotreated Renewable Jet (HRJ), and for the purpose of this specification, the terms are considered interchangeable. Finished fuel containing FT-SPK or HEFA-SPK shall contain additives in accordance with 3.3. Finished fuel containing FT-SPK shall conform to the properties of Table A-II in addition to those of Table I. Finished fuel containing HEFA-SPK shall conform to the properties of Table B-II in addition to those of Table I. During the platform certification/approval process, permission from both procuring activity and the applicable fuel technical authority listed below shall be obtained prior to the use of a finished fuel containing SPK. All USAF aircraft are certified for the use of fuel containing FT-SPK while Army and Navy Aircraft are not. All three Services are currently in the process of certifying their respective aircraft for fuel containing HEFA-SPK, where some aircraft are now certified and other aircraft yet remain within the relevant service certification process.

Cognizant activity for the US Navy and US Marine Corps: Naval Fuels and Lubricants Cross Functional Team, AIR-4.4.1, Building 2360, 22229 Elmer Road, Patuxent River, MD 20670-1534.

Cognizant activities for the US Army:

US Army Ground: Fuels and Lubricants Technology Team, RDECOM-TARDEC, RDTA-DP, Building 210, 6501 E. 11 Mile Road, Warren, MI 48397-5000.

US Army Aviation: US Army RDECOM, Attn: RDMR-AEP, Building 4488, Room C-211, Redstone Arsenal, AL 35898-5000.

Cognizant activity for the US Air Force: Alternative Fuels Certification Office, ASC/WNN, 1981 Monohan Way, Building 12, Area B, Wright-Patterson AFB, OH 45433-7205.

Procuring Activity: Product Technology & Standardization, DLA Energy, Rm 2843, 8725 John J. Kingman Road, Fort Belvoir, VA 22060.

3.2 Chemical and physical requirements. Unless otherwise specified (see 3.1.1), the chemical and physical properties of the fuel shall be in accordance with those listed in Table I.



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3.3 Additives. The type and amount of each additive used shall be made available when requested by procuring activity or user (see 6.2.d). The only additives approved for use are those referenced in this specification.

3.3.1 Antioxidants. Immediately after processing and before the fuel is exposed to the atmosphere (such as during rundown into feed/batch tankage), add an approved antioxidant formulation (3.3.1.1) or combination of approved antioxidant formulations 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 milligrams (mg) nor more than 24.0 mg of active ingredient per liter (L) of fuel (6.0 to 8.4 lb/1000 barrels) to all JP-8 fuel that contains blending stocks that have been hydrogen treated or SPK derived from hydrotreated, hydrocracked, or hydroisomerized products of a Fischer-Tropsch or HEFA process.

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 or SPK derived from hydrotreated, hydrocracked, or hydroisomerized products of a Fischer-Tropsch or HEFA process.

3.3.1.1 Antioxidant formulations. 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-dimethylphenol
28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols

f. 55 percent min 2,4-dimethyl-6-tert-butylphenol and
15 percent min 2,6-di-tert-butyl-4-methylphenol and
30 percent max mixed methyl and dimethyl tert-butylphenols

3.3.2 Metal deactivator. A metal deactivator, N,N'-disalycylidene-1,2-propanediamine, may be blended into the fuel. The concentration of active material used on initial batching of the fuel at the refinery shall not exceed 2.0 mg/L. Cumulative addition of metal deactivator when re-doping the fuel shall not exceed 5.7 mg/L. Metal deactivator additive shall not be used in JP-8 unless the supplier has obtained written consent from the procuring activity and user.

3.3.3 Static dissipater additive. An additive shall be blended into the fuel 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 Innospec Fuel Specialties LLC (formerly Octel Starreon LLC), Newark, DE 19702.

3.3.4 Corrosion inhibitor/lubricity improver additive. A corrosion inhibitor/lubricity improver (CI/LI) additive in accordance with MIL-PRF-25017 shall be blended into the F-34 (JP-8) grade fuel by the contractor. The CI/LI 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 QPL-25017. The contractor or transporting agency, or both, shall maintain and upon request shall make available to the Government evidence that the CI/LI additives used are equal in every respect to the qualification products listed in QPL-25017. The point of injection of the CI/LI additive shall be determined by agreement between the purchasing authority and the supplier.



