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11 April 2008
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DETAIL SPECIFICATION

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

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

Comments, suggestions, or questions on this document should be addressed to HQ AFPET/AFTT, 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 http://assist.daps.dla.mil.

AMSC N/A FSC 9130

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, not all requirements could be converted due to the military-unique nature of the product (see 6.1) and the need for compatibility with deployed systems. 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 dissipator 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 dissipator 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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-PRF-25017	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble
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

(Copies of these documents are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia PA 19111-5094 or online at http://assist.daps.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 D 56	Standard Test Method for Flash Point by Tag Closed Cup Tester (DoD Adopted)
ASTM D 86	Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure (DoD Adopted)
ASTM D 93	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester (DoD Adopted)
ASTM D 129	Standard Test Method for Sulfur in Petroleum Products (General Bomb Method) (DoD Adopted)
ASTM D 130	Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test (DoD Adopted)
ASTM D 156	Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method) (DoD Adopted)
ASTM D 381	Standard Test Method for Gum Content in Fuels by Jet Evaporation (DoD Adopted)
ASTM D 445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) (DoD Adopted)
ASTM D 976	Standard Test Methods for Calculated Cetane Index of Distillate Fuels (DoD Adopted)
ASTM D 1094	Standard Test Method for Water Reaction of Aviation Fuels (DoD Adopted)
ASTM D 1266	Standard Test Method for Sulfur in Petroleum Products (Lamp Method) (DoD Adopted)
ASTM D 1298	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 D 1319	Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption (DoD Adopted)
ASTM D 1322	Standard Test Method for Smoke Point of Kerosine and Aviation Turbine Fuels (DoD Adopted)
ASTM D 1840	Standard Test Method for Naphthalene Hydrocarbons in Aviation

	Turbine Fuels by Ultraviolet Spectrophotometry (DoD Adopted)
ASTM D 2276	Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling (DoD Adopted)
ASTM D 2386	Standard Test Method for Freezing Point of Aviation Fuels (DoD Adopted)
ASTM D 2622	Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry (DoD Adopted)
ASTM D 2624	Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels (DoD Adopted)
ASTM D 2887	Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography (DoD Adopted)
ASTM D 3120	Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry (DoD Adopted)
ASTM D 3227	Standard Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method) (DoD Adopted)
ASTM D 3241	Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure) (DoD Adopted)
ASTM D 3242	Standard Test Method for Acidity in Aviation Turbine Fuel (DoD Adopted)
ASTM D 3338	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels (DoD Adopted)
ASTM D 3343	Standard Test Method for Estimation of Hydrogen Content of Aviation Fuels (DoD Adopted)
ASTM D 3701	Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry (DoD Adopted)
ASTM D 3828	Standard Test Methods For Flash Point by Small Scale Closed Cup Tester (DoD Adopted)
ASTM D 3948	Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD Adopted)
ASTM D 4052	Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter (DoD Adopted)
ASTM D 4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D 4177	Standard Practice for Automatic Sampling of Petroleum and Petroleum Products (DoD Adopted)
ASTM D 4294	Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectrometry (DoD Adopted)
ASTM D 4306	Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination (DoD Adopted)
ASTM D 4529	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D 4737	Standard Test Method for Calculated Cetane Index by Four Variable Equation

ASTM D 4809	Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method) (DoD Adopted)
ASTM D 4952	Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test) (DoD Adopted)
ASTM D 5001	Standard Test Method for Measurement of Lubricity of Aviation Turbine Fuels by the Ball-on-Cylinder Lubricity Evaluator (BOCLE)
ASTM D 5006	Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels (DoD Adopted)
ASTM D 5186	Standard Test Method for Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels and Aviation Turbine Fuels by Supercritical Fluid Chromatography
ASTM D 5452	Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration (DoD Adopted)
ASTM D 5453	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 D 5972	Standard Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method)
ASTM D 6045	Standard Test Method for Color of Petroleum Products by the Automatic Tristimulus Method
ASTM D 7153	Standard Test Method for Freezing Point of Aviation Fuels (Automatic Laser Method)
ASTM D 7154	Standard Test Method for Freezing Point of Aviation Fuels (Automatic Fiber Optical Method)
ASTM D 7224	Standard Test Method for Determining Water Separation Characteristics of Kerosine-type Aviation Turbine Fuels Containing Additives by Portable Separometer
ASTM E 29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with the Specifications (DoD Adopted)
IEEE/ASTM SI 10	American National Standard for Use of the International System of Units (SI): The Modern Metric System (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)

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

3. REQUIREMENTS

3.1 Materials. Fuel supplied under this specification shall be refined hydrocarbon distillate fuel oils 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 Materials for Blending. With the approval of both the procuring activity and the applicable fuel technical authorities listed below, up to 50 volume % of the finished fuel may consist solely of Synthetic Paraffinic Kerosene (SPK) derived from a Fischer-Tropsch (FT) process meeting requirements of Appendix A. Finished fuel shall contain additives in accordance with 3.3. During the platform certification/approval process, JP-8 containing SPK will be designated JP-8/SPK.

