METRIC
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29 September 1992
SUPERSEDING
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10 February 1989

MILITARY SPECIFICATION

TURBINE FUEL, AVIATION, GRADES JP-4, JP-5, AND JP-5/JP-8 ST

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 aviation fuel (see 6.1).

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

Grade	NATO Code No.	Description
JP-4	F-40	Wide cut, gasoline type
JP-5	F-44	High flashpoint, kerosene type
JP-5/JP-8 ST		Special test fuel, high flashpoint, kerosene type, for engine development and qualification testing (see 6.1).

1.3 References. General references in other documents to turbine fuels in accordance with this specification with grade not specified shall be interpreted to also include turbine fuels in accordance with *MIL-T-83133*.

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

AMSC N/A FSC 9130

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2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications, 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 listed in the issue of the *Department of Defense Index Specifications and Standards (DODISS)* and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

MIL–I–25017	–	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric)
MIL–I–27686	–	Inhibitor, Icing, Fuel System
MIL–T–83133	–	Turbine Fuels, Aviation, Kerosene Types, NATO F–34 (JP–8) and NATO F–35
MIL–I–85470	–	Inhibitor, Icing, Fuel System, High Flash NATO Code Number S–1745

STANDARDS

FEDERAL

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

MILITARY

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

QUALIFIED PRODUCTS LIST

QPL–25017	–	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric)

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

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the *DODISS* cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the *DODISS* are the issues of the documents cited in the solicitation (see 6.2).

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AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

ASTM D86	–	Standard Test Method for Distillation of Petroleum Products
ASTM D93	–	Standard Test Methods for Flash Point by Pensky–Martens Closed Tester
ASTM D129	–	Standard Test Method for Sulfur in Petroleum Products (General Bomb Method)
ASTM D130	–	Standard Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test
ASTM D156	–	Standard Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)
ASTM D240	–	Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter
ASTM D323	–	Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)
ASTM D381	–	Standard Test Method for Existent Gum in Fuels by Jet Evaporation
ASTM D445	–	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D976	–	Standard Test Methods for Calculated Cetane Index of Distillate Fuels
ASTM D1094	–	Standard Test Method for Water Reaction of Aviation Fuels
ASTM D1266	–	Standard Test Method for Sulfur in Petroleum Products (Lamp Method)
ASTM D1298	–	Standard Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
ASTM D1319	–	Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
ASTM D1322	–	Standard Test Method for Smoke Point of Aviation Turbine Fuels
ASTM D1405	–	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D2276	–	Standard Test Method for Particulate Contaminant in Aviation Fuel
ASTM D2386	–	Standard Test Method for Freezing Point of Aviation Fuels
ASTM D2622	–	Standard Test Method for Sulfur in Petroleum Products by X–Ray Spectrometry (DoD adopted)
ASTM D2624	–	Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels Containing a Static Dissipator Additive
ASTM D2887	–	Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
ASTM D3120	–	Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry
ASTM D3227	–	Standard Test Method for Mercaptan Sulfur in Gasoline, Kerosene, Aviation Turbine, and Distillate Fuels (Potentiometric Method)
ASTM D3241	–	Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure)
ASTM D3242	–	Standard Test Method for Acidity in Aviation Turbine Fuel

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ASTM D3338	–	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D3343	–	Standard Test Method for Estimation of Hydrogen Content of Aviation Fuels
ASTM D3701	–	Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry
ASTM D3703	–	Standard Test Method for Peroxide Number of Aviation Turbine Fuels
ASTM D3828	–	Standard Test Methods for Flash Point by Setaflash Closed Tester (DoD adopted)
ASTM D3948	–	Standard Test Methods for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer (DoD adopted)
ASTM D4052	–	Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter
ASTM D4057	–	Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4176	–	Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Clear and Bright Pass/Fail Procedures) (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 Products by Energy–Dispersive X–Ray Fluorescence Spectroscopy
ASTM D4306	–	Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
ASTM D4809	–	Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Intermediate Precision Method)
ASTM D4952	–	Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)
ASTM D4953	–	Standard Test Method for Vapor Pressure of Gasoline and Gasoline–Oxygenate Blends (Dry Method)
ASTM D5006	–	Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
ASTM D5190	–	Vapor Pressure of Petroleum Products (Automatic Method)
ASTM D5191	–	Vapor Pressure of Petroleum Products (Mini Method)
ASTM E29	–	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM E380	–	Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19013.)