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

| Property | Min | Max | Test Method |
|---|---|---|---|
| Color, Saybolt [1] | | | D156 [2] or D6045 |
| Total acid number, mg KOH/g | | 0.015 | D3242 |
| Aromatics, vol percent | | 25.0 | D1319 |
| Sulfur, total, mass percent | | 0.30 | D129, D1266, D2622, D3120, D4294 [2], or D5453 |
| Sulfur, mercaptan, mass percent or | | 0.002 | D3227 |
| Doctor test | | negative | D4952 |
| Distillation temperature, °C [3] | | | D86 [2] or D2887 [4] |
| Initial boiling point [1] | | | |
| 10 percent recovered | | 205 | |
| 20 percent recovered [1] | | | |
| 50 percent recovered [1] | | | |
| 90 percent recovered [1] | | | |
| Final boiling point | | 300 | |
| Residue, vol percent | | 1.5 | |
| Loss, vol percent | | 1.5 | |
| Flash point, °C [5] | 38 | | D56, D93 [2], D3828, or IP 170 |
| Density | | | D1298 or D4052 [2] |
| Density, kg/L at 15°C or | 0.775 | 0.840 | |
| Gravity, API at 60°F | 37.0 | 51.0 | |
| Freezing point, °C | | -47 | D2386 [2], D5972, D7153, or D7154 |
| Viscosity, at -20°C, $mm^2/s$ | | 8.0 | D445 |
| Net heat of combustion, MJ/kg | 42.8 | | D3338, D4529, or D4809 [2] |
| Hydrogen content, mass percent | 13.4 | | D3343 or D3701 [2] |
| Smoke point, mm, or | 25.0 | | D1322 |
| Smoke point, mm, and | 19.0 | | D1322 |
| Naphthalene, vol percent | | 3.0 | D1840 |
| Calculated cetane index [1] | | | D976 [6] or D4737 |
| 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 [8] | |
| Existent gum, mg/100 mL [9] | | 7.0 | D381 [2] or IP 540 |
| Particulate matter, mg/L [10] | | 1.0 | D2276 or D5452 [2] |
| Filtration time, minutes [10] | | 15 | |



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

| | | | |
|---|---|---|---|
| Particulate counting, cumulative channel counts [11]<br>≥ 4 µm[1]<br>≥ 6 µm[1]<br>≥ 14 µm[1]<br>≥ 21 µm[1]<br>≥ 25 µm[1]<br>≥ 30 µm[1] | | | IP 564, IP 565, or IP 577 |
| Water reaction interface rating<br>Microseparometer Rating [12] | | 1b | D1094<br>D3948 or D7224 [2] |
| Fuel system icing inhibitor, vol percent | 0.10 | 0.15 | D5006 [13] |
| Fuel electrical conductivity, pS/m [14] | | | D2624 |

NOTES:

1. To be reported – not limited.
2. Referee Test Method.
3. A condenser temperature of 0 °C to 4 °C (32 °F to 40 °F) shall be used for the distillation by ASTM D86.
4. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X5 of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887.
5. ASTM D56 may give results up to 1 °C (2 °F) below the ASTM D93 results. ASTM D3828 may give results up to 1.7 °C (3 °F) below the ASTM D93 results. Method IP 170 is also permitted, may give results up to 2.2 °C (4 °F) below the ASTM D93 results.
6. Mid-boiling temperature 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 4.5.3 for ASTM D3241 test conditions and test limitations.
8. Peacock or Abnormal color deposits result in a failure.
9. The preferred vaporizing medium for aviation turbine fuel is steam, however, the existent gum test (ASTM D381 or IP540) may be performed using air as the vaporizing medium at the following operating temperatures: Bath: 232 °C to 246 °C; Test well: 229 °C to 235 °C. If air is used instead of steam while performing ASTM D381, it shall be recorded. Test Method ASTM D381, using steam jet operating conditions, shall be the referee test method.
10. A minimum sample size of 3.785 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in Appendix C. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D2276 or ASTM D5452.
11. To assist in the data collection process, the results should be reported to afpet.afth@wpafb.af.mil or AFPA/PTOT, 2430 C St. Bldg. 70 Area B, Wright Patterson AFB OH 45433 when available.
12. The minimum microseparometer rating at point of manufacture using a Micro-Separometer (MSEP) shall be as follows:

| JP-8 Additives | MSEP Rating, min. |
|---|---|
| Antioxidant (AO)*, Metal Deactivator (MDA)* | 90 |
| AO*, MDA*, and Fuel System Icing Inhibitor (FSII) | 85 |
| AO*, MDA*, and Corrosion Inhibitor/Lubricity Improver (CI/LI) | 80 |
| AO*, MDA*, FSII and CI/LI | 70 |

*Even though the presence or absence does not change these limits, samples submitted for specification or conformance testing shall contain the same additives present in the refinery batch. Regardless of which minimum the refiner selects to meet, the refiner shall report the MSEP rating on a laboratory hand blend of the fuel with all additives required by the specification.