Procuring Activity: Product Technology and Standardization, DESC, 8725 John J. Kingman Road, Fort Belvoir, VA 22060

Cognizant activity for the Navy and 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 Air Force: Fuels Certification Office, 77th Monohan Street, Area B, Wright-Patterson AFB, OH 45433-7017.

Cognizant activities for the Army:

Army Ground: US Army TARDEC/RDECOM, 6501 E. 11 Mile Road, AMSRD-TAR-D (MS-110), Warren, MI 48397-5000.

Army Aviation: US Army RDECOM, Attn: AMSRD-AMR-AE-P, Building 4488, Room C-211, Redstone Arsenal, AL 35898-5000

3.1.2 Non-FT Materials. The use of synthetic blending materials represents a potential departure from experience and from the key assumptions which form the basis for fuel property requirements. It is the long-term goal of this specification to fully encompass fuels derived from synthetic materials and non-conventional sources once they have been defined but, this is only partially complete. Until this is accomplished, specific fuel formulations from synthetic materials or non-conventional sources may be submitted to AFRL/RZTG, Bldg 490, 1790 Loop Road N, WPAFB, OH 45433 to begin evaluation of compliance with the intent of this specification.

3.2 Chemical and physical requirements. The chemical and physical properties of a finished fuel containing only the materials described in 3.1 shall conform to the requirements listed in Table 1.

3.2.1 Chemical and physical requirements of blended finished fuels. The chemical and physical properties of a finished fuel blend containing any amount of synthetic SPK as described in 3.1.1 shall conform to the requirements listed in Table 2.

3.3 Additives. The type and amount of each additive used shall be made available when requested by the procuring activity or user (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), an approved antioxidant (3.3.1.1) shall be blended into the fuel in order to prevent the formation of gums and peroxides after manufacture. The concentration of the 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 were manufactured from a Fischer-Tropsch 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 nor Fischer-Tropsch products.

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 redoping 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 at the point of injection to within the range specified in Table 1 for fuel offered in accordance with 3.1 or as specified in Table 2 for finished fuel when allowed per 3.1.1. 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 conforming to 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 the latest revision of QPL-25017. The contractor or transporting agency, or both, shall maintain and upon request shall make available to the Government evidence that the 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 1. Chemical and physical requirements and test methods.

Property	Min	Max	Test Methods ASTM Standards
Color, Saybolt [1]			D 156 [2] or D 6045
Total acid number, mg KOH/gm		0.015	D 3242
Aromatics, vol percent		25.0	D 1319
Sulfur, total, mass percent		0.30	D 129, D 1266, D 2622, D 3120, D 4294 [2], or D 5453
Sulfur mercaptan, mass percent or Doctor test		0.002 negative	D 3227 D 4952
Distillation temperature, °C [3] (D 2887 limits given in parentheses)			D 86 [2] or D 2887
Initial boiling point [1]			
10 percent recovered		205 (186)	
20 percent recovered [1]			
50 percent recovered [1]			
90 percent recovered [1]			
Final boiling point		300 (330)	
Residue, vol percent		1.5	
Loss, vol percent		1.5	
Flash point, °C [4]	38		D 56, D 93 [2], or D 3828
Density			D 1298 or D 4052 [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	D 2386 [2], D 5972, D 7153, or D 7154
Viscosity, at -20°C, mm^2/s		8.0	D 445
Net heat of combustion, MJ/kg	42.8		D 3338, D 4529, or D 4809 [2]
Hydrogen content, mass percent	13.4		D 3343 or D 3701 [2]
Smoke point, mm, or	25.0		D 1322
Smoke point, mm, and	19.0		D 1322
Naphthalenes, vol percent		3.0	D 1840
Calculated cetane index [1]			D 976 [5] or D 4737
Copper strip corrosion, 2 hr at 100°C (212°F)		No. 1	D 130
Thermal stability			D 3241 [6]
change in pressure drop, mm Hg		25	
heater tube deposit, visual rating		<3 [7]	

