METRIC

MIL-DTL-83133H
w/ AMENDMENT 2
24 December 2013

SUPERSEDING
MIL-DTL-83133H
w/ AMENDMENT 1
14 September 2012

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, Building 70, Area B, Wright-Patterson AFB OH 45433-7632 or e-mailed to AFPA.PTPS@us.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A FSC 9130

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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

2.2 Government documents.

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

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-24, F-27, F-34, F-35, F-40 and F-44)

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

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 and Marking 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 online at http://quicksearch.dla.mil.)

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

ASTM INTERNATIONAL

ASTM 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 High Pressure Decomposition Device 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)
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 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, 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)
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
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 D7171	Standard Test Method for Hydrogen Content of Middle Distillate Petroleum Products by Low-Resolution Nuclear Magnetic Resonance Spectroscopy
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 D7619	Standard Test Method for Sizing and Counting Particles in Light and Middle Distillate Fuels, by Automatic Particle Counter
ASTM D7777	Standard Test Method for Density, Relative Density, or API Gravity of Liquid Petroleum by Portable Digital Density Meter
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 from http://www.astm.org or from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken PA 19428-2959.)

UOP, LLC

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

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

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 Fuel -- Portable Automatic Particle Counter Method
IP 577	Determination of the Level of Cleanliness of Aviation Turbine Fuel -- Automatic Particle Counter Method Using Light Extinction
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 http://www.energyinstpubs.org.uk or from the Energy Institute, 61 New Cavendish Street, London, WIG 7AR, 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, oil 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 US Navy and US Air Force aircraft are certified for the use of fuel containing FT-SPK and HEFA-SPK. All tactical/combat equipment/vehicles in the US Army Ground fleet are approved to use fuel containing FT-SPK and HEFA-SPK. Platform certification/approval process is still on-going for US Army Aviation; therefore, permission from both procuring activity and the applicable cognizant activity listed below shall be obtained prior to the use of a finished fuel containing SPK.

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

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.

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.

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 JP-8 (F-34) grade fuel by the contractor. The CI/LI additive is optional for F-35, unless stated in the contract. 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.

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

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

Property	Min	Max	Test Method
Sulfur, mercaptan, mass percent or Doctor test		0.002 negative	D3227 D4952
Distillation temperature, °C [3] Initial boiling point [1] 10 percent recovered 20 percent recovered [1] 50 percent recovered [1] 90 percent recovered [1] Final boiling point Residue, vol percent Loss, vol percent		 205 300 1.5 1.5	D86 [2] or D2887 [4]
Flash point, °C [5]	38		D56, D93 [2], D3828, or IP 170
Density Density, kg/L at 15 °C or Gravity, API at 60 °F	 0.775 37.0	 0.840 51.0	D1298, D4052 [2], or D7777
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, D3701, or D7171 [2]
Smoke point, mm or Smoke point, mm, and Naphthalenes, vol percent	25.0 19.0	 3.0	D1322 D1322 D1840
Calculated cetane index [1]			D976 [7] or D4737
Copper strip corrosion, 2 hr at 100 °C (212 °F)		No. 1	D130
Thermal stability Change in pressure drop, mm Hg Heater tube deposit, visual rating		 25 <3 [9]	D3241 [8]
Existent gum, mg/100 mL [10]		7.0	D381 [2] or IP 540
Particulate matter, mg/L [11] Filtration time, minutes [11]		1.0 15	D2276 or D5452 [2]
Particulate counting, cumulative channel counts [12] ≥ 4 µm [1] ≥ 6 µm [1] ≥ 14 µm [1] ≥ 21 µm [1] ≥ 25 µm [1] ≥ 30 µm [1]			IP 564, IP 565, IP 577, or D7619
Water reaction interface rating		1b	D1094
Microseparometer Rating [13]			D3948 or D7224 [2]

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

Property	Min	Max	Test Method
Fuel system icing inhibitor, vol percent	0.07	0.10	D5006 [14]
Fuel electrical conductivity, pS/m [15]			D2624

NOTES:

1. To be reported – not limited.
2. Referee Test Method.
3. A condenser temperature of 0 °C to 5 °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 X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" 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. Deleted.
7. Mid-boiling (50 percent recovered) 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.
8. See 4.5.3 for ASTM D3241 test conditions and test limitations.
9. Peacock or Abnormal color deposits result in a failure.
10. The preferred vaporizing medium for aviation turbine fuel is steam; however, the existent gum test IP 540 may be performed using air as the vaporizing medium. If air is used instead of steam, it shall be recorded. Test Method ASTM D381, using steam jet operating conditions, shall be the referee test method.
11. 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.
12. Although this test is not yet a requirement, to assist in the data collection process, request that test results should be reported to afpa.ptmt@us.af.mil or AFPA/PTMT, 2430 C St. Bldg. 70 Area B, Wright Patterson AFB OH 45433 when they are available.
13. 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.