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

13. Test shall be performed in accordance with ASTM D5006 using the DiEGME scale of the refractometer.
14. The conductivity must be between 150 and 600 pS/m for F-34 (JP-8) and between 50 and 600 pS/m for F-35, at ambient temperature or 29.4 °C (85 °F), whichever is lower, unless otherwise directed by the procuring activity. In the case of JP-8+100, JP-8 with the thermal stability improver additive (see 3.3.6), the conductivity limit must be between 150 to 700 pS/m at ambient temperature or 29.4 °C (85 °F), whichever is lower, unless otherwise directed by the procuring activity.

3.3.5 Fuel system icing inhibitor. The use of a fuel system icing inhibitor shall be mandatory for JP-8 and shall be in accordance with MIL-DTL-85470. The point of injection of the additive for JP-8 shall be determined by agreement between the purchasing authority and the supplier. The fuel system icing inhibitor is not to be added to NATO F-35 unless so directed by the purchasing authority.

3.3.6 Thermal stability improver additive. Due to logistic concerns, personnel at the operating location shall request written approval from the cognizant activity to add a thermal stability improver additive to the fuel. If approval is given, the concentration of the additive and location of injection shall be specified by the cognizant service activity listed below. For USAF aircraft, this approval does not override the single manager's authority for specifying allowed/disallowed fuels. JP-8 fuel with an approved thermal stability improver additive at the required concentration shall be designated as JP-8+100. Thermal stability improver additive shall not be used in JP-8 without approval, in writing, from:

Cognizant activity for the US Navy and US Marine Corps: Naval Fuels and Lubricants Cross Functional Team, AIR-4.4.1, Building 2360, 22229 Elmer Road, Patuxent River, MD 20670-1534.

Cognizant activity for the US Air Force: Air Force Petroleum Agency, AFPA/PTP, 2430 C Street, Building 70, Area B, Wright-Patterson AFB 45433-7632.

Cognizant activities for the US Army:

US Army Ground: Fuels and Lubricants Technology Team, RDECOM-TARDEC, RDTA-DP, Building 210, 6501 E. 11 Mile Road, Warren, MI 48397-5000.

US Army Aviation: US Army RDECOM, Attn: RDMR-AEP, Building 4488, Room C-211, Redstone Arsenal, AL 35898-5000.

3.3.6.1 Qualified additives. Qualified thermal stability improver additives are listed in Table II.

***TABLE II. Qualified thermal stability improver additives.***

| Additive Name | Qualification Reference | Manufacturer |
|---|---|---|
| SPEC AID 8Q462 | AFRL/PRSF<br>Ltr, 9 Dec 97 | GE Water & Process Technologies<br>9669 Grogan Mill Road<br>The Woodlands, TX 77380 |
| SPEC AID 8Q462W | ASC/ENFA<br>Tech Eval, 12 Apr 11 | GE Water & Process Technologies<br>9669 Grogan Mill Road<br>The Woodlands, TX 77380 |
| AeroShell Performance Additive 101 | AFRL/PRSF<br>Ltr, 13 Jan 98 | Shell Aviation Limited<br>Shell Centre<br>York Road<br>London, UK SE1 7NA |



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3.3.7 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 in Table I.

3.5 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable 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 quality conformance inspections (see 4.2).

4.2 Qualification inspection conditions. Test for acceptance of individual lots shall consist of tests for all requirements specified in section 3. Quality conformance inspection shall include the test requirement herein.

4.2.1 Inspection lot. For acceptance purposes, individual lots shall be examined as specified herein and subjected to tests for all requirements cited in section 3.

4.3 Inspection.

4.3.1 Inspection conditions.

4.3.1.1 Refined hydrocarbon material. Fuel supplied from traditionally refined hydrocarbon distillate fuel oil meeting requirements of 3.1 shall comply with the specified limiting values in Table I using the cited test methods. The specified limiting values must not be changed. This precludes any allowance for test method precision and adding or subtracting digits. For the purposes of determining conformance with the specified limiting values, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right hand place of digits used in expressing the specified limiting value, in accordance with the Rounding-Off Method of ASTM E29.

4.3.1.2 Synthesized hydrocarbon material. Fuel supplied containing synthesized materials meeting requirements of Table A-I or Table B-I as stipulated in 3.1.1 shall comply with the specified limiting values in Table I and Table A-II or Table B-II, respectively, using the cited test methods. The specified limiting values must not be changed. This precludes any allowance for test method precision and adding or subtracting digits. For the purposes of determining conformance with the specified limiting values, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right hand place of digits used in expressing the specified limiting value, in accordance with the Rounding-Off Method of ASTM E29.