TABLE 1. Chemical and physical requirements and test methods – Continued

Property	Min	Max	Test Methods ASTM Standards
Existent gum, mg/100 mL		7.0	D 381
Particulate matter, mg/L [8]		1.0	D 2276 or D 5452 [2]
Filtration time, minutes [8]		15	
Water reaction interface rating		1 b	D 1094
Water separation index [9]			D 3948 or D 7224 [2]
Fuel system icing inhibitor, vol percent	0.10	0.15	D 5006 [10]
Fuel electrical conductivity, pS/m [11]			D 2624

NOTES:

1. To be reported – not limited.
2. Referee Test Method.
3. A condenser temperature of 0° to 4°C (32° to 40°F) shall be used for the distillation by ASTM D 86.
4. ASTM D 56 may give results up to 1°C (2°F) below the ASTM D 93 results. ASTM D 3828 may give results up to 1.7°C (3°F) below the ASTM D 93 results. Method IP170 is also permitted.
5. Mid-boiling temperature may be obtained by either ASTM D 86 or ASTM D 2887 to perform the cetane index calculation. ASTM D 86 values should be corrected to standard barometric pressure.
6. See 4.5.3 for ASTM D 3241 test conditions and test limitations.
7. Peacock or Abnormal color deposits result in a failure.
8. A minimum sample size of 3.79 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in Appendix B. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D 2276 or ASTM D 5452.
9. The minimum microseparometer rating 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.

10. Test shall be performed in accordance with ASTM D 5006 using the DiEGME scale of the refractometer.
11. 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.

TABLE 2. Chemical and physical requirements and test methods for JP-8 with up to 50 percent SPK blend component

Property	Min	Max	Test Methods ASTM Standards
Color, Saybolt [1]			D 156 [2] or D 6045
Total acid number, mg KOH/gm		0.015	D 3242
Aromatics, vol percent	8.0	25.0	D 1319
Olefins, vol percent		5.0	D 1319
Sulfur, total, mass percent		0.30	D 129, D 1266, D 2622, D 3120, D 4294 [2], or D 5453
Sulfur mercaptan, mass percent or		0.002	D 3227
Doctor test		negative	D 4952
Distillation temperature, °C [3]			D 86
Initial boiling point [1]			
10 percent recovered (T10)	157	205	
20 percent recovered [1]			
50 percent recovered (T50)	168	229	
90 percent recovered (T90)	183	262	
Final boiling point		300	
T50 – T10	15		
T90 – T10	40		
Residue, vol percent		1.5	
Loss, vol percent		1.5	
Flash point, °C [4]	38	68	D 56, D 93 [2], or D 3828
Density			D 1298 or D 4052 [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	D 2386 [2], D 5972, D 7153, or D 7154
Viscosity, at -20°C, mm^2/s		8.0	D 445
Net heat of combustion, MJ/kg	42.8		D 3338, D 4529, or D 4809 [2]
Hydrogen content, mass percent	13.4		D 3343 or D 3701 [2]
Smoke point, mm, or	25.0		D 1322
Smoke point, mm, and	19.0		D 1322
Naphthalenes, vol percent		3.0	D 1840
Calculated cetane index [1]			D 976 [5] or D 4737
Copper strip corrosion, 2 hr at 100°C (212°F)		No. 1	D 130
Thermal stability			D 3241 [6]
change in pressure drop, mm Hg		25	
heater tube deposit, visual rating		<3 [7]	

TABLE 2. Chemical and physical requirements and test methods for JP-8 with up to 50 percent SPK blend component – Continued

Property	Min	Max	Test Methods ASTM Standards
Existent gum, mg/100 mL		7.0	D 381
Particulate matter, mg/L [8]		1.0	D 2276 or D 5452 [2]
Filtration time, minutes [8]		15	
Water reaction interface rating		1 b	D 1094
Water separation index [9]			D 3948 or D 7224 [2]
Fuel system icing inhibitor, vol percent	0.10	0.15	D 5006 [10]
Fuel electrical conductivity, pS/m [11]			D 2624
Lubricity, wear scar diameter, mm		0.85	D 5001

NOTES:

1. To be reported – not limited.
2. Referee Test Method.
3. A condenser temperature of 0° to 4°C (32° to 40°F) shall be used for the distillation by ASTM D 86.
4. ASTM D 56 may give results up to 1°C (2°F) below the ASTM D 93 results. ASTM D 3828 may give results up to 1.7°C (3°F) below the ASTM D 93 results. Method IP170 is also permitted.
5. Mid-boiling temperature may be obtained by ASTM D 86 to perform the cetane index calculation. ASTM D 86 values should be corrected to standard barometric pressure.
6. See 4.5.3 for ASTM D 3241 test conditions and test limitations.
7. Peacock or Abnormal color deposits result in a failure.
8. A minimum sample size of 3.79 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in Appendix B. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D 2276 or ASTM D 5452.
9. The minimum microseparometer rating 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.