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DEPARTMENT OF TRANSPORTATION

Title 49 Code of Federal Regulations (CFR) Parts 100–177

Title 49 CFR Part 173.150	–	Exceptions for Class 3 (Flammable and Combustible Liquids)
Title 49 CFR Part 173.243	–	Bulk packaging for certain high hazard liquids and dual hazard liquids which pose a moderate hazard

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

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

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

3. REQUIREMENTS

3.1 Materials. The fuel supplied under this specification shall be refined hydrocarbon distillate fuel oils containing additives in accordance with 3.3. The feed stock from which the fuel is refined shall be crude oils derived from petroleum, tar sands, oil shale or mixtures thereof.

3.2 Chemical and physical requirements. The chemical and physical requirements of the finished fuel shall conform to those listed in table I or table II, as applicable.

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

3.3.1 Antioxidants. Immediately after processing (i.e., during the rundown into feed/batch tank) and before the fuel is exposed to the atmosphere, an approved antioxidant shall be added to all JP–5 and JP–5/JP–8 ST fuels and to JP–4 fuels that contain blending stocks that have been hydrogen treated to prevent the formation of gums and peroxides after manufacture. JP–4 fuels that do not contain hydrogen treated blending stocks may have the antioxidant added at the option of the supplier. The concentration of antioxidant to be added shall be as follows:

a. For JP–5, JP–5/JP–8 ST, and hydrogen treated JP–4: Not less than 17.2 mg, nor more than 24 mg of active ingredient per liter of fuel (6.0 to 8.4 lb/1000 barrels).

b. For those JP–4 fuels not hydrogen treated, the supplier may (at his option) add not more than 24.0 mg of active ingredient per liter of fuel (8.4 lb/1000 barrels).

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TABLE I. Chemical and physical requirements and test methods

Requirements	Grade JP-4	Grade JP-5	Test Method ASTM Standards
Color, Saybolt	Rpt	Rpt	*D156*
Total acid number, mg KOH/g, max	0.015	0.015	*D3242*
Aromatics, vol percent, max	25.0	25.0	*D1319*
Olefins, vol percent, max	5.0	5.0	*D1319*
Sulfur, Mercaptan, mass percent, max OR	0.002	0.002	*D3227*
Doctor test	Negative	Negative	*D4952*
Sulfur, total mass, percent, max	0.40	0.40	*D1266*, *D2622*, *D129*, *D3120*, or *D4294* 11/
Distillation temperature, deg C (D2887 limits in parentheses)			*D86* 1/ 11/ or *D2887*
Initial boiling point	Rpt	Rpt	
10 percent recovered, max temp	Rpt	205 (185)	
20 percent recovered, max temp	145 (130)	Rpt	
50 percent recovered, max temp	190 (185)	Rpt	
90 percent recovered, max temp	245 (250)	Rpt	
End point, max temp	270 (320)	300 (330)	
Residue, vol %, max (for D86)	1.5	1.5	
Loss, vol %, max (for D86)	1.5	1.5	
Flash point, deg C (deg F), min		60 (140)	*D93*, or *D3828* 11/
Density, at 15° C			*D1298* or
kg/L, min (API max)	0.751 (57.0)	0.788 (48.0)	*D4052* 11/
kg/L, max (API min)	0.802 (45.0)	0.845 (36.0)	
Vapor pressure, 37.8° C (100° F) kPa (psi)			*D323*, *D4953*,
minimum	14 (2.0)		*D5190*, or
maximum	21 (3.0)		*D5191* 11/ 12/
Freezing point, deg C (deg F), max	–58 (–72)	–46 (–51)	*D2386*
Viscosity, at –20° C, max centistokes		8.5	*D445*