4.4 Sampling plans.

4.4.1 Sampling. 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 Sampling for inspection of filled containers. A random sample of filled containers shall be selected from each lot and shall be subjected to the examination of filled containers as specified in 4.5.1.3.

4.5 Methods of inspection.

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. Before filled, each 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 with one or more defects under the required fill shall be rejected.

4.5.2 Chemical and physical tests.

a. Tests to determine conformance to chemical and physical requirements of fuel supplied from traditionally refined hydrocarbon distillate fuel oil meeting requirements of 3.1 shall be conducted in accordance with Table I. The finished fuel shall pass all tests listed in Table I. No additional testing shall be required. Requirements contained herein are not subject to corrections for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding off of significant figures, ASTM E29 shall apply to all tests required by this specification.

b. Tests to determine conformance to chemical and physical requirements of fuel supplied containing synthesized materials meeting requirements of Table A-I or Table B-I as stipulated in 3.1.1 shall be conducted in accordance with Table I and Table A-II or Table B-II, respectively. The finished fuel shall pass all tests listed in Table I and Table A-II or Table B-II, respectively. No additional testing shall be required. Requirements contained herein are not subject to corrections for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding off of significant figures, ASTM E29 shall apply to all tests required by this specification.

4.5.3 Thermal stability tests. The thermal stability test shall be conducted using ASTM D3241. Unless otherwise specified (see thermal stability in Table A-I and Table B-I), the thermal stability test shall be conducted in accordance with 4.5.3.1 and 4.5.3.2. The heated tube shall be rated visually (see Annex A1 of ASTM D3241).

4.5.3.1 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.

4.5.3.2 ASTM D3241 reported data. The following data shall be reported:

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

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

## 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.



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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. JP-8 contains military unique additives that are required by military weapon systems. This requirement is unique to military aircraft and engine designs. When authorized, JP-8 (F-34) may be used in ground - based turbine and diesel engines. NATO F-35 is intended for commercial aviation, but can be converted to JP-8 (F-34) by the addition of the appropriate additives.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

b. Quantity required and size containers desired.

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

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

6.3 Conversion of metric units. Units of measure have been converted to the International System of Units (SI) (Metric) in accordance with ASTM SI10. If test results are obtained in units other than metric or there is a requirement to report dual units, ASTM SI10, should be used to convert the units.

6.4 Definitions.

6.4.1 Bulk lot. A bulk lot consists of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container or manufactured in a single plant run through the same processing equipment, with no change in ingredient material.

6.4.2 Packaged lot. A packaged lot consists of an indefinite number of 208-liter (55-gallon) drums, or smaller unit packages of identical size and type, offered for acceptance and filled from an isolated tank containing a homogeneous mixture of material; or filled with a homogeneous mixture of material run through the same processing equipment with no change in ingredient material.

6.4.3 Homogenous product. A homogeneous product is defined as a product where samples taken at various levels of the batch tank are tested for the defining homogeneous characteristics and all values obtained meet the repeatability precision requirements for that test method.

6.4.4 Synthesized Paraffinic Kerosene (SPK) Kerosene consisting of n-paraffins, iso-paraffins and cycloparaffins.

6.4.5 Fischer-Tropsch (FT) Process A catalyzed chemical process in which carbon monoxide and hydrogen are converted into liquid hydrocarbons of various forms. Typical catalysts used are based on iron and cobalt.

6.4.6 Hydroprocessed Esters and Fatty Acids (HEFA) SPKs. Synthetic Paraffinic Kerosene produced by hydroprocessing plant, algal oils or animal fats.

6.4.7 Hydroprocessed or Hydrotreated Renewable Jet (HRJ) Terminology used to identify HEFA SPKs.

6.5 Subject term (key word) listing.

Antioxidants
Corrosion inhibitor
Fischer-Tropsch
Flash point
Freezing point
Hydroprocessed Esters and Fatty Acids (HEFA)
Hydroprocessed / Hydrotreated Renewable Jet (HRJ)
Hydrocarbon distillate fuel



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Hydrogen content
Icing inhibitor
Synthesized Paraffinic Kerosene (SPK)
Lubricity improver
Static dissipater
Thermal stability improver

6.6 International agreements. Certain provisions of this specification are the subject of international standardization agreement ASIC AIR STDACS (FG) 4022, ASIC AIR STD 15/09, NATO STANAG 1135, and NATO STANAG 3747. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.7 Material safety data sheet. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.8 Test report. Test data required by 4.5 should be available for the procurement activity and user in the same order as listed in Table I. The Inspection Data on Aviation Turbine Fuels form published in ASTM D1655 should be used as a guide. Also, the type and amount of additives used should be reported.