10. Test shall be performed in accordance with ASTM D 5006 using the DiEGME scale of the refractometer.
11. 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 conform to 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 Navy and 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 Air Force: HQ Air Force Petroleum Agency, HQ AFPET/AFT, 2430 C Street, Building 70, Area B, Wright-Patterson AFB 45433-7632.

Cognizant activities for the Army:

Army Ground: US Army TARDEC/RDECOM, 6501 E. 11 Mile Road, AMSRD-TAR-D (MS-110), Warren, MI 48397-5000.

Army Aviation: US Army RDECOM, Attn: AMSRD-AMR-AE-P, 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 3.

TABLE 3. Qualified thermal stability improver additives.

Additive Name	Qualification Reference	Manufacturer
SPEC AID 8Q462	AFRL/PRSF Ltr, 9 Dec 97	GE Water & Process Technologies 9669 Grogan Mill Road The Woodlands, TX 77380
AeroShell Performance Additive 101	AFRL/PRSF Ltr, 13 Jan 98	Shell Aviation Limited Shell Centre York Road London, UK SE1 7NA

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 or finished fuel blend 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 1 for any finished fuel containing only the materials described in 3.1 or, Table 2 for finished fuel blends containing any amount of SPK as described in 3.1.1.

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 applicable requirements specified in section 3. Quality conformance inspection shall include the test requirements herein.

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

4.3 Inspection.

4.3.1 Inspection conditions. Any finished fuel containing only the materials described in 3.1 shall comply with the limiting values specified in Table 1 using the cited test methods. Any finished fuel blend containing any amount of SPK as described in 3.1.1 shall comply with the limiting values specified in Table 2 using the cited test methods. Any SPK blend component as described in 3.1.1 shall comply with the limiting values specified in Table A-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 E 29.

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 D 4057 or ASTM D 4177, 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 D 4057.

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. Tests to determine compliance with chemical and physical requirements shall be conducted in accordance with Table 1 or Table 2 and/or Table A-I as follows. Any finished fuel containing only the materials described in 3.1 shall pass all tests listed in Table 1. Any finished fuel containing any amount of SPK as described in 3.1.1 shall pass all tests listed in Table 2. Any SPK blend component as defined in 3.1.1 shall pass all tests listed in Table A-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 E 29 shall apply to all tests required by this specification.

4.5.3 Thermal stability tests. The thermal stability test shall be conducted using ASTM D 3241. The heated tube shall be rated visually (see Annex A1 of ASTM D 3241).

4.5.3.1 ASTM D 3241 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 D 3241 reported data. The following data shall be reported:

a. Differential pressure in millimeter of mercury at 150 minutes, or time to differential pressure of 25 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, 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 SI 10. If test results are obtained in units other than metric or there is a requirement to report dual units, ASTM SI 10, 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 Synthetic Paraffinic Kerosene (SPK) Kerosene consisting solely of n-paraffins, cyclic-paraffins, and iso-paraffins.

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

6.5 Subject term (key word) listing.

Antioxidants
Corrosion inhibitor
Fischer-Tropsch
Flash point
Freezing point
Hydrocarbon distillate fuel
Hydrogen content
Icing inhibitor
Synthetic Paraffinic Kerosene (SPK)
Lubricity improver
Static dissipator
Thermal stability improver

6.6 International agreements. Certain provisions of this specification are the subject of international standardization agreement ASIC AIR STD 15/6, ASIC AIR STD 15/9, 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 1 for materials conforming to 3.2 requirements or as listed in Table 2 for materials conforming to 3.2.1 requirements. The Inspection Data on Aviation Turbine Fuels form published in ASTM D 1655 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.

SYNTHETIC PARAFFINIC KEROSENE (SPK)

A.1 SCOPE

A.1.1 Scope. This Appendix addresses 100 percent SPK derived from manufactured products of a Fischer-Tropsch process (identified in 3.1.1). This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 REQUIREMENTS

A.2.1 Chemical and physical requirements. The chemical and physical requirements of the SPK shall conform to 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 (SDA). If 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. Chemical and physical requirements and test methods for 100 percent SPK.