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TABLE I. Chemical and physical requirements and test methods (Cont'd)

Requirements	Grade JP-4	Grade JP-5	Test Method ASTM Standards
Heating value,			
Aniline–gravity product, min, OR	5,250	4,500	*D1405*
Heat of combustion, MJ/kg, (BTU/lb), min	42.8 (18,400)	42.6 (18,300)	*D3338*, *D4809*, or *D240* 2/ 11/
Calculated Cetane Index		Rpt	*D976* 3/
Hydrogen content, mass percent, min OR	13.5	13.4	*D3701* 4/
Smoke point, mm, min	20.0	19.0	*D1322*
Copper strip corrosion, 2 hr at 100° C (212° F), max	1	1	*D130*
Thermal stability:			
Change in pres. drop, mm of Hg, max	25	25	*D3241* 5/
Tube deposit code, less than	3	3	
Existent gum, mg/100 mL, max	7.0	7.0	*D381* 13/
Particulate matter, mg/L, max	1.0	1.0	*D2276* 6/
Filtration time, minutes, max	10	15 7/	*D2276* 6/
Water reaction			*D1094*
Interface rating, max	lb	lb	
Water separation index, min	8/	8/	*D3948*
Peroxide number, ppm by wt, max	—	8.0	*D3703*
Fuel system icing inhibitor			*D5006*
volume percent min	0.10	0.15	9/
volume percent max	0.15	0.20	9/
Fuel electrical conductivity, pS/m allowable range	150–600 10/		*D2624*

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1/ A condenser temperature of 0° to 4° C (32° to 40° F) shall be used for the distillation of JP–5 and JP–5/JP–8 ST fuels. For JP–4, group 3 test conditions shall be used.

2/ *ASTM D3338*, for calculating the heat of combustion, is only allowed for use with JP–4 fuel. When the fuel distillation test is performed using *ASTM D2887*, the average distillation temperature used in *ASTM D3338* shall be calculated as follows:

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

3/ Mid–boiling temperatures may be obtained by either *D86* or *D2887* to perform the Cetane Index calculation. If D86 values are used, they should be corrected to standard barometric pressure.

4/ *ASTM D3343* or *ASTM D3701* may be used to measure hydrogen content of JP–4. When measuring hydrogen content of JP–5 and JP–5/JP–8 ST fuel, only *ASTM D3701* shall be used.

5/ See 4.5.2.1 for *ASTM D3241* test conditions and test limits.

6/ A minimum sample size of one gallon shall be filtered. Filtration time will be determined in accordance with the procedure in appendix A. The procedure in appendix A may also be used for the determination of particulate matter as an alternate to *ASTM D2276*.

7/ The flow reducer ring of appendix A, 30.c is not required for JP–5 and JP–5/JP–8 ST fuel.

8/ The minimum water separation index rating using Micro Separometer rating (MSEP) shall be as follows:

Product	Additives	MSEP, min
JP–4	Antioxidant (AO)*, Metal Deactivator (MDA)*, and Fuel System Icing Inhibitor (FSII)	85
JP–4	AO*, MDA*, FSII, and Corrosion Inhibitor/Lubricity Improver (CI/LI)	70
JP–5 and JP–5/JP–8 ST	AO and MDA*	90
JP–5 and JP–5/JP–8 ST	AO, MDA*, and FSII	85
JP–5 and JP–5/JP–8 ST	AO, MDA*, and CI/LI	80
JP–5 and JP–5/JP–8 ST	AO, MDA*, CI/LI, and FSII	70

* The presence or absence of this additive does not change these limits.

Regardless of which minimum the refiner elects to meet, the refiner shall report the MSEP rating on a laboratory hand blend of the fuel with all additives required by the specification.

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9/ Tests shall be performed with *ASTM D5006* or method 5327 or 5340 of *FED-STD-791*. Use the appropriate scale of the refractometer.

10/ The conductivity must be in the range of 150 to 600 pS/m at ambient fuel temperature or 29.4°C (85°F), whichever is lower.