6.9 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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# FISCHER-TROPSCH SYNTHESIZED PARAFFINIC KEROSENE (FT-SPK)

## A.1 SCOPE

A.1.1 Scope. This Appendix addresses requirements of 100 percent SPK derived from manufactured products of a Fischer-Tropsch (FT) process (identified in 3.1.1) and test requirements in addition to Table I for finished fuels containing any amount of FT-SPK (not to exceed 50 volume percent). This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance. Blending of the FT-SPK with at least 50% petroleum sourced JP-8 must occur prior to any further blending with fuel containing any other synthetic blending component to ensure that the resulting blend always has at least 50% petroleum-sourced content.

## A.2 REQUIREMENTS FOR FT-SPK

A.2.1 Chemical and physical requirements. The chemical and physical properties of the SPK shall be in accordance with those specified in Table A-I.

A.2.2 Additives.

A.2.2.1 Antioxidants. Addition of antioxidants shall adhere to the criteria specified in 3.3.1.

A.2.2.2 Static dissipater additive. If 100% FT-SPK is to be transported prior to blending with refined hydrocarbon distillate fuel, static dissipater additive shall be injected in sufficient concentration to increase the conductivity of the fuel to within the range specified in Table A-I. 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 Innospec Fuel Specialties LLC (formerly Octel Starreon LLC), Newark, DE 19702.

***TABLE A-I. FT-SPK chemical and physical requirements and test methods.***

| Property | Min | Max | Test Method |
|---|---|---|---|
| Aromatics, mass percent | | 0.5 | D2425 |
| Sulfur, total, mass percent | | 0.0015 | D2622, D3120, or D5453 [1] |
| Cycloparaffins, mass percent | | 15 | D2425 |
| Paraffins, mass percent [2] | | | D2425 |
| Carbon and Hydrogen, mass percent | 99.5 | | D5291 |
| Nitrogen, mg/kg | | 2 | D4629 |
| Water, mg/kg | | 75 | D6304 |
| Phosphorus, mg/kg | | 0.1 | UOP 389 |
| Metals (Al, Ca, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn), mg/kg | | 0.1 per metal | UOP 389 |
| Halogens, mg/kg | | 1 | D7359 |
| Total acid number, mg KOH/g | | 0.015 | D3242 |
| Flash point, °C [3] | 38 | | D56, D93 [1], D3828, or IP 170 |
| Density<br>Density, kg/L at 15°C or<br>Gravity, API at 60°F | <br>0.751<br>52.0 | <br>0.770<br>57.0 | <br><br>D1298 or D4052 [1] |
| Freezing point, °C | | -47 | D2386 [1] or D5972 |



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***TABLE A-I. FT-SPK chemical and physical requirements and test methods – Continued***

| Property | Min | Max | Test Method |
|---|---|---|---|
| Distillation temperature, °C<br>Initial boiling point [2]<br>10 percent recovered<br>20 percent recovered [2]<br>50 percent recovered [2]<br>90 percent recovered [2]<br>Final boiling point<br>Residue, vol percent<br>Loss, vol percent<br>90 percent recovery gradient [5] | <br><br><br><br><br><br><br><br><br>22 | <br><br>205<br><br><br><br>300<br>1.5<br>1.5<br> | D86 [1] or D2887 [4] |
| Viscosity at -20°C, $mm^2/s$ | | 8.0 | D445 |
| Viscosity at 40°C, $mm^2/s$ [2,6] | | | D445 |
| Net heat of combustion, MJ/kg | 42.8 | | D3338 or D4809 [1] |
| Thermal stability (2.5 hours at 325°C)<br>change in pressure drop, mm Hg<br>heater tube deposit, visual rating | | <br>25<br><3 [7] | D3241 |
| Particulate matter, mg/L [8] | | 1.0 | D2276 or D5452 [1] |
| Filtration time, minutes [8] | | 15 | |
| Microseparometer Rating | 85 | | D3948 or D7224 [1] |
| Electrical conductivity, pS/m | 50 | 600 | D2624 |

NOTES:

1. Referee Test Method.
2. To be reported – not limited.
3. ASTM D56 may give results up to 1 °C (2 °F) below the ASTM D93 results. ASTM D3828 may give results up to 1.7 °C (3 °F) below the ASTM D93 results. Method IP 170 is also permitted, may give results up to 2.2 °C (4 °F) below the ASTM D93 results.
4. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X5 of D2887 for comparison with the specified property criteria.
5. The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 90 percent recovered point must be at least 22 °C.
6. Future revision(s) anticipated for Army requirement supporting ground equipment using JP-8 under the Single Fuel Policy that will require viscosity at 40 °C to a minimum of 1.3 $mm^2/s$. The Army welcomes discussions and comments from existing or potential SPK manufacturers regarding the desired viscosity at 40 °C. Contact Army point of contact via e-mail at tardec.pol.help@us.army.mil or using the address indicated in 3.1.1.
7. Peacock or Abnormal color deposits result in a failure.
8. A minimum sample size of 3.785 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in Appendix C. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D2276 or ASTM D5452.



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A.3 ADDITIONAL REQUIREMENTS FOR FINISHED FUEL CONTAINING FT-SPK.

A.3.1 Chemical and physical requirements. The chemical and physical properties of finished fuel containing FT-SPK (FT-SPK must meet requirements of Table A-I and FT-SPK content of finished fuel may not exceeded 50 volume percent) shall be in accordance with those specified in Table I and in addition those specified In Table A-II.

***TABLE A-II. Additional Chemical and physical requirements for JP-8 containing FT-SPK.***

| Property | Min | Max | Test Method |
|---|---|---|---|
| Aromatics, vol percent | 8.0 | | D1319 |
| Distillation °C [1]<br>50 percent recovery gradient [4]<br>90 percent recovery gradient [5] | <br>15<br>40 | | D86 [2] or D2887 [3] |
| Derived cetane number | 40 | | D6890 [2] or D7170 |

NOTES:

1. A condenser temperature of 0 °C to 4 °C (32 °F to 40 °F) shall be used for the distillation by ASTM D86.
2. Referee Test Method.
3. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X5 of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887.
4. The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 50 percent recovered point must be at least 15 °C.
5. The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 90 percent recovered point must be at least 40 °C.



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# HYDROPROCESSED ESTERS AND FATTY ACIDS SYNTHESIZED PARAFFINIC KEROSENE (HEFA-SPK)

## B.1 SCOPE

B.1.1 Scope. This Appendix addresses requirements of 100 percent HEFA-SPK derived from manufactured products of hydroprocessing animal fat, plant oil, or algal oil triglycerides (esters and fatty acids (identified in 3.1.1) and test requirements in addition to Table I for finished fuels containing any amount of HEFA-SPK (not to exceed 50 volume percent). This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance. Fuel blends with any percentage of HEFA -SPK will be designated as "JP-8/HEFA." Blending of the HEFA-SPK with at least 50% petroleum sourced JP-8 must occur prior to any further blending with fuel containing any other synthetic blending component.

## B.2 REQUIREMENTS FOR HEFA-SPK

B.2.1 Chemical and physical requirements. The chemical and physical properties of the HEFA-SPK shall be in accordance with those specified in Table B-I.

B.2.2 Additives.

B.2.2.1 Antioxidants. Addition of antioxidants shall adhere to the criteria specified in 3.3.1.

B.2.2.2 Static dissipater additive. If 100% HEFA-SPK is to be transported prior to blending with refined hydrocarbon distillate fuel, static dissipater additive shall be injected in sufficient concentration to increase the conductivity of the fuel to within the range specified in Table B-I. 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 Innospec Fuel Specialties LLC (formerly Octel Starreon LLC), Newark, DE 19702.

***TABLE B-I. HEFA-SPK chemical and physical requirements and test methods.***

| Property | Min | Max | Test Method |
|---|---|---|---|
| Aromatics, mass percent | | 0.5 | D2425 |
| Sulfur, total, mass percent | | 0.0015 | D2622, D3120, or D5453 [1] |
| Cycloparaffins, mass percent | | 15 | D2425 |
| Paraffins, mass percent [2] | | | D2425 |
| Carbon and Hydrogen, mass percent | 99.5 | | D5291 |
| Nitrogen, mg/kg | | 2 | D4629 |
| Water, mg/kg | | 75 | D6304 |
| Phosphorus, mg/kg | | 0.1 | UOP 389 |
| Metals (Al, Ca, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Pd, Pt, Sn, Sr, Ti, V, Zn), mg/kg | | 0.1 per metal | UOP 389 |
| Halogens, mg/kg | | 1 | D7359 |
| Total acid number, mg KOH/g | | 0.015 | D3242 |
| Existent gum, mg/100 mL | | 7.0 | D381 [1] or IP 540 |
| Fatty Acid Methyl Ester (FAME), mg/kg | | 5 | IP 585 or IP 590 |