14. Test shall be performed in accordance with ASTM D5006 using the DiEGME scale of the refractometer.
15. 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 (NATO F-37). 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-SIE-ES-FPT-FLT, 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 Ltr, 9 Dec 1997	GE Water & Process Technologies 9669 Grogan Mill Road The Woodlands, TX 77380
SPEC AID 8Q462W	ASC/ENFA Tech Eval, 12 Apr 2011	GE Water & Process Technologies 9669 Grogan Mill Road The Woodlands, TX 77380
AeroShell Performance Additive 101	AFRL/PRSF Ltr, 13 Jan 1998	Shell Aviation Limited Shell Centre York Road London, UK SE1 7NA
BASF Kerojet™ 100	AFRL/RQTF Ltr, 25 Oct 2013	BASF Corporation 100 Park Avenue Florham Park, NJ 07932

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

4. VERIFICATION

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

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 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 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 "Test Method for Visual Rating of D3241 Heater Tubes" 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.

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/lubricity improver, 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
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 agreements 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 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

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.

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, mg/kg		15	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 Density, kg/L at 15 °C or Gravity, API at 60 °F	 0.751 52.0	 0.770 57.0	D1298 or D4052 [1]

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

Property	Min	Max	Test Method
Freezing point, °C		-47	D2386 [1] or D5972
Distillation temperature, °C [4] Initial boiling point [2] 10 percent recovered 20 percent recovered [2] 50 percent recovered [2] 90 percent recovered [2] Final boiling point Residue, vol percent Loss, vol percent 90 percent recovery gradient [6]	 22	 205 300 1.5 1.5 	D86 [1] or D2887 [5]
Viscosity at -20 °C, mm^2/s		8.0	D445
Viscosity at 40 °C, mm^2/s [2]			D445
Net heat of combustion, MJ/kg	42.8		D3338 or D4809 [1]
Thermal stability (2.5 hours at 325 °C) change in pressure drop, mm Hg heater tube deposit, visual rating		 25 <3 [8]	D3241
Particulate matter, mg/L [9]		1.0	D2276 or D5452 [1]
Filtration time, minutes [9]		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. A condenser temperature of 0 °C to 5 °C (32 °F to 40 °F) shall be used for the distillation by ASTM D86.
5. 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 X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" 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.
6. 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.
7. Deleted.
8. Peacock or Abnormal color deposits result in a failure.
9. 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.

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] 50 percent recovery gradient [4] 90 percent recovery gradient [5]	 15 40		D86 [2] or D2887 [3]
Derived cetane number	40		D6890 [2] or D7170

NOTES:

1. A condenser temperature of 0 °C to 5 °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 X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" of D2887 for comparison with the specified property criteria.
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.

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. 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 .

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, mg/kg		15	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

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 Density, kg/L at 15 °C or Gravity, API at 60 °F	 0.751 52.0	 0.770 57.0	 D1298 or D4052 [1]
Freezing point, °C		-47	D2386 [1] or D5972
Distillation temperature, °C [4] Initial boiling point [2] 10 percent recovered 20 percent recovered [2] 50 percent recovered [2] 90 percent recovered [2] Final boiling point Residue, vol percent Loss, vol percent 90 percent recovery gradient [6]	 22	 205 300 1.5 1.5 	D86 [1] or D2887 [5]
Viscosity at -20 °C, mm^2/s		8.0	D445
Viscosity at 40 °C, mm^2/s [2]			D445
Net heat of combustion, MJ/kg	42.8		D3338 or D4809 [1]
Thermal stability (2.5 hours at 325 °C) change in pressure drop, mm Hg heater tube deposit, visual rating		 25 <3 [8]	D3241
Particulate matter, mg/L [9]		1.0	D2276 or D5452 [1]
Filtration time, minutes [9]		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. A condenser temperature of 0 °C to 5 °C (32 °F to 40 °F) shall be used for the distillation by ASTM D86.
5. 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 X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" 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.
6. 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.

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

7. Deleted.
8. Peacock or Abnormal color deposits result in a failure.
9. 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] 50 percent recovery gradient [4] 90 percent recovery gradient [5]	 15 40		D86 [2] or D2887 [3]
Derived cetane number	40		D6890 [2] or D7170

NOTES:
1. A condenser temperature of 0 °C to 5 °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 X4 "Correlation for Jet and Diesel Fuel (Procedures A and B)" of D2887 for comparison with the specified property criteria.
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.

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 "Apparatus for Determining Total Contaminant" 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 non-serrated 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.

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.6.1.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 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.6.1.i, C.6.1.j, C.6.1.k, and C.6.1.l.

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. When a reducing ring is not used, then total solids shall be determined as per ASTM D5452 and the use of a control filter shall be required.

CONCLUDING MATERIAL

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

Review activities:
Army – AR, AV
Air Force – 11, 84, 99

Preparing activity:
Air Force – 68
(Project 9130-2014-001)

Note: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information using the ASSIST Online database at https://assist.dla.mil.