11/ Referee Test Method.

12/ When using *ASTM D5191* for vapor pressure determinacy of JP-4, the quality control checks, section 10, must be performed each day using cyclohexane, 22.5 kPa (3.27 psi) and toluene, 7.1 kPa (1.03 psi) as the reference pure materials. When performing *ASTM D5190* and *D5191*, the instruments and equations from the 1991 Round-Robin will be used (see *ASTM Research Report, ASTM RR:D02-1286 1991 Vapor Pressure Test Method Round Robin Program*).

13/ If air is used instead of steam while performing *ASTM D381*, it must be reported. In case of a failure with air, the sample must be retested using steam.

TABLE II. Chemical and physical requirements for JP-5/JP-8 ST

Requirements	Min	Max	Test Method ASTM Standards
Aromatics, vol percent	23.0	27.0	*D1319*
Density, at 15° C, kg/L (API)	0.815 (42.1)	0.845 (36.0)	*D1298* or *D4052*
Hydrogen Content, wt percent	13.3	13.5	*D3701*
Smoke Point, mm	18.0	21.0	*D1322*
NOTE: All other requirements of table I for grade JP-5 apply.			

3.3.1.1 The following antioxidant formulations are approved:

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

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

c. 2,6-di-tert-butylphenol

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

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

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3.3.2 Metal deactivator. A metal deactivator, N,N'–disalicylidene–1,2–propanediamine or N,N'–disalicylidene–1,2–cyclohexanediamine may be blended into the fuel in an amount not to exceed 5.8 mg active ingredient per liter of fuel (2 lb/1000 barrels or 22 mg/gal (US)). Metal deactivator additive shall not be used in JP–5 or JP–4 unless supplier has obtained written consent from procuring activity.

3.3.3 Corrosion inhibitor. A corrosion inhibitor conforming to *MIL–I–25017* shall be blended into the JP–4, JP–5, and JP–5/JP–8 ST fuel by the supplier. 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 supplier or transporting agency, or both, shall maintain and upon request shall make available to the Government evidence that the corrosion inhibitors used are equal in every respect to the qualification products listed in *QPL–25017*.

3.3.4 Fuel system icing inhibitor. The use of a fuel system icing inhibitor shall be mandatory. For JP–4 the icing inhibitor shall be in accordance with *MIL–I–27686* or *MIL–I–85470*; for JP–5 and JP–5/JP–8 ST fuel the icing inhibitor shall be in accordance with *MIL–I–85470*. The point of injection of the additive for JP–4, JP–5, and JP–5/JP–8 ST, and the type of additive for JP–4 shall be determined by agreement between the purchase authority and the supplier.

3.3.4.1 JP–4 with fuel system icing inhibitor in accordance with *MIL–I–27686* should not be mixed with JP–4 with fuel system icing inhibitor in accordance with *MIL–I–85470*. Mixing them will cause problems during the determination, using the refractometer, of volume percent of icing inhibitor in the fuel.

3.3.5 Static dissipator additive. A static dissipator additive shall be added to JP–4 fuels in sufficient concentration to increase the conductivity of the fuel to within the range specified in table I, at the point of injection. The point of injection shall be determined by agreement between the purchasing authority and the supplier. The following static dissipator additive is approved: Stadis 450 marketed by E. I. duPont de Nemours Co., Wilmington DE.

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

3.4 Workmanship. At the time of Government acceptance, the finished fuel shall be visually free from undissolved water, sediment, or suspended matter and shall be clear and bright. In case of dispute, the fuel shall be clear and bright at 21° C (70° F). If the finished fuel is not visually free from sediment or suspended matter but meets the Table I particulate matter content of 1.0 mg/L max, the fuel shall be considered to have met this workmanship requirement.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified

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herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

4.3 Inspection conditions. Requirements contained in table I and table II are absolute, as defined in *ASTM E29*, and shall not be subject to correction for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding off of significant figures, *ASTM E29* shall apply to all tests required by this specification.