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***TABLE B-I. HEFA-SPK chemical and physical requirements and test methods – Continued***

| Property | Min | Max | Test Method |
|---|---|---|---|
| Flash point, °C [3] | 38 | | D56, D93 [1], D3828, or IP 170 |
| Density<br>Density, kg/L at 15°C or<br>Gravity, API at 60°F | <br>0.751<br>52.0 | <br>0.770<br>57.0 | <br><br>D1298 or D4052 [1] |
| Freezing point, °C | | -47 | D2386 [1] or D5972 |
| Distillation temperature, °C<br>Initial boiling point [2]<br>10 percent recovered<br>20 percent recovered [2]<br>50 percent recovered [2]<br>90 percent recovered [2]<br>Final boiling point<br>Residue, vol percent<br>Loss, vol percent<br>90 percent recovery gradient [5] | <br><br><br><br><br><br><br><br><br><br>22 | <br><br>205<br><br><br><br>300<br>1.5<br>1.5<br> | D86 [1] or D2887 [4] |
| Viscosity at -20°C, $mm^2/s$ | | 8.0 | D445 |
| Viscosity at 40°C, $mm^2/s$ [2,6] | | | D445 |
| Net heat of combustion, MJ/kg | 42.8 | | D3338 or D4809 [1] |
| Thermal stability (2.5 hours at 325 °C)<br>change in pressure drop, mm Hg<br>heater tube deposit, visual rating | | <br>25<br><3 [7] | D3241 |
| Particulate matter, mg/L [8] | | 1.0 | D2276 or D5452 [1] |
| Filtration time, minutes [8] | | 15 | |
| Microseparometer Rating | 85 | | D3948 or D7224 [1] |
| Electrical conductivity, pS/m | 50 | 600 | D2624 |

NOTES:

1. Referee Test Method.
2. To be reported – not limited.
3. ASTM D56 may give results up to 1 °C (2 °F) below the ASTM D93 results. ASTM D3828 may give results up to 1.7 °C (3 °F) below the ASTM D93 results. Method IP 170 is also permitted, may give results up to 2.2 °C (4 °F) below the ASTM D93 results.
4. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X5 of D2887 for comparison with the specified property criteria.
5. The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 90 percent recovered point must be at least 22 °C.
6. Future revision(s) anticipated for Army requirement supporting ground equipment using JP-8 under the Single Fuel Policy that will require viscosity at 40 °C to a minimum of 1.3 $mm^2/s$. The Army welcomes discussions and comments from existing or potential SPK manufacturers regarding the desired viscosity at 40 °C. Contact Army point of contact via e-mail at tardec.pol.help@us.army.mil or using the address indicated in 3.1.1.



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***TABLE B-I. HEFA-SPK chemical and physical requirements and test methods – Continued***

7. Peacock or Abnormal color deposits result in a failure.
8. A minimum sample size of 3.785 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in Appendix C. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D2276 or ASTM D5452.

B.3 ADDITIONAL REQUIREMENTS FOR FINISHED FUEL CONTAINING HEFA-SPK.

B.3.1 Chemical and physical requirements. The chemical and physical properties of finished fuel containing HEFA-SPK (HEFA-SPK must meet requirements of Table B-I and HEFA-SPK content of finished fuel may not exceeded 50 volume percent) shall be in accordance with those specified in Table I and in addition those specified In Table B-II.

***TABLE B-II. Additional chemical and physical requirements for JP-8 containing HEFA-SPK.***

| Property | Min | Max | Test Method |
|---|---|---|---|
| Aromatics, vol percent | 8.0 | | D1319 |
| Distillation °C [1]<br>50 percent recovery gradient [4]<br>90 percent recovery gradient [5] | <br>15<br>40 | | D86 [2] or D2887 [3] |
| Derived cetane number | 40 | | D6890 [2] or D7170 |

NOTES:
1. A condenser temperature of 0 °C to 4 °C (32 °F to 40 °F) shall be used for the distillation by ASTM D86.
2. Referee Test Method.
3. Distillation property criteria are specified in ASTM D86 scale units. ASTM D2887 results shall be converted to estimated D86 results by application of the correlation in Appendix X5 of D2887 for comparison with the specified property criteria. Distillation residue and loss limits provide control of the distillation process during the D86 test method and do not apply to D2887.
4. The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 50 percent recovered point must be at least 15 °C.
5. The temperature difference between the temperature that demarks the 10 percent recovered point and the temperature that demarks the 90 percent recovered point must be at least 40 °C.