Property	Min	Max	Test Method
Aromatics, vol percent		1	D 5186
Sulfur, total, mass percent		0.0015	D 2622, D 3120, or D 5453 [1]
Distillation temperature, °C			D 86
Initial boiling point [2]			
10 percent recovered	157	205	
20 percent recovered [2]			
50 percent recovered	168	229	
90 percent recovered	183	262	
Final boiling point		300	
Residue, vol percent		1.5	
Loss, vol percent		1.5	
Flash point, °C	38	68	D 56, D 93 [1], or D 3828
Density			D 1298 or D 4052 [1]
Density, kg/L at 15°C or	0.751	0.840	
Gravity, API at 60°F	37.0	57.0	

TABLE A-I. Chemical and physical requirements and test methods for 100 percent SPK - Continued.

Property	Min	Max	Test Method
Freezing point, °C		-47	D 2386 [1] or D 5972
Viscosity at -20°C, mm^2/s		8.0	D 445
Viscosity at 40°C, mm^2/s [2]			D 445
Net heat of combustion, MJ/kg	42.8		D 3338 or D 4809 [1]
Calculated cetane index [2]			D 976 [3] or D 4737
Naphthalenes, vol percent		0.1	D 1840
Thermal stability			D 3241
change in pressure drop, mm Hg		25	
heater tube deposit, visual rating		<3 [4]	
Particulate matter, mg/L [5]		1.0	D 2276 or D 5452 [1]
Filtration time, minutes [5]		15	
Water separation index			D 3948 or D 7224 [1]
With SDA	70		
Without SDA	85		
Electrical conductivity, pS/m [6]	150	450	D 2624

NOTES:
1. Referee Test Method.
2. To be reported – not limited.
3. Mid-boiling temperature may be obtained by ASTM D 86 to perform the cetane index calculation. ASTM D 86 values should be corrected to standard barometric pressure.
4. Peacock or Abnormal color deposits result in a failure.
5. A minimum sample size of 3.79 liters (1 gallon) shall be filtered. Filtration time will be determined in accordance with procedure in Appendix B. This procedure may also be used for the determination of particulate matter as an alternate to ASTM D 2276 or ASTM D 5452.
6. Electrical Conductivity when required per A.2.2.2 shall be determined at ambient temperature or 29.4°C (85°F), whichever is lower, unless otherwise directed by the procuring activity.

METHOD FOR DETERMINATION OF FILTRATION TIME AND TOTAL SOLIDS

B.1 SCOPE

B.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.

B.2 METHOD

B.2.1 Summary of method. 3.79 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.

B.3 APPARATUS

a. Membrane filter: White, plain, 47 mm diameter, nominal pore size 0.8 µm. The membrane filter must be approved by ASTM for use with ASTM D 5452.

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 2 in ASTM D 5452).

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° ± 5° C (194° ± 9° F).

g. Forceps: Flat-bladed with unserrated nonpointed 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.

B.4 PREPARATION

B.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 D 5452. All metal parts of the filtration apparatus are to be electrically bonded and grounded, including the fuel sample container. See ASTM D 5452 for other safety precautions.

B.5 SAMPLING

B.5.1 Sampling. Obtain a representative 3.79 L (1 gallon) sample as directed in paragraph 8 of ASTM D 5452. When sampling from a flowing stream is not possible, an all level sample or an average sample, in accordance with ASTM D 4057 and/or ASTM D 4177 shall be permitted. The 3.79 L (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.

B.6 PROCEDURE

B.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 ± 5°C 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 3.79 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 3.79 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 B.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° ± 5°C (194° ± 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/liter by using the following formula:

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

l. Should the sample exceed the 30-minute filtration time and a portion of the fuel is not filtered, the solids content in mg/liter will be figured as follows: Determine the volume of fuel filtered by subtracting the mL of fuel remaining from 3.785.

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

B.7 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° and 30°C (64° 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.

B.8 NOTES

B.8.1 Filtration time. If it is desired to determine the filtration time and not the total solids content, perform the test by omitting steps B.6.1i, B.6.1j, B.6.1k, and B.6.1l.

B.8.2 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 D 5452 apply.

CONCLUDING MATERIAL

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

Preparing activity:
Air Force – 68
(Project 9130-2007-001)

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

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