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

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

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

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

4.4.2 Sampling plans

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

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

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

4.5 Inspection methods

4.5.1 Examination of product

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

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

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

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

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

4.5.2.1.1 *ASTM D3241* test conditions.

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

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

c. Fuel flow rate: 3.0 mL/min.

d. Test duration: 150 minutes.

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

a. The maximum visual rating of the heater tube deposits is less than a code 3 (appendix B, 10.6).

b. The visual rating of the heater tube shows neither peacock type deposit (code P) nor abnormal type deposits (code A) (appendix B, 10.6.3.1 and 10.6.3.2).

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

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

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4.5.2.1.3 *ASTM D3241* **reported data.**

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

b. Heat tube deposit code rating at the end of the test.

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

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

5. PACKAGING

5.1 Packaging, packing, and marking. Packaging, packing, and marking shall be in accordance with *MIL-STD-290*. All fuel containers shall be marked with the flashpoint obtained in 4.5.2 in both degrees F and degrees C of the fuel contained therein. For JP-4, a flashpoint of -29°C (-20°F) may be assumed.

5.2 Transportation of fuels. The transportation of the JP-4, JP-5, and JP-5/JP-8 ST fuels shall be in accordance with the Department of Transportation Rules and Regulations listed in 2.2.

6. NOTES

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

6.1 Intended use. The JP-4 and JP-5 fuels covered by this specification are intended for use in aircraft turbine engines. The JP-5/JP-8 ST (special test) fuel is a worst-case kerosene type aviation turbine fuel in terms of fuel effects on engine starting, altitude relight, combustor durability, and exhaust smoke emissions. This fuel is intended for use in the development, testing, and qualification of engine components, engines, and aircraft. When authorized, the JP-5/JP-8 ST fuel may also be used for qualification testing of ground-based turbine and diesel engines.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

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

c. Grade of fuel required (see 1.2).

d. Quantity required and size containers desired.

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

f. Location and injection method for addition of fuel system icing inhibitor (JP–4, JP–5, and JP–5/JP–8 ST and electrical conductivity additive (JP–4 only).

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

6.4 Subject term (key word) listing

Antioxidant
Aviation turbine fuel
Corrosion inhibitor
Fuel
Icing inhibitor
Jet fuel
JP–4
JP–5
JP–8
Special test fuel
Static dissipator additive
Turbine

6.5 Units of measure have been converted to the International System of Units (Metric) in accordance with *ASTM E380*.

6.6 Grade JP–8 fuel. Characteristics of JP–8 fuel (such as density, distillation temperatures, et cetera) are very similar to those of JP–5. Materials and accessories suitable for use with JP–4, JP–5, and JP–5/JP–8 ST fuel are also suitable for use with JP–8.

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

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

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

Preparing activity:
Air Force – 11

Project No. 9130–0161

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APPENDIX A

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

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

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

30. Apparatus

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

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

c. Insert ring: The insert ring shall only be used with JP-4 fuel. A 47-mm diameter paper flow reducer ring with dimensions to give filtering area of 4.8 cm^2. (Millipore Corporation Part No. XX10 047 10.)

d. Vacuum flask: A minimum of 4 liters.

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

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

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

h. Solvent filtering dispenser: Containing a 0.45 micron maximum pore size filter in the delivery line.

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

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

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

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

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

60. Test procedure

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

70. Test limits.

a. Filtration time:

(1) The maximum allowable filtration time shall be 10 minutes for grade JP-4 and 15 minutes for grade JP-5.

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

(3) The fuel temperature shall be between 18° and 30°C (64° and 86°F).

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

80. Notes.

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

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

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APPENDIX B

HEATER TUBE DEPOSIT RATING

10. Visual method.

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

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

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

10.4 Insert the ASTM color standard into the tuberator.

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

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

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

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

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

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

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

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

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

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

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

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3. DOCUMENT TITLE

TURBINE FUEL, AVIATION, GRADES JP-4, JP-5, AND JP-5/JP-8 ST

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

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