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# METHOD FOR DETERMINATION OF FILTRATION TIME AND TOTAL SOLIDS

## C.1 SCOPE

C.1.1 Scope. This Appendix describes the method 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. This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

## C.2 METHOD

C.2.1 Summary of method. 3.785 liters (1 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.

## C.3 APPARATUS

a. Membrane filter: White, plain, 47 mm diameter, nominal pore size 0.8 µm. The membrane filter must conform to ASTM D5452 requirements.

b. Filtration apparatus: The apparatus, constructed of stainless steel, consists of a funnel and a funnel base with a filter support such that a membrane filter and a flow reducing washer can be securely held between the sealing surface of the funnel and funnel base (see Figure 1 in ASTM D5452).

c. Flow reducing washer: A 47-mm diameter flow reducer washer with an effective filtration 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 °C ± 5 °C (194 °F ± 9 °F).

g. Forceps: Flat-bladed with unserrated non-pointed tips.

h. Dispenser, rinsing solvent (petroleum ether): Containing a 0.45 µm membrane filter in the delivery line. If solvent has been pre-filtered using a 0.45 µm filter then an inline filter is not required.

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.

## C.4 PREPARATION

C.4.1 Preparation of apparatus and sample containers. All components of the filtration apparatus (except the vacuum flask), sample containers and caps must be cleaned as described in paragraph 9 of ASTM D5452. All metal parts of the filtration apparatus are to be electrically bonded and grounded, including the fuel sample container. See ASTM D5452 for other safety precautions.

## C.5 SAMPLING

C.5.1 Sampling. Obtain a representative 3.785 liter (1 gallon) sample as directed in paragraph 8 of ASTM D5452. 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 3.785 liter (1 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.



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C.6 PROCEDURE

C.6.1 Test procedure.

a. Using forceps, place a new membrane (test) filter in a clean petri dish. Place the petri dish with the lid slightly ajar in a 90 °C ± 5 °C (194 °F ± 9 °F) oven for 30 minutes. Remove the petri dish from the oven and place it near the balance with the lid slightly ajar, but still protecting the filter from airborne contamination, for 30 minutes.

b. Weigh the test filter. A filter weighing in excess of 90 mg will not be used for time filtration testing.

c. Place a flow reducing washer (required only for time filtration testing) on top of funnel base then place a test filter on top of the reducing washer and secure the funnel to the funnel base.

d. Immediately prior to filtering the fuel, shake the sample to obtain a homogeneous mix and assure that fuel temperature does not exceed 30 °C (86 °F). Clean the exterior or top portion of the sample container to ensure 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 3.785 liters (1 gallon) sample, periodically shaking the sample container to maintain a homogenous mix. Record the vacuum (kPa or inches of mercury) 1 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 3.785 liters (1 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, report filtration time as “>30 minutes” and the total volume of fuel filtered.

h. Report the vacuum (kPa or inches of mercury) as determined from the average of the two readings taken in C.6.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 vacuum on and filter the 100 mL rinse. Turn vacuum off and wash the inside of the funnel with 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 filter by directing a gentle stream of petroleum ether from the solvent dispenser from the edge of the filter 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 test filter (from the funnel base and flow reducing washer if present) and place in a clean petri dish. Dry in the oven at 90 °C ± 5 °C (194 °F ± 9 °F) for 30 minutes with the cover on the petri dish slightly ajar. Remove the petri dish from the oven and place it near the balance with the lid slightly ajar, but still protecting the filter from airborne contamination, for 30 minutes. Reweigh the filter.

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

$$\frac{\text{weight gain of filter in mg}}{3.785\ \text{L}} = \text{mg/L}$$

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



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the mL of fuel remaining from 3785 mL.

$$\frac{\text{weight gain of filter in mg}}{\text{mL of fuel filtered } \times 0.001} = \text{mg/L}$$

C.6.2 Test conditions for filtration time.

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

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

C.7 NOTES

C.7.1 Filtration time. If it is desired to determine the filtration time and not the total solids content, perform the test by omitting steps C.6.1i, C.6.1j, C.6.1k, and C.6.1l.

C.7.2 Total solids. If it is desired to determine the total solids content and not the filtration time, use of the flow reducing washer 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 ASTM D5452 apply.



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CONCLUDING MATERIAL

Custodians:
Navy – AS
Army – AT
Air Force – 68
DLA – PS

Review activities:
Army – AR, AV
Air Force – 11

Preparing activity:
Air Force – 